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THE

AMERICAN NATURALIST

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ON EXCAVATIONS MADE IN ROCKS BY SEA-URCHINS.

BY J. WALTER FEWKES.

THE cavities made by sea-urchins in solid rocks were first described at length by Mr. E. T. Bennett[1] many years ago (1825), and since their discovery the phenomenon has been repeatedly mentioned and discussed. The habit is not confined to any single genus, and it seems capable of proof that the same species does not resort to this practice in all localities in which the animal occurs.

The history of the different opinions in regard to the character of the excavations and the means and object of the boring have been considered by others. It is my purpose to barely refer to the historical part of the subject, or simply mention it without further comment. The question has both a geological and zoological, and likewise a botanical side, as the aid of certain low genera of algæ has been thought necessary to account for the phenomenon.

Leske and Linnæus described a species of Cidaris, *C. saxatilis*, but it does not appear that either of them was familiar with the boring habit of sea-urchins. Rumphius mentions the fact that some sea-urchins are found in holes. Lamarck first gave a

[1] Notice of a Peculiar Property of a Species of Echinus. Trans. Linn. Soc., Vol. XV. p. 74, 7, 1826.

description of *E. lividus*[2] from a specimen taken by Lalande in the neighborhood of Marseilles, and although he does not mention the excavations made by this species, according to Dr. P. Fisher he had in his possession in 1811 a rock excavated by them.

Dr. Fisher[3] in 1864 published an historical account of the observations made by others on this subject up to that year. The additions to our knowledge since that time to the present year have been historically considered in a paper by George John.[4] From these two contributions, as well as from the writings on the subject by Bennett,[5] Cailliaud,[6] Trevelyn,[7] Robert,[8] Lory,[9] Deshayes[10] and Hesse[11] a very good idea of what is known on this subject may be obtained.

The boring habit has been observed in the following rock formations: Chalk, coral limestone, limestone, sandstone, gneiss, granite and lavas. It has also been observed in many other rocks, some of which have not been identified.[12] Excavating sea-urchins have been reported from Ireland, England, the Coasts of France[13] on the English Channel, Bay of Biscay, and Mediterranean, Algiers, Azores, Florida, West Indies, Coast of California,

[2] An attempt by Valenciennes (*Comp. Rend.*, Vol. XLI., p. 743-755) to separate the boring sea-urchin allied to *E. lividus* from the type described from the Mediterranean, under a name *E. tenebrans*, has not been generally followed. The Strongylocentrotus, which makes the excavations at Grand Manan, differs in no way, except possibly that some of the spines are more stumpy, from ordinary specimens which do not bore in rock.

[3] Note sur les perforations de l'*Echinus lividus* Lamk. *Ann. d. Sci. Nat.*, V. Ser., Vol. I. p. 321.

[4] Ueber bohrende Seeigel. *Arch. f. Naturg.*, 55 Jahr, I. Band, 3 Heft.

[5] Notice of a Peculiar Property of a Species of Echinus. Trans. Linn. Soc., 217, 1826.

[6] Observations et nouv. faits sur les Mollusques perforants en general. *Comp. Rend.* t. 39, pp. 43-46. Observations sur les oursins perf. de Bretagne, *Revue et Maz. Zoöl.*, Vol. VIII., pp. 158-179.

[7] Supposed boring powers of the *Echinus lividus*. *Edinb. Philos. Journ.*, 46, pp. 386-87.

[8] Action perforante d'une espece d'Echinoderme. *Comp. Rend.*, t. 39, p. 639.

[9] Observations sur les oursins perforant le granite sur les côtes de la Bretagne. Bull. Soc. Geol., p. 43-46, 1856.

[10] *Ibid.* [11] *Ann. d. Sci. Nat.*, t. VII., p. 251.

[12] John gives a tabular view of the kinds of stone, locality, accompanying organism and observer. made up from his study of the literature.

[13] Fisher has already published a table stating the localities on coasts of France where *Echinus lividus* with excavating habits has been found.

Panama, Australia, Mauritius and Reunion. Not a single instance is recorded from North of Florida on the Atlantic seaboard of North America, with the exception of those from Grand Manan reported in the present paper.

Although it is well known that the sea-urchins of several species are able to excavate holes in solid rock, that habit has not been sufficiently well noted in our common sea-urchin *S. drobachiensis*.[14] It is indirectly referred to in our text-books on Zoölogy, but I have not yet seen a definite statement of a locality on our coast where the excavations can be seen and the boring habit studied. During the past summer (1889) an interesting specimen of rock excavation was observed by the author on the Island of Grand Manan, New Brunswick. A mention of it may not be without value to those interested in this subject or who have in mind a study of the phenomenon. The Black Ledges, which lie near the island of Nantucket, Grand Manan, are rocky reefs bare at low tide and wholly covered at high water. These ledges are made up of a hard mica schist, through which run veins of harder quartzite.[15] These ledges have their surface covered for the most part with "sea weeds" belonging to different kinds of Fuci and Laminariæ, and although not exposed to the full force of the sea from the Bay of Fundy, are still at times beaten by a heavy surf. The sides of the Black Ledges are thus broken or eroded here and there, so that many pools and deep clefts or recesses are forced in them. These recesses are in no way characteristic, but take the form of simple niches in the rock, wholly or partially walled in by the bowlders which lie strewn about, and are often simply natural depressions or basins in the rock. They are generally small, and often have overhanging walls. One of these depressions, which can be visited at low tide only, shows the work of the sea-urchin in rock excavations in the clearest manner. The rock on the sides of which the depressions are

[14] A. Agassiz states (Revision of the Echini, p. 706) that *Strongylocentrotus purpuratus* has this habit on coast of "California." The kind of rock on which the excavation takes place and the name of the observer not given.

[15] This quartzite is found in several places on Grand Manan in such quantities as to impart a white color to the cliffs, and to it may possibly be traced local names, as White Head, given to a well known island lying off the coast.

formed is inclined at a small angle to a perpendicular, and is almost bare of algæ, so that the boring can be seen without difficulty. The basins ordinarily have water in them at low tide. There is no coralline on the floor of the cavity.

The number[16] of sea-urchins at Grand Manan is very great, as was long ago noted by Dr. William Stimpson. In many places it is impossible to see the bottom of the bay, so densely populated is it with these animals. In the rock recess above referred to, the surface of the shelf before the animals were disturbed was paved with sea-urchins, and the number of examples of excavations which they had formed were therefore very numerous. The cavities made by the sea-urchins impart to the rock an appearance not unlike the upper surface of honeycomb, with this difference, that the bounding rim of each excavation is always ring-shaped and entire.

The separate excavations which are shown in the figure, sometimes with the *Strongylocentrotus in situ*, sometimes with the same removed, are never very deep, but are undoubtedly made by the echinoderm. Their surfaces are concave, corresponding with the convexity of the sea-urchin's body, and very smooth, as if freshly cut or worn. They are often larger than the sea-urchin inhabiting them, and roomy enough to admit a free motion of the contained animal. In no instance is the depth of the depression greater than the smaller diameter of the animal. The edge of

[16] The wealth of asteroid and ophiuroid life at Grand Manan is also marvelous to one who has confined his attention to collecting in Massachusetts Bay. The bottom of the passages between the islands would seem to be covered in places with these animals. The dredge near High Duck Island was gorged with specimens of *Ophiopholis aculeata*, with here and there specimens of *Ophiacantha and Ophioglypha*. *Amphiura squamata*, although common, is not found in such multitudes. There is reason to believe from its extreme rarity that the *Comatula* recorded by Stimpson from Grand Manan is a straggler. Certainly the genus is very rare in these waters. *Leptasterias*, *Solaster*, *Crossaster*, and *Hippasterias* were dredged, but they are not common. *Pteraster* also occurs, but is not so frequently found as off Razor Island near Eastport. *Cribrella* is a common Grand Manan genus of starfishes, and a colony of its young, fifty or more in number, were found by M. J. S. Owens on the under side of the rock at low tide near Nantucket. This association in a colonial condition of the young of this genus is an interesting fact, which is probably connected with a want of freedom in earlier stages. *Ctenodiscus crispatus* was not seen by us at Grand Manan, although others have found it there. It was, however, taken at Eastport in subsequent dredging. On the whole the dredging at Grand Manan is not so rich for variety of starfish and ophiuran life as at Easport. The echinoid life is certainly as rich in one place as in another.

the rim which forms a dividing edge between two contiguous excavations is often covered by an incrustation of genera of calcareous algæ.

Prof. W. G. Farlow, of Harvard University, has kindly identified some of the corallines from specimens of the rock submitted to him. He finds upon them, *Lithothamnion polymorphum* (L.) Aresch., and *Melobesia lenormandi* Aresch. A third kind with papillæ, which he interprets as the beginning of branches, he is inclined to regard a young stage of *Lithothamnion fasciculatum*. He writes me that "the corallines of Northern Europe have been more studied since date of his Marine Algæ of New England, and there may be a question whether the nomenclature of our Eastport species should not be modified to adapt itself to recent work in Artic corallines." The most abundant coralline in the neighborhood of the excavation is the first mentioned. From the sections which I have made of alga, and rock, and a minute examination of the line of contact, I cannot see that the former has in anyway modified the surface of the latter, a result practically the same as that arrived at by John in his studies.

While it is possible that this deposit may in some instances augment the depth of the depression, the amount of such increase is not large, for the alga is generally limited to the top of the bounding rim of the depression, and the walls of its deepest part are filed perfectly smooth, while the sides of the depression and more especially the bounding rim are sometimes covered with and augmented by this encrusting coralline. The surface of the hole as above remarked had no coralline, and generally the rock appeared to be freshly cut.

Hesse records an observation of a sea-urchin boring in oyster shells, and regards this habit as a means of getting food. While it is not impossible that a modicum of nourishment may be obtained in this case by the sea-urchin, it seems to the author improbable that the amount thus obtained can be any considerable quantity. I have learned from good authority (Mr. Cheney) that the spiles of weirs at Grand Manan are sometimes excavated by sea-urchins so that the bark of the birch posts is worn through and even depressions made in the wood tissue. In this instance it may be that the object was food. New observations on this point are necessary, not only as far as the question of excavation in woody fibre is concerned, but also as to the contents of the stomach of those urchins which are found performing this function.

It does not seem to me that the coralline plays any considerable part in the excavation of the rock directly or indirectly, and the sections published by John appear to demonstrate that there is no chemical or other action due to the coralline upon the rock formation upon which it lies. While we would naturally suspect that the geodes[17] once tenanted by urchins might be covered with coralline when deserted by them, in a majority of cases the cavities which are still tenanted have no algous deposit. In those cases where the sea-urchin and the coralline still exist together and in which the surface of the latter is worn by the animal, we may suppose that in the interval during which the sea-urchin had vacated the geode the coralline had taken possession of the cavity, and in due time another sea-urchin had returned to the recess and begun work again upon the layer of calcareous algous formation covering the stone.

My attention was first called to the excavations of Strongylocentrotus by Mr. Webster Cheney, of Nantucket Island, who had discovered them while gunning. Mr. Cheney was not aware, at the time of his discovery, that the fact was known that sea-urchins have their habit of boring in the rocks. I visited the place with a fellow student, Mr. Owens, of Bridgeton, New Jersey.

The following observation was made on the migration of the animal from its excavation, which seems to look as if more than one sea-urchin is concerned in the excavation of a single hole, or that some of the sea-urchins are nestlers as well as borers. It was found, after the sea-urchins had been removed from the excavations which they had made, that in the course of time the holes were repeopled and inhabited by different individuals from those first found there.[18] New individuals thus find the old exca-

[17] The term geode, meaning a cavity, has been used for these excavations. It seems applicable, although used in a somewhat different sense by geologists.

[18] I have, however, no observations to prove that the sea-urchins ever voluntarily leave their cavities for food and after such an excursion return again to them.

vations suited to their purposes, and it is just to conclude that they continue the work of excavation which their predecessors began. They seem to take advantage of the depression already made for their protection.

It may likewise be supposed that in the case of death, natural or violent, an occupation of the former excavation by a new individual may take place. This is possibly true also in the case of boring sea-urchins from the Azores or the coast of France, where very much deeper recesses are sometimes hollowed in the rock. The fact that the sea-urchin is much larger than the entrance by which it entered the cavity, would thus seem to mean, not that the same individual had hollowed out the entire chamber, but that the sea-urchin which now occupies the cavity had grown larger since it passed through the hole excavated by its predecessor.

An interesting question often asked, and as yet unanswered in a satisfactory manner, is, "How do the sea-urchins make these excavations in the solid rock?" This question is a very difficult one to answer, and several attempts have been made to do so satisfactorily. It is not necessary to mention all the theories suggested, but one or two of the more reasonable may be considered.

Robert supposed that the constant motion of the sea-urchin by which the spines act as files after long attrition has worn out these excavations.

It has been suggested by Cailliaud, and this it must be confessed seems a more reasonable explanation, that the cavities are gnawed or chiselled out by the action of the teeth. Both of these explanations seem possible; but the latter is more probable than the former, as several observations seem to point to this conclusion. Among the facts which support Cailliaud's hypothesis are the following: the teeth are very hard, they have means of repair when their tips are worn, and their surface and cutting points are bare, and well adapted for cutting. It may also be added that the muscles which move the jaws are strong. It would seem, so for as their relative hardness goes, that these organs rather than the spines are the tools which have worn out these holes.

The author believes, however, that Robert was partly right for ascribing to the spines a portion of the work done in excavating the cavities. In sea-urchins taken from rock cavities the spines immediately about the mouth and those on the circumference are somewhat worn in specimens from Grand Manan. Moreover, the surface of the depression is perfectly smoothed in such a symmetrical manner that it seems necessary to suppose a rotary[19] motion of the sea-urchin to effect it. This smoothness, already pointed out in sea-urchin excavations by Trevelyan, could not, I think, have resulted from the teeth alone.

The major part of the work in the excavation of rock by sea-urchins must, however, fall upon the teeth and the dental apparatus. Upon this point the writings of Cailliaud are conclusive. These teeth are probable chisels, which pry into the rock or gouge out fragments, and in that way eventually remove considerable quantities of rock from its bed. A. Agassiz adopts the theory that sea-urchin excavations are chiseled out by the teeth, but offers no evidence bearing on Cailliaud's theory.

John has, it seems to me, furnished important data, indicating that the teeth play a part in the wearing out of the rock cavities in which the urchins live, for he was able to find in the alimentary canal of the sea-urchin fragments of stone similar to that in which the borings were made. The simple fact, however, that grains of rock similar to those of the locality of the sea-urchin are found, is not in itself an evidence that they were chiseled out of the rock by the teeth. We know that toothless Echinoidea, as for instance genera of Spatangoids, often have their alimentary canal full of sand, which has apparently been swallowed by the animal. There seems no reason to refuse to believe that any of the so-called round sea-urchins are not able to swallow small pebbles in the same way, but while it is true that the one (spatangoid) generally lives on the sand, and the other (echinoid) on rocky bottom, one can readily see how small fragments might be picked up by the latter and swallowed.[20]

[19] This rotary motion is yet to be observed, but it may be said that if it exists it must be very slow, as the animals never move rapidly.

[20] Sea-urchins are at times scavengers, or at all events a carcass of a seal sunk in the water will be found to be covered with these animals. Possibly they feed on the sea fleas and other animals which do the work of scavengers.

We have members of almost all the lower groups of animals, as sponges, annelids and other worms, mollusks and crustaceans, all of which are endowed with boring habits. The excavating habit possessed by the sea-urchin may belong to the same category as that of these animals, and it may be a voluntary act for self protection or other purposes. There is, however, this very interesting fact pointed out by others in relation to the boring sea-urchin, in which it seems to differ from those already mentioned. The habit of excavating seems to be one which is limited to individual sea-urchins which live in certain exposed positions, where the tides are very high. Thousands of specimens of sea-urchins on rocks where there was not a visible sign of excavating can be found, and those echinoderms which are below the wash of the tide, as well as some in its force, exhibit no manifestation of this power. These facts lead me to ask if it is not possible that there are influences in environment or in physical forces acting upon them which make certain individuals an involuntary agent in boring. Or is it not probable that we may find the excavating power due in part to the action of the sea itself. It is in other words possible that the force which excavates these geodes is somewhat similar to that exerted in the case of the formation of the geologic phenomenon known as "pot-holes." The living body of the sea-urchin might occupy the same relation to the cavity in which it lies that the inert stone does to the pot-hole in which it is often found, and which it played an essential part in creating. The fact that beautiful examples of pot-holes can be seen worn out of the solid rock on the adjoining island of Grand Manan, not far from the sea-urchin excavations, has suggested this explanation, which certainly has much to recommend it. We may, if we adopt this theory as a part of the explanation, regard the echinoid body clothed with its spines as an involuntary agent moved about by the waves, slightly perhaps, yet moved enough to wear out by its attrition in course of time the solid substance of the rock. The spines, teeth, and possibly the body itself may thus exert a wearing action capable in time of making an excavation into the solid rock. This explanation would furnish good reason for the very smooth character of the floor of many of the sea-urchin hollows.

One can readily imagine how in the beginning of the growth of the cavity, in order to cling more tenaciously to the rock, the sea-urchin seeks out a small natural depression in which it anchors itself by its suckers for protection from the surf. Constant movement of its body, due to the waves, and consequent attrition of the spines and teeth, caused by the movement of the water, deepens this slight depression until it reaches a considerable size, which is enlarged by every motion of the animal. To this increase in size voluntary movements of teeth and spines also contribute.[21]

The accompanying figure taken from a photograph by Mr. Northrop, of the School of Mines, New York, represents a number of these sea-urchins as they naturally lie in their excavations, and also several cavities, formerly occupied, from which the inhabitants have been removed. Although these holes are not so deep and therefore not so conspicuous as can be seen in rocks from some other coasts which might be introduced in illustration, they are the only ones which I have ever seen from our vicinity which exhibit this phenomenon.[22]

I am tempted to return to an aspect of the subject to which I have already alluded. Notwithstanding the large numbers of sea-urchins found at Grand Manan, the places where the excavating habit can be studied are very few in number and very local. I know indeed of no other locality except on the Black Ledges where there are excavations of this kind, and yet there are many places where the conditions are identical, and where the animals are equally abundant. It may be concluded from these facts that there must be certain peculiarities of environment especially adapted to these animals to present favorable conditions in individuals for this habit. It would seem that a mechanical explanation that the depressions were in a way due to forces analogous to the action of those at work in the excavation of "pot-holes"

[21] James Salter. on the Structure and Growth of the Teeth of Echinus. *Quart. Journ. Micr. Sc.*, 1861, p. 216.

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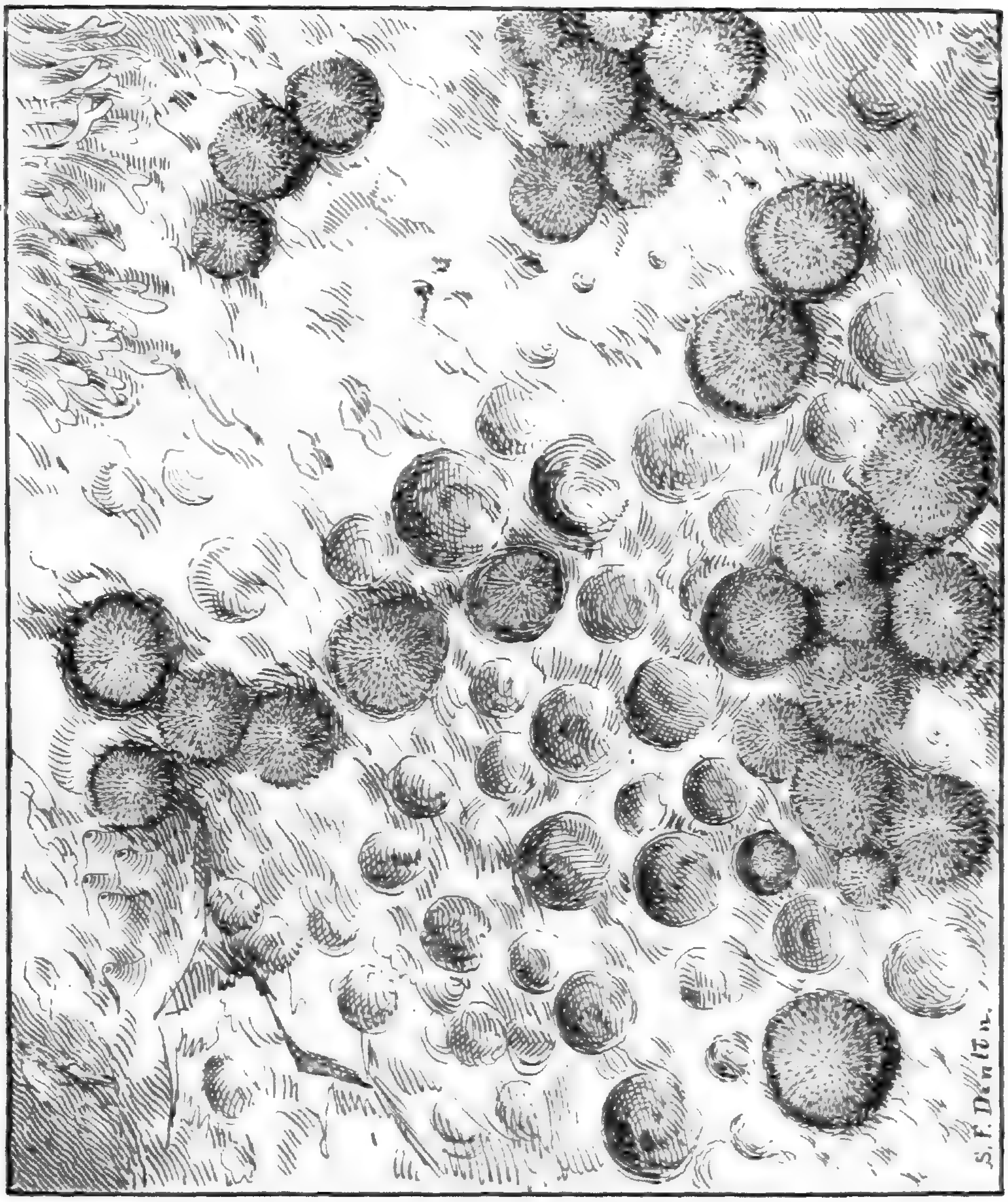
PLATE I.



BURROWING ECHINI.

The above figure was taken from a photograph of a part of the side of the grotto in which the sea-urchins are found. The photograph was kindly taken for me by Professor Northop of the School of Mines, New York City, to whom I am indebted for this and other kindnesses.—(*See page 10.*)

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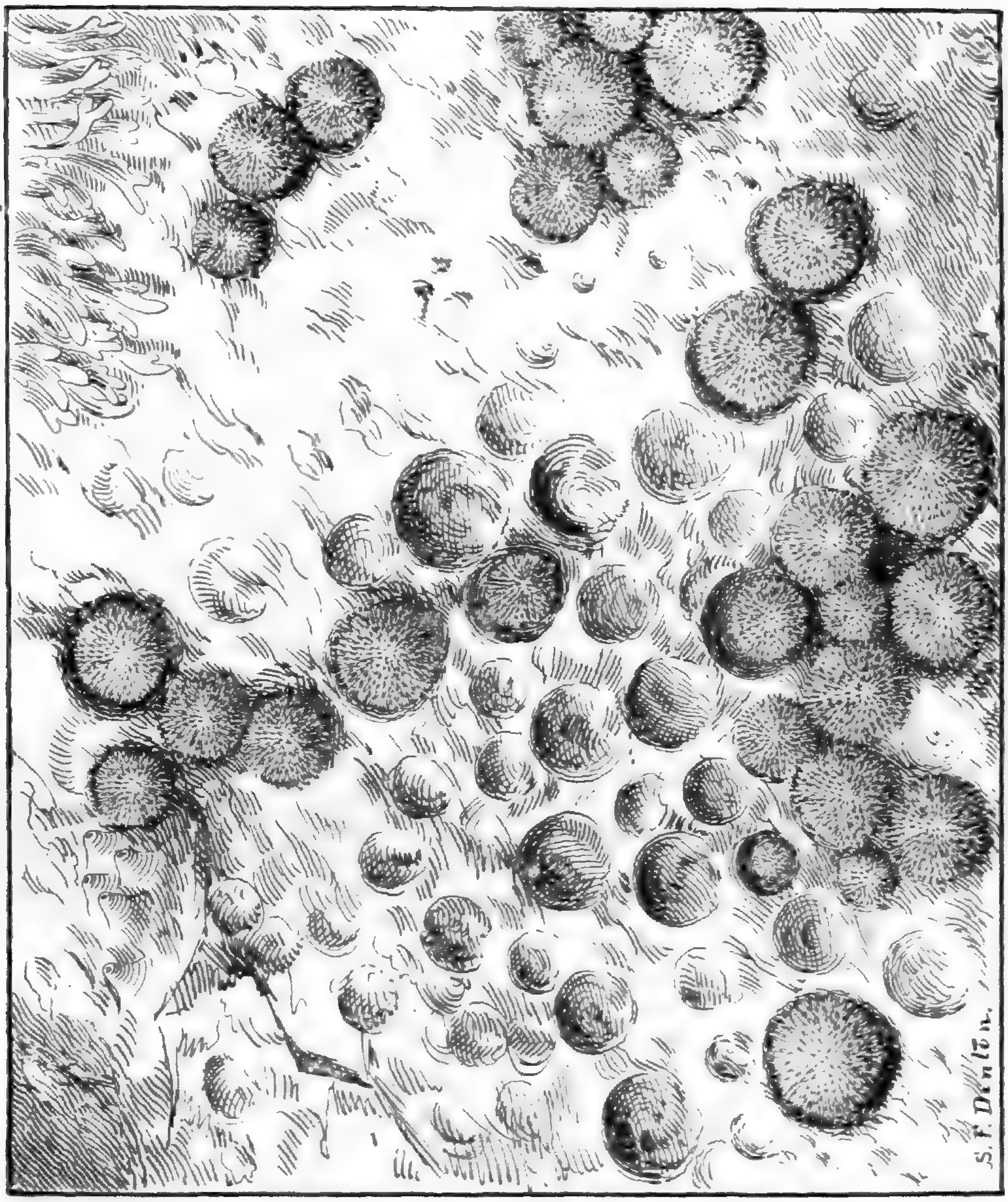

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affords in a way a harmonious explanation of the extreme rarity of these excavations on the coast of an island densely populated by sea-urchins. There seems no satisfactory reason why, if the process of excavating is simply a habit, we should find it so rarely exhibited. It is true that some species of mollusks sometimes excavate and sometimes do not, but while it is not improbable that there are many localities on our coast where specimens to illustrate this process may be found, they are certainly not as numerous as we might justly suspect they might be if the power of excavating was a voluntary one alone, and not in some way connected with forces acting about them. It likewise seems as if, knowing as we do that the habit of boring in rocks is found in those animals where the process is wholly voluntary, we might ascribe the habit in sea-urchins to the animal itself. We are at a loss to explain why sea-urchins make excavations only when they are in certain places and under certain conditions.

This peculiarity has already been noted by Deshayes in regard to *Echinus* (*Strongylocentrotus*) *lividus* on the two shores of France, and needs a further study.[23]

Dr. George Dimmock informs me that he has seen these excavations at Banyuls-sur-Mer. As these excavations exist on the shore of the Mediterranean, the suggestion that the excavations are limited to rocks beaten by a heavy surf or where there is a large tide would seem to be unsupported. Still, in a general way, the excavations made by sea-urchins are greater and more numerous on coasts beaten by a strong sea, and where there is a considerable tidal variation.

A theory that the work of excavation is in part assisted by acid secretions from organs of the body, feet, or mouth, does not seem plausible, or at all events requires more decisive observations than have yet been brought to its aid. The excavations are in all kinds of rock, and it seems improbable that a secretion could be made by them which would act on lava, limestone, slate and granite. The same may be said also of the

[23] According to Fisher, Lalande found them near Marseilles, while Arthur Eloffe, Marcel de Serres and Cailliaud have observed or recorded sea-urchins in holes near the lighthouse of Planier, also on the Mediterranean.

supposed power of the suckers of the ambulacral feet or the other soft structures of the body. Until more facts are advanced in support of these theories we can hardly accept them as well founded.

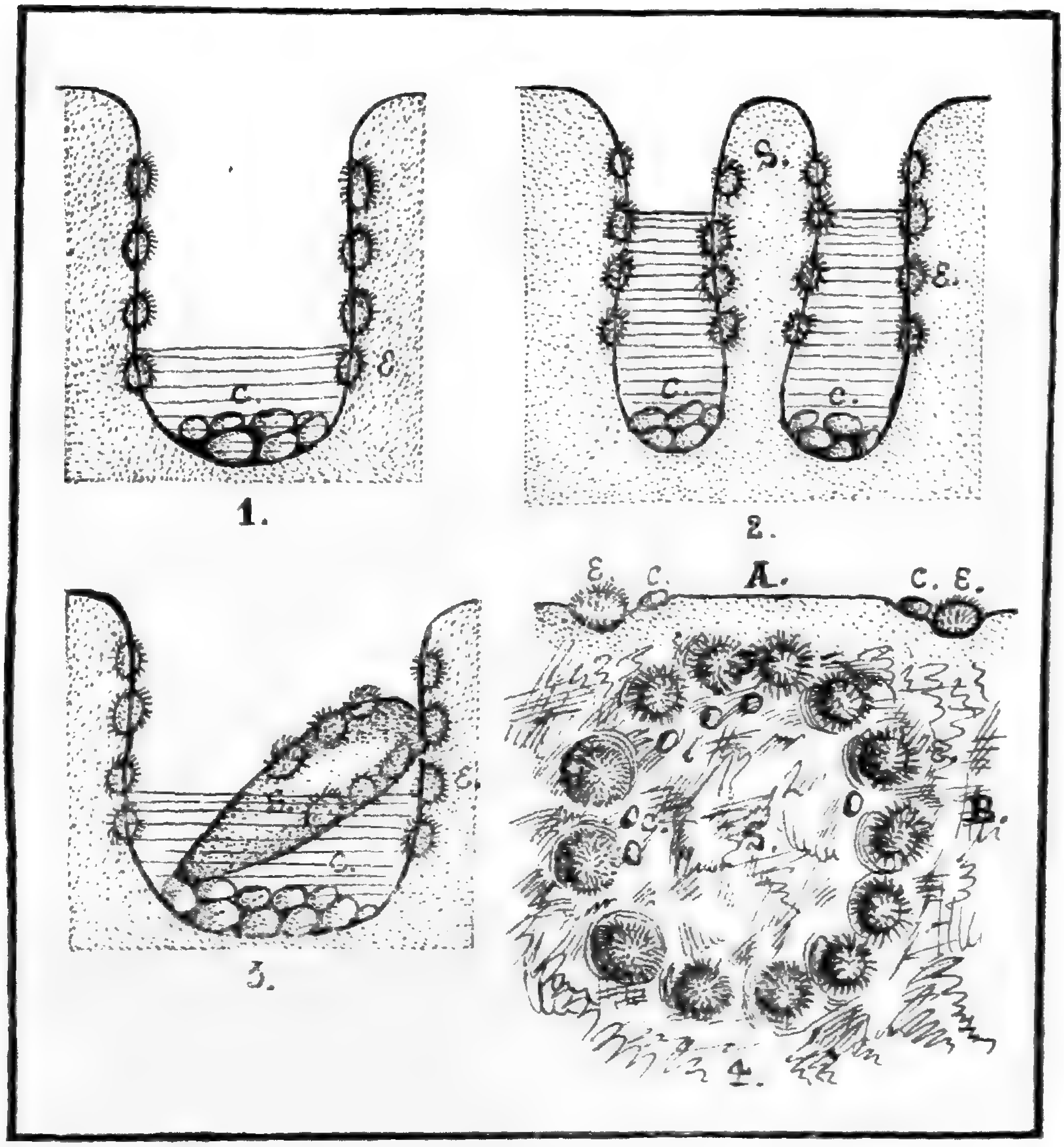
Either the calcareous spines, the wall of the test, or, most important of all, the teeth are singly or together the agents which have produced these excavations. It seems to the author plausible that mechanical movements of the sea-urchin by the waves, in combination with voluntary action, has played some part in the formation of these cavities. It might facilitate our framing a satisfactory answer to the question if we knew whether or not the matter worn off from the surface of the sea-urchin excavations was always passed into the alimentary canal. An examination of the stomachs of sea-urchins which inhabit these excavations might by following John's method throw light on this question. Unfortunately I have nothing to add to what is already known bearing on this subject.

An interesting example of erosion and the excavating habit of the sea-urchins has been called to my attention by Prof. Jules Marcou, of Cambridge. At my request Professor Marcou has kindly written out his notes, which have never been published, and are consequently quoted entire in the following pages :

"PERFORATIONS DU CALCAIRE SABLEUX NUMMULITIQUE INFÉRIEUR PAR L' *Echinus lividus* DANS LES ROCHES DE HALDE À BIARRITZ.

" Entre le vieux Port de Biarritz et la côte des Basques, s' advance la Pointe des Roches de Halde, toujours très fortement battue par les vagues ; à basse marée l' extrémité de la Pointe se découvre sur une longeur moyenne de 75 pieds anglais (25 metres); et au milieu d'algues diverses on trouve tout une population littorale (Moules, Patelles, Littorines, Actinies et surtout des Oursins). L'oursin est l'espéce commune tout le long de la côte de l'Atlantique, *Echinus lividus* Lam.; non seulement cet oursin se creuse une niche dans laquelle il vit, mais bien plus il agit en corps pour se créer une habitation collective.

PLATE II.



DIAGRAMS OF SEA-URCHIN EXCAVATIONS AT BIARRITZ,

(JULES MARCOU, DEL.)

A few words in explanation of the diagram may lead to a better comprehension of them. Fig. 1 represents a pot-hole partially filled with water, on the walls of which sea-urchins (*e*), can be seen; at the bottom of the pot-hole there are small stones (*c*); the breadth of these pot-holes is indicated by Professor Marcou as one and one-half feet, the depth, two feet. Fig. 2 shows a stylated pot-hole; and Fig 3, a pot-hole in which the style (*s*) is broken off and appears as a stone, somewhat larger than the other (*c*). On the large stone the sea-urchins can be seen clinging in their canties. Fig. 4 has two parts: *A*, which shows a section of the rock on which, when seen from above, the sea-urchins are arranged in a ring. These sea-urchins are sunk in depressions, while centripetally to them appear the small stones, (*c*), which are supposed to form the annular depression about the style (*s*); *B* of Fig. 4 represents the ring of sea-urchins on the surface of the rock, seen from above.—(*See page 13.*)

"On voit dans le calcaire sableux des espèces de marmite ou de mortier, tous habités par cet oursin, et dont voici les divers états, lorsque je les ai observé, à la marée basse le 8 mai, 1876.

"Tout à fait à l'extrémité des Roches de Halde, là où l'eau reste dans les anfractuosités, les depressions et les marmites, au milieu d'algues très épaisses; on rencontre:

"1. [25] Des trous ayant de un pied, à deux pieds de profondeur au maximum, et de un pied à un pied et demi de diametre, en forme de marmite; au fond on voit des cailloux trés arondis et usés, qui à chaque marée sont fortement agités par les mouvement violent de l'eau, qui déferle toujours avec une grande force sur toute la Pointe de Halde et recoivent ainsi un mouvement circulaire, qui les fait creuser de plus en plus la marmite où ils se trouvent. Chacune de ces marmites est occupée par plusieurs rangs d'oursins, étagés les uns au dessous des autres, sur trois, quatre, ou cinq ligues; et chaque oursin occupe une niche de deux a quatre centimetres de profondeur, qu'il a creusé lui-même avec ses piquants dont il se sert comme d' une lime.

"2. La marmite ou mortier a quelquefois au milieu une colonne solide de calcaire.

"3. La colonne du milieu fini par être usée à son pied par le mouvement continuel de rotation des cailloux accumulés au fond de la marmite et j'en ai vu un example avec la colonne detacheé et gisant comme un pilon au fond d'un mortier, comme la figure ci-joint. Les echinus sur la colonne isolée et qui agissait alors en tournant comme les autres cailloux roulés, étaient vivants et ne paraissaient pas être incommodés par le mouvement de rotation auquel ils étaient soumis, deux fois par 24 heures.

"4. Enfin j'ai vu un commencement de marmite. Des oursins s'étaient placés sur un espèce de cercle et y avaient creusés leurs niches; quelque petits cailloux detachés commençaient leur office de creusement du calcaire pour arriver à créer une station-marmite pour les échinides.

[25] Each of the above-mentioned conditions is illustrated by a diagram bearing the same number. These diagrams are copied from drawings which Prof. Marcou has kindly made and sent to me, and convey very well the peculiarity of these remarkable excavations.

"Comme aspect chacune de ces marmites avec sa population de 40 à 60 Echinus, et peut-être plus, resemble à une façade de maison avec un habitant à chaque fenêtre ouverte et qui seraient occupés à regarder ce qui se passe. Tous les échinides étaient bien portants, et je n'en ai pas vu de mort.

"JULES MARCOU."

According to Fisher, Cailliaud says that excavations by sea-urchins were observed at Biarritz by MM. Sæmann and Cazenavette. This was probably the first observation of this habit in this locality, but I am unable to discover from Cailliaud's account that the peculiar relation to pot-holes was noticed by them, or by any author quoted by him in the preparation of his paper.

It is remarkable that such an interesting case of erosion should have escaped their observation, a fact which may be ascribed possibly to the inaccessible position in which these rock erosions were to be found. Marcou was engaged in collecting fossils when the pot-holes were discovered, which led him to portions of the coast not easily visited.[26]

Fisher also observed that the common sea-urchin at Biarritz has the habit of excavating, although the relation of these urchins to pot-holes in that locality seems to have escaped his notice. He writes: "A marée basse une grande partie des rochers du Port-Vieux sont émergés et rejoinnent quelques blocs plus élevés, placés au large, qu'il serait facile de relier par une jetée. La mer bat vigoureusement contre des roches plus résistantes que les falaises de la côte des Basques; le sol du port est un sable très-fin. . . . Quand on examine les rochers á marée basse, on trouve au-dessous de la ligne d'émergence des excavation sprofondes, de grandeur variable, depassant quelquefois un mètre carré en superficie. Jamais ces excavations ne manquent d'eau, lors même que leur contour émerge à l'epoque des grandes marées; leur profondeur permet á la mer d'y laisser au moins un

[26] At the time of his visit Prof. Marcou was not specially engaged in a study of the work of these animals, but the examples of rock erosion were so striking that his attention was attracted to them, and he retains to-day thirteen years after his visit, a vivid memory of them. On his return to America he called the attention of several persons to his observation, but nothing was published, and apparently no great interest was excited in them.

décimetre d'eau. C'est dans ces sortes de cuvettes que vivent les oursins (*Echinus lividus*, Lamk.) parqués par groupes de vingt-cinq á cent disposés dans un ordre admirable, possédant moins un trou ; leurs excavations sont tellement rapprochées, qu'il est impossible à d'autres oursins de conquérir une place dans la colonne.

"La position des oursins est invariable ; la bouche reste appliquée en bas, au centre du trou ; l'anus est par conséquent en haut. A l'époque de mes observations (août, 1863), les oursins gardaient une immobilité compléte, les radioles étant redressées ; ils s'engageaient si bien dans les excavations, que souvent leur extraction m'en a paru impossible.

"Je n'ai pas aperçu d'oursins sur des roches émergées et privées d'eau ; et partout où j'en ai trouvé, ils étaient logés dans des trous particuliers."

From the above quotation, which is but a part of the description which Dr. Fisher gives of the work of sea-urchins at Biarritz, it is evident that he carefully studied these excavations at this point, but neither from this description nor from the remainder of his account am I able to find that the peculiar relation observed by Marcou between sea-urchins and pot-holes was seen. He makes a minute comparison with the perforations found at Biarritz of a number of specimens, which at the time of his writing existed in the Museum d'histoire Naturelle at Paris.

It may not be out of place to call attention to certain peculiarities in sea-urchin excavations suggested by Prof. Marcou's notes. From the observations it seems that veritable "pot-holes" were found at Biarritz in which there is a central column of rock, which is unlike in its relationship to the pot-hole to the columella to the cup of certain corals. This central axis or style he supposes to be formed by the wearing away of the rock about it, by which it is left standing as a pinnacle.[27]

Prof. Marcou believes that the first stage of development of the ring-shaped stylated pot-hole is due to the sea-urchins exca-

[27] It is of course necessary to know whether this pinnacle is of the same rock as that which bounds the "pot-holes," and not a concretionary structure. Prof. Marcou has furnished the desired information, for he says that the style is of the same kind of rock as that in which the pot-hole is worn.

vating in a ring-shaped depression (Fig. 4, A. and B.) enclosing the central area. The animals are assisted in their work by the presence of small stones (*c*), which have been washed in by the waves. An interesting observation in relation to the sea-urchins is that on the inner surface of the pot-hole there are many small excavations worn by the sea-urchins (*e*). Each sea-urchin is lodged in a cavity which it has worn out. Moreover, there are also similar holes (Fig. 2) excavated by the sea-urchins with the animals still in them on the central style. The Echinoids occupied their supplementary excavations when they were seen by Prof. Marcou, and the cavities are so shallow that a small part of the body of the sea-urchin projects beyond the level of the rim of the hole. The position is certainly exceptional, but not less remarkable than the fact that we have a pot-hole with a central columella.[28] Prof. Marcou also observed "pot-holes," and the surfaces of the enclosed stone (*s*) were tenanted with sea-urchins which were found in slight depressions. The size of the enclosed stones would seem to imply that they are due to a breaking away at the base of the central style of the first kind, and not that they were the active agents in wearing down the inner surface of the pot-hole.

The first type (Fig. 1) of pot-holes with sea-urchins, which were observed by Prof. Marcou, may be nothing more or less than ordinary "pot-holes" in which the wearing stone is found at the bottom. They are interesting as possessing supplementary cavities worn in the sides by the sea-urchins. This type may have been either derived from the third (Fig. 3), that with a larger enclosed stone, which itself came from the stylated (Fig. 2), or it may have been developed, as in the case of ordinary pot-holes which do not have the stylated axis, by simple grinding resulting from the movement of the stone. It can readily be seen that the third instance (Fig. 3) mentioned by him is derived from the second (Fig. 2), and that the second may have been derived from the fourth. The first, however, may have been formed as all simple pot-holes, by the rocks or pebbles within it, as ordi-

[28] It certainly cannot be supposed that the pot-holes with a central pinnacle of this kind are formed in the same way as ordinary kinds.

narily explained by geologists. It may, of course, have been formed from the third by repeated grinding of the rock without the sea-urchin contributing any help.

The statement that the sea-urchins are arranged in stories is an interesting one. I am unaware that a similar arrangement has ever before been observed, and I have never seen similar examples of the arrangement of sea-urchins in a ring, as observed by Prof. Marcou, and described by him in the fourth instance (B, Fig. 4).

The wearing away of the zone of rock, leaving the central axis (*s*) standing, is certainly a remarkable case of erosion, unlike any which has been recorded.

The explanation advanced to explain the central style is certainly an ingenious one, and should be investigated by those naturalists who visit Biarritz. The hypothesis that the sea-urchins bore in the solid rock a ring of excavations, the walls of which were broken down by the small "cailloux" (*c*), seems plausible, but why the sea-urchins should arrange themselves in a ring (B, Fig. 4) is not wholly clear to me. It is a well known fact that sea-urchins have a habit of getting together bits of sticks, algæ shell, etc., by which they cover themselves. Those that live on sandy sea bottom, as our common clypeastroid Echinarachnius, crawl under the sand in order to hide themselves. [29] The boring sea-urchin possibly collects the stones for this purpose, which,

[29] I have observed on the Florida Reef an interesting case of the inclusion of an Echinoderm by the growth of coral about it. This phenomenon is not a rare one as far as other animals of various groups are concerned, but there is reason to believe that the inclusion of an Echinoderm by growing coral is not common. At all events I am not familiar with a printed record of this fact. The inclusion takes place by a simple growth of the cœnosarc around the urchin, leaving the animal in a cyst, which is in free communication with the external water through a small opening. This imprisonment of a sea-urchin by a growth of coral cœnosarc is in its results not unlike the excavating habit of the sea-urchin, and may have been mistaken for it. The conditions, however, are readily distinguished from each other, and the process by which both are brought about is radically different. In both instances we probably have a means of protection of the animal from the waves. I am informed by Mr. C. H. Maynard that sea-urchin excavations on the Bahamas are tenanted by a genus of Chitons. This mollusk may not be a commensalist, only so far as to seek the protection of the hole from the surf. Mr. Maynard likewise finds a small fish inhabits these sea-urchin excavations, and he tells me that when alarmed the fish hides among the spines or under the body of the sea-urchin. This is a phenomenon somewhat like the habit of hiding under stones which has long been known in Lepadogaster and the "butterfish," and other fishes, and can hardly be interpreted as an instance of commensalism.

dropping off, fall down between the sea-urchins, and by their grinding action serve to enlarge the depression. The stones, however, are too large to be placed there by the sea-urchins, and it is probable that they were simply caught in the depression after having been thrown there by the waves.

Prof. Marcou has furnished the following directions for those who would examine the interesting pot-holes which he has discovered at Biarritz :

South of "le port Vieux" there push out to the west into the sea at least three peninsulas, separated by parallel bays. The road to the Côte de Basques runs at the base of these peninsulas, on the eastern edge. The pot-holes were observed at the western end of the most western of these peninsulas. The locality is rich in fossil echinoidea, serpulæ, and other animals.

The question of why and how the sea-urchins bore in the rock seem to have been answered in as many ways as the number of observers. The sea-urchin excavations at Grand Manan have certain resemblances to and differ somewhat from those recorded by others. My interpretation of their cause, as derived from their study at this locality, also differs somewhat from those of other observers. As to the question why the sea-urchins make these hollows there seems at least two answers. Their main object is probably for protection from the waves, as has already been shown by several naturalists. At the same time that the depressions serve for protection, they would form receptacles for water, which would be of great use to the animal between tides. [30] Ordinarily not much water would be retained in that way, but in the case of the pot-holes at Biarritz it would be considerable in amount, and natural aquaria with a continual supply of pure water would be at hand. Prof. Marcou has aptly compared the situation of these colonies of sea-urchins on the walls of a pot-hole to a hotel with guests. The simile, though fanciful, may not be far from the truth. It is a significant fact that sea-urchin excavations where the tides are small, as in the Mediterranean, are also not very large.

[30] Marcel de Serres (Sur l'action perforante de l'*Echinus lividus*. *Comp. Rend.*, Vol. XVIII., pp. 405, 406) tries to explain the rarity of sea-urchins' excavations on the coast of the Mediterranean by the absence of the ebb and flow of the tide.

The almost universal presence of a calcareous alga on the rim of the sea-urchin boring might seem to indicate that there is a symbiosis between the alga and the animal. It would seem as if the rim was built up, in part at least, by the alga, as a protection for the sea-urchin, and that in return the alga received certain advantages. In the case of very deep sea-urchin excavations this would not hold, as there can be no doubt that the cavity is made by the urchin boring in the rock.[31]

Among other statements which might well be quoted, Caillaud reaches the following conclusion, which is very significant Speaking of rock excavations, and of the buccal armature, he asks, "S'il n'était pas dans la nature de ces êtres de creuser des roches, pourquoi seraient-ils ainsi pourvus et outillés de poinçons en émail dont les sommités s'usent, puis se renouvellent, se cracourcissent dès lors et doivent, de toute nécessité, recevoir le prolongement nécessaire pour conserver leur longueur voulue tant que l'oursin travaille? Si cet appareil," he continues, "si bien combiné pour agir sur la pierre n'avait pas ce but, il deviendrait inutile à cette tribu de veritables Echinus que en sont pourvus; ils auraient reçu des simples dents fixes et ordinaires, comme tant d'autres dans cette immense famille, comptant, comme nous l'avons dit, en vivants et fossiles, seize cents espèces. Comme example, nous citerons particulièrement le genre Clypéaster, à qui tous les moyens de perforer les roches sont interdits."

It is interesting, taken in connection with the above quotation, to speculate as to the character and use of the "Aristotle's Lantern" in the Clypeastroids, and its absence in the Spatangoids. The lantern of the genus Echinarachnius is so small and inconspicuous that it is difficult to believe that its function is the same as in the round sea-urchins, or echinoids. Moreover the manner of life of this genus is such that we can hardly suppose that there

[31] Deshayes does not accept the view that the sea-urchin bores in the rock. He regards them as simply seeking out excavations already existing. He finds first that it is without example elsewhere in the animal world that the same species on one coast bores holes, and on another does not. Secondly, the habit once acquired would be universal for individuals of the same species. Thirdly, the sea-urchins have no organ for boring, and, lastly, the holes are covered with calcareous algæ. These views have been discussed by others. I think, in answer to the first and second objections, we may say that the wave motion brings it about that individuals in one place bore, and in another do not.

is any need of a complicated buccal apparatus such as is found in Strongylocentrotus. One is even tempted to regard the lantern in Echinarachnius as a rudimentary organ which has lost its functional importance.[32]

While it is next to impossible to say how much or how little of the excavation is due to any one of the three means of wearing away of the rock, the teeth, spines, and wave action, we can safely conclude that the most important factor in this work is the dental apparatus. Next in importance are possibly the spines, while last of all comes that work done by the rolling about of the sea-urchin due to the motion of the water. To the general proposition advanced by John, we might also add that there is evidence that the time which has elapsed between the inception of the sea-urchin's work in excavation and the present condition of the cavities is probably much larger than the life of the individual which now occupies it. In an interval between two occupants the interregnum may have been filled out by effective grinding out of the cavity by the motions of the test of the former occupant, or by fragments of the spine, the teeth, or other hard parts of the dead animal which has left this heritage as a means when moved by the water to grind out the excavation for its successor.

After a somewhat extended discussion of the views of others, John gives as his conclusions in regard to sea-urchin excavations the following summary:

"Die in den Gesteinen gefundenen und von Seeigeln bewohnten Höhlen rühren von diesen selbst her. Der Echinus erzeugt seine Wohnstätten mittelst seines Kauapparates und sekundär mit Hilfe der Stacheln durch rotierende Bewegung. Er bohrt sich solche Höhlungen, um einen Schutz gegen das brandende Meer zu haben.

"Die Kalkalgen, welche die von Seeigeln bewohnten Gesteine bedecken, lagern sich mechanisch auf das Gestein und haben

[32] It seems to the writer capable of proof that the flat sea-urchins are structurally lower as far as their internal anatomy goes than the so-called "round sea-urchins." Still that proposition would not be accepted by one or two prominent special students of these animals, and this does not seem the place to present arguments in its support, or to combat objections which might readily be made to it.

keinen Einfluss auf die chemische Beschaffenheit der Oberfläche desselben, kömmen daher auch nicht mit dem Entstehen der Echinushöhlen in Zusammenhang gebracht werden."

The above conclusions are substantially those to which the author has been led by a study of the sea-urchin excavations at Grand Manan, except that he would also adduce the motion of the sea as an additional factor in the excavation of these cavities. By this wave action the sea-urchin covered with spines is moved about, rubbing against the wall of the cavity in which it rests. A continued action of the spines and other hard parts of the animal on the rock thus deepens the depression at the same time that it files the surface smooth.

SUMMARY.

The results of the preceding pages may be briefly stated as follows:

1. *Strongylocentrotus drobachiensis* on the coast of Grand Manan sometimes makes excavations in solid rock.

2. The excavations are made by the sea-urchin by means of its teeth, spines, combined with motions of the animal produced by waves and tide. The object is primarily for protection, but secondarily a sufficient amount of water is in that way retained by the animal during half tide, or when otherwise uncovered.

3. The coralline accompanying the sea-urchin, generally found at the rim of the excavation, takes no part in the formation of the recess, although its presence may be necessary to the animal for some unknown reason.

3. Sea-urchins are found at Biarritz, France, which live in stories on the walls of peculiar pot-holes, some of which have a central style also tenanted by the same animals in small depressions.

5. The sea-urchins play some part in the formation of stylated pot-holes, although they are assisted by the movements of stones, produced by the action of tides and waves.

Boston, January 1st, 1890.

INSTANCES OF THE EFFECTS OF MUSICAL SOUNDS ON ANIMALS.

BY ROBERT E. C. STEARNS.

SOME years ago I observed in a casual way the effect of musical sounds upon certain animals, and was inclined to pursue the inquiry and endeavor to learn by careful experiment through the medium of music how far or in what degree there might exist between man and certain animals that fellow-feeling which makes the whole world kin.

The fraternal relation between dog and man, whether the latter be civilized or savage, is too well known to require remark. So, too, with other animals which man has domesticated, notably the horse and cat.

Some four or five years ago, at a meeting of the Biological Section of the British Association, Sir John Lubbock read some interesting notes on the intelligence of the dog. The man and the dog he said, have lived together in more or less intimate association for many thousands of years, and yet it must be confessed that they know comparatively little of one another. That the dog is a loyal, true, and affectionate friend must be gratefully admitted, but when we come to consider the psychical nature of the animal, the limits of our knowledge are almost immediately reached. I have elsewhere suggested that this arises very much from the fact that hitherto we have tried to teach animals rather than to learn from them—to convey our ideas to them rather than to devise any language or code of signals by which they might communicate theirs to us.

So it occurred to me that we might learn something of the animals around and about us,—add somewhat to the stock of knowledge, and get many interesting hints, some useful and some curious, as to their inner nature,—by the aid of music or musical sounds, by observing the effect of such sounds upon them.

In pursuing an investigation of this kind, we would naturally experiment with the domesticated animals *first*, and of such animals those with which we are the most intimate. Thus the dog and cat are household pets; in many cases housemates from birth to death. Generations of these animals are born within the social atmosphere of the same human family, and quite likely derive or receive through heredity, as well as by individual contact or experience, a feeling or sense of security, protection and fraternity.

While such animals may be regarded perhaps as becoming, though such contact, somewhat humanized, and therefore less adapted or satisfactory for the purposes of such experiments, on the other hand their familiarity with a great number of sounds which their untrained brethren know nothing of would seem to be fully an off-set, and again their familiarity with man would operate adversely to a feeling of fear when experimental sounds were being made.

We do not know that any influence analagous to music inspires the military ants in their great marches, or that the monœcious snails have any occasion for love songs. But these are not next of kin in the scale of Nature, and we have poor relations nearer home who seem to be moved by the same or similar impulses with ourselves.

By voice or sounds fully as much as by facial expression or gesture—movement of body or limb—the emotions are expressed by the human animal, and this is in great measure the case among the animals which follow along after or below man. The moods and tenses of feeling, pleasure and pain, joys and sorrows, are made apparent by the intonation of the voice, by the sounds which such conditions induce, provoke or compel.

We speak of the sense of hearing. An inquiry of the kind herein suggested, relates to the sense of sounds.

The sense of sounds among the higher animals we may assume to be nearly universal, and among dogs and some other animals, combined with memory, tends to the development of the intellectual quality, as the sense of hearing in a certain aspect is an intellectual rather than a physical sense.

To what degree this sense of sounds is developed or exists, can be learned only by experiment, and requires on the part of the experimenter what I unfortunately do not possess,—a knowledge of music, and the ability to play upon one or more instruments.

The sense of sounds, we may assume, varies in animals below man as it does in man, or as the color sense varies; often limited, or nearly or quite wanting; hence the term color-blindness, and we may use the term sound-deafness in an analagous way.

The experiments of Lubbock referred to show a great difference in the perceptions and receptivity of dogs, as between his black poodle "Van" and Mrs. Lubbock's collie "Patience." In speaking of it Sir John says, "I was rather disappointed at this, as if it had succeeded the plan would have opened out many interesting lines of inquiry. Still, in such a case one ought not to wish for one result more than another, as of course the object of all such experiments is merely to elicit the truth, and our result in the present case, though negative, is very interesting."

To the terms music and musical sounds, in this connection, an exceedingly liberal definition must be conceded,—liberal in a simple and non-technical sense, so as to include:

1. Sounds not even musical, but occurring in simple rhythmic order or succession, like the common marching drum-taps, when the full military band is resting.

2. Melodious sounds, or sounds in themselves musical, occurring in harmonious sequence.

3. The same in various strains or keys, more or less complex, but combined and arranged in accordance with harmony.

Of these definitions the first will oftenest serve the purpose.

It would seem that in the selection of tunes or sounds for experimental use, a hint may be had from the animals by observing the special sounds uttered by them in their various moods.

With the birds, for instance, a tune or sounds which include the notes uttered in their amorous moods at or about mating-time.

Many of the sounds which by man are regarded as musical and agreeable may not produce an agreeable impression upon animals, but may have an annoying effect upon them, as the monotonous, attenuated and irritating hum of the mosquito, the filing of a saw, or the riveting of a steam boiler, with its rasping and tumultuous clangor, have upon us.

I spoke of sounds that are regarded as musical by man, but here comes to mind a wide chasm in the way of difference between the musical sense or taste of the European or Caucasian, and the Chinese or Mongolian, idea of music and musical sounds, whether vocal or instrumental.

Some time ago there appeared in a New York paper an account of an interview with an Englishman residing in that city, who, it was stated, had a mania for collecting and taming various small animals, lizards, snakes, spiders, etc.

The question was asked, "How do you manage the taming process?" Answer.—"It was simple enough. First of all I tried kindness. By kindness I mean warmth and music, and as much food as the animals could possibly eat, so as to get them in to a state of torpor. If they were not well advanced in amiability in a week the music was stopped altogether, and I gave but little food. This made them savage. They then had music occasionally, the doses increasing in proportion to the improvement in their temper."

Question.—"What kind of music did you give them?"

Answer.—"It varied a great deal. Some of them liked a piano best. Some liked a violin, and others a flute, and one was never so happy as when listening to an Æolian harp I had erected on the window of the room I kept them in. They all liked a musical box. You might not believe it, but there was not a single one of my snakes or lizards that could not distinguish instruments and tunes. They had very good taste and ear, and would keep time to slow measured music by wagging their heads, and if I ever created discord when playing they would get quite in a rage. I remember a thunderstorm angered them once, and I could hardly keep them from attacking one another, and indulging in a free fight. Luckily an itinerant German band was within hail, and I prevailed upon its members by financial arguments to play to those beasts for an hour. They were pacified, but the neighbors for two hundred yards around were not."

While conceding a liberal margin for the embellishment of the interviewer and the enthusiasm of the interviewed, there is no doubt that the leaven of the fact prevails in the foregoing. The statement as to the wagging of heads, however, may safely be disregarded.

Without further preamble or speculation, in proceeding with the data which are here brought together, we will begin with the domestic animals, and first with the dogs,—"dogs of high and low degree."

DOGS AND MUSIC.

Goodrich relates many interesting anecdotes on the apparent effect of music on various animals, among which I find this:

"A dog in Paris, at the commencement of the Revolution, was know to musicians by the name of 'Parade,' because he regularly attended the military at the Tuilleries, stood by and marched with the band. At night he went to the Opera, and dined with any musician who intimated, by word or gesture, that his company was asked, yet always withdrew from any attempt to make him the property of any individual."

Mr. W. S. Jones states that he has "a Skye terrier about four months old who, when the piano is played, seems to be curiously fascinated by the sound, and comes toward it, but then howls in a most plaintive way with his nose in the air, as if protesting against the sound."

C. J. W. says, "a black-and-tan terrier that we kept for some time was particularly sensitive to music. Although scales played on the piano made her yell piteously, it was by the concertina's sweet influences that she was most affected, flying before it, and, if unable to leave the room, whining until the tune was stopped. A Spitzbergen dog-friend of ours is much excited by music, but when one tune is played its excitement is more marked;—the tune is, 'Bonny Dundee.' Dogs are not peculiar in their feeling for music: witness the fact that retired cavalry horses obey the call of the bugle when accidentally heard."

To the Rev. Mr. James of Tuscarora, Nevada, I am indebted for the following and other pertinent instances :

"In Eureka, Nevada, I visited in a family who were the proud possessors of a dog named 'Ben.' Ben was one of those smart dogs who knew everything. He was passionately fond of piano music; it silenced the wagging of his tail, and the studious look of the eyes, as you sat at the instrument, denoted pleasure; but no sooner would the harmonica (mouth organ) be played than he would howl and give short yelps in a ferocious style. The music of the ordinary organ affected him in the same way."

An old friend, Prof. George Davidson, of California, has kindly furnished me with many interesting items, among which the following relate to dogs:

"A small black-and-tan named 'Bessie,' belonging to Mr. A. B. Corson, of North Fifth Street, Philadelphia, will, on hearing 'Shall we meet beyond the River?' sung, throw her head back and set up a most dismal howl, while the tears will run down her cheeks. If the tune is played solemnly on an organ and no word spoken, the same thing will occur; but if any of the words are spoken, with not the slightest musical intonation, she will run to the speaker, and beg and plead in her own way, and do everything but speak, to have it stopped."

"'Toodles,' a Spitz, belonging to the same person, will howl when a discord occurs, or when an accordeon is played, but is not otherwise affected; while 'Rose,' another Spitz, will lie at the foot of the organ, apparently pleased with the music, but making no demonstration of either pleasure or annoyance."

"A black-and-tan, rather larger, named 'Duke,' belonging to Mr. Loney, of North Sixth Street, Philadelphia, will, on hearing 'Hold the Fort' sung, start in with the rest, and will actually sing in dog fashion as long as the singing goes on, and appears to be delighted with the music."

"A Spitz which belonged to Mr. Charles Wetherald (formerly of North Sixth Street, but now of Bryn Mawr), named 'Blanco,' was so affected by the music of a violin that he would howl, and if the music was persisted in would fly at the musician, and one or the other would have to leave."

DOGS AND CHURCH-BELLS.

"Living next door to us in our English home was the sexton of a church, in the belfry of which was a beautiful peal of eight bells. Each Sunday morning and evening before service the sexton, as leader of the bell ringers, would go to the belfry (the church stood exactly opposite his house) to perform his duties. He had a large Newfoundland dog, which—no sooner did he perceive the sexton going out—would take his stand just outside the door of his master's house, and immediately the bells began to ring would raise his head and howl in the most melancholy and profound manner. No speaking to him would change his position; he would go on until the ringing ceased."

A Salem, Illinois, dog has been reported as similarly affected by the sound of church bells, and, it would seem, by Presbyterian in particular:

"Conrad Bollinger for some years past was the owner of two dogs which were much attached to each other. Several months since one of them died, and the effect thereby produced on the one living was very marked. It for days acted strange, as if lost; and when the bell of the Cumberland Presbyterian Church rang it set up a doleful noise. This it does at each ringing of the bell, during which time it will gaze intently up at the belfry. If the ringing is not protracted it keeps up the whining, howling noise, and when done it returns to the house, which is near to the church. None of the other bells seem to affect this dog."

HOUNDS AND THE BUGLE.

In Mrs. Custer's entertaining volume, "Boots and Saddles," she mentions the effect of the Cavalry Bugle-call as follows: "The pack of hounds were an endless source of delight to the general. We had about forty; the staghounds, that run by sight, and are, on the whole, the fleetest and most enduring dogs in the world, and the fox-hounds, that follow the trail with their noses close to the ground. The first rarely bark, but the latter are very noisy. The general and I used to listen with amusement to their attempts to strike the key note of the bugler when he sounded the calls summoning the men to guard, mount, stables, or retreat. It rather destroyed the military effect to see beside his soldierly figure a hound sitting down absorbed in imitation. With lifted head and rolling eyes there issued from the broad mouth notes so doleful they would have answered for a *misericordia.*

During a period of ill health I boarded for several months at a hotel in Auburn, California, and a part of nearly every day was passed in the shade of a vine-clad summer house, on the neighboring grounds of an acquaintance, Dr. Todd. A friend of mine, a young man in poor health, boarded with the Doctor, and we were together every day.

Doctor Todd had an old collie that served the purpose of a watch-dog. Our relations with the animal were such that it knew us to be friendly; during the day the dog was always with us. Without the slightest look, word, or sign of command, rebuke or menace by either of us, the moment I commenced to imitate a French horn he would immediately leave and skulk away to his kennel, evidently very much annoyed, and that too without regard to the tune. When a veritable horn was played upon by my companion the poor dog trembled in every limb, went to his kennel, and remained there in a state of nervous agitation, made neither a bark, howl or moan, but wore a deplorably pitiable expression, as if his nerves were absolutely unstrung. No doubt the sounds affected him as the filing of a saw or Chinese instrumental music affect me.

(*To be continued.*)

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 677, Vol. XXIII., 1889.)

NASTURTIUM. *Tropæolum* sp.

IT is rather as ornamental flower-garden plants that the nasturtiums are now so universally grown. Yet they are also classed among kitchen-garden esculents, the flower-buds and the seeds serving, when pickled, as a caper substitute, and the flowers used for garnishing. In 1683 Worlidge,[1] in England, says, "from a Flower are now become an acceptable Sallad, as well as the blossom." In 1690 Quintyne[2] grew them in the royal kitchen-gardens of France. Both species were received in Europe in the 16th century, as will be seen from the appended synonymies. Both are found wild in Peru.

Tropæolum minus L.

This species seems to have been first known in Europe about 1574, described by Monardes;[3] it is figured by Lobel[4] in 1576, and is generally spoken of about this period as a new and rare plant. It was in the vegetable-garden in England, in 1726,[5] probably before, and is mentioned in American gardens in 1806.[6] The synonymy appears as below:

Nasturtii Indici genuina effigies. Lob. Obs., 1576, 338, cum ic.

Nasturtium peregrinum, myconii. Lugd., 1587, 656, cum ic.

Flos sanguineus. Lugd., 1587, 1918.

Nasturtium Indicum. Lob. ic, 1591, 616; Dod., 1616, 397, cum ic.

Mastuorzo. Cast. Dur., 1617, 277, cum ic.

Pelon mexixquiletl, seu nasturtio Peruino. Hern., 1651, 161, cum ic.

Cardamindum minus et vulgare. Feuille, Peru, 1725, III., t. 8.

[1] Syst. Hort. By J. W. Gent., 1683, 216.
[2] Quintyne. Comp. Gard., 1693, 189.
[3] Hort. Eyst., 1713, ord. 13, fol. 1.
[4] Lobel. Obs., 1576, 338.
[5] Townsend. Seedsman, 1726, 40.
[6] McMahon. Am. Gard. Cal., 1806.

Tropæolum majus L.

"The seeds of this rare and faire plant came first from the Indies into Spaine and those hot regions, and from thence into France and Flanders, from whence I have received seeds that hath borne with me both flowers and seede," says Gerarde in 1597.[7] We cannot agree with those authors who consider this the dwarf form, as the figure given comes nearer to the Tall, as it was figured by J. Bauhin,[8] in his works printed in 1651, with the name *scandens*, thirty-three years before its asserted introduction by Linnæus. Ray,[9] in 1686, speaks of its use as a vegetable, and this use is also spoken of by Townsend[5] in 1726. In American gardens it was noticed by McMahon[6] in 1806, and by all the early garden writers, as being the predominant kind in culture.

The synonymy I offer is shorter than the preceding:

Nasturtium Indicum. Cam. ic., 1588, t. 31.

Nasturtium Indicum. Indian cresses. Ger., 1597, 196.

Nasturtium indicum folio peltato scandens. J. Bauh., 1651, II., 75.

Cardamindum ampliore folio and majore flore. Feuille, Peru, 1725, III., t. 8.

The *nasturtium* or *Indian cress*,[7] or *capucin capers*,[2] with the epithet Tall or Dwarf, is called in France, *capucine*, *cresson du Mexique*, *fleur de sang*, *fleur sanguine*, *cresson de Peru*, *cresson d'Inde*; in Germany, *kapuciner kresse*, *Indianische kresse*; in Flanders and Holland, *capucine kers*; in Italy, *nasturzio*, *astuzzia*; in Spain, *capuchina*; in Portugal, *chagas*;[10] in Norway, *blomkarse*;[11] in Arabic, *tortour el-bachah*.[12]

Tropæolum tuberosus R. et P.

In Bolivia this plant is extensively cultivated in the high mountain districts, for its tubers, which are considered a delicacy, and are highly esteemed. It does not seem to have entered European or American culture, although it is retained by Vil-

[7] Gerarde. Herb., 1597, 196; 1633, 251.
[8] J. Bauhin. Hist., 1651, II., 75.
[9] Ray. Hist., 1686, 487.
[10] Vilmorin. Les Pl. Pot., 56.
[11] Schubeler. Cult. Pfl. de Norw., 118.
[12] Delile. Fl. Ægypt, Ill.

morin among garden esculents.[10] It was described in 1794, and was carried to France in 1836,[13] but its tubers were not found palatable to European taste.[14] The tubers are of good size, and are marked with purple upon a yellowish ground.

The tuberous-rooted nasturtium is called in France *capucine tubereuse;* in Germany, *Peruanische knollenkresse;* in Flanders, *knoll-kapucien;* in Spain, *capuchina tuberculosa;*[10] in Peru, *mayna,*[15] *massua;* in Bolivia, *isano,*[13] *ysano;*[16] in Mexico, *ysano,* or *taiacha.*[13]

NEW ZEALAND SPINAGE. *Tetragonia expansa,* Ait.

This plant was first found by Sir Joseph Banks, in 1770, at Queen Charlotte's Sound, New Zealand, and its merits discovered to the sailors of Captain Cook's expedition round the world. It reached Kew gardens in 1772.[17] It also occurs in Australia, both on the coast and in the desert interior, in New Caledonia, China, Japan, and Chili.[18] Don[17] says three varieties are found in Chili, one with smooth leaves, one with leaves hoary beneath, and a third small and glabrous. It was cultivated as a spinage plant in England in 1821 or earlier.[17] It was in use in France in 1824 or earlier.[19] In the United States its seed was distributed among members of the New York Horticultural Society in 1827, and in 1828 it appeared in our seed catalogues.[20] St. Hilaire[21] records its use as a spinage in South Brazil, and Bojer[22] in the Mauritius.

The New Zealand spinage is called in France *tetragone, cornue, tetragone etalee, epinard de la nouvelle-zelande;* in Germany, *neuseelandischer spinat;* in Flanders, *vierhouk, vierkant-vrugt;* in Denmark, *myseelandsk spinat;* in Italy, *tetragona;*[23] in the Mauritius, *tetragone;*[22] in Japan, *tsuri na,* i.e., creeping cabbage.[24]

[13] Heuze. Les Pl. Alim., II., 546.
[14] Bon Jard., 1882, 435.
[15] Kunth. Syn., II., 256.
[16] Jour. Hort. Soc., IX., 59.
[17] Don. Gard. and Bot. Dict., III., 152.
[18] Mueller. Sel. Pl., 1876, 237.
[19] Pirolle. L'Hort. Fran., 1824-5, 256.
[20] Thorburn's Cat., 1828, 88.
[21] St. Hilaire. Fl. Br. Merid., 1824.
[22] Bojer. Hort. Maur., 1837, 155.
[23] Vilmorin. Les Pl. Pot., 1883, 552.
[24] Thunberg. Japan, 1784, 208.

NIGHTSHADE. *Solanum nigrum* L.

This plant, says Vilmorin, is not as yet used in France as a vegetable, but in warm countries the leaves are sometimes eaten as spinage.[25] It is mentioned by Galen[26] among aliments in the second century, but was not cultivated in Germany in Fuchsius,[27] time, 1542, although it retained its name, *Solanum hortense*, perhaps from its former cultivation. It is a plant of a wide distribution, occurring in the northern hemisphere from Sweden, and the north-east of America from Hudson Bay, even to the equatorial regions, as for example at Timor, the Galapagos, the Antilles, Abyssinia, the Mascarene Isles, Mauritius, Van Diemen's Land, Chili, etc.[28] It is found as a pot herb in the markets of Mauritus,[29] and is used as a spinage in Central Africa.[30] In China the young shoots are eaten, as also its black berries,[31] and in the Mississippi Valley the little black berries are made into pies and other pastry.[32]

The *Nightshade* or *black nightshade* is called in France, *morelle noire, M. de l'ile de France, M. commune, brede, creve-chien, herbe aux magiciens, morette, raisin de loup;* in Germany, *verbesseter nachschatten spinat;* in Italy, *erba mora;* in Spain, *yerba mora.*[33]

OKRA. *Hibiscus esculentus* L.

The Spanish Moors appear to have been well acquainted with this plant, which was known to them by the name of *bamiyah*. Abul-Abbas el-Nebati, a native of Seville, learned in plants, who visited Egypt A. D. 1216, describes in unmistakable terms the form of the plant, its seeds and fruit, which last, he remarks, is eaten when young and tender with meal by the Egyptians.[34] The references to this plant in the earlier botanies are not numerous, and the synonymies offered are often incorrect. I think the following, however, are justified:

25 Vilmorin. The Veg. Gard., 355.
26 Galen. De Alim., Lib. 2, Bruns. edition, 1547, 153.
27 Fuchsius. De Stirp., 1542, 69.
28 Decandolle. Geog. Bot., 573.
29 Seemann. Gard. Chron., 1861, 622.
30 Grant. Speke's Nile, 576.
31 Smith. Mat. Med. of Ch., 201.
32 Bessey. Bot., 502.
33 Vilmorin. Les Pl. Pot., 354.
34 Pharmacographia, 1879, 94.

Trionum theophrasti. Rauwolf, in Ap. to Lugd., 1587, 31, cum ic.

Alcea ægyptia. Clusius, Hist., 1601, 2, 27, cum ic.

Honorius bellus. In Clus., l.c., 2, 311.

Bamia alessandrina. Cast. Dur., 1617, Ap., cum ic.

Quingombo. Marcg. Bras., 1648, 31, cum ic.; Piso., Bras., 1658, 211, cum ic.

Malva rosea sive hortensis. J. Bauhin, 1651, II., 951.

Ketmia americana annua flore albo, fructu non sulcato longissimo. Comelyn, Hort. Med., Amstelod, 1701, 150, cum ic.

Of these the last only, that of Comelyn, represents the type of pod of the varieties usually to be found in our gardens, but plants are occasionally to be found bearing pods which resemble those figured in the above list. I find little recorded, however, concerning variety, as in the regions where its culture is particularly affected there is a paucity of writers. Miller's Dictionary, 1807, mentions that there are different forms of pods in different varieties; in some not thicker than a man's finger, and five or six inches long; in others very thick, and not more than two or three inches long; in some erect; in others rather inclined. Lunan,[35] in Jamaica, in 1814, speaks of the pods being of different size and form in the varieties. In 1831 Don[36] describes a species, the *H. bammia*, Link., with very long pods. In 1863 Burr[37] describes four varieties in American gardens, two dwarfs, one pendant-podded, and one tall and white-podded. In 1885, at the New York Agricultural Experiment Station, varieties were grown under eleven different names, and from these we were able to satisfy ourselves of three distinct sorts only. Vilmorin[38] in 1885 names but two sorts, the long-fruited and the round-fruited.

Its culture is now recorded in nearly all the tropical countries, and it reached Brazil before 1648, as recorded by Marcgravius. It is recorded in gardens about Philadelphia in 1748,[39] in Virginia in 1781,[40] and in general garden culture in 1806.[41]

35 Lunan. Jam., 1814, II., 12.

36 Don. Gard. and Bot. Dict., I., 480.

37 Burr. Field and Gard. Veg., 614.

38 Vilmorin. The Veg. Gard., 1885, 356.

39 Kalm. Trav., I., 74.

40 Jefferson's Notes.

41 McMahon. Am. Gard. Cal., 1806.

Okra, ocra, or *gombo,* in India *ochro* and *gobbo*[42] is called in France *gombo, gombaud, ketmie comestible, calalon, quiabo, quingombo, okra;* in Italy, *ibisco;* in Spain, *gombo;*[43] in Greece, *vamies;*[44] in Brazil, *quingombo, quiabo;*[45] in the Mauritius, *lalo;*[46] in Curaçoa, *gigambo.*[51]

In Arabic, *bamyeh toneyly, i.e., bamia* with long fruit,[47] *bamia, bamia schami, bamia stambouli, rumi;*[48] in Angola, *quillobo;*[49] in Bengali, *ramturay, dhenroos;*[50] in Burma, *yung-ma-dae;*[44] in Central Africa, *bameea;*[51] in Congo, *quingombo* or *quigombo;*[49] in Egypt, *bamia,*[44] *chama;*[52] in Hindustani, *ram-turai, bhinde;*[50] in India, *dhenroos, ramturee, bhindee;*[53] in Malabar, *vendah;*[50] in Nubia, *djyoundou;*[44] in Persia, *bamiyah;*[51] in Tamil, *venda, venday;* in Telegu, *benda.*[50]

OLLUCO. *Ullucus tuberosus* Lozano.

Although Vilmorin says the culture of this plant has not given good results in France, yet he includes it in his book on vegetables. It was brought into French culture in 1848 by the Minister of Agriculture.[54] It is cultivated in the Andes of Peru, Bolivia and New Granada, Chili and Mexico.[55] The tubers are yellow, very smooth, starchy, and are developed on runners proceeding from the base of the stem.[56] Lieut. Herndon,[57] who ate them in Peru, pronounced them more glutinous than the *oca* and not so pleasant to the taste.

The *olluco* is called at Quito *ulluco* or *melloco;*[58] in Peru, *ulluca;*[57] in the Andes of Peru and Bolivia, *oca quina;*[59] in Chili, *melloes* and *ulloco;* in Mexico, *papa lissa.*[55]

Acosta,[60] in speaking of the food plants of Colao, Peru, where the climate is cold and dry, says, "The Indians use an other

[42] Firminger. Gard. in Ind., 141.
[43] Vilmorin. Les Pl. Pot., 242.
[44] Pickering. Ch. Hist., 274.
[45] St. Hilaire. Fl. Bras. Merid.
[46] Bojer. Hort. Maurit., 30.
[47] Delile. Fl. Æg. Ill.
[48] Forskal. Fl. Æg. Arab., c. XVII., 125.
[49] Piso. De Ind., 1658, 211; Marcg. Bras., 1648, 31.
[50] Drury. Useful Pl. of Ind., 1.
[51] Pharmacographia, 94.
[52] Gard. Chron., 1882, Oct. 7, 458.
[53] Speede. Ind. Handb. of Gard., 1842, 180.
[54] Decaisne & Naudin. Man., IV., 106.
[55] Heuze. Les Pl. Alim., II., 545.
[56] Herndon. Amazon, 52.
[57] Gard. Chron., 1848, 828, 862.
[58] Don. Gard. and Bot. Dict.
[59] Treas. of Bot.
[60] Acosta. Hist. of the Ind., 1604, 259.

kinde of roote, which they call *Papas;* these rootes are like to grownd nuttes, they are small rootes, which cast out many leaves. They gather this *Papas*, and dry it well in the Sunne, then beating it they make that which they call *Chuno*, which keepes many daies, and serves for bread. In this realme there is great trafficke of *Chuno*, the which they carry to the mines of Potozi; they likewise eat of these *Papas* boyled or roasted. There is one sweete of these kindes, which grows in hot places, whereof they do make certaine sawces and minced meats, which they call *Locro*."

As the *olluco* is said by Heuze to be only eaten raw, outside of Mexico, we may believe that Acosta refers in this extract to this plant, the potato and the sweet potato.

ONION. *Allium cepa* L.

The culture of the onion was known at a remote period, and in the ancient Egyptian paintings a priest is frequently seen holding them in his hand, or covering an altar with a bundle of thin leaves and roots.[61] Hippocrates[62] mentions that they are commonly eaten 430 B.C. Theophrastus,[63] 322 B.C., names a number of varieties, the Sardian, the Cnidian, Thamocracian, and the Setanicon, all named from the places of growth. Those of Issus and Sardis are white. Dioscorides,[64] 60 A.D., speaks of the onion as long or round; yellow or white. Columella,[65] 42 A.D., speaks of the Marsicam, which the country people call *unionem*, and this word seems to be the origin of our word *onion*, the French *ognon*. Pliny,[66] A.D. 79, devotes considerable space to the *cepa*, and says the round onion is the best, and that the red are more highly flavored than the white. Palladius,[67] 210 A.D., gives minute directions for culture. Apicius,[68] A.D. 230, gives a number of recipes for the use of the onion in cookery, but its uses by this epicurean writer are rather as a seasoner than as an edible. In

[61] Wilkinson. Ancient Egyptians, I., 168.

[62] Hippocrates. Opera, Camerarius ed., Paris, 1546, 113.

[63] Theophrastus. Bodæus ed., 1644, 761, 785.

[64] Dioscorides. Ruel ed., 1529, 135.

[65] Columella. Lib. XII., c. 10.

[66] Pliny. Lib. XIX., c. 32.

[67] Palladius. Lib. III., c. 24.

[68] Apicius. De Opsoniis, etc. Amsterdam, 1709.

the thirteenth century Albertus Magnus[69] describes the onion, but does not include it in his list of garden plants where he speaks of the leek and garlic, by which we would infer, what indeed seems to have been the case with the ancients, that it was in less esteem than these now minor vegetables. In the sixteenth century Amatus Lusitanus[70] says the onion is one of the commonest of vegetables, and occurs in red and white varieties, and of various qualities, some sweet, others strong, and yet others intermediate in savor. In 1570, Matthiolus[71] refers to varieties as large and small, long, round and flat, red, bluish, green and white. Laurembergius,[72] in 1632, says onions differ in form, some being round, others oblong; in color, some white, others dark red; in size, some being large, others small; from their origin, as German, Danish, Spanish, etc. He says the Roman colonies during the reign of Agrippa grew in the gardens of the monasteries a Russian sort, which attained sometimes the weight of eight pounds. He calls the *Spanish* onion oblong, white and large, excelling all other sorts in sweetness and size, and grown in large abundance in Holland. At Rome the sort which brings the highest price in the markets is the *Caieta;* at Amsterdam the *St. Omer.*

At the present time Vilmorin[73] describes sixty varieties, and there are a number of varieties grown which are not noted by him in France. In form these may be described as flat, flattened, disc-form, spherical, spherical-flattened, pear-shaped, long. This last form seems to attain an exaggerated length in Japan, where I have been told that they often equal a foot in length. In 1886, Kizo Tamari,[74] a Japanese commissioner to this country, says, "Our onions have not large globular bulbs. They are grown just like celery in this country, and have long, white, slender stalks." In addition to the forms mentioned above we rank the *top onion* and the potato onion among our varieties. The onion is described in many colors, such as white, dull white, silvery white, pearly white, yellowish green, coppery yellow, salmon yel-

69 Albertus Magnus. De Veg., Jessen ed., 1867, 487.

70 Amatus Lusitanus. In Diosc., 1554, 273.

71 Matthiolus. Com., 1570, 389.

72 Laurembergius. Apparat. Plant., 1632, 27.

73 Vilmorin. Les Pl. Pot., 1883.

74 Am. Hort., Sept., 1886, 10.

low, greenish yellow, bright yellow, pale salmon, salmon pink, coppery pink, chamois, red, bright red, blood red, dark red, purplish.

But few of our modern forms are noticed in the early botanies. The following synonymy includes all I have noted, but in establishing it it must be noted that many of the figures upon which it is founded are quite indistinct.

I. Bulb flat at bottom; tapering towards stem.

Cepa. Fuchsius, 1542, 430.
Cepa rotunda. Bodæus, 1644, 787.
Cæpe sive Cepa rubra et alba. J. Bauhin, 1651, II., 549.
Geant de Rocca. Vilm., 1883, 387.
Mammoth Pompeii. American Seedsmen.
Golden Queen. American Seedsmen.
Paris Silverskin. American Seedsmen.
Silver White Etna. American Seedsmen.

The difference at first sight between the crude figure of Fuchsius and the modern varieties is great, but ordinary experience indicates that the changes are no greater than can be observed under selection.

II. Bulb round at bottom; tapering towards stem.

Zwiblen. Roszlin, 1550, 121.
Cepa. Tragus, 1552, 737.
Cæpa. Cam. Epit., 1586, 324.
Blanc hatif de Valence. Vil., 1883, 378.
Neapolitan Marzajola. American Seedsmen.
Round White Silverskin. American Seedsmen.
White Portugal. American Seedsmen.

III. Bulb roundish, flattened above and below.

Cepa. Matth., 1558, 276; Pin., 1561, 215.
Cæpa capitata. Matth., 1570, 388.
Cepe. Lob. Obs., 1576, 73; ic., 1591, I., 150.
Cepa rubra. Ger., 1597, 134.
Cepa rotunda. Dod., 1616, 687.
Rouge gros-plat d'Italie. Vilm., 1883, 387.

Bermuda. American Seedsmen.
Large Flat Madeira. American Seedsmen.
Wethersfield Large Red. American Seedsmen.

IV. Bulb rounded below, flattened above.

De cepis. Pictorius, 1581, 82.
Philadelphia Yellow Dutch or Strasburg. American Seedsmen.

V. Bulb spherical, or nearly so.

Cepa. Tragus, 1552, 737. Lauremb., 1632, 26.
Cepe. Lob. Obs., 1576, 73; ic., 1591, I., 150.
Cepe alba. Ger., 1597, 134.
Cæpa capitata. Matth., 1598, 419.
Jaune de Danvers. Vilm., 1883, 380.
Danvers. American Seedsmen.

VI. Bulb dishing on the bottom.

Cepa rotunda. Bodæus, 1644, 786.
Extra Early Red. American Seedsmen.

VII. Bulb oblong.

Cæpa. Cam. Epit., 1586, 324.
Cepea Hispanica oblonga. Lob. ic., 1591, I., 150.
Cepa oblonga. Dod., 1616, 687; Bodæus, 1644, 787.
Piriform. Vilm., 1883, 388.

VIII. The top onion.

In 1557 Dalechamp [75] records with great surprise an onion plant which bore in the place of seed, small bulbs.

The onion was named by Chaucer,[76] in England, about 1340. In Mexico *onyons* are mentioned by Peter Martyr[77] before 1557, in Peru before 1604,[78] in New England about 1629,[79] in Virginia in 1648,[80] and were among the Indian foods destroyed by General Sullivan [81] in western New York in 1779. In 1806 McMahon [82] records eight varieties in American gardens.

75 Hist. Gen., 1587, 532.
76 Chaucer. Prologue, V., 636.
77 Eden. Hist. of Trav., 1577.
78 Acosta. Hist. of the Ind., 1604, 261.
79 Wood. New Eng. Prosp., 1st ed., II.
80 A Perf. Desc. of Va., 1649, 4.
81 Conover. Early Hist. of Geneva, 47.
82 McMahon. Am. Gard. Cal., 1806.

The onion is called in France, *ognon, oignon;* in Germany, *Zwibel;* in Flanders, *ajuin;* in Holland, *uijen;* in Denmark, *rodlog;* in Italy, *cipolla;* in Spain, *cebolla;* in Portugal, *cebola*;[83] in the Mauritius, *oignon;*[84] in Norway, *rodlog;*[85] in Greek, *krommuon;* in Latin, *cepa.*

In Arabic, *bussul,*[86] *basal;*[87] in Bengali, *pulantoo, peeaj;*[88] in Ceylon, *loono;*[86] in China, *tsum xi;* in Cochin China, *cay hanh;*[89] in Hindustani, *pee-aj;*[86] in India, *peeaj;*[90] in Japan, *soo, fitmosi;*[91] in Java, *brangbang;*[86] in Malay, *bawangmera;*[88] in Persia, *peeaj;*[86] in Sanscrit, *palandu, latarka,*[88] *sukandaka*;[86] in Tamil, *venggayum;* in Telegu, *wolliguidda.*[88]

ORACH. *Atriplex hortensis* L.

This spinach plant is grown as a vegetable, and also to use as a salad, mixed with sorrel in order to correct the acidity. It was known to the ancient Greeks and Romans, and it seems to have been used more in the early times before the introduction of the spinach than now. Two varieties are known; the red and the green, each with a sub-variety of a paler color. It was known to Turner[92] in England in 1538, who calls it *areche*, or *red oreche.* In 1686 Ray[93] mentions the white and the red, even as mentioned by Gerarde[94] in 1597. In 1623 Bauhin[95] mentions the red, the white, and the dark green. In 1806, three kinds are named by McMahon[96] as in American gardens.

Orach, orache, French spinach, or *Mountain spinach* is called in France, *arroche, armol, arrode, arrouse, belle dame, bonne dame, eripe, erode, follette, iribe, irible, prudefemme;* in Germany, *gartenmelde;* in Flanders and Holland, *melde, hofmelde;* in Italy, *atreplice;* in Spain, *armuelle;* in Portugal, *armolas;*[97] in Nor-

[83] Vilmorin. Les Pl. Pot., 374.
[84] Bojer. Hort. Maur., 1837, 347.
[85] Schubeler. Culturpflanz, 53.
[86] Ainslie. Mat. Med., I., 269.
[87] Delile. Fl. Ægypt, Ill.
[88] Birdwood. Veg. Prod. of Bomb., 186.
[89] Loureiro. Fl. Cochin Ch., 201.
[90] Speede. Ind. Handb. of Gard., 156.
[91] Kæmpfer. Amoen, 830; Thunb. Jap., 132.
[92] Turner. Libellus, 1538.
[93] Ray. Hist., 1686, 191.
[94] Gerarde. Herb., 1597, 256.
[95] Bauhin. Pinax, 1623, 119.
[96] McMahon. American Gar. Cal., 1806.
[97] Vilmorin. Les Pl. Pot., 13.

wegian, *havemelde*;[98] in Greece, *vlita, spanakia*;[99] in Greek, *atraphaxis*; in Latin, *atriplex*; in Egyptian, *ohet*;[99] in India, *buthooa*.[100]

OXALIS. *Oxalis* sp.

There are two species which have been introduced into European gardens, but as an aliment they are there of little importance; they are yet included by Vilmorin[101] among kitchen esculents. The roots are the parts principally used, yet the acid leaves find use as a salad.

Oxalis crenata Jacq.

This species is cultivated in Peru in gardens about Lima,[102] and quite extensively in the mountains,[103] from Chili even to Mexico.[104] It was introduced into England in 1829,[105] and was for a time cultivated as a culinary plant.[106] It seems now to have fallen into disuse. Burr[107] included it among American garden esculents in 1863. A red and a yellow variety are mentioned.[105]

The *oxalis* is called in France, *oxalis crenelee, oxalide, surelle tubereuse*; in Flanders, *zverklaver*;[101] in Peru, *oca*.[105]

Oxalis deppei Lodd.

This species is said to be a native of Brazil, whence it was introduced into the kitchen-gardens of Europe,[108] reaching England in 1827.[109] In 1860 Loudon[110] says about 1850 it began to replace in esteem the *O. crenata*. The young leaves are served like sorrel, put into soup, or used as greens; the flowers are excellent in salad, alone or mixed with corn salad; the roots are served boiled.[109] It was likewise recorded by Burr[107] for American gardens in 1863.

98 Schubeler. Culturpflanz, 80.
99 Pickering. Ch. Hist., 248.
100 Speede. Ind. Handb. of Gard., 154.
101 Vilmorin. Les Pl. Pot., 1883, 395.
102 Don. Gard. and Bot. Dict., 1831, I., 756.
103 Gibbon. Amazon, 153.
104 Heuze. Les Pl. Alim., II., 542.
105 Bon Jard., 1882, 513.
106 Gard. Chron., Dec. 8, 1883, 726; Loudon, Hort., 1860.
107 Burr. Field and Gard. Veg. of Am., 1863, 41.
108 Decaisne and Naudain. Man., IV., 102.
109 Gard. Chron., 1841, 68.
110 Loudon. Hort., 1860.

PARA CRESS. *Spilanthes* sp.

Under the name of Para cress several species of *Spilanthes* are occasionally cultivated, the piquant leaves being mixed with other salads, and having the property of stimulating the salivary glands; they should hence be classed with medical salads.

Spilanthes oleracea L.

Recorded as cultivated in France[111] in 1860 and in 1824, and in the Mauritius[112] in 1837, and is used also as a salad in the Mascarenhas, the East Indies and South America.[113]

It is called in France *cresson de Para, spilanthe, spilanthe des potageres,*[114] *abecedaire;*[115] in Germany, *hussarenknopf;* in Flanders, *ABC kruid;*[114] in Japan, *hoko so.*[116]

Spilanthes fusca H. P.

This species also cultivated,[117] and seems to be the *cresson du Bresil* of Vilmorin.[114]

PARSLEY, *Apium petroselinum* L.

This biennial is found wild in southern Europe, from Spain to Macedonia, also in Algiers and in the Lebanon.[118] It seems to be the *apium* of the ancient Romans, the *selinon* of Theophrastus,[119] who, 322 B. C., describes two varieties, one with crowded, dense leaves, the other with more open and broader leafage. Columella[120] A. D. 42, speaks of the broad-leaved and curled sorts, and gives directions for the culture of each, and, A. D. 79, Pliny[121] mentions the cultivated form as having varieties with a thick leaf, a crisp leaf, etc., evidently copying from Theophrastus. He adds, however, from apparently his own observation, that the *apium* is in general esteem, for the sprays find use in large quantities in broths,

111 Noisette. Man., 1860, II., 367; L'Hort. Fran., 1824.
112 Bojer. Hort. Maurit., 1837, 184.
113 Unger. Pat. Off. Rept., 1859, 356.
114 Vilmorin. Les Pl. Pot., 198.
115 Noisette, l. c., 367.
116 Black. Treas. of Bot.
117 Bon Jard., 1882, 567.
118 Decandolle. Orig. Des. Pl. Cult., 72.
119 Theophrastus. Lib. VII., c. 4.
120 Columella, Lib. XI., c. 3.
121 Pliny. Lib. XIX., c. 37, c. 46. Lib. XX., c. 44.

and give a peculiar palatability to condimental foods. In Achæa it is used, so he says, for the victor's crown in the Nemean games.

A little later Galen,[122] A. D. 164, praises the parsley as among the commonest of foods, sweet and grateful to the stomach, and that some eat it and *Smyrnium* mixed with the leaves of lettuce. Palladius,[123] about 210 A. D., mentions the method of procuring the curled form from the common, and says that old seed germinate more freely than do fresh seed (a peculiarity of parsley seed at present, and which is directly the opposite to that of celery seed). Apicius,[124] A. D. 230, a writer on cookery, makes use of the *apium viride*, and of the seed. In the 13th century Albertus Magnus[125] speaks of *apium* and *petroselinum* as being kitchen-garden plants; he speaks of each as being an herb the first year, a vegetable the second year of growth; he says the *apium* has broader and larger leaves than the *petroselinum*, the petroselinum has leaves like the cicuta; that the petroselinum is more of a medicine than a food.

At the present time we have for forms the common or plain-leaved, the celery-leaved or Neapolitan, the curled, the fern-leaved, and the Hamburg or turnip-rooted.

I. The plain-leaved form is not now much grown, having become superseded by the more ornamental curled forms. In 1552, Tragus[126] says there is no kitchen-garden in Germany without it, and it is used by the rich as well as the poor, and Matthiolus,[127] in 1558 and 1570, says it is one of the most common plants of the garden. In 1778 Mawe[128] says it is the sort most commonly grown in English gardens, but many prefer the curled kinds, and in 1834 Don[129] says it is seldom cultivated. It was in American gardens in 1806.

Petroselinum. Trag., 1552, 459.

[122] Galen. De Alim., Lib. II., Gregorius ed., 1547, 154.

[123] Palladius. Lib. V., c. 3.

[124] Apicius. De Opsonibus, etc., Amsterdam, 1709.

[125] Albertus Magnus. De Veg., Jessen ed., 1867, passim.

[126] Tragus. De Stirp., 1552, 459.

[127] Matthiolus. Comm., 1558, 362; 1570, 512.

[128] Mawe. Gard., 1778.

[129] Don. Gard. and Bot. Dict., III., 279.

[130] McMahon. Am. Gard. Cal., 1806.

Apium hortense. Matth., 1558, 362; 1570, 512; 1598, 562; Pin., 1561, 333; Lugd., 1537, 700; Lob. ic., 1591, 706; Ger., 1597, 861; Dod., 1616, 694.

Garden parsley. Lyte's Dod., 1586, 696.

Common parsley. Ray, 1686, 448; McMahon, 1806, 127.

Plane parsley. Mawe, 1778.

Common plain leaved. Don, 1834, III., 279.

Plain parsley. Burr, 1863, 433.

Persil commun. Vilm., 1883, 403.

II. The celery-leaved or Neapolitan is scarcely known outside of Naples. It differs from the common parsley in the large size of its leaves and leaf stalks, and it may be blanched as a celery.[131] It was introduced into France by Vilmorin in 1823.[132] Pliny mentions parsleys with thick stalks, and says the stalks of some are white. It may be the *Apium hortense maximum* of Bauhin[133] in 1596, as the description applies well. He says it is now grown in gardens, and was first called English Apium. He does not mention it in his Pinax, 1623, under the same name, but under that of *latifolium.* Linnæus[134] considers this to be the *Ligusticum austriacum* Jacq.

It is figured by Bauhin in his Prodromus.[135] I have never seen it.

Persil celeri ou de Naples. L'Hort. Fran., 1824.

Naples or Celery-leaved. Burr, 1863, 434.

Persil grand de Naples. Vilm., 1883, 404.

III. The curled parsleys. Of these we have many varieties, differing but in degree, such as the curled, extra curled, moss curled, and triple curled. Pena & Lobel,[136] in 1570, mention this form, and say it is very elegant and rare, brought from the mountains the past year and grown in gardens, the leaves curled on the borders, very graceful and tremulous, with minute incisions. In the synonymy many of the figures do not exhibit the curled aspect which the name and description indicates; we hence make two divisions, the curled and the very curled. The curled was in American gardens preceding 1806.

131 Vilmorin. The Veg. Gard., 1885, 380.
132 L'Hort. Fran., 1824; Bon. Jard., 1824–5, 254.
133 Bauhin. Phytopin., 1596, 268.
134 Linnæus. Sp., 2d ed., 1680.
135 Bauhin. Prodromus, 1671, 80.
136 Pena & Lobel. Adv., 1570, 315.

(*a*.) The curled.

Apium crispum sive multifidum. Ger., 1597, 861, cum ic.

Apium crispum. Matth. Op., 1598, 562, cum ic.

(*b*.) Very curled.

Apium crispatum. Adv., 1570, 315: Lugd., 1587, 700.

Apium. Cam. Epit., 1586, 526.

Petroselinum vulgo, crispum. J. Bauh., 1651, III., Pt. 2, 97.

Curled. Townsend, 1726, 33; Mawe, 1778; McMahon, 1806, 127; Thorb. Kal., 1821.

Apium crispum. Mill. Dict., 1731, ex Mill. Dict., 1807.

Apium petroselinum. Bryant, 1783, 24.

Curled or Double. Fessenden, 1828, 222; Bridgeman, 1832.

Persil frise. L'Hort. Fran., 1824; Vilm., 1883, 404.

Dwarf curled. Fessenden, 1828, 222; Burr, 1863, 432.

Curled leaved. Don, 1834, III., 279.

IV. The fern-leaved has leaves which are not curled, but are divided into a very great number of small thread-like segments, and is of a very dark green. I first note it in American seed catalogues of 1878. It seems, however, to be described by Bauhin in his edition of Matthiolus, 1598, as a kind with leaves of the coriander, but very many extending from one branch, laciniate, and the stem leaves unlike the coriander because long and narrow.

V. The Hamburg parsley is grown for its roots, which are used as parsnips are. It seems to have been used in Germany in 1542[137] or earlier, but its use was indicated as of Holland origin even then in the name used, Dutch parsley. It did not reach England until long after. In 1726 Townsend,[138] a seedsman, had heard that "the people in Holland boil the roots of it, and eat it as a good dish," and Miller[139] is said to have introduced it in 1727, and to have grown it himself for some years before it became appreciated. In 1778[140] it is said to be called Hamburg parsley, and to be in esteem. In 1783 Bryant mentions its frequent occurrence in the London markets. It was in American gardens in 1806.

[137] Fuchsius. De Stirp., 1542, 573.

[138] Townsend. Seedsman, 1726, 33.

[139] Miller's Dict., 1807.

[140] Mawe. Gard., 1778.

Oreoselinum. Germanis Deutsch petersilg. Fuch. 1542, 573.
Petroselinum. Tragus, 1552, 459.
Apium. Cam. Epit., 1586, 526.
Apium hortense Fuchsii. J. Bauhin, 1651, III., Pt. 2, 97.
Apium latifolium. Mill. Dict., 1737.
Dutch parsley. Gard. Kal., 1765, 127.
Hamburg parsley. Mawe, 1778.
Broad-leaved. Mawe, 1778.
Hamburg or large rooted. McMahon, 1806; Burr, 1863, 433.
Large rooted. Thorb. Kal., 1821.
Persil tubereux. L'Hort. Fran., 1824.
Persil a grosse racine. Vilm., 1883, 405.

VI. A Persil panache is mentioned by Pirolle, in L'Hort. Français, 1824, but I find no further account.

The *Parsley* is called in France *persil;* in Germany *petersilie;* in Flanders and Holland *peterselie;* in Holland *pieterselie;* in Denmark *petersilje;* in Italy *prezzemolo, petroncino, erbetta;* in Spain *perejil;* in Portugal *selsa;*[141] in Norway *persille;*[142] in Russia *petruschka.*[143]

In Arabic *maquedounis, bagedounis,*[144] *kussah;*[145] in China, *hu-sui;* in Egypt, *bagdunis;*[146] in India, *vjmood, vjooaen khorasanee;*[147] in Japan, *kin, seri;*[148] in Persia, *karefo.*

PARSNIP. *Pastinaca sativa* L.

It has been supposed that the *pastinaca* of the Romans included the carrot and the parsnip, and that the *elaphoboscon* of Pliny[149] was the parsnip. Pliny describes the medicinal virtues of the *elaphoboscon,* and says it is much esteemed as a food. The references however do not prove this plant to be cultivated, nor do the references to the *pastinaca* satisfactorily indicate the parsnip. I am unwilling to accept such evidence as we find that the cultivated parsnip was known to the ancient Greeks and Romans.

141 Vilmorin. Les Pl. Pot., 403.
142 Schubeler. Culturpflanz, 94.
143 McIntosh. Book of the Gard., II., 232.
144 Delile. Fl. Æg. Ill.
145 Birdwood. Veg. Prod. of Bomb., 163.
146 Bretschneider. On the Study, etc., 15.
147 Speede. Ind. Handb. of Gard., 181.
148 Kaempfer. Amoen., 825; Thunberg, Jap., 120.
149 Pliny, Lib. XXII., c. 37.

Among the early botanists there exists quite a confusion in names between the carrot and the parsnip. The root must, however, have come into general use long before these records, and perhaps its culture started in Germany, as it seems to have been unknown to Ruellius[150] in 1536, but is recorded by Fuchsius[151] in Germany in 1542, who gives a figure but calls it *gross zam mosen.* It is figured by Roszlin[152] in 1550 under the name *pestnachen,* and in 1552 is recorded by Tragus[153] as having a sweet root, used especially by the poor, and better known in the kitchens than fat.

The following is a synonymy founded on pictures and descriptions combined, all representing our long parsnip form of root, but some indicating the hollow crown, upon which some of the modern varieties are founded, especially Camerarius in 1586.

Sisarum sativum magnum. Fuchs., 1542, 751.

Pestnachen. Roszlin, 1550, 106.

Pastinaca. Trag., 1552, 440.

Pastinaca sativa. Matth., 1558, 353; 1570, 500; 1598, 548; Pin., 1561, 318.

Pastinaca domestica vulgi. Lob. Obs., 1576, 407; ic. 1591, I, 709.

De Pastinaca. Pastenay, gerlin oder moren. Pictorius, 1581, 94.

Pastinaca domestica. Cam. Epit., 1536, 507; Cast. Dur., 1617, 837.

Pastinaca sativa vulgi, Matthioli. Lugd., 1587, 719.

Pastinaca latifolia sativa. Ger., 1597, 870; Dod., 1616, 680.

Pastinaca sativa latifolia, Germanica, luteo flore. J. Bauh., 1651, II., Pt. 2, 150, 151.

Long parsnip of the moderns.

In 1683 the long parsnips are figured in England as in great use for a delicate sweet food,[154] are spoken of by Ray[155] in 1686, Townsend[156] 1726, Mawe,[157] 1778, and Miller[158] 1807, etc.

The round parsnip, or *Panais rond* of the French, is called *Siam* by Don[159] in 1834. Its roots are funnel-shaped, tapering very abruptly, often curving inwards. I find little of its early his-

150 Ruellius. De Nat. Stirp., 1536.
151 Fuchsius. De Stirp., 1542.
152 Roszlin. Krauterb., 1550, 106.
153 Tragus. De Stirp., 1552, 441.
154 Worlidge. Syst. Hort., by J. W. Gent., 1683, 175.
155 Ray. Hist., 1686, 410.
156 Townsend. Seedsman, 1726, 22.
157 Mawe. Gard., 1778.
158 Miller's Dict., 1807.
159 Don. Gard. and Bot. Dict., 1834, III., 339.

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155 Ray. Hist., 1686, 410.
156 Townsend. Seedsman, 1726, 22.
157 Mawe. Gard., 1778.
158 Miller's Dict., 1807.
159 Don. Gard. and Bot. Dict., 1834, III., 339.

tory. It was noted in the *Bon Jardinier* for 1824, as also by Pirolle in Le Hort. Français, by McIntosh, Burr, and other more recent writers.

The introduction of the Parsnip to America was probably by the earliest colonists. It is mentioned at Margarita Island by Hawkins[160] in 1564; in Peru by Acosta[161] in 1604, as cultivated in Virginia in 1609[162] and 1648,[163] in Massachusetts in 1629,[164] and as common in 1630,[165] and were among the Indian foods destroyed by Gen. Sullivan[166] in Western New York in 1779.

The *parsnip* is called in France *panais*, *grand chervia cultive*, *pastenade blanche*, *patenais*, *racine blanche*; in Germany, *pastinake;* in Flanders and Holland, *pastenaak*; in Holland, *pinkster nakel*; in Denmark, *pastinak*; in Italy, *pastinaca*; in Spain, *chirivia*; in Portugal, *pastinaga*;[167] in Norway, *pastinak*.[168]

(*To be continued.*)

[160] Hawkins' Voy. Hak. Soc. ed., 27.
[161] Acosta. History of the Ind., 1604, 261.
[162] A True Decl. of Va., 1610, 113.
[163] A Perf. Des. of Va., 1640, 4.
[164] Higginson. Mass. Hist. Soc. Coll., 1st ser., I., 118.
[165] New England's Annoyances. 1630. Anon. The first recorded poem in America.
[166] Conover's Early Hist. of Geneva, 47.
[167] Vilmorin. Les Pl. Pot., 398.
[168] Schubeler. Culturpfl., 95.

EDITORIAL.

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

SOME interesting expressions of opinion as to the essential nature of organic evolution have been recently published in England. We refer to the addresses before the physiological and biological sections of the British Association for the Advancement of Sciences, by Dr. Burdon Sanderson and Sir William Turner; to the book "Darwinism," by Alfred Russel Wallace; and to the review of the latter by Prof. E. Ray Lankester, which has just appeared in *Nature*.

Dr. Burdon Sanderson distinguishes the functions of living beings into two divisions, growth and metabolism, which are the subject matter of two sciences, morphology and physiology. Evolution results from modification of growth, and as growth is really metabolism under some directive influence, it is interesting to note the aspect the subject presents to this able physiologist as expressed in the closing remarks of his address: "The word life is used in physiology in what, if you like, may be called a technical sense, and denotes only that state of change with permanence which I have endeavored to set forth to you. In this restricted sense of the word, therefore, the question, What is life? is one to which the answer is approachable, but I need not say that in a higher sense—higher because it appeals to higher faculties in our nature—the word suggests something outside of mechanism, which may perchance be its cause rather than its effect."

Sir William Turner says: "To reject the influence which use and disuse of parts may exercise both on the individual and on his offspring, is like looking at an object with only a single eye. All biologists will, I suppose, accept the proposition that the individual soma is influenced or modified by its environment. Now, if on the basis of this proposition the theory be grafted that modifications or variations thus produced are capable of so affecting the germplasm of the individual in whom the variation arises as to be transmitted to its offspring—and I have already given cases in point—then such variations might be perpetuated. If the modification is of service, then presumably it will add to the viability of the individual, and through the interaction of the soma and the germplasm, in connection with their respective nutritive changes, will so affect the latter as to lead to its being transmitted to the offspring. From this point of view the environment would, as it were, determine and regulate the nature of those variations which are to become hereditary, and the possibility of variations arising which are likely to prove useful becomes greater than on the theory that the soma exercises no influence on the germplasm. Hence I am unable to accept the proposition that somatogenic characters are not transmitted, and I cannot but think that they form an important factor in the production of hereditary characters."

These are the views of two of England's most distinguished biologists, and we find them to be in strong contrast to those expressed by Dr. Wallace and Prof. Lankester, no less able men in their respective fields. Dr. Wallace does not yet see beyond natural selection, and well illustrates the peculiar blindness to the nature of the origin of variations which is prevalent in quarters which hold to what they consider to be pure Darwinism, but which has been better termed "post-Darwinism." But as an illustration of how difficult it is to keep one's eyes from twisting to the right, Dr. Wallace does actually endeavor to explain the origin of the rotated eye of the flat-fish by appealing to the inheritance of an acquired character, which is ever increased by the transmission of additional acquisition. This is, as wittily remarked by Lankester, "flat Lamarckism." And Lankester has slipped into rationality in the same way, in attributing the asymmetry of the Gastropod Mollusca "to the cumulative effect of a mechanical cause." Both these gentlemen thus inadvertently abandon the major premise of the post-Darwinians—that acquired characters cannot be inherited. Prof. Weismann and others endeavor to sustain this position by experimenting on the inheritance of mutilation, as though it were not already sufficiently well known that broken heads and legs are not inherited! The evidence of palæontology ought to be of some value as to what is and what is not inherited, but this has not yet come fairly into the hands of either Dr. Wallace or Dr. Lankester. "The American evolutionists" will soon furnish them with some additional information on this topic, all quite as much within the "scientific method" as are the speculations of Weismann, though Dr. Wallace and Prof. Lankester think that they have not done so in the past. According to the latter, the opponents of post-Darwinism are not "laboratory men," which explains their shortcomings. But there are laboratories and laboratories! The laboratories where section cutting and staining form the methods of studying nature are of high importance, but they do not cover the whole ground. Indeed, the adepts at this work are sometimes grossly ignorant of gross anatomy. In the estimation of some of these gentlemen the value of a scientific pursuit is inversely as the size of the objects studied. What the value of cetology can be in such eyes we do not know, unless it be something to be promptly sat upon.

—THE recent establishment of four geological surveys in as many States of the South, is a matter of congratulation. The first to lead the way was Arkansas, whose survey is in active prosecution by Prof. Branner. The Texas Legislature next inaugurated the work, and appointed Prof. Dumbel to superintend it. Prof. Dumbel has displayed much energy in getting his organization to work, and much is to be expected from his corps of able assistants. In the present number of the NATURALIST we announce the opening of the surveys of Missouri by Prof. Winslow, and of Georgia under Prof. J. W. Spencer. The people of the South were never more alive to the importance of developing the resources of their States, and of contributing their share to the stock of our knowledge of creation in all its aspects.

RECENT LITERATURE.

DeToni's Sylloge Algarum.[1]—This large volume of nearly fifteen hundred pages is devoted to the Chlorophyceæ, and bears he sub-title "Sylloge Chlorophycearum." In general appearance it is like the well-known Sylloge Fungorum of Saccardo, even to peculiarities of type and printing.

After a brief prefatory chapter, one hundred and thirty-nine pages are given to a most useful Bibliotheca Phycologica, in which about thirty-five hundred titles of papers and books on algæ are given, and also thirty-six titles of exsiccatæ. This portion of the work is particularly valuable to the student, as it enables him readily to find the extent of the literature in a particular department of the subject.

The Chlorophyceæ, according to DeToni, constitute a class including four orders, viz.: Confervoideæ, Siphoneæ, Protococcoideæ, and Conjugatæ, and these again are subdivided into families, apparently co-ordinate with the "orders" Phanerogams. The system is as follows:

CHLOROPHYCEÆ (Kuetz. ex parte) Wittr.

Ord. I.—**Confervoideæ** (Ag.) Falk.

A. OOGAMÆ.

Fam. 1. *Coleochætaceæ* (Naeg.) Prings.
" 2. *Mycoideaceæ* (Van Tiegh.) Hausg.
" 3. *Œdogoniaceæ* (De Bary) Wittr.
" 4. *Cylindrocapsaceæ* Wille.
" 5. *Sphæropleaceæ* (Kuetz.) Cohn.

B. ISOGAMÆ.

Fam. 6. *Ulvaceæ* (Lamour.) Rabeuh.
" 7. *Ulotrichiaceæ* (Kuetz.) Borzi.
" 8. *Chorolepidaceæ* (Rabeuh.) Borzi.
" 9. *Hausgirgiaceæ* DeToni.
" 10. *Cladophoraceæ* (Hassall) Witt. char. emend.
" 11. *Pithophoraceæ* Wittr.
" 12. *Gomontiaceæ*, Born & Flah.

Ord. II.—**Siphoneæ**, Grev. em.

A. OOGAMÆ.

Fam. 13. *Vaucheriaceæ* (Gray, Dumort.

[1] *Sylloge Algarum omniam hucusque cognitarum*, digessit Doct. J. Bapt. DeToni. Instituti Botanici Patavini Adjutor, etc., etc. Vol. I. Patavii XXV., Julii, MDCCCLXXXIX. Sumptibus Auctoris, Typis Seminarii, pp. 12+CXXXIX+1315. 8vo.

B. Isogamæ.

Fam. 14. *Dasycladiaceæ* (Endl.) Cramer.
" 15. *Derbesiaceæ* Thur.
" 16. *Bryopsidaceæ* (Bory.) Thur.
" 17. *Caulerpaceæ* Reicheub.
" 18. *Spongodiaceæ* Lamour.
" 19. *Udoteaceæ* (Endl.) J. Ag.
" 20. *Hydrogastraceæ* (Endl.) Rabeuh.
" 21. *Phyllosiphonaceæ* Frank.

Ord. III.—**Protococcoideæ,** (Menegh.) Kirch.

Fam. 22. *Volvocaceæ* (Cohn) Kirch.
" 23. *Palmellaceæ* (Decaine) Næg. em.

Ord. IV.—**Conjugatæ** (Link.) DeBary.

Fam. 24. *Zygnemaceæ* (Menegh.) Rabeuh.
" 25. *Desmidiaceæ* (Kuetz.) DeBary.

These families include two hundred and twenty-nine genera, and twenty-nine hundred and ninety-two (2992) species. Very many of the genera contain but a single species, there being no less than eighty-nine such, with many containing but two species. On the other hand, there are several large genera, *e. g.*, Œdogonium, with 189 species; Cladophora, with 229; Spirogyra, 84; Closterium, 103; Cosmarium, 307; Euastrum, 99; Staurastrum, 250.—Charles E. Bessey.

Gremli's Flora of Switzerland.[2]—This little volume is a genuine pocket manual,—a trifle large, perhaps, but still small enough to be readily slipped into the traveler's coat pocket. It measures 4¾ by 7 inches, and is less than an inch in thickness. The contrast between these measurements and those of our ordinary manuals is striking, *e.g.*, Gray's, 8½ by 5¾ by 1½ inches; Coulter's, about the same; Chapman's, 8¾ by 5¾ by 1½; Wood's Classbook, 8½ by 6¼ by 1¾; Wood's Botanist and Florist, 8 by 5¼ by 1⅛. This contrast is still greater when we note the fact that this book contains descriptions of fully 2500 species, while Gray's has but 2348, and Coulter's 1881.

The descriptions are brief, but apparently quite satisfactory, and much space is saved by the liberal use of abbreviations. Keys are abundantly provided, so that there need be no difficulty in determining the name and classification of any plant.

In print, binding, and general appearance (including color), this

[2] *The Flora of Switzerland*, for the use of Tourists and Field-botanists, by A. Gremli. Translated from the fifth edition by Leonard W. Paitson, London. David Nutt, 270 Strand, 1889. Printed at Zurich. 12mo, pp. xxiv., 454.

little book resembles the well-known Baedeker's Handbooks.—CHARLES E. BESSEY.

Lubbock's Senses of Animals.[3]—One of the recent additions to the International Science Series is by the genial English naturalist, Sir J. Lubbock, and contains the results of his observations on the senses and intelligence of animals, especially of insects. Having found it necessary to consult many memoirs in various languages, in order to well understand the mechanism of the senses, and the organs by which sensations are transmitted, the author has in this work brought together the notes thus made, and given a list of the principal memoirs consulted. Commencing with man, Sir J. Lubbock works his way downward through the lower animals, dwelling chiefly upon the class which has especially engaged his attention. Chapter I. deals with touch; taste and smell have each a chapter devoted to them; hearing occupies two chapters, and sight takes up the chapters VI. and VII. The eighth chapter is on problematical sense-organs, such as the muciferous canal of fishes, light organs, etc. The range of vision and hearing, and the existence of unknown senses, are also here discussed. It is known that among ants, bees, and wasps, some at least hear sounds which we cannot, and that they can perceive the ultra-violet rays to us invisible. Chapter IX. refers to bees and colors, treating of the author's experiments, and answering Dr. Müller's objections. The limits of vision in animals form the subject of the tenth chapter, while the eleventh treats of recognition among ants, and the twelfth of the habits of solitary wasps and bees. Chapter XIII. deals with the supposed sense of direction, the possession of which he is inclined to deny to bees. In his chapter upon the sense of hearing, he does not argue that the vertebrate semicircular canals are the seat of such a sense. The last chapter details, among other things, the author's celebrated experiments with word-cards upon his dog Van.

RECENT BOOKS AND PAMPHLETS.

Archivos do Museo Nacional do Rio de Janeiro, Vol. VII. From the Museum.

BARROIS, CHARLES.—Faune du Calcaire D'Erbray. Extrait des Mémoires de la Société Géologique du Nord. Tome III., Avril, 1889. From the author.

BAUR, G.—Osteologische Notizen über Reptilien. Separatabdruck aus dem *Zoologischen Anzeiger*, 1888. From the author.

[3] On the Senses, Instincts, and Intelligence of Animals, by Sir J. Lubbock, M.P. F.R.S., etc. International Scientific Series LXV. Kegan Paul, Trench & Co., London, 1888.

BAUR, G.—The Systematic Position of Meiolania Owen. Extract from the *Annals and Mag. Nat. Hist.*, Jan., 1889. From the author.

BELL, ALEXANDER GRAHAM.—Facts and Opinions relating to the Deaf. From the author.

BLANFORD, W. T.—Address delivered at the Anniversary Meeting of the London Geological Society, Feb. 15, 1889. From the author.

Boletin de la Academia Nacional de Ciencias en Cordoba (Republica Argentina), 1887, Tomo X. From Eduardo Holmberg.

BOULENGER, G. A.—On Some Reptiles and Batrachians from Iguarasse, Pernambuco. Description of two new Snakes from Hong Kong and note on the dentition of *Hydrophis viperina*. Extract from *Annals and Magazine of Natural History* for July, 1888. From the author.

BRONGNIART, CHARLES and EMILE SAUVAGE.—Faunes ichthyologique et entomologique de Comentry. Extrait du *Bull. de la Société de l'Industrie Minérale*. Tome II., 1888. From the authors.

BRONGNIART, C. M.—Notice sur Quelques Poissons des Lignites de Ménat. Rapport sur une note de M. Maxime Corun, présentée à l'Académie des Sciences la 18 Septembre, 1882, relative à l'action des huiles lourdes de goudron sur les vignes. Extrait du No. 32 des *Annales*. Les Entomophthorées et leur application à la destruction des insects nuisibles. From the author.

BRONGNIART, CHARLES.—On Pleuracanthus. Extract from *Geol. Mag.*, Dec. III., Vol. V., 1889.

BURRILL, T. J., and F. S. EARLE. Parasitic Fungi of Illinois. Extract *Bull. Ill. State Laboratory Nat. Hist.*, 1887. From the author.

BROWN-GOODE, G. and Associates.—The Fishery Industries of the United States. From the U. S. Fish Commission.

CALDERON, S.—Aperçu général du relief et régions géologiques de l'Espagne. Extrait de l'Annuaire Géologique Universal. Tome II.—Resumé de quelques Etudes de Physique géologique. Extrait du *Bull. de la Société Géologique de France*, Novembre, 1886.—Les Roches Cristalline massives de l'Espagne, Extrait du *Bull. de la Société Géologique de France*, Décembre, 1884.—Apuntes Sobre el Estado presente de la Ciencia Orogénica. Anal. de la Soc. Esp. de Hist. Nat., Tomo XVI., 1888.—La Sal Comim y su Papel en el Organismo del Globo. Anal. de la Soc. Esp. de Hist. Nat., Tomo XVII., 1888. From the author.

CHAPMAN, F. M.—Preliminary Description of two apparently new Species of the Genus Hesperomys from Florida. Description of a new Sub-species of the Genus Sigmodon from Florida.—On the Habits of the Round-tailed Muskrat (*Neofiber alleni* True). Extract from *Bull. Am. Mus. Nat. Hist.*, Vol. II. No. 3. From the author.

CROSBY, W. O.—Geology of the Black Hills of Dakota. From the Proceedings of the Boston Soc. Nat. Hist., Vol. XXII. From the author.

DANA, JAMES D.—On Volcanoes and Volcanic Phenomena of the Hawaiian Islands. Extract from the *Am. Journal Science*. Vol. XXXIII.-XXXVII., 1887-89. From the author.

DOLLO, LOUIS.—On the Humerus of Euclastes. Extract from the *Geological Magazine*, June, 1888. From the author.

EVERMAN, B. W.—Birds of Carroll County, Indiana. Extract from *The Auk*, Oct., 1888 and Jan., 1889. From the author.

FORBES, S. A.—On the Food Relations of Fresh-Water Fishes. *Bull. Ill. State Laboratory of Nat. Hist.*, Vol. II.

GALLOWAY, B. T.—Report of the Section of Vegetable Pathology, 1888. From the Department of Agriculture.

Geological Survey of New Jersey, Vol. I. Topography, Magnetism, Climate.

GULICK, J. T.—Divergent Evolution through Cumulative Segregation. Extract from the Linnæan Society's Journal of Zoology, Vol. XX. From the author.

HECTOR, JAMES.—Twentieth Annual Report on the Colonial Museum and Laboratory, and Sixteenth Annual Report on Colonial Botanic Garden of New Zealand. Index to Reports of Geol. Survey of New Zealand from 1866–1885. From the author.

INGERSOLL, ERNEST.—Our Country Cousins, From the author.

KEYES, C. R.—On some Fossils from the Lower Coal Measures at Des Moines, Iowa. Reprint from the *American Geol.*, July, 1888. From the author.

KILIAN, M. W.—Systéme Crétacé. Extrait de l'Annuaire Géologique Universal. Tome IV., 1888. From the author.

KNOWLTON, F. H.—Description of a Problematic Organism from the Devonian at the Falls of Ohio. Extract from the *Am. Jour. of Science*, Vol. XXXVII., March, 1889. From the author.

LAMPERT, KURT.—Fortschritt in der Meereskunde. Separatabdruck aus der *Natur*, 1889, No. 22.—Zoologie, Separatabdruck aus *Humboldt*, Band VIII., Heft 5. From the author.

LÜTKEN, CHR. FR.—Tillseg til Bidrag til Kimdskab om Arterne ap Slaegten *Cyamus* Satr. eller Hvallusene. From the author.

LYDEKKER, R.—Notes on the Sauropterygia of the Oxford and Kimeridge Clays. Note on the Ichthyopterygia. Extracts from the *Geol. Mag.*, 1888. From the author.

LYDEKKER, R.—Nototherium and Zygomaturus. Extract from the *Annals and Mag. Nat. Hist.*, Feb., 1889.—On the Remains and Affinities of five Genera of Mesozoic Reptiles. Extract from *Quarterly Journ. Geol. Soc.*, Feb., 1889. From the author.

MAJOR, FORSYTH.—Sur un gisment d'oisements fossiles dans l'île de Samos, contemporains de l'âge de Pikermi. From the author.

MALLERY, G.—Philosophy and Specialties. *Bull. Philosophical Soc. of Washington*, Vol. XI. From the author.

MCGEE, W. J.—Paleolithic Man in America. Reprint from *Popular Science Monthly*. From the author.

Mineral Resources of the United States. From the U. S. Geol. Survey.

POHLMAN, JULIUS.—Cement Rock and Gypsum Deposits in Buffalo.—The Life-History of Niagara. Reprint from Trans. Am. Inst. of Mining Engineers, Oct., 1888. From the author.

Report of the Commissioners of Education, 1886–'87. From the Bureau of Education.

Reports of the Director of the Mint for 1887 and 1888. From James P. Kimball.

Report of Trustees of Peabody Museum of Am. Archæology and Ethnology, Vol. IV., No. 2. From the Museum.

Report of Trustees of New York State Museum of Nat. Hist., 1887. From the Museum.

RILEY, C. V.—The Song Notes of the Periodical Cicada. Extract from the proceedings Am. Ass. Adv. Science, Vol. XXXIV. From the author.

ROMERO, DON MATIAS.—Speech on the 65th Anniversary of the birth of General U. S. Grant. From the author.

SHUFELDT, R. W.—Examples of Fractures and their Union in the Bones of Birds. In the *New York Med. Journ.* From the author.

The Western Society for Psychical Research. List of Members. From J. E. Woodhead, Secretary.

WILLARD, DEFORREST.—Osteotomy for Anterior Curves of the Leg. Reprint from the *Medical and Surgical Reporter*, Jan. 19. 1889. From the author.

WOLTERSTORFF, W. VON—Triton palmatus am Harz. Separatabdruck aus dem *Zoologischen Anzeiger*, No. 253, 1887. From the author.

General Notes.

GEOGRAPHY AND TRAVEL.

Africa.—Notes Concerning Stanley.—A letter from H. M. Stanley, narrating the difficulties encountered by him in the ascent of the Aruwimi or Huri, and accompanied by a sketch map, appears in the May issue of the Proc. Roy. Geog. Soc. As the contents of this letter, the sufferings from hunger, insects, poisoned arrows and horrors of every kind, and the final triumph, are now well known, they will not here be recounted. Hejambi Rapids (about 27° 10′ E.) marks a division between two kinds of architecture and language. Below, the houses are conical; above, the villages are long and straight, and the huts square and surrounded by tall logs which form separate courts. Huri is the most widely known native name for the Aruwimi. The Albert Nyanza seems to be growing smaller. Emin Pasha states that during his acquaintance with it islands have become headlands. Near the south end the steamer has to anchor about five miles from shore. The tribes of the forest and valley of the Huri are cannibals. Dwarf people, here called Wambutti, are numerous between the Hepoko and the grass-land, and are expert with their arrows.

Dr. R. W. Felkin has examined some of the arrows with which the Tikki-Tikki attacked Stanley and his party, and finds that the latter's idea that the poison is derived from ants is erroneous. The poison will kill in twenty minntes unless the antidote be used, and thus the deaths of Mr. Stanley's men were due to tetanus, which in tropical climates is often fatal to wounded men. The formic acid of ants, though an external irritant, is not a deadly poison. The poison used by the Tikki-Tikki is obtained from a tree which occurs both in Central Africa and on the east coast north of Mombasa. It is allied to the Strophanthus, but is more active and deadly.

Wadai and Darfur.—The third part of Dr. Nachtigal's work upon the Sahara and Sudan, dictated by the deceased traveler to a shorthand writer, has now been published by Mrs. Groddeck, to whom Dr. Nachtigal had confided its completion. One of the reasons which prevented Dr. Nachtigal from previously publishing it was his uncertainty regarding the Futa river, which he believed to be a continuation of the Welle, but purposed to settle the question in another expedition.

The map with this volume comprises the region between Lake Fibri and Khartoum. The territory of Wadai proper covers 64,000 square miles, but the authority of its ruler extends over several desert tribes, making a total area of 100,000 square miles, and a population of some two and a half millions. The northern part is hilly; the central well watered, with a light sandy soil; the southern covered with a rich clay. The Baltha and Butêha are dry during most of the year, though water can be found by digging, but in the rains they are mighty streams. Runga and Dar Kuti, subject to Wadai, are pagan; the first has fifteen, the second fourteen villages. Wadai is, on the whole, less fertile than Darfur, and still less so than Barum, but it is rich in ostriches in the north, and in elephants in the south. The population is mixed negro and Arab.

Darfur or Dâr-Fôr is about the size of Prussia, and has a population of more than 3,000,000 settled inhabitants, and half a million of nomads. The people are Arab and negro, more or less mingled. The Forâwa form the bulk of the population, and are dark-colored and middle-sized, *those in the remote parts still pagans.*

The Ubangi and Ngala.—A map in the June issue of the Proc. Roy. Geog. Soc. renders clear the accompanying papers of Captain Vangele, who has solved the question of the identity of the Welle and the Mobangi or Ubangi, and of Mr. J. R. Werner, who writes of the tributaries Ngala and Aruwimi, and of the back channel Ngiri, which connects the lower part of the Ubangi's course with the main Congo, there nearly parallel to it. In one place the two rivers approach very close, but north of 1° 30′ N. they diverge, the Congo's course lying nearly east and west, while the Mobangi continues west of north till it reaches 4° 30′ N., when the course bends eastward, its upper waters being the Welle and other streams of the Bandjia country. The Ngala or Mangalla has no connection with the Ubangi, but its upper course also trends eastward.

Madagascar.—L. H. Ransome describes and gives a map of the course of the river Antanambalana (Madagascar) in the May number of the Royal Geographical Society's Proceedings. This stream is in the northeast of the island, in the territory of the Betsimisaraka. The Antanambalana has no important tributaries, so far as surveyed, save the Vohimar, which enters it twenty miles from the mouth. The region is one of mountains covered with virgin forest. Among the timber are rosewood, ebony, and many hard woods as yet unknown to commerce. Mr. Ransome tells of a wild man, five feet nine inches high, covered with thick black hair, who was caught by some Malagasy while asleep on a branch of a tree, and who died five months after his capture. He learned a few words, and conveyed the intelligence that he had a father and two brothers in the forest. The Betsimisaraka are darker than the ruling Hovas, and also hardier. The women are relatively tall, the men averaging five feet five inches. The dress of the men is a grass mat and piece of cloth round the loins, but some of the richer wear a white or bright tinted cotton garment called a lamba. The women wear a lamba, draped more closely, and fastened by a girdle. Both sexes carry charms round the neck, and every native has a snuff-box of bamboo or horn. The only weapon is a spear, with a flat tail-piece for digging up roots. The houses are built on poles, the floor four to eight feet from the ground. There is usually but one room; the ascent is by a notched inclined pole, and there are no windows or chimneys.

German East Africa.—According to Dr. K. W. Schmitt (*Petermann's Mitteilungen*, May, 1889), the greater portion of German East Africa is not capable of remunerative cultivation, though there are highly fertile tracts, among them the wooded and mountainous region of Usambara and the western part of Bordie, and much of the country around Kilimanjaro. The country of the Nguru resembles Usambara in its geological formation, forests, and numerous small rivers. Useguha and other districts near form a vast waterless steppe, and vast steppes with oases of mountains stretch west of Usambara. Western Ukami is fertile, but beyond it extends the desolate Mkata steppe.

Mr. Arnot and Garenganze.—On January 7th of this year, Mr. F. S. Arnot read before the Royal Geographical Society an account of his wanderings in Africa, from 1881 to that date. With a very slender outfit, and without offensive arms, save for hunting, he first crossed Africa from Plutal to Bihé and Benguela, reversing Serpa Pinto's journey, and then traveled aross the Central Plateau of the continent to the sources of the Congo and Zambezi, discovering a mountainous and healthful country. The overflow of the Chobe river during the dry season is by Mr. Arnot explained by the nature of the soil around the northern feeders of this river. The porous ground absorbs the early rains, and the hills yield up their store towards the end of the latter rains. The Ovimbundu, an enterprising people living between Benguela and Bihé, told our traveller of a country called Garenganze, lying north of the Barotse region. This Mr. Arnot resolved to reach. The Ovimbundu bring to the Portuguese markets large quantities of rubber from a root abounding in the plains east of the Kwanza and Kukema rivers. Between Bihé and Bailundu, (about 16° E.) springs of the Okovango, which flows to Lake Ngami are met with close to those of feeders of the Kwanza, which flows northwards. Westward of this the territory of the Vachibokwe was entered, and the sources of the Kutia, a tributary of the Kwanza, were passed. Soon afterwards the head of the Monyango, the southern-most feeder of the Kasai, was met with; and a little further on were the springs of the Elume, which runs into the Zambezi. The Vachibokwe are active and industrious, and were the first to discover a method of extracting rubber from the "Talamba" root. Eastward of these are the Luvale or Va-luena. Kangombe, a Va-luena chief, is a great slave hunter, and the terror of the Lunda or Muata-yamoo. Beyond the Lumese and Luena tributaries of the Zambezi is the great Kifumadji flat, which in the rainy season is flooded to a depth of two or three feet. The Lunda country was then crossed in sight of the Zambesi, here flowing westward. Kaomba Mountain or Border Craig, as Mr. Arnot styles it, marks the watershed between Zambesi and Congo. The country became mountainous about 25° E., and the Lokoleshe, Lufupa, Luburi, and Lulua were large streams crossed before the Lualaba was reached—all flowing northwards. The Sambau mountains, inhabited by a portion of the Samba tribe, who dwell in caves, were left to the left hand, and then, after passing the Lukurawe, a rugged mountainous land was entered. Leave of Msidi, the potentate of Garenganze, had to be asked before entering the capital. Auguries were consulted before admitting the visitor, and fortunately these proved auspicious. Garenganze is a name made by Msidi for the kingdom he has created. The Arabs knows it as Katanga. The capital is on an immense plain called Mukurra, with high mountains on two of its sides. Msidi's town consists of a number of villages around a double-topped hill in the south of the plain. Msidi's kingdom extends from the Lualaba to the Luapula, and from the Luba country on the north to the mountains dividing the Congo and Zambezi water-systems. Mr. Arnot stayed at Msidi's capital for more than two years.

The Leeba of Livingstone is really the Zambezi.

The great Lombwe caves are very remarkable and extensive, and are inhabited by a considerable number of natives. One cave, the the Kotasa, has two mouths, the distance between them being five miles.

Asia—Ascents in the Caucasus.—Koshtantan, 17,091 feet high, in the main Caucasus, has been ascended by A. F. Mummery, after the failure of a first attempt. Mr. H. W. Holder has ascended some of the peaks around the Bezingi Glacier, including Salananchera (about 15,500 feet), Koshtantan, and Kartantan, or the Saddle Peak (about 16,500 feet); and Mr. Cockin, who accompanied Mr. Holder and stayed behind, afterwards ascended Shkara (17,200–17,300 feet), and the second peak of Djanga (16,700–16,800 feet), and then, crossing to the south side of the chain, ascended the northern peak of Ushba. Koshtantan is somewhat higher than Dychtan, thus proving the correctness of the measurements of the Russian survey. In an attempted ascent of the Mishirgi Tan, Mr. Holder and his companions were brought to a stand at 13,000 feet. They estimate the height of that peak at a little more than 16,000 feet, and it lies but slightly southeast of Koshtantan. The main glacier streams of the Caucasus, the Bezingi, Mishiri, and Dych Su, have but slight fall, but the smaller upper streams which form them are cascades of ice.

Notes from Prjevalsky's Last Journey.—In his fourth voyage, Gen. Prjevalski explored a portion of the Keren-Lim that had not been previously visited, forming an arc of a circle with the convexity to the north. Towards the east, by the chain of Marco Polo, the already known portion of the range is reached. This convex range consists of several parallel chains, named Columbus, Moscow, Russia, Prjevalski, separated from each other by wild valleys with a poor flora and fauna, but rich in gold. One of these valleys, 210 kilometres long, with a width varying from 21 to 42 kilometres, was named by the traveller the "Valley of the Winds," on account of its formidable tempests. Gen. Prjevalski believes that this valley affords the best means of communication between China and East Turkestan, also the shortest (1,700 kilometres).—*Revue de Geographie.*

Bokhara.—According to Dr. Heyfelder (*Petermann's Mitteilungen*, Vol. VII, 1889), Bokhara has an area of 275,000 square kilometres. The Tadjiks, the primitive Iranian race, though a tall fine people, have been conquered by the more war-like and energetic Turanian Auzbecks, The Tadjiks are agriculturalists, gardeners, artisans, merchants; the Ausbecks by preference functionaries or soldiers. Arabs are numerous, also Persians, and the language of the latter is that of the court and of good society. The Jews are attired somewhat like those of Poland, and their commercial relations extend to Russia, France, Austria, and England. The Hindus are small and feeble; they are small tradesmen, and given to usury; if they become rich, they recross the frontier. Afghans attend the markets from time to time, and some settle and purchase lands. There are 2,000 Europeans in the Khanate, counting the Russian garrisons of Chardjui and Korki.

America.—Dr. Nansen's Journey across Greenland.—Dr. F. Nansen read an account of his memorable journey across the inland ice of Greenland, before the Royal Geographical Society, on June 24, 1889. The result of the expedition was to prove that Greenland, at the point crossed (61°–64° N. lat.) is covered with a shield-shaped stratum of ice, of such thickness that it fills up all irregularities in the surface, rising rapidly but regularly from the east coast to a height of 9,000 to 10,000 feet, almost flat in the middle, and falling again regularly toward the west coast. Some geologists argue from this that the interior is a vast tableland, but Dr. Nansen believes that it is not, but that Nordenskjold was right in believing the internal configuration of the mountains comparable to that of Scandinavia. If there are deep fjords and lofty mountains on the coast, he argues that the ice has also excavated deep valleys in the interior. The surface of the snow-field consists of soft, loose and dry snow, readily moved by the wind, and is even and polished like a lake in still weather. Thin ice-crusts, the product of summer meltings, occur at intervals, but hard ice or snow cannot be found with the six-foot sticks used in *ski* or snow-shoe running. The party had a snowfall almost every day, and as there is no real snow-melting in the interior, the melting of the day freezing again at night, it would seem that the quantity of snow is still increasing. Yet the flowing of the ice to the shores keeps it down, the surplus coming to the coast as water as well as ice.

Geographical News.—America.—The population of British Guiana at the end of 1887 was 277,038, of whom 102,746 were East Indians.

It is probably not generally known that the Santa Cruz Indians about fifty years ago drove out the Mexicans from southwest Yucatan, and have since retained possession. Mr. W. Miller crossed this territory last year from Bacalar to Santa Cruz. The Indians pretend to be Christians, remember a few prayers, and have rude churches, but no priests. Near Tutum is an oracular cross, and the belief is firm that the voice which issues from it is that of God. In one village are several whites, descendants of Spaniards, but in dress, manners and ideas reduced to the Indian level.

J. Bellamy (Proc. Roy. Geog. Soc., Sept., 1889) describes an expedition to the Cockscomb Mountains of British Honduras. The highest peak, Victoria, is a little below 4,000 feet. The interior of this country is less known than Central Africa.

In 1857 only 4,951 immigrants reached the Argentine Republic; in 1888 the number was 155,632. At the present rate of increase, the population by the end of the century will be 7,000,000. Sixty-five per cent. of the immigrants are Italians, fifteen per cent. Spaniards, and ten per cent. French.

Europe.—In the immense empire of Russia, with a population of 108,787,235 in 1885, there were at that date, according to Dr. Göhlert (Ausland, 1888), only 36 towns with more than 50,000 inhabitants, and only 13 with more than 100,000. The latter are: St. Petersburg (861,303), Moscow (753,469), Warsaw (454,298), Odessa (240,-000), Riga (176,332), Kharkhov (171,426), Kiev (165,561), Kazan (139,015), Saratov (122,829), Tashkend (121,410), Kichenev (120,-074), Lodz (113,413), and Vilna (102,845).

According to the preliminary results of the census of Switzerland, taken Dec. 1st, 1888, the total population at that date was 2,934,055, as compared with 2,846,102 in 1880. The slightness of the increase is accounted for by the excessive emigration. During the eight years above, 160,000 Swiss left the country.

Geographical News.—Africa.—The Germans have been active in the survey of the Cameroons and Gold Coast. Kund and Tappenbeck, with 240 men, started last year on a second expedition to the upper courses of the Sannaga and Njong. It was found that the lower course of the latter river lies seven minutes west of its position on existing maps. Dr. L. Wolf has passed through the hitherto unknown Udjuti country.

The most recent estimate of the population of Morocco places it at 9,400,000, viz., 3,200,000 in Fez, 3,900,000 in Morocco proper, 850,-000 in Tafia, and 1,450,000 in Sus, Adrar, and the northern Draa. This estimate exceeds all previous ones.

Dr. Colin has prepared a map of the district of Bambuk (Senegambia), and his survey has definitely fixed the topography of the country and proved errors in former maps. Thus the river Faleme, instead of running straight to Labe in Futa-Djallon, bifurcates into two streams of almost equal importance.

From a note in the September issue of the Proc. Roy. Geog. Soc. it appears that the Lake Basso-narok is identical with Lake Samburu, and that the river Omo of Borelli discharges into it. MM. Teleki and Hoenel declare that it has no outlet. As the Samburu is 1,970 feet above the sea, while the Victoria Nyanza is 3,800, this lake must form a distinct basin.

An article upon nilometers in the Proc. Roy. Geog. Soc. for January, by Col. Ardagh, contains many interesting facts respecting those methods of measuring the rise of the Nile. It seems that the estimates now given by the Sheikh in charge are utterly unreliable.

MM. Delcommune and Haneuse have performed a voyage of 503 miles on the Lomanie, and have arrived within three days' march of Nyangwe. They have proved that this stream is the one traversed by Wissmann and Pogge after leaving Nyangwe. The river is 250 metres wide, and 12 to 18 deep, and affords the most direct route from Stanley Falls to Lake Tanganyika.

According to Prof. Virchow, positive data have been obtained to prove the existence of an Egyptian stone age; but there is a yawning gap between this evidence and the time of Menes. Skulls of the older dynasties agree with statues of the temple-building kings to prove that in old times the type of the Egyptian skull was brachycephalic. But the modern fellaheen are long-headed. Prof. Virchow believes in the distinctness of both Egyptians and Nubians from the negro. The latter never changes color, while in the former color deepens by exposure to sun, and vice versa. This is why the Egyptians painted the men red, and the women light yellow.

Baron v. Steinacker does not give a very roseate picture of the German Protectorate in Southwest Africa in his recent article in the *Mitteilungen.* There seems to be no available harbor along the coast save Walfish Bay, which is English; the coast is without water, the middle districts have few spots favorable for agriculture, and it is only in the north and northeast that the agriculturist can have scope. The southern parts of the Kubango and Chobe districts are impassable swamps in the rainy season. The Hereros and the Hottentots are at constant strife. The report is accompanied by a map, embodying the Baron's surveys, as well as previous ones.

M. Camille Douls has been assassinated by his guides, between the Oases of Alouef and Akabli, 900 kilometres south of Oran; but whether from fanaticism or cupidity is not known. As on his previous journey, he was in the disguise of a Mussulman.

M. Foa and two other Frenchmen have ascended the Whene, or Ouené, which forms the boundary between Dahomey and Porto Novo.

M. Crampel made in 1888 an important journey of discovery into the country northwest of the Ogowé, reaching the Upper Ivindo, its largest tributary, and penetrating to the boundary between the French and the German possessions. The natives of this part are known as the Pahuins. A stream called N'Tem, flowing westward, was discovered, and M. Crampel believes it identical with the upper course of the Campo.

Asia and Oceanica.—Sir Wm. Macgregor, Administrator of British New Guinea, has returned to Port Moresby, after the ascent of a crest of the Owen Stanley range named Mt. Victoria, 13,121 feet above sea-level. A newly discovered mountain north of this range he has named the Albert Edward, and estimates its highest peak at 12,500 ft. The country along the range of mountains ending in East Cape is fully inhabited, and full of cocoa-nut trees. The island of Tubutubu, in the Engineer group, is very populous, and the people are great traders. Between Milne Bay and Mullen's Harbor, on the main land, there is a range of hills some 800 feet high, basalt on the Milne Bay side, coral limestone on the other face. From Mullen's Harbor a canoe trip was undertaken for the purpose of visiting the fierce and hostile Werewere, and impressing on them the policy of keeping on good terms with the Government.

Dr. H. Zöller, accompanied by three officers, has ascended the Finisterra range in New Guinea to a height of 9,000 feet, and reports that Mount Gladstone still rose 1000 feet higher. A new range between the Finisterre and the Bismarck ranges was found, and named the Kràtke. Its apparent height was 10,000 feet. About 140 miles of country were surveyed.

The conclusion of Dr. A. Meyer, that no water-way exists between Macluer Inlet and Galvink Bay (New Guinea), has received confirmation from Dutch officials who have investigated the matter, and from Lieut. Ellis, who explored the coast from May to November, 1887.

M. Eugene Markow, M. Popoff and seven others have recently ascended Mount Ararat. The limit of eternal sun was crossed at 13,500 feet, but at 14,000 a lady-bug was found, and some flowers were gathered at 15,500. The travelers erected a cairn at the summit, which will be visible at the base, and may thus serve to dissipate the superstition of the natives, who will not believe that any one has ascended the holy mountain.

Mr. S. E. Peal (Proc. Roy. Geog. Soc. Feb. '89.) has an interesting article upon the origin and orthography of river names in Indo China. It seems that the great eastern tributary of the Upper Irawadi is spelled in no less than thirteen different ways, and that the Salwin has thirteen other designations beside that here given.

M. Alexandron has determined the height of the Khan Tengri, in the Thian Shan, at 23,950 feet.

Baron Sternberg and a party recently attempted the ascent of Elbruz, but only succeeded in reaching the saddle or depression between the two main peaks. Though they spent sixteen hours at a height of 17,840 feet, they felt no symptoms of mountain sickness.

The well-known Prof. Schweinfurth was, from Nov. 1838 to March 1889, in Arabia Felix, with the object of making botanico-geographical studies. Travel is safe in Yomen, and the natives are courteous towards Europeans. The designations "stair-mountain" and "step-mountain," both found in old hieroglyphics, refer especially to the cultivated terraced slopes of South Arabia, and possess no meaning if applied to the Somali country. The ancient Egyptians dedicated certain trees to particular deities. Thus the sycamore was sacred to Athor, and the fruit of the persea (*Mimusops schunperi*), was a gift to the gods and to the departed. The persea has for several centuries disappeared from Egypt, but the sycamore still exists there. The persea grows wild in Nomen.

M. E. Favec contributes to the August issue of the Proc. Roy. Zool. Soc. an account of his explorations on the Upper Gascoyne and Ashburton rivers, in West Australia. The result of the trip was the discovery of several large tributary rivers running into the Ashburton, and on the Gascoyne there are indications of the existence of gold reefs.

Siberia has a railway from Samara to Oufa, opening up the riches of the Ural.

The three first sheets of the map of Central Asia, published by the Russian Government, and containing Lake Baikal, the basin of the Amur, and the coast of the Japan sea, have appeared. When complete this map will have thirty-two sheets, and will represent the entire country between the Caspian and the east coast of Asia, on a scale of 1–1,630,000.

GEOLOGY AND PALÆONTOLOGY.

Archean Characters of the Rocks of the Nucleal Ranges of the Antilles.[1]—During a visit this year to the southeastern part of the island of Cuba, the speaker had made some examinations of the rocks which form the nucleus of the spurs of the Sierra Maestra, and there is strong reason to believe of the axial range of the entire island and of Jamaica, Santo Domingo, Puerto Rico, and the Windward Islands as well. From the field observations there made, and an examination of the specimens under the microscope, it seems highly probable that these rocks, instead of being igneous extrusions of the Tertiary period and later, are in reality of much earlier date, and may not be entirely volcanic.

The considerations which support this view are—

1. Microscopic analysis shows immense alteration to have taken place, and consequently a very long period to have elapsed.

2. The complexity of the congeries of rocks forbids the hypothesis of their having been derived from one mass. Where this congeries, therefore, is unconformably adjacent to the Tertiary, there can be no reasonable doubt that the crystalline rocks are the elder. This point of view was suggested by Mr. Teall, who would consider the argument valid also for the contact with the Cretaceous, and perhaps older series. It is difficult to see why it should not hold equally good for the contact between these crystalline and the Paleozoic rocks as made out by De Castro near Cienfuegos, etc.

3. The characters of the several associated rocks are those which one finds united in very many Archean regions throughout the world.

4. The products of alteration of these rocks are similar to those which one finds in the districts just alluded to.

5. The chemical peculiarities of the iron ores found in contact with these rocks are similar to those which one finds in the ores of the Archean regions, both in the low percentage of phosphorous and in the pyrite and (more sparingly) chalco-pyrite disseminated through the ore, and in other respects.

6. If this nucleal mass had been forced up from the earth's interior in a state of igneous fusion there would not be now (as there are) abundant traces of stratification and structure, implying an original sedimentation.

[1] Read by Dr. Persifor Frazer at the Bath Meeting of the British Association, 1888.

7. If this mass had resulted from volcanic outflow there must have been contact phenomena, and changes induced on the surfaces of the rocks with which it was brought in contact. No such contact alteration has been observed between these rocks and those of either the Paleozoic, Mesozoic, or Cænozoic groups which in different localities meet them.

8. The direction of the range, considered as a whole, lends support to the hypothesis that it is a fork of the Andes which, diverging from the main axis in Guatemala, traverses the peninsula of Yucatan, and in a symmetrical curve sweeps through the highlands of Cuba and Jamaica, Hayti, Puerto Rico, the Windward Islands and the northeast coast of Venezuela. This rim of high land once enclosed the Caribbean as another Mediterranean Sea.

9. The shapes of the hills of this range, produced by weathering, are not those usually visible in regions of volcanic, but rather of metamorphic rocks.

The rocks which furnished the basis for the above conclusions are all, or nearly all, alteration products. In some cases they appeared to be the results of a series of metamorphoses, some of their constituents seeming to pass through cycles of change, ending in the mineral with which the alteration began after a number of intermediate stages. The rocks are diabases or diorites, with epidote, porphyritic dolerites, which resemble and have been taken for syenites; garnet rock; actinolite; felsite and orthofelsite porphyry, like that of the South Mountain of southeastern Pennsylvania, of St. David's Head in Wales, and elsewhere. To these are added pyrite, and iron ores and crystalline limestone. Copper and manganese ores are not rare, but their relations to the rocks under consideration have not been made out.

NOTE.—A number of the first petrologists of Europe who have examined the slides are disposed to consider the specimens of not later than Paleozoic age, while none are willing to deny that they *may* be earlier.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—A most interesting rock is described by Osann[2] as forming the body of the hill known as Hoyazo, in the Spanish Province Almeria. The rock is an andesite consisting of a ground-mass of colorless glass containing small crystals of cordierite, flakes of biotite, lath-shaped microlites of plagioclase, and of an orthorhombic pyroxene, in which are porphyritic crystals of labradorite, a large quantity of biotite, columnar crystals of bronzite, hornblende, augite, and cordierite. The last-named mineral occurs in the form of irregular grains associated with quartz, and also in well-developed crystals, with a pleochroism: $A =$ yellowish-white; $B =$ dark violet; $C =$ light violet. In the rock are inclusions of quartz, of aggregates of quartz and cordierite, and of a biotite gneiss rich in cordierite and garnet. A portion of the cordierite, separated from the rock, was analyzed with this result:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	Sp. Gr.
48.58	32.44	3.15	9.17	tr	6.03	2.625–2.628

The mineral is usually fresh, but contains numerous inclusions of sillimanite, whose composition is: $Al_2O_3 = 63.52\ \%$, $SiO_2 = 35.43\ \%$. The granular cordierite is supposed to represent the remains of foreign inclusions in which the mineral was an original constituent. The crystallized variety is thought to have arisen from the solution of a portion of the inclusions and a subsequent re-separation of cordierite, as well-developed crystals. The author regards the same explanation as applicable to all the cases in which cordierite has been found in volcanic rocks, *i.e.*, it is a secondary mineral produced by the solution of foreign inclusions in the magma of the eruptive.——Lacroix[3] intends to make a complete study of pyroxene gneiss, and of rocks containing scapolite. He has published the first results of his work in a very excellent paper which is occupied with descriptions of the rocks of these two classes, together with the rocks associated with them as they are found in Brittany and in other parts of France, in Saxony, Austria, Spain, Algeria, Norway, Sweden, New York, Canada, Ceylon, India, and a few other places. As is to be expected, Lacroix finds many interesting facts connected with the structure, composition and genesis

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. d. deutsch. geol. Gesells.*, XL., 1888, p. 694.

[3] *Bull. Soc. Franc. d. Min.*, XII., 1889, p. 83.

of these two little-known rock groups. He has discovered that the scapolite rocks are sometimes the result of contact phenomena in marbles. Sometimes they are the result of the alteration of gabbros, and sometimes they are original. In every case it is found that there is a tendency of the rock to possess as constituents one or more rare rock-forming minerals. As the writer has examined all these very carefully, his paper is a mine of wealth to the petrographer who has to deal with rare minerals. Among the most interesting observations described may be mentioned the existence of dumortierite and cordierite in a gneiss from Bamle, Norway; fuchsite in a mica-schist from Salem, India; and the new mineral fouquéite in a gneiss from the same vicinity. Original epidote and parallel growths of this mineral with allanite in a pyroxene gneiss from Morbihan, France, and in a scapolite gneiss from Odegården, Norway, are described, as are also the regular arrangement of rutile needles in phlogopite and garnet and micropegmatitic intergrowths of pyroxene and quartz (page 297), pyroxene and oligoclase (pp. 316–318), garnet and quartz (p. 317), and amphibole and oligoclase (p. 319). The varieties of feldspar known as sun-stone and esmarkite are referred to, the properties of the minerals of the scapolite group are discussed, and the occurrence of secondary and original wollastonite and wernerite is mentioned. Contact rims consisting of hypersthene and amphibole, and tremolite and amphibole, are pictured around olivine in olivine-gabbros, and a rim consisting of biotite and amphibole is figured as seen around ilmenite. In addition to the observations made by Lacroix, there are incorporated in the paper descriptions of the facts discovered by earlier workers in the domain of these rocks. It therefore becomes a valuable compendium of our knowledge of scapolite rocks, so far as known. In connection with his description of the New York rock, Lacroix gives an interesting account of the properties of the minerals found in the neighborhood of Pierrepont.——Mr. J. P. Iddings [4] has just published one of the most interesting papers that has yet appeared on the subject of lithophysæ. The article opens with a description of the macroscopic structure of the great mass of obsidian known as Obsidian Cliff, in the Yellowstone National Park. The most striking feature of the southern portion of the mass is its perfect columnar structure, with the columns all perpendicular to the surface over which the rock flowed. A petrographical description of the rock follows, and it is in this portion of his paper that the author shows well his ability to treat a complicated subject. Spherulites and lithophysæ are minutely

[4] Seventh Ann. Rep. Direct: U. S. Geol. Survey, p. 255

described, and very fine pictures of the structures are given. Without being able to enter into a full discussion of the points so clearly brought out by Mr. Iddings, it is interesting to note that he regards the lithophysæ as having been produced, after the partial solidification of the rock in which they occur, by the expansion of the vapors imprisoned within the rock-mass before its eruption. The formation of the minerals coating the walls of the cavities was caused by the action of this water upon the materials of the rock. The expansion of the vapors was due to the diminution of the pressure under which they were confined in consequence of the upward bending of the rock layers above the places now occupied by the lithophysæ. These conclusions are in direct opposition to those of Szabo, Roth, Zirkel, and Cole,[5] who regard lithophysæ as resulting from the alteration of spherulites.——A nephelinite composed of a granular aggregate of nepheline cementing porphyritic crystals of olivine, shreds of biotite, microlites of augite and magnetite, is announced by Levy and Callot[6] as existing in a boss near Rougiers in Var, France.

New Minerals.—*Tephrowillemite.*—Dr. Koenig[7] communicates the discovery of a brownish-gray, resinous, infusible substance at the Trotter Mine, Franklin, N. J. Only a portion of a single mineral was obtained, which yielded on analysis:

$SiO_2 = 27.75$, $ZnO = 60.61$, $MnO = 10.04$, $Fe_2O_3 = 1.80$, $CaO =$ tr.

It is a *manganese willemite* with the formula $(ZnMnFe)_2\ SiO_4$.——*De-Saulesite.*—Associated with the above-described mineral, and also with *sphalerite*, *chloanthite*, *fluorite*, *apatite* and *nicolite*, beneath a stratum of yellow garnet, at a depth of 340 feet from the surface, is a greenish substance encrusting fluorite and filling cavities in it. In the closed tube it yields water and turns brown. It is infusible before the blowpipe, but at this high temperature it regains its original color. Its composition is:

SiO_2	NiO	ZnO	FeO	CaO	MgO	As_2O_5	H_2O at 100°	H_2O at 600°
31.62	38.22	4.00	2.03	.70	.42	4.77	9.44	7.14

corresponding to $NiZnFe\ (SiO_3) + 1\frac{1}{2}$ Aq. It is therefore a *nickeliferous garnierite.*——*Yttrialite.*—From the gadolinite locality in Llano County, Texas, five miles south of Bluffton, Messrs. Hidden and Mackintosh[8] have discovered a very large number of new and rare

[5] AMER. NATURALIST, Jan., 1887, p. 70.

[6] *Comptes Rendus*, 1889, p. 1124.

[7] *Proc. Acad. Nat. Sciences, Phila.*, Pt. II, 1889, p. 184.

[8] *Amer. Jour. Sci.*, Dec. 1889, p. 474.

yttria and thoria minerals associated with less rare compounds in the quartz veins cutting granite. Among the bodies new to mineralogy was found a yellowish substance in large masses with an olive-green color on a fresh fracture. Its specific gravity is 4.575, and its hardness 5–5.5. It is soluble in hydrochloric acid, decrepitates when heated, and breaks into an infusible and insoluble powder. Its composition is:

SiO_2	PbO	ThO_2	MnO	FeO	CaO	Al_2O_3	Ce_2O_3	Y_2O_3	$(LaDi)_2O_3$	UO_3	Ign.
29.17	.854	12.00	.77	2.89	.60	.55	1.86	46.50	2.94	.83	.79.

——*Thorogummite* usually occurs in small pieces intimately associated with *fergusonite* and *cyrtolite*. It has a dull yellowish-brown color, a hardness of 4–4.5, and Sp. Gr. of 4.485. Occasionally groups of crystals with a ziron-like habit have been found. The mineral becomes of a dull greenish hue after ignition, and is soluble in nitric acid. Composition:

SiO_2	UO_3	ThO_2	Al_2O_3	Fe_2O_3	$(CeY)_2O_3$	PbO	CaO	H_2O	P_2O_5	Ign
13.085	22.43	41.44	.965	.845	6.69	2.16	.41	7.88	1.19	1.23

corresponding to $UO_6(ThOSi)_3, (OH)_{12}$, or *gummite* in which the water has been replaced by thorite.——*Metagadolinite* is a grayish brown amorphus alteration product of gadolinite from the above mentioned locality. It has a red streak, a hardness of 3, and a specific weight of 3.494. Mr. Goldsmith [9] has made an approximate analysis of it, and regards it as a new mineral.[10] His result is:

SiO_2	$YO(?)$	$Ce_3O_4(?)$	Fe_2O_3	CaO	MgO	H_2O
18.145	21.854	20.662	26.026	3.642	2.14	9.761

——*Daviesite*.—Associated with other decomposition products of lead ores at Minas Beatriz, Sierra Gordo, Chili, Mr. Fletcher [11] discovered tiny, colorless, prismatic crystals of an orthorhombic mineral, with an axial ratio 1.2594 : 1 : .6018, and the plane of its optical axes parallel to $\infty P\bar{\infty}$. From the few chemical tests made upon the small amount of material at his command, Fletcher supposes the mineral to be an oxychloride of lead.——*Dudgeonite* [12] was found at the Pibble Mine, near Creetown, Scotland, in little cavities occurring in *nickeline*. It is a grayish-white earthy substance, with a slightly resinous lustre. Its

[9] *Proc. Acad. Nat. Sci. Phila.* Pt. II., 1889, p. 164.

[10] Cf. F. A. Genth. *Amer. Jour. Sci.*, Sept. 1889., pp. 198–200.

[11] *Miner. Mag.*, VIII., May, 1889, p. 171.

[12] Heddle: *Miner. Mag.*, May, 1889, p. 200.

hardness is 3–3.5. In composition it corresponds to *annabergite*, with one-third of the nickel replaced by calcium $(\frac{2}{3}NiO, \frac{1}{3}CaO)_3 As_2O_5 + 8 H_2O$. [NiO=25.01, CoO=.76, CaO=9.32, As_2O_5=39.33, H_2O=25.01].——*Hydroplumbite* and *Plumbonacrite.*—The former mineral is in very small scaly crystals, with a pearly lustre, forming thin flakes of a pure white color, covering all the lead minerals of a specimen of associated lead ores, that probably came from Leadhills, Scotland. The amount of the new mineral obtained was too small for analysis; but from the synthesis of a similar substance, Heddle[13] infers that its composition is $3PbO\ H_2O$. The second mineral (from Wanlockhead) resembles *hydroplumbite* in appearance, but yields upon analysis a result corresponding to the formula $PbCO_3 + 3\ PbO\ H_2O$ [PbO=92.85, CO_2=4.76, H_2O=2.01, residue=.78].——*Flinkite* is described by Hamberg[14] from Pajsberg, Sweden. It occurs in greenish-brown tabular orthorhombic crystals, with a hardness of 4.5, and Sp. Gr =3.87. Its composition is:

As_2O_5	Sb_2O_5	Mn_2O_3	Fe_2O_3	MnO	CaO	MgO	H_2O
29.1	2.5	20.2	1.5	35.8	.4	1.7	9.9

——*Fouquéite.*—In his excellent paper on scapolite rocks, Lacroix[15] describes a dimorphous form of zoisite occurring as a constituent in an anorthite gneiss from the District of Salem, Madras, India. The new mineral is found in corroded and rounded monoclinic crystals, elongated in the direction of their *c* axes, and polysynthetically twined with the orthopinacoid as the composition face of the various lamellæ. They possess a well-marked cleavage parallel to the face assumed as the basal plane, which makes an angle of 108° with $\infty P\bar{\infty}$. The plane of their optical axes is oP, and the optical angle 2V is about 90°, with *b* as the positive acute bisectrix. The pleochroism is weak in yellow tints. The mineral is infusible before the blowpipe, and has a specific gravity of 3.24–3.31. It occurs in two varieties, the compositions of which are as follows:

	SiO_2	Al_2O_3	FeO	CaO	Loss.
Colorless:	36.6	32.5	1.9	23.9	2.7
Yellow:	38.3	31.9	4.4	23.5	2.7

——*Pleonektite* occurs with *arseniopleite* in the gangue of the manganese mine, Sjögrufvan, Grythyttan Parish, Örebro, Sweden. It is a light gray mineral,[16] with a hardness of 4, and a metallic fatty lustre. It is

[13] Ib., p. 201.

[14] Geol. För. Förh., XI., 1889, p. 212.

[15] Bull. Soc. Franç de Min., 1889, p. 327.

[16] Ingelström: *Neues Jahrb. f. Min.*, etc., 1889, II., p. 40.

transparent in thin splinters. Before the blowpipe it decrepitates, but does not fuse. On charcoal it gives the reactions for lead, antimony, arsenic, traces of manganese and water. It is probably a lead antimony arseniate resembling *hedyphane.*——*Anthocroite.*—When the ore from the Jakobsberg braunite mine is treated with hydrochloric acid, there is left as a residue a violet sand composed of little grains of a mineral that occurs scattered throughout the ore as well as throughout all the minerals associated with the ore, and in veins cutting the surrounding limestone. The largest masses of the mineral are in a magnese *vesuvianite,* and from this it can be obtained in a pure form. Lumps of the new mineral[17] consist of small transparent grains of a light amethyst color, and a hardness of 5–6. It is biaxial, with an optical angle (in air) of about 100°. Its analysis shows it to be a bisilicate with the composition:

SiO_2	MnO	CaO	MgO	Al_2O_3. Fe_2O_3	K_2O.Na_2O
51.6	3.4	23.3	13.5	1.4	6.8

——*Michel-lévyite* is the monoclinic form of barium sulphate, of which *barite* is the orthorhombic form. It was discovered by Lacroix[18] in the crystallized limestone of Templeton, Canada. It is a flaky, white substance, with three cleavages. These are assumed as the three pinacoids, giving 77°–78° as the value of β. The plane of the optical axes is perpendicular to $\infty P\bar{\infty}$, and the value of the optical angle is nearly 90° The principal bisectrix probably coincides with the axis *b*. Specific gravity=4.39.——*Messelite* is found in aggregates of colorless or brown tabular crystals in a clay slate at Messel, a station on the railroad between Darmstadt and Aschaffenberg, Hessen. The crystals[19] are monoclinic, with an extinction of 20° on the clinopinacoid. Their average percentage composition corresponds to the formula $(Ca\,Fe\,Mg)_3\,(PO_4)_2 + 2\frac{1}{2}H_2O$.——*Wiluite* is the name given by *Prendel*[20] to a variety of *vesuvianite* from Wilui, Russia. Its composition is:

SiO_2	TiO_2	Al_2O_3	CaO	MgO	Fe_2O_3.FeO	MnO	Alk	Loss
38.30	1.09	13.07	35.92	5.83	4.25	tr.	.37	.96

Crystals cut parallel to a prismatic face show the hour-glass structure in which the two constituent substances have different refractive indices. In sections parallel to the base the inner substances show a bi-

[17] Ib., p. 36.

[18] *Comptes Rendus*, CVIII., 1889, p. 1126.

[19] Muthman: *Zeits. f. Kryst.*, XVII., 1889, p. 93.

[20] Ib., p. 94.

axial interference figure with an optical angle of 3°–4°, while in the exterior zone the axial angle is 30°–35°. In both substances the axial figure is decreased by heating. Their hardness is above .7, and their specific gravity, 3.331. Their conductivity for heat is greatest in the direction of the *c* axis.——Three new *cupro-descloizites* are described and analyzed by Hillebrand.[21] The first occurs massive in the Mayflower Mine, Beaverhead county, Montana, in lumps of a dull yellow to pale orange color. The second is found as thick botryoidal incrustations in quartz, with a dull green color on the surface, and a brown color on a fresh fracture. It is found at the Lucky Cuss Mine, Tombstone, Arizona. The third came from the Commercial Mine, Georgetown, New Mexico, where it also is found as an incrustation on *quartz*. It varies in color from yellow through all shades of orange red to deep reddish-brown. The incrustations are distinctly crystalline, being made up of globular masses composed of little flat crystals crowded close together. At other times the incrustation is acicular in shape, when it appears to have formed on bunches of radiating *vanadinite* needles. The composition of this variety is:

PbO	CuO	FeO	ZnO	V_2O_5	As_2O_5	P_2O_5	H_2O	Cl	SiO_2	CaO	MgO
56.01	1.05	.07	17.73	20.44	.94	.26	2.45	.04	1.01	.04	.03

BOTANY.

Uredinial Parasites.—From a practical standpoint as well as from a biological, uredinial parasites are exceedingly interesting. A specimen, or specimens rather, found in Dawes County, Nebraska, this summer (July 20), deserve, I think, special mention. An Æcidium on *Lygodesmia juncea* Don. (Æcidium compositarum Mart. var. lygodesmiæ Webber), was found very commonly. It was very destructive, frequently distorting whole plants, and, by partially stopping the growth above, giving them a somewhat depressed much branched appearance.

The avenger, however, was close at hand, entirely too close for the good of the Æcidium. Not in the form of man, with his multifarious external poison applications, but simply another little parasite on this parasite, wreaking vengence. It was the little *Tuberculina persicina* (Ditm.) Sacc., a plant closely allied to the smuts, found very rarely in

[21] *Amer. Jour. Sci.*, June, 1889, p. 434.

America. It was very destructive to the Æcidium, its smooth violet-colored spores completely filling up fully half the pseudoperidia and injuring many more, destroying and taking the place of the æcidiospores. It has been reported before from but one place in America, so far as I can learn,—from Oregon,—unless we consider, as Farlow has hinted (*Botanical Gazette,* 1885, page 245), that Synchytrium jonesii Pk. (Tuberculina jonesii Pk. Sacc.) is identical with it.

On the same specimens of Æcidium, another but more common parasite was also found,—*Darluca filum* (Biv.) Cast. This is not usually very destructive. Cases are found, however, in which it is. To *Uromyces junci* (Desm.) Tul. it is frequently very injurious. Specimens of the uredo of *Puccinia rubigo-vera* on wheat collected at Crete, Nebraska, in July, 1886, are much injured by it. Perhaps it is a much more injurious species than we are wont to suppose. We have nothing to fear from it, however, as we have from some of its hosts. If it is a common wheat-rust parasite, we on the contrary can heartily say, would that it were more common.—HERBERT J. WEBBER, *Lincoln, Nebraska.*

The Lichens of the Guinea Islands.—The lichens of the three islands of St. Thomas, Prince, and Capra, lying in the Gulf of Guinea, off the west coast of tropical Africa, have recently been treated by Nylander, in a little work of 54 pages (*Lichenes Insularum Guineensium*). A noticeable feature of the lichen flora of these islands is that while on St. Thomas Island the *Corticolæ* predominate, on Prince the *Saxicolæ* are much more common; also quite a number *Foliicolæ* are found on the former. This will give an idea of the nature of the land in the islands. Another feature important to American lichenologists, is that of the 129 species enumerated, about 40 are found in our own country, or about one-third of the species are common to both places. In this pamphlet Dr. Nylander seems to lay considerable stress on chemical reactions, especially that of sodium on the "gelatinous hymenium," as a means of determining species. The "observations" in the back part of the book contain considerable information regarding new species from various localities, that of most interest to us being observation six, containing descriptions of new species collected by Dr. Eckfeldt and W. W. Calkins, etc., principally in Florida.—THOS. A. WILLIAMS, *Lincoln, Nebraska.*

The Flora of Central Nebraska (Continued).—In climbing the bluffs we gathered specimens of *Fragaria vesca* L., and succeeded in disposing of quite a number of its elongated conical berries. On the climb up we ate berries also of *Rubus strigosus* Michx., *Ribes aureum* Pursh., *R. floridum* L., and *R. rotundifolium* Michx. At the base of the bluff the common *Cystopteris fragilis* Bernh., grew. Near the top, in more open places, we discovered the western fern *Woodsia oregana* Eaton. At the top and also over the sand hills in numerous places the dwarf sand cherry *Prunus pumila* L. occurs very plentifully.

Along the bank of the river, just above the water's edge, we found rank growths of *Asplenium filix-fœmina* Bernh., and *Aspidium thelypteris* (L.) Swartz. Nowhere else in Nebraska have I seen such a luxuriant growth of ferns. I collected fronds of each fully two and a half feet high. This is the only place the former species is known to occur in Nebraska. About a mile further up the stream a low wet patch of ground of about two acres in extent is a perfect mat of ferns *Onoclea sensibilis* L., and *Aspidium thelypteris* (L.) Swartz.

The next morning we took a walk along the edge of the bluffs on the south side to investigate the flora and the fauna of the "blow-outs."[1] Here we made some excellent finds. Right in the "blow-outs," where almost nothing else grew, we found quite commonly bunches of *Redfieldia flexuosa* Vasey (Torr. Bull., July, 1887). Such a find pleased me, but think of finding also in the same place bunches of *Eragrostis tenuis* (Ell.) Gray. The former has heretofore been reported from Colorado and Canadian R., the latter from Texas and Arizona. Both were also found in Nebraska this summer near Valentine. Branches of *Muhlenbergia pungens* Thurb. were also common, and are found usually just at the edge of the "blow-outs," hanging over. *Astragalus pictus* Gray, var. *filifolius* Gray (bird-egg, I call it, from its beautifully mottled red or purple and white pods), also frequents the "blow-outs." These with *Lathyrus polymorphus* Nutt., *Psoralea lanceolata* Pursh., *Pentstemon cæruleus* Nutt., and sparingly *Munroa squarrosa* Porr., form at this place the principal and remarkable flora of the Dismal River "blow-outs."

On the hillsides, etc., patches of buffalo grass (*Buchloë dactyloides* Engelm.) frequently occur, and in one place a few stems of *Paspalum setaceum* Michx. were found. *Yucca angustifolia* Pursh. is scattered here and there all through this region, and almost every plant has its leaves more or less affected by *Kellermannia yuccigena* E. and E.

In the grass on a sandy hill another find of the trip was made, *Tylostoma angolense* Welw. and Curr. This until last year was known

[1] A "blow-out" is a crater-like cavity in the side of a sand hill. Within it is a mass of loose sand, bordered by grasses and other plants which grow upon its margin. It is supposed to be formed by the action of the wind.

to occur only in one place, so far as I can learn in Angolia, Africa. In the summer of 1887 Mr. Marsland, a student of the University of Nebraska, collected three specimens in Manitou, Colorado, and handed them to me for identification. Failing to determine the species satisfactorily, the specimens were referred to Mr. A. P. Morgan, who pronounced them *Tylostoma angolense*. Besides this stalked puff-ball specimens of *Bovista circumscissa* Berk. and Curt., *Secotium warnei* Peck, and *Lycoperdon fragile* Vitt., were found in the grass.

Descending into the valley on the road back I gathered specimens of *Clematis ligusticifolia* climbing over the underbrush. The leaves of this also were contorted and frequently almost destroyed by *Æcidium clematidis* D. C. In a pond two species of *Chara* were collected, *Chara coronata* A. Br. and *Chara*—(undetermined).

Circæa lutitiana, a common plant in eastern States, but not yet discovered in Eastern Nebraska, and not given by Coulter in his Rocky Mountain Botany, was noticed in a shaded nook. It has also been collected during the summer near Valentine. Specimens were also collected of *Euphorbia petaloidea* Engelm., *Monarda citriodora* Cerv., *Froelichia ploridana* Moquin., *Ipomœa leptophylla* Torr., and *Asclepias verticillata* L., var *pumilla* Gray.

On the Middle Loup River, in the same county, and representing the same flora, we found in stagnant pools, *Ricia fluitans* L., *Utricularia minor* L., *Pediastrum angulatum* (Ehrb.) Menegh. and *Merismopedia violacea* (Breb.) Ktz., a little violet-colored plant that has not been known before to occur in America. It is distinguished from known American species by its smaller size and violet color. Specimens of *Triglochin maritimum* L., and *Commelyna virginica* L., were found in low places, but they are rather rare.—H. J. WEBBER, *Botanical Laboratory, University of Nebraska.*

Bailey's Studies of Carex.—The initial number of the *Memoirs of the Torrey Botanical Club* is devoted to an article by Professor L. H. Bailey, entitled, "Studies of the Types of Various Species of the Genus Carex." The purpose of the paper is well stated in the opening paragraph, which may well be reproduced here:

"An attempt has been made during the past year to see all the existing types of North American species of Carex. These types are widely scattered, largely in the Old World, and the whereabouts of many of them have been entirely unknown. Many of them had never been seen by a student of the genus since their publication, and there was reason to believe that some species which had been seen by our earlier botanists have not been properly comprehended in the light of our fuller knowledge. The examination has proved that many of our catalogued species are fictitious, and that considerable changes in nomenclature must be made. However such radical changes are to be regretted, they are nevertheless unavoidable if priority of publication is to be considered; and there is the surety that in the future the changes must be very few. The very oldest types have been seen so far as they are known to exist, and almost every name which has been applied to North American species is accounted for and understood. It is, therefore, evident that any further changes in the names of our species must be almost entirely such as rest upon judgments of the systematic merits of accepted species and varieties."

Professor Bailey visited or had access to twenty-six important collections of carexes, twenty-one of which are in European herbaria. In his paper he upholds the use of the oldest published name or combination in every instance. He has given varietal names "only to those forms which assume a considerable degree of permanence under various conditions, and the combining of which would lead to confusion in the knowledge of the species." He has no sympathy "with that ultra refinement of classification which gives names to specimens rather than to species and their larger variations. Such refinements serve no useful purpose, and do not merit the name of science.

Eighty-four species are critically noticed in the paper, and the synonymy carefully determined. The notes under each species are of the greatest value to the student of this difficult genus, and will have to be carefully studied by every one who wishes to know what are the latest views as to the relationship of the many puzzling species.—CHARLES E. BESSEY.

ZOÖLOGY.

The Zoological Position of Palawan.—Mr. A. H. Everett, in a paper before the Zoölogical Society of London, contends that Palawan and the other islands intervening between Borneo and Mindoro form an integral part of the Bornean group, and do not belong to the Philippine group with which they are usually associated. His grounds are that they are connected with Borneo by a shallow submerged bank, and are separated from the Philippines by water over 500 feet in depth; the fauna also shows a marked preponderance of

Bornean over Philippine forms, and farther, that those which must be regarded as belonging to the latter group are more extensively modified than are those from Bornean sources.

Bahaman Sea Anemones.—In a beautifully illustrated paper (*Jour. Morphol.* III.), Dr. J. P. McMurrich describes the sea anemones of the Bahamas, using as a basis material which he collected while a student at the Johns Hopkins summer laboratory. Fourteen species in all were found, of which *Bunodes tæniatus* and *Auloctinia stelloides* are regarded as new. The descriptions of the species contain many comments upon the synonymy and numerous details of structure impossible to present in abstract. Dr. McMurrich, from a study of these forms, concludes that the Bahaman Actinarian fauna is much more closely allied to that of the Indo-Pacific than it is to that of the rest of the Atlantic, the similarity of many species to those of the Red Sea being remarkable. The occurrence of *Lebrunnea neglecta* in shallow water in the Bahamas is interesting, since the other members of the sub-tribe to which it belongs occur in the deep seas off the coast of Chili. Dr. McMurrich explains this by supposing (with Semper) that uniformity of temperature is of more importance than the absolute degree of heat and cold.

The Siphonophores.—Prof. Ernest Haeckel finds (*Jena. Zeitsch.* 1888, and Vol. XXVIII. of the Zoölogy of the Challenger Expedition) that the Siphonophores embrace two very distinct groups, which agree only in being hydroid colonies, the individuals of which must be regarded as Craspedote medusæ modified for special functious. These two groups are called Siphonanthæ and Disconanthæ. In the first are included the great majority of the species, the Disconanthæ including only Porpita telella, etc. In the Siphonanthæ the colony is to be regarded as a Craspedote medusa, from the proboscis of which have budded numerous other medusæ which have become specialised for their different functions. In the Disconanthæ we have a Craspedote medusa, with its central proboscis and its marginal tentacles. Instead, however, of secondary individuals budding from the proboscis, these arise from secondary probosces which bud later from the under side of the disc. This view, it will be seen, is intermediate between the two theories of the morphology of the Siphonophores. According to the first, each Siphonophore is to be regarded as a single medusa, the various organs—swimming bells, gonads, tentacles, etc.—being dislocated parts of this medusa duplicated by budding. The other view is that the Siphonophore is a medusoid colony, each of the appendages to be regarded as an (often modified) hydroid or medusa.

The Mesenteries in the Antipatharia.—At a recent meeting of the Royal Society of Edinburgh, Mr. George Brook described the structure of the radial septa or mesenteries in the Antipatheria. The usual directive pair of septa were found, but besides these traces of bilaterality were not seen, and their positions were not explicable on the usually received explanations, but on applying the law developed by Lacaze-Duthiers for the Hexactiniæ to the septa of the antipatharian polyps, and regarding the order of the formation in the one as comparable to their length in the other, order was at once introduced.

The Eyes of Limulus.—Mr. S. Watase has made a careful study of the structure and development of the lateral and central eyes of Limulus, a preliminary account of which appears in the Johns Hopkins *Circulars*, No. 70. The compound lateral eyes have a faceted cornea, each facet corresponding to a conical lens projecting from the inner surface. Surrounding each lens is an ommatidial pit consisting of a single layer of ectodermal cells. In the centre is an axial process of a gigantic ganglion cell, while around it are arranged the pigmented ommatidial cells, each of which secretes on its inner (central) surface a finely striated "rod." Each of these retinular cells is in connection with nerve fibres, while around it are elongate pigment cells developed from the ectoderm. Mr. Watase does not find the intrusive mesodermal pigment described by Messrs. Lancaster and Bowne. In connection with the development of the eyes there is a formation of a V-shaped groove, which later flattens out, forming a partial optic invagination. The optic nerves arise as fibres from the ectoderm cells of the outer wall of the groove. The median eyes are also described, but without diagrams it is not easy to follow the account either of structure or development. Apparently the dorsal ectoderm gives rise to the "vitreous body" or corneal hypodermis, while the retina is produced by an invagination of ectoderm from the central surface, which grows forward and upward to connect with the other elements. Mr. Watase does not attempt to account for this strange condition.

Note on the Feeding Habits of Cermatia forceps Raf.—From an observant public school teacher, Miss Kate Rondeau, of Golconda, Illinois, I have received an item of information concerning the feeding habits of *Cermatia forceps*, new to me and to the literature of the species, so far as I am acquainted with it.

This myriapod was quite abundant during one summer in Miss Rondeau's residence (upon one of the islands of the Ohio River), especially in the kitchen and dining room. It seemed to be strictly nocturnal in its habits, coming out, however, freely by night in the lighted rooms. "I have seen a dozen or more," she says, "at one time, remaining motionless for perhaps half an hour, when suddenly one, with a quick movement of one of its many legs, would catch an unwary house-fly that approached too near. Sometimes this would be eaten immediately, but sometimes held in the foot until two or three more flies were caught. I have seen the Cermatia thus eating one fly while holding two or three others.

"Only the soft part of the body of the fly is eaten, the legs, wings, and head dropping to the floor. In the morning the table and floor were always specked with these remains, showing that the Cermatia was a very successful fly-catcher."

I identified the form to which these remarks apply, by her minute description and by her subsequent recognition of a figure.—S. A. Forbes.

The Scottish Fishing Board.—Among the various papers in the report of this board, which in its functions corresponds with our Commission of Fish and Fisheries, we notice that it is advised, in order to restore the lobster fishery to its former condition, that the limit of size of lobsters permitted to be sold be raised from 8 to 9 inches in length, and it is also proposed to attempt artificial hatching of lobsters. The paper is by Prof. Ewart and Mr. T. W. Fulton. Mr. Thomas Scott catalogues 230 species of Crustacea as occurring in the Firth of Forth. Red codfish has been causing trouble in Scotland. Here it was believed by Dr. Farlow to be caused by *Clathrocystis rosea-persina*, but, Dr. Edington, of the Scottish Board, ascribes it to *Bacillus rubescens*, also introduced with the salt.

Coluber obsoletus Say.—A fine specimen of *Coluber obsoletus* Say was obtained on Snake Hill, near Newburgh, Orange county, New York, during the summer of 1888.—John I. Northrop.

Hesperiphona vespertuca.—About noon, December 12, 1889, I procured a specimen of this rare bird. It was feeding on the seeds of a maple in front of the University buildings. The specimen is a male, and in fine plumage. It was apparently alone, as no others have been seen as yet. The only authority I find for its identification in Ohio is Ohio Geological Report, Vol. IV., by J. M. Wheaton, p. 314, where he reports it was identified by Dr. Kirkland, March 24, 1860. The bird differs in a few details from most of the descriptions. A complete description will be given in next issue of Bulletin of Scientific Laboratories. Dr. Wheaton states that the song of the evening grosbeak is a miserable failure. In Vol. I. of the Bulletin will be found a note on the song, and the complete osteology of the species, by Prof. C. L. Herrick, with plates.—W. G. TIGHT, *Denison University, Granville, O.*

Note on the Seventh Cervical Vertebra of the Cat.—While preparing a skeleton of a young cat, I was interested to note that the diapophyses of the seventh cervical vertebra were perforated for the passage of the vertebral artery and vein. Flower (Osteology of the Mammalia, p. 38) states that "the transverse process" (of the Carnivora) "has no inferior lamella, and its base is imperforate." Wilder, however (Anatomical Technology, p. 172), says that in the cat the last cervical vertebra is rarely perforated.—JOHN I. NORTHROP.

Zoological News.—Protozoa.—J. Künstler (*Comptes Renders*, 1888) has found a protozoan parasite resembling *Lophomonas blattarum* in the posterior part of the intestine of Limulus. In the same place he describes other entozoic protozoa from various hexapods.

Dr. Plate's observations on the luminosity of Noctiluca (*Ann. and Mag. Nat. Hist.*, 1889) are interesting. When specimens were placed on moist blotting-paper, and examined under a high power, he found that the character of the light varied. At times it consisted of sharp flashes followed by total darkness, or by a faint light for a minute or two. Again, the surface might be faintly luminous while at the same time small points sparkled brightly, or, lastly, the whole surface was luminous on account of such sparkling points. The light is produced by the outer layer of plasma, and is stimulated by irritation. Pure oxygen passed over the specimens produced a dull light visible for several minutes. In nitrogen no light is produced.

The most noticeable of Gruber's new species of Protozoa (*Bericht Naturfor. Gesellschaft Freiburg*, 1888) is a new Protomyxa, which differs from Haeckel's oft-quoted species, *P. aurantiaca*, in being colorless. Staining with picrocarmine brought out the fact that nuclear substance (chromatin) was actually present as small granules scattered through the protoplasm. The bearings of this upon the validity of the Monera is at once evident.

Crustacea.—Rev. A. M. Norman presents some notes on British Amphipods in the *Annals and Magazine of Natural History* for June. A new genus, *Megaluropus*, is described, and the synonymy of several species of *Œdiceridæ* is straightened out. In August he continues with notes on Leucothoidæ, Pardaliscidæ, and Gammaridæ. The American *Gammarus ornatus* is shown to be the same as *G. locusta*, while there are notes on three other species which range to American seas.

Arthropoda.—Mr. Arthur Dendy reports (*Nature*, Feb. 14, 1889) the discovery of a new species of Peripatus in Victoria, Australia.

Albert D. Michael describes (*Jour. Roy. Micros. Soc.*, Feb., 1889) the anatomy of the mite *Uropoda krameri*. The paper is not one admitting of abstract. The general features of the species are Gamasid, but as in its shape it approaches the Bropodidæ, so it does in its structure.

Hexapoda.—According to the *Jour. Roy. Micros. Soc.* for December, Dr. D. Casagrande claims that in the silk-worm (in which he traced the metamorphosis of the alimentary canal from the larval to the adult stage) "the epithelium of the œsophagus and of the hind gut of the perfect insect is derived from the mid gut; in such a case the œsophageal and hind gut epithelium in the adult insect cannot be regarded as ectodermic in origin, as they are in the larva, but must be entodermic, arising as they do from the mid gut." The writer has recently shown (Am. Nat., XXII., p. 471, 1888, and more fully in a paper soon to be issued) that in Crangon the alimentary tract proper is wholly of ectodermal origin. Now no one has yet published any complete account of the development of the digestive tract in the Hexapods, but there is much reason for suspecting that in this group a similar condition of affairs exists. The observations of Dr. Casagrande are strongly confirmatory of this view, which, if it be true, relieves us from the necessity of replacing organs derived from one germ layer by cells derived from another.—J. S. Kingsley.

Vertebrata.—T. H. Morgan concludes (*J. H. U. Circ.*, No. 70) that in *Amblystoma punctatum* part of the blastopore is converted into the neurentric canal, and part persists as the anus, while in *Rana halecina* the blastopore completely closes.

The South American bat (*Noctilio leporinus*) is stated to eat fish. Specimens have recently been studied in which fish-scales were found in the stomach.

Mr. P. L. Sclater sends to *Nature*, No. 1012, the substance of a suggestion made by Mr. W. Rodier, of New South Wales, for the extermination of rabbits, which has at least the elements of plausibility. It is to catch as many of the rabbits as possible by means of traps, ferrets, etc., and to destroy only the does taken, setting the males free. "The results of this mode of operation are that the male rabbits, as soon as they begin to predominate in numbers, persecute the females with their attentions, and prevent them from breeding. They also kill the young rabbits that happen to be born, and where they largely predominate in numbers, worry the remaining does to death." Mr. Rodier states that on his station an eight months' trial has resulted in clearing the country of the pests.

Fishes.—Jenkins and Evermann describe (Proc. U. S. Nat. Mus., 1888) eighteen new species of fishes from Guaymas, on the Gulf of California. Hermosilla is a new genus of the family Sparidæ, and Pseuddoblennius of the family Blenniidæ. Clevelandia is reduced to synonymy as was done some time ago in this Journal.

Dr. R. W. Shufeldt (*Jour. Morphology*, II., pt. 2) has given some details of the osteology of an unique specimen of the fish *Grammicolepis brachiusculus* Poey. The account is too detailed for abstract, but with Professor Poey, Dr. Shufeldt thinks the relationships of the Grammolepidæ tend mostly in the direction of the Casangidæ.

Birds.—Mr. F. E. Beddard concludes (*Proc. Zoöl. Soc.*, London), from a study of the muscular system of Polyboroidei, that this genus is not even an aberrant type of Falconidæ, and does not deserve even sub-family rank.

EMBRYOLOGY.

A Physiological Hypothesis of Heredity and Variation.—The extravagant claims made by Prof. Weismann, the author of the doctrine of the *isolation of the germ-plasma*, and of the doctrine of *heredity* based upon it, as well as the strenuousness with which it is insisted that there is no other way in which the facts of inheritance may be coördinated, requires that a re-examination be made of the grounds upon which those claims are supposed to rest. This is all the more necessary, in that this author and his followers repudiate the evidence upon which the claim is made that acquired characters, taken in the widest Lamarckian sense, can be transmitted. During a period extending over fifteen years the present writer has devoted himself to a study of the genesis of adaptations, and with the lapse of time the conviction has grown only the clearer that these authors are laboring under a delusion. The way in which they have placed themselves upon record shows that they have not reckoned with the consequences of their reckless speculations.

In the first place, the supposition of a germ-plasma distinct from the plasma of the parent-body is a needless interjection into the machinery of hypothesis of biological evolution. It does not make the matter one whit clearer to suppose that the germ-plasma is necessary, than to suppose that *all of the living plasma of any and every distinct species is an idioplasm, or is specific in so far as that species is concerned.* If we now suppose, as a consequence of the action of the principle of physiological division of labor, first propounded by H. Milne-Edwards, that *all the plasma, or the whole of the specific protoplasm or idioplasm of the organism, becomes physiologically differentiated and incapable of undergoing embryonic development, except that of the germ-cells or germinal plasma*, as long ago urged by Professor Huxley, we get the same result as that reached by Weismann without involving ourselves in the consequences which beset his hypothesis. *This germinal matter is the only functionless and idle plasma in the parent body*, capable of growing and consequently of multiplying its cellular units within the parental organism at the expense of the surplus metabolism of the latter as a whole. Moreover, the germinal cells are alone capable of detaching themselves, or being detached, from the parental organism as products of over-nutrition, which have become useless to the life of the parent, as assumed in my preliminary paper "On the origin and meaning of sex." This recognizes the apparent fact of the setting aside or isolation of the germ-plasma, but does not make that fact the cause of the stability of species through the continuity of processes of growth, and the assumed but not empirically demonstrated isolation of such germ-plasma. My interpretation is in absolute accord with the requirements of the principles of modern physiology, while the hypothesis of Weismann and his followers is in conflict with those principles, and ultimately, as a necessary consequence, with the still more comprehensive principle of the conservation of energy. Modern physiology, as well as the doctrine of the conservation of energy, positively forbids us to interpose any barrier between the plasma of the parent-body and that of the germ-cells, as is done by the promulgators of the hypothesis of the continuity and isolation of the germ-plasma. To do so robs us of the possibility of appealing to the agency of the workings of metabolism as the efficient causes of the modification of the germinal matter. Since metabolism, and all that it implies, is the only agent to which, according to modern physiology, we can appeal, without interjecting gemmules, plastidules, pangens or some other accessory and needless agency into living organisms, as the efficient agents in the transmission of hereditary traits, we are restricted in our choice to metabolism alone. In this way only is it possible to get rid of a *deus ex machina* in the form of an idioplasm in the sense first implied by Nägeli, or of the gemmules of Darwin and Brooks, the plastidules of Haeckel, the pangens of De Vries, or the physiological units of H. Spencer.

The preceding paragraph contains, in essence, my own hypothesis according to which all the facts of hereditary transmission and variation may be coördinated without losing or rendering unavailable the advantages which may be derived from the supposition that acquired characters may be transmitted.

On my view metabolism itself becomes the means of transmitting the changes in the adult organism, due to the complex interaction between it and its surroundings to the idle, functionless and passive germ-cells, because it is a demonstrable fact that these are the only cells in a multicellular organism which have no work to perform which is of direct benefit to the individual life of that organism, unless it may be to take up the surplus nutriment not used up by the metabolism of the parent-body in the secular exhibition of the sum total of its physiological energies, in the struggle for existence.

On my view the idioplasmic or specific molecular character of the plasma of the germ-cells, in common with that of the protoplasm of the whole body (which latter always tends to repair injuries, or even, in lower forms, replace lost parts), tends, in virtue of its acquired specific traits, to repeat the organization of its parent type, in the course of its development, not because it is something different from the protoplasm of the cells of the rest of the body, but because it is wholly unspecialized and without physiological differentiation, as first urged by Prof. Huxley and subsequently maintained by H. Spencer. Molecular impressions experienced in the course of variations in the modes of manifestation of or disturbances of the balance of the metabolism of the parent-body are supposed upon this view to be transmitted as molecular tendencies to the idle or passive plasma of the germ-cells. Variations in the molecular constitution and tendencies of the germinal matter are supposed to thus arise at different times in the same parent, and that, consequently, successive germs may be thus differently impressed. In this way also the molecular tendencies of the plasma of the germ-cells of different individuals may be also modified simultaneously or successively through the effect of enforced changes in the metabolism of multitudes of contemporaneons adult individuals of the same species, thus leading to a tendency toward concurrent or simultaneous variation of offspring in the same or a similar direction.

It will be seen that this is the only hypothesis which renders the possibility of concurrent or simultaneous variation within the limits of a species either conceivable or intelligible. It also lends itself to an intelligible comprehension of the phenomena of the correlation of the growth of parts, and it is also the only view which holds out any promise of coördination with the highly ingenious and suggestive hypotheses of Prof. Wilhelm Roux.[1]

It will be at once perceived that my hypothesis of the acquisition of variations and their transmission is the simplest that has yet been offered. It interjects nothing hypothetical into our conception of the physical substratum of living organisms, except the necessarily unknown and unknowable constitution of the molecular factors of metabolism, already assumed by all scientific physiologists, all of whose conceptions of living processes are based upon the theory of metabolism, and thus brought into harmony with the all-inclusive doctrine of the conservation of energy. Growth and development without accompanying metabolism is simply unthinkable. All of the tendencies, capabilities and manifestations of growth in all living organisms are coëxtensive with and the concomitants of metabolism. From this conclusion there is no possible means of escape. To imagine the existence in living bodies of a hypothetical entity for the sole and express purpose of superintending and ordering the sequence and modes of action of the processes of development is, to the mind of one who is imbued with the true scientific spirit, no better than an appeal to "vitality" to explain the sequence and nature of the phenomena of life. Such methods in biological science ought to have received their quietus from Huxley's suggestive and witty comparison of the "vitality" of an organism with the "horologity" of a clock.

That a certain habit of metabolism is inheritable is sufficiently attested by the notorious transmissibility of the tendency to obesity in the human race, since illustrations will immediately occur to almost every one of families in which the tendency is known to be hereditary. Similarly there is scarcely a possibility of doubt that the greatly increased fertility of domesticated races of animals and plants is almost exclusively due to a gradually increased power of appropriating nutriment due to a change in the molecular habit or mode of metabolism of the plasma of the body under better conditions of nourishment

[1] Der Kampf der Theile im Organismus. 8vo., pp. VII., 244, Leipzig, 1881.

which has been slowly augmented and fixed by inheritance.[2] Even certain species of fishes, when well fed and kept in confinement, not only spawn several times during a season, instead of only once, as I am informed by Dr. W. H. Wahl, but also when kept from hibernating, as he suggests, tend to vary in the most astounding manner. The wonderful results of Dr. Wahl, attained in the comparatively short period of six years, show what may be done in intensifying the monstrous variations of Japanese gold-fishes, through selection, confinement in tanks and aquaria, with comparatively limited room for swimming, plenty of food, etc., all of which conditions tend to favor growth and metabolism, and the expenditure of energy under such wholly new and restricted conditions as to render it almost certain, as he thinks, that these factors have something to do with the development of the enormous and abnormally lengthened pectoral, ventral, dorsal, double anal and caudal fins of his stock. Some of the races of these fishes have obviously been affected in appearance by abundant feeding, as is attested by their short, almost globular bodies, protuberant abdomens, and greedy habits, as I have observed in watching examples of this short-bodied race living in Dr. Wahl's aquaria. In these last instances we are brought face to face with modifications occurring in fishes under domestication which are infinitely in excess, morphologically speaking, of anything known amongst any other domesticated animals. That the abundant feeding and exposure to a uniform temperature during the whole year, and confinement in comparatively restricted quarters, has had something to do with the genesis of these variations, through an influence thus extended upon the metabolism affecting the growth of certain parts of the body, which have tended to become hereditary, there can scarcely be any doubt.[3]

That such changed conditions would also favor variability to a high degree we cannot doubt. That, moreover, the passive or idle plasma

[2] The only possible explanation of the phenomenon of the after-effect of the first impregnation of the viviparous female mammal upon all subsequent offspring by the male parent of such first offspring can be explained only upon the supposition that this singular effect is produced, as supposed by Sir W. Turner, through a permanent disturbance of the metabolic habit of the maternal organism by that offspring during the first uterine gestation.

[3] Since the foregoing was written, I have been able, through the helpful generosity of my friends, Mr. W. P. Seal and Dr. Wahl, who have supplied me with fresh material, to verify my suspicion that the muscular system of the highly modified races of Japanese gold-fishes is relatively much less well developed than in the usual and unmodified type found in open rivers. From careful dissections and measurements the evidence is conclusive that the muscular system has undergone marked degeneration and enfeeblement in the extremely modified domestic races, probably owing to disuse.

of the germ-cells would be thus impressed by changes in the manner of exhibition of the metabolism of the bodies of the parent fishes there can scarcely be any question.

In fact, if it is borne in mind that the extremely unspecialized and functionless condition of the germinal plasma is in itself favorable to variation through its impressibility by imperceptible changes in external conditions, we should almost cease to wonder at the variability of multicellular animals, which, as is well known, is always intensified under the influence of domestication.

It may not be generally known that abundant food and inappreciable variations of the conditions of life exert a most astonishing influence upon the size, form, rate of multiplication, and tendency toward conjugation in ciliated infusoria. The individuals differ in size by many times the bulk of the smallest condition of the same species, and there are equally great and unaccountable differences in form arising from unknown causes, as I learn by keeping the same colonies under prolonged observation, and no less than two very distinct and highly characteristic modes of fission may occur in the same species, whether free or attached in habit. So great are these differences that I am convinced that individuals of one and the same species have been regarded in some instances as distinct species by different observers who have not observed the same form under a great variety of conditions.

In an earlier essay,[4] giving synoptically the results of an extended study of the subject of sex, I assumed that the egg, or oösperm, was inherently more capable of variation in its early stages of development than during the later larval or adolescent period. This is what should have been expected if my hypothesis of the nature of heredity and the causes of variation is true, no less than upon the ground of the known want of morphological specialization characterizing all the germs of multicellular organisms. If we seek for facts in support of this view, we have them in abundance in the extreme sensitiveness of the ova of many metazoa to outward influences of the most trivial character. I may cite in illustration the well-known experiments of Weber in producing monstrosities from the recently fertilized eggs of the pike by simply shaking them somewhat roughly. To the same effect speaks the fact, well-known to fish-culturists, that the eggs of Salmonidæ immediately after fertilization must be handled with extreme care, some experienced persons declaring that it is even dangerous to disturb them in any way for the first few days, lest the

[4] Origin and Meaning of Sex. AMER. NATURALIST, pp. 501-508, Vol. XXIII., 1889.

greater part develop as double and variously deformed monsters. Such monstrous and worthless broods of larval salmon, which were doubtless the result of careless or ignorant treatment of the ova, I have myself seen. The same or similar facts are known to intelligent breeders of domesticated birds and fowls. And to this evidence it may be added that such monstrosities occur during development amongst invertebrates in a state of nature, as I have repeatedly observed in the case of the American lobster. The liability to deformities so produced is also known to diminish as development advances, thus firmly establishing, on the basis of fact, the view for which I contend. This also supports my conclusion, previously noted elsewhere, that the divergence of species must be studied from the stand-point that the tendency toward variation and divergence is most pronounced in the egg, and not in the adult, and in response to adaptive requirements to which the adult organism cannot so directly respond. This view further involves the conclusion that widely distinct forms, perhaps even phyla, have been directly evolved from the morula and planula stages as consequences of the greater capacity for direct adaptation possessed by germs in these stages, and that the earlier phases of segmentation are consequently far more significant than the later and more highly modified larval stages, all of which must be regarded as more or less directly adaptive, as a study of their structures and metamorphoses in relation to their surroundings renders self-evident, since many of them possess features which cannot be shown to have ever been of the least use to any conceivable ancestral form of the adult, as, for example, the placenta, amnion, and allantois, which are striking illustrations of this truth.

The father of modern transformism, Lamarck, was also one of the first to appreciate the significance of that foundation principle of modern physiology, which was named metabolism by Theodore Schwann. The further consequences of the differentiation of metabolic processes, *pari passu* with morphological differentiation were traced and elaborated as we have already seen by two great masters in biology, namely H. Milne-Edwards and Huxley, and it has been sought to show that a further consideration of the capabilities of metabolism indicates that it may become the foundation of an intelligible hypothesis of heredity, which takes as its logically necessary basis the assumption that there is no scientific warrant for the belief in the isolation of the germinal matter of living bodies in such wise that it is out of the range of the influence of the effects of the physiological activity of the whole parent organism. This must be so on the ground of the universality of the occurrence of metabolism, even during the maturation or or growth of germs in the parent body, the contrary opinion being in conflict with fact.

The Lamarckian philosophy of transformism therefore offers the foregoing hypothesis of heredity as a substitute for the preposterous one of the isolation of germ-plasma, which, as here shown, is in the most obvious conflict with the principle of the conservation of energy. An isolated germ-plasma is as undemonstrable as the presence of bow-legged goblins in the moon. The primary postulate of that hypothesis is suicidal. There is no middle course to be taken. Biologists who commit themselves to an acceptance of the biological vagaries of Weismann array themselves against the modern rigorously scientific tendency to examine the problems of biology from the standpoint of the physicist.

In that the doctrine of the isolation of the germ-plasma is in irreconcilable conflict with the great cardinal principle upon which the whole fabric of modern physiological science rears its stately proportions, namely, with the general theory of metabolism, and, consequently, with the still more imposing and universal principle of the conservation of energy, we therefore realize what a colossal fabric of speculative rubbish must be consigned to the limbo of untenable and forgotten hypotheses in what is represented by the misguided labors af the advocates of the existence of an unalterable germ-plasma.—John A. Ryder.

PHYSIOLOGY.

An Experimental Investigation of Strychnine Poisoning.—It is a known fact that certain organs extract certain substances from the blood. The kidney, for instance, takes up urea; the motor nerves have an elective affinity for curare, the nervous system for lead, etc. As regards any drug which particularly affects any organ, the question may arise whether the organ is affected because of a special attraction for the drug or because of a special susceptibility to its action. For example, does strychnine affect the spinal cord because the latter stores up a relatively larger quantity of it than other organs, or is the spinal cord more susceptible to its influence than is muscle, or liver, for instance? In order to throw light upon this subject, Dr. Lovett[1] has

[1] *Journal of Physiology*, Vol. IX., p. 99.

studied experimentally in the Harvard Physiological Laboratory the action of strychnine upon frogs.

A quantitative table was first constructed showing the time that various amounts of strychnine require to produce convulsions in frogs of known weight. A certain amount of a solution of strychnine sulphate was then injected into a frog, and after a stated time various organs, spinal cord, muscle, liver, brain, blood, etc., were removed and rubbed up with water to a fluid consistency. Given quantities of each of these were then injected into separate frogs, and from the time of the appearance of the convulsions, by comparison with the quantitative table, the relative amounts of the drug absorbed by the various organs of the first frog were calculated. The results go to show that the spinal cord takes up relatively more strychnine than any other organ. In the case of one frog—a typical one—the relative amounts of the drug in one gram of several organs were as follows: spinal cord, 1.52 mgr.; liver, .325 mgr.; muscle, .377 mgr. On comparing the relative amounts in the blood and cord it was found that after small doses the cord contained more than the blood, while the reverse obtained with large doses. This relation seems to be constant. From these experiments the question of the affinity of the spinal cord for strychnine seems to be answered most clearly. The susceptibility of its protoplasm to the drug is left undecided.—L. GOFF.

The Muscle Current.—Dr. R. Nicolaides, of the University of Athens, gives[1] the results of some observations with the capillary electrometer to determine the duration and law of disappearance of the muscle current. He finds that in the excised gracilis or sartorius of the frog the current falls away at first quickly, then more slowly, and very gradually disappears. The whole duration naturally varies, but is considerable, *e.g.*, 380 minutes (gracilis). The longitudinal section currents are very weak, and of shorter duration than those between longitudinal and transverse sections. His results show that the muscle current runs a course parallel to that of the muscle irritability, lasting as long as it lasts, and disappearing according to the same law as it disappears.—L. GOFF.

Effect of Atropin on the Chorda Tympani.—The two kinds of secretory fibres distinguished by Heidenhain in gland nerves have for some time enjoyed an undisputed right to existence. It has been recognized that there are "secretory" fibres, controlling the secretion of water and salts, and "trophic" fibres, controlling the elaboration

[1] Du Bois Reymond's *Archiv.*, 1889, p. 73.

of organic matter. It has, moreover, been suggested by Langley[1] that we must assume a third kind of fibre, which he calls "anabolic," to account for the formation of fresh substance in the gland cells. More recently, however, Langley[2] has studied the effect of atropin on the chorda tympani, and has obtained results which throw doubt on his own and Heidenhain's views. These results he sums up as follows:—"The various changes caused in the gland cells by nerve stimulation are all affected by atropin, and to approximately equal extents. When paralysis of the chorda occurs, it is a paralysis of the whole of its function with regard to the gland cells. In other words the phenomena of atropin poisoning give us indication of the existence of more than one kind of secretory nerve fibre in the chorda tympani." It should be observed that this last sentence puts the case too strongly. Langley's experiments indicate that the trophic and anabolic fibres may in some cases be paralyzed more completely than the secretory, though the degree of difference is slight; and the existence of the three kinds of fibres cannot yet be regarded as absolutely disproved.

Bayliss and Bradford,[3] who have worked on the electrical phenomena of the submaxillary gland, assert that stimulation of the secretory fibres causes the hilus of the gland to become positive to the outer surface, and stimulation of the trophic fibres makes the outer surface positive to the hilus. Since the first current is abolished by atropin sooner than the second, the presumption is that the secretory fibres are paralyzed sooner than the trophic. Langley, however, thinks that the two currents are due to the preponderance of, first, *physical*, and second, *chemical* changes in the gland cells, and that therefore the electrical phenomena are not incompatible with his results.—MARY A. JOHNSON.

Secretion of Salts in Saliva.—The power of choice exercised by a gland in the selection of substances offered it by the blood is little understood. Novi[4] brings forward facts that bear in a general way upon this point in studying the chlorine (*i.e.*, NaCl) contents of the submaxillary saliva of the dog. He finds this to vary with two factors, viz.: the rate of secretion, and the amount of NaCl present in the blood. If the latter remain the same, increasing the rate of secre-

[1] *Journal of Physiology*, Vol. VI. p. 88.

[2] *Journal of Physiology*, Vol. IX., p. 55.

[3] *Proc. Roy. Soc.*, Vol. XL., p. 203, 1886.

[4] Du Bois Reymond's *Archiv.*, 1888, p. 403.

tion increases the percentage of Cl in the saliva, which confirms the results of Heidenhain and of Werther. Again, if the rate of secretion remain unchanged, increasing the quantity of NaCl in the blood, as by injection of a ten per cent. NaCl solution into the jugular vein, increases the Cl contents of the saliva. The Cl increase in the saliva is here more rapid than that of the blood. If both factors vary simultaneously, the results vary; but it seems that a moderate change in the NaCl contents of the blood can overcome a considerable change in the rate of secretion. The percentage of NaCl in the saliva reached as high as .627, but never equaled that of the blood.

Langley and Fletcher in a paper presented to the Royal Society, and not yet printed,[1] while in general confirming the results of Novi, make a study of numerous other influences affecting the secretion of salts, such as dyspnœa, clamping the carotid, bleeding, pilocarpine, atropin, lithium citrate, potassium iodide and potassium ferrocyanide. "The general result of these experiments is to show that the secretion of water, of salts, and of organic substances are differently affected by different conditions, and that the percentage composition of saliva is determined by the strength of the stimulus, by the character of the blood, and by the amount of blood supplied to the gland. All, or nearly all, the arguments which have been adduced to prove that the secretion of organic substance is governed by special nerve-fibres, have their counterparts with regard to the secretion of salts, so that we might imagine at least three kinds of secretory fibres to be present. The experiments, on the whole, indicate that this complicated arrangement does not exist, but that the stimulation of a single kind of nerve-fibre produces varying effects according to the varying conditions of the gland cells."

[1] See abstract in *Proceedings of Royal Society*, Vol. XLV., No. 273, p. 16.

ANTHROPOLOGY AND ETHNOLOGY.

The Discovery of the Pool of Bethesda, Jerusalem.—Until a comparatively recent date the large reservoir known as Birket Israel, immediately beneath the north wall of the Temple Enclosure (Mosque of Omar), and a few paces inside of St. Stephen's Gate, has been accepted generally as the Pool of Bethesda. This, for a long period, has not been supplied with water, unless during the "rainy season," when a small pool may occasionally collect at the bottom. Also, it is fast being filled with rubbish by the Turkish authorities, and will soon disappear from sight. There were many discrepancies connected with the place, however, which forbade the more critical from being satisfied that it was the correct site.

Meanwhile, the discoveries in the ruins adjoining and northwest of the old Crusader Church of St. Ann, which stands a short distance to the northward of the Birket Israel, have gradually established the fact that the true site of the Bethesda is not the Birket Israel, but is beneath the ruins which, for centuries buried in rubbish, are still partly built over by the comparatively modern houses of the Moslems; for this is in the Mohammedan quarter of Jerusalem. Some few years ago, excavations brought to light a crypt beneath the remains of an old church or chapel constituting a principal part of the ruins; and beneath this, again, a large cistern-like chamber cut in the rock and decked over with solid masonry. In this reservoir water collected during the periodical rains, and many considered the evidence already sufficient to prove it the Bethesda.

Subsequent explorations have revealed the remains of two tiers of five-arched porches, the upper tïer in the crypt, the lower in the pool. And the intelligent labors of the Algerine Monks, who are in charge of the property, have been further rewarded recently by the recovery of another pool, to the westward of that first discovered, containing a good supply of water; the entire agreeing with the descriptions of the Bethesda as given by the Fathers of the Church and Christian pilgrims and writers as early as the fourth century.

The correspondence of the five-arched porches to those mentioned in the gospel of St. John (v., 2.) will not escape notice. The remains of the upper porches extend above the pool at right angles from the north wall of the crypt beneath the church, in which the apse, at the east end, though dilapidated, is still distinctly defined.

The rubbish which has been removed contained a number of interesting antiquities, including Jewish and Roman coins, and fragments of carved marble; while lower down were found pieces of ancient pottery and glass, the latter partly decayed and iridescent, together with broken icons, images or idols, in *terra cotta*, one being the upper portion (from the head to the waist) of a figure of Ashtaroth, the goddess of that serene people, the Zidonians. This was in the red burnt clay similar to that of the Moabite idols.

The work of excavating being continued, on clearing away the *débris* that choked the fifth arch or porch westward of the apse, in the crypt beneath the church already mentioned, the remains of a painting or fresco were revealed upon the plaster of the wall in the rear. This discovery was made just before Easter, or about April 18, 1889. The fresco represents an angel, as if descending into and troubling the water, which latter is depicted by conventional, zigzag, and wavy lines of an olive-green shaded with black, more suggestive of Egyptian hieroglyphics than of modern art, and surrounding the figure on every side. The right hand of the angel was shown as uplifted; but this has been carefully destroyed, probably by the Moslems (after their manner) in the early days of their power. So also the face of the angel, which has been battered so as to be completely obliterated. The glory or nimbus above the head, painted an orange-yellow, still remains, but little injured. The edge of the pool appears to be indicated by a broad red line enclosing the painting, and having an occasional rectangular projection into the water, perhaps representing steps, or the piers for the porches. On the east side of this fifth barreled arch (the wall extending at right angles) are the remains of another figure, also in fresco, much defaced, and supposed to represent the Saviour. Above the head, evidently intentionally mutilated, is a portion of the nimbus, and, in the lower outer corner of the painting, part of a blue robe.

It is to be regretted that these frescoes, the colors of which were quite bright when first uncovered, have since greatly faded, so that the blue is now a dull ashy gray. The reds and yellows, though lowered in tone, preserve their hues somewhat better, however.

To recapitulate: It will be perceived from my brief account that the remains described consist of four tiers of structure. First, the Turkish houses built upon the rubbish covering the ruins; next, the small church with apse; beneath this, the crypt with five porches, containing the frescoes; and fourth and last, underneath all, the pool itself, cut in the solid rock, and with five arches of well-preserved masonry. This last, from the historical and other evidence, I have not the slightest doubt is the *Piscina Probatica*—the veritable Pool of Bethesda.—HENRY GILLMAN, *Jerusalem, Palestine, April 24, '89.*

MICROSCOPY.[1]

Certain Improvements in Born's Method of Reconstructing Objects from Serial Sections.—The original method of Dr. Born was treated with considerable detail in Vol. XVIII., 1884, of the NATURALIST; since which time several improvements have been effected, descriptions of which have appeared from time to time. We take the following from a recent number of the *Zeitsch. für Wiss. Mikr.*, Vol. V., 1888.

The block of paraffine holding the carefully imbedded object should be cut into as perfect a prison as possible, the use of special instruments for this process being recommended. It is further advised that one of the faces at right angles to the plane of the knife should be marked in such a way as to leave no question as to its identity when the sections are cut. This marking may be brought about by the use of scoring, the lines being filled with coloring matter, and then covered in the ordinary way by dipping in warm paraffine.

The sections should have a thickness of about 1-50 mm., and the paraffine should be so prepared that it will not crush or crack before the edge of the knife.

The finally mounted sections are placed under the microscope, and by means of a camera the outlines are drawn to scale on separate pieces of paper. The thickness of each section and the amount of increase in size of the camera drawing over the original being known, it is a simple matter to determine the desired relative thickness of the wax that is to be applied to the paper bearing the drawing.

The improved method of applying the wax is as follows:

A lithographer's stone having been brushed over with turpentine, the paper is evenly spread upon it, and a strip of metal of the desired thickness is placed along each side. Wax is now poured over the paper, and, by means of an iron roller, is pressed into a layer of equal thickness with parallel strips of metal, which at the same time support the roller and limit the spread of the wax. The thicknesses recommended for the plates are 0.4, 0.6, 0.8, 0.9, 1, 1.12, 1.5, 1.8 and 2. mm. Combinations of these will give a sufficient range of thicknesses to correspond with all ordinary sections.

After the plates have all been made the careful work of removing the surplus wax should be undertaken, the drawing on the attached paper directing the work. Finally the enlarged sections are stuck together in their proper order, the model resulting.

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

Kastschenko's Apparatus.[1]—Apparatuses planned to assist in processes of plastic reconstruction have been devised by Dr. N. Kastschenko, which may be profitably used in preparing the paraffine block for ordinary ribbon cutting.

The original apparatus had for its object to pare down the sides of a paraffine block in such a way that some geometrical pattern might surround the object. This pattern or "definition line" was intended to facilitate the reproduction of the object in a magnified model from sections made.

From the author's point of view, of course it is important that the definition or boundary surfaces (which in a section of the object are seen as definition or boundary lines) should be perfectly parallel, or at any rate have a fixed and determined position. The apparatus which he advocates is intended to effect this. The two models were constructed for the Thomas-Jung and for the Spengel-Becker microtomes. They are shown in Figs. 1 and 2, their natural size. (Plate III.)

In Fig. 1 is shown the cutter or parer as constructed for the Thomas-Jung object-holder. It may, however, be fitted to any microtome with a cylindrical object-holder. Its construction is extremely simple. It consists of a stout ring *b*, the internal diameter of which is exactly equal to that of the object-holder. The ring is immovably united to the piece *a*, which in its turn is exactly like the paraffine cylinder which fits into the object-holder. In the ring is seen the binding screw *c*. The paraffine-holder *d*, which fits inside the ring, may be either solid or hollow.

The holes in *d* and *a* are for the purpose of turning round the apparatus. While the object is being pared down the part *a* is fixed firmly in the object-holder, and when the block has had its definition-surfaces thus prepared, it is removed from the cutter and fixed on the object-holder in such a way that it is cut in a direction perpendicular to the surfaces.

The second model (Fig. 2), represents an apparatus intended to be used in any ordinary object-holder, and is of such dimensions that movement in any direction when it is fixed in the clamp is possible. This "parer" fits into the apparatus *e*, which consists of two blocks of wood loosely united by short metal wires. The wooden holder of course fits into the clamp while the block is being shaved down. When the boundary surfaces have been satisfactorily adjusted to the paraffine block, the latter is removed from the "cutter" or parer, and inserted into the wooden holder wherein it is sectioned.

[1] From an abstract in the Journal of the Royal Mic. Society, February, 1889.

ENTOMOLOGY.[1]

Rectal Glands in Coleoptera.—While studying the histology of *Passalus coenutus* Fab., recently, I found in the alimentary canal, between the colon and rectum, a structure which I consider homologous with the similarly located rectal glands of other groups of insects.

The colon has six longitudinal rows of diverticula, each diverticulum being in depth about one-third of the diameter of the colon. It consists of a somewhat spiny chitinous layer. Next is the lumen, external to which is a layer of cubical epithelial cells. Next is a layer of circular muscle fibus, and, alternating with the six rows of diverticula, six bands of longitudinal muscle fibres.

The rectum has a lining of smooth chitin resting on an epithetial layer, the cells of which are slightly more calumnar than those of the colon or of the intervening structure. Then come scattered circular muscles and six bundles of longitudinal fibres.

The anterior end of the structure uniting the colon and rectum forms the posterior wall of the last diverticulum of each row. Rising towards the lumen proper, from the bottom of this diverticulum, the wall soon bends posteriorly, forming a sort of side pocket, then returns and completes the posterior side of the diverticulum. The wall now passes backward for a distance about equal to that of three diverticula, then turns outward and slightly forward forming a small groove around the tube. It then bends back, narrowing the diameter of the lumen and making this rather conical, then gradually widens and becomes modified to form the rectum.

The anterior of these two parts of the structure I shall term the cushion, and the posterior portion, the cone. In cross-section the cushion is seen to consist of six longitudinal ridges, each ridge continuing the line of a row of the diverticula of the colon. The chitin in the last of these is smooth, but when it bends and forms the inner face of the cushion it becomes thickly set with short blunt spines, which point backwards. There are no spines in the groove between the cushion and the cone, but they begin at the posterior edge of the groove, and continue from this point to the rectum.

In both cushion and cone the underlying epithelium is cubical and contains prominent nuclei. It shows no traces of a glandular function.

The muscles are greatly developed. At the anterior end of the cushion they pass from one side of a ridge to the other, and between

[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.

the ridges the six longitudinal bands are continued from the colon. Passing back the muscles become oblique, and external to the groove they are entirely longitudinal. In the cone they are oblique, then circular, and near the rectum a few oblique ones again appear. External to the muscles is scattered connective tissue. Tracheas and nerve fibres enter and ramify in the structure.

The ridges which compose the cushion are quite marked an teriorly and have a central median groove. Posteriorly the ridges are less marked, the median grooves becoming as deep as those separating the ridges.

Both from its histology and its position I regard this structure as a true rectal gland. Its function, however, I believe to be that of a valve. Minot (Histology of the Locust) says that Chun's decision as to their function is only "a speculative opinion." In favor of their being valves we find the following facts:

1. They are the best developed, and the most alike in insects which feed on solid and quite innutritious food. In those forms with more concentrated or liquid food they vary greatly and may even be wanting.

2. Their structure is to be best explained by the assumption of a valvalar function. This explains the thick spiny chitinous lining and the remarkable development of the muscles.

3. Their location is explained by this assumption, for a valve at this point would serve to retain the food in the absorptive portions of the digestive track till all nutriment was extracted; then the combined action of the spines and of peristaltis of the muscles would pass the remainder on.

The rectal glands therefore would retain their primitive valvular function in those insects which have retained their primitive food habits. In the more highly differentiated forms, with concentrated food they become modified, serving other purposes or are rudimentary.—H. T. FERNALD.

EXPLANATION OF FIGURES, PLATES IV. AND V.

FIG. 1. Longitudinal section of the rectal gland of Passalus, x 50 (about). *C.* colon, *R.* rectum, *ch.* chitin layer, *cir. m.* circular muscle fibres, *cone* cone, *c. t.* connective tissue, *cush.* cushion, *ep.* epithelium, *l. m.* longitudinal muscle fibres, *tr.* trachea.

FIG. 2. Cross section along line *A B* of Fig. 1 x 90.

FIG. 3. Cross section along line *C D* of Fig. 1 x 90.

FIG. 4. Cross section along line *E F* of Fig. 1 x 90.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Meeting of Station Botanists.—The Association of American Agricultural Colleges and Experiment Stations held its last annual meeting on November 12–16, at Washington, D.C. Several of the botanists connected with the experiment stations were present and held separate meetings. During the convention some advantageous changes were made, one of which was the division of the Association into at least five committees as follows: Agriculture, Botany, Chemistry, Entomology, and Horticulture. The college presidents and station directors will probably also form its committees as they may see fit. The chemists have held separate meetings for years under the title of Official Chemists; the entomologists organized last summer at the Toronto meeting of the A. A. A. S., and the station horticulturists held a convention at Columbus last summer. Before the Washington meeting the botanists were not fully organized, but were prepared to pass upon a constitution, when the division of the Association into sections was made, thus providing for the special meetings so much desired by the station workers, but up to this time unrecognized by the controlling spirits of the Association.

Several of the station botanists while at the Toronto meeting of the A. A. A. S. found time to get together and talk over matters that most concerned them in their work. Dr. Beal was made chairman, and among other things the Washington meeting was planned for. The Secretary communicated with a large number of economic botanists, and had the time been more favorable there would have been a large attendance. Some of the wheel horses were much missed upon this account. However, as it was, some good meetings were held, but the best of all, the botanists are now organized, committees have been appointed, and it remains very largely with the workers themselves whether the succeeding meetings are successful.

Dr. Geo. Vasey, chairman for the first two sessions, presented a valuable report of the growth of Botanical Division of the Department of Agriculture. This branch of the public service has accumulated a vast amount of material that now offers unequaled facilities for the best kind of botanical work. Dr. Vasey expressed the hope that station botanists would avail themselves of the assistance the Botanical Division can render them. At the same time the several botanists can reciprocate in some measure by contributing collections and facts of observation not otherwise in easy reach of the division. At the close of a lengthy and interesting discussion of this paper a committee was formed, which drafted the following resolution: The Station Botanists desire to express their hearty appreciation of the generous support afforded the Botanical Division of the Department of Agriculture, as is evidenced by the printing of the various bulletins of the Division, and the public ation of a Journal devoted to the special interests of Botanists, and in view of the unequaled facilities afforded by the large amount of botanical material accumulated in the Division available for the preparation of much needed monographs on important or difficult groups of plants, wish to urge upon the attention of the Secretary the desirability of prosecuting this special work, and its early publication, both in the interest of botanical science and for the direct assistance of station botanists.

A paper from Dr. W. J. Beal upon "The Province of the Botanist in the Experiment Station," was read by the Secretary. It was shown that many subjects fall quite naturally to two or more of a station staff. For example, cross-fertilization may be done by the horticutural agriculturist or botanist, but a knowledge of botany is needed in any case. Grass experiments are in one sense agricultural, but a botanist is needed to determine the species. It is without doubt the work of the botanist to both determine the nature of a fungus disease and experiment with remedies.

During a discussion upon the amount of teaching to be done by the station botanist, a paper by Dr. C. E. Bessey was read, showing that it was important for the station and college to hold close to each other. The advantages were mutual, for advanced students could at the same time do experimental work and learn how to conduct investigations. It was the prevailing sense of the meeting that only a few advanced students should be taught by the station botanist, and all large classes instructed by a college professor.

A paper was presented by Professor McCarthy upon Seed-testing, in which it was advocated that some uniform method should be adopted. To this end a committee was appointed to report at the next annual meeting of the Association. The last evening of the Convention, after organizing as a committee or section under the new order of things with Prof. S. M. Tracy as Chairman, was spent in individual reports of work done. Among others, Professors Galloway, Chester, Saunders, Thaxter, and Arthur thus reported. It is proposed to obtain similar information from all the station botanists in the country, and embody it in a bulletin for assistance in coöperative work, and a committee was appointed to prepare such a pamphlet, which it is hoped to issue through the office of experiment stations.—BYRON D. HALSTED, Secretary.

The Seventh Congress of the American Ornithologists' Union.—The seventh annual Congress of the American Ornithologists' Union convened at the American Museum of Natural History, on November 12th, and for the first time in the Union's history it was found necessary to extend the usual three-days session to four days, the Congress adjourning November 15th, to meet in Washington on the third Tuesday of November, 1890.

Each succeeding meeting of the Union has shown increased attendance, and the present was no exception, twenty active and thirty-two associate members being present. The active members who attended are as follows:

Dr. J. A. Allen, of the American Museum of Natural History; Charles F. Batchelder, of Cambridge, Mass.; William Brewster, of the Museum of Comparative Zoölogy; Frank M. Chapman, of the American Museum of Natural History; Charles B. Cary, of the Boston Society of Natural History; Dr. Elliot Coues, of Washington, D. C.; William Dutcher, Jonathan Dwight, Jr., L. S. Foster, all of New York City; Col. N. S. Goss, of Topeka, Kans.; Dr. George Bird Grinnell, George N. Lawrence, both of New York City; Dr. Edgar C. Mearns, U. S. A., of Fort Snelling, Minn.; Dr. C. Hart Merriam, of the Department of Agriculture; Dr. James C. Merrill, U. S. A.; Robert Ridgway, of the Smithsonian Institution; John H. Sage, of Portland, Conn.; George B. Sennett, of New York City; Dr. R. W. Shufeldt, U. S. A., Washington, D. C.; Gordon Trumbull, of Hartford, Conn. Among the attending associate members were: Egbert Bogg, of Utica, N. Y.; Dr. Louis B. Bishop, of New Haven, Conn.; W. A. Conklin, of the Central Park Menagerie, New York City; P. L. Jany, of the Smithsonian Institution; Robert B. Lawrence, of New York City; Leverett M. Loomis, of Chester, S. C.; Mrs. Olive Thorne Miller, of Brooklyn; T. S. Palmer, of Berkeley, Cal.; C. B. Riker, of South Orange, N. J.; Dr. W. C. Rives, of Newport, R. I.; Wendell Prime, of New York City; Witmer E. Stone, of Philadelphia; Dr. Spencer Trotter, of Swarthmore, Pa.; Ernest E. Thompson, of Toronto, Can., and Dr. Louis A. Zerega, of New York City,

The first day's session was devoted entirely to the transaction of business, including election of officers and members. Several amendments to the constitution were presented to be considered at the next annual meeting ; the most important relates to increasing the active membership. The present constitution admits only fifty members to this class, but since the formation of the union the study of ornithology has received such an impetus, and so many new and worthy candidates for honors have appeared on the field, that the originally restricted number of fifty necessarily excludes many earnest workers who are deserving of higher recognition than admission to associate membership implies.

The officers of the preceding year were re-elected, but Dr. Merriam, much to the regret of the Union, firmly declined his re-election as Secretary, a post he has filled since the organization of the Union, and Mr. J. H. Sage was unanimously elected to this office. There were eight applicants for the single vacancy in the active member list ; the fortunate candidate being Dr. Arthur P. Chadbourne, of Cambridge, Mass.

Four Corresponding and eighty Associate members were added to the roll of the Union, which contains now nearly five hundred names.

The remaining three days of the session were almost entirely devoted to a consideration of the large number of papers presented to the Union, the titles of which are appended. Many of these papers will appear in the official organ of the Union, *The Link*, and it is not necessary to further allude to them here. Special attention, however, is directed to Dr. Allen's timely paper on the "Extent to which it is Profitable to recognize Geographical Variation among North American Bird," wherein the writer makes some most pregnant remarks on the present tendency of ornithologists to describe insufficiently differentiated forms ; and to Dr. Merriam's remarks on the "San Francisco Mountain and Vicinity (Arizona) from the Faunal Standpoint." This paper, based on Dr. Merriam's field work during the past season, marks an epoch in the study of faunal areas, and the methods of observation and tabulation employed present vast opportunities for further work by all intelligent field naturalists.

During the session the visiting members were daily entertained at lunch by the Linnæan Society of New York City, and this pleasant social feature was by no means the least enjoyable of what proved to be the most successful congress of the Union.

The following papers were read :

1. Observations on the Avifauna of Arizona, by Edgar A. Mearns, M.D. 2. The Winter Distribution of the Bobolink (*Dolichonyx oryzivorus*), with Remarks on its Routes of Migration, by Frank N. Chapman. 3. On the Changes of Plumage in the Bobolink, by Frank M. Chapman. 4. To what extent is it profitable to recognize Geographical Variation among North American Birds? by J. A. Allen. 5. Birds that have

struck the Bartholdi Statue of Liberty, Bedloe's Island, New York Harbor;—A History, by Jonathan Dwight, Jr. 6. On the Forms of the *Thryothorus ludovicianus* group of Wrens, by J. A. Allen. 7. On the Eastern Forms of *Geothlypis trichas*, by Frank M. Chapman. 8. Observations on some of the Summer Birds of the Alpine Portions of Pickens County, South Carolina, by Leverett M. Loomis. 9. Notes upon *Coccothraustes vespertinus* as a Cage-bird, by R. W. Shufeldt, M.D. 10. Remarks on Waterhouse's "Index Generum Avium," by J. A. Allen. 11. Remarks on Dr. Blanchard's Report to the Congrès International de Zoologie, on a Code of Nomenclature, presented at the Paris Session, 1889, by J. A. Allen. 12. On Peculiarities of Coloration in the Woodpeckers of the Genus *Dryobates* from the Northwest Coast, by Frank M. Chapman. 13. Note on *Cyanocitta stelleri littoralis* Maynard, by Frank M. Chapman. 14. On the Western Form of the Warbling Vireo, by Edgar A. Mearns, M.D. 15. On Seasonal and Individual Variation in certain Flycatchers of the Genus *Elaenea*, by J. A. Allen. 16. Remarks on San Francisco Mountain and vicinity (Arizona) from the Faunal standpoint, by Dr. C. Hart Merriam. 17. Abundance of the Wild Pigeon in Central and Eastern New York in 1835, by Prof. R. W. Whitfield. (By invitation.) 18. On the Maximiliar Type of S. A. Birds in the American Museum of Natural History, by J. A. Allen. 19. On the Birds of the Straits of Mackinae, by J. Dwight, Jr. 20. Note on the First Capture of the Little Brown Crane in New England, by Wm. Brewster. 21. Note on the Occurrence of the Canada Jay in Massachusetts, by William Brewster. 22. On the Habits of some Orange County, Florida, Birds, by B. Mortimer. 23. On the Mottled Duck in Kansas, by N. S. Goss. 24. *Phalænoptilus nuttalli nitidus*, is it a valid Race? by N. S. Goss.

Indiana Academy of Science.—The Fifth Annual Meeting of the Indiana Academy of Science was called to order Monday morning, December 30, 1889, at 10 o'clock, in the rooms of the State Board of Agriculture, at Indianapolis, by President John C. Brauner. After the appointment of the usual committees, and the transaction of business, the reading of papers was begun. The following papers were presented:

Description of a new species of *Rhinoptera* from the Gulf of California.—By title.—B. W. Evermann and O. P. Jenkins.

Fishes in the Yellowstone Park.—David S. Jordan.

Notes upon the Economic Phases of Entomology and Ornithology.—C. W. Hargitt.

Observations on the Destruction of Birds by Storms.—A. W. Butler.

In the afternoon 16 members were elected. The following papers were then presented:

The Breeding Habits and Larval Stages of *Amblystoma microstomum*.—O. P. Hay.

Aquatic Respiration of the Amblystomas.—O. P. Hay.

The Life-History of *Chorophilus triseriatus*.—O. P. Hay.

On Sulphophenylpropionic Acid.—Chase Palmer.

Soap Analysis.—John F. Schnaible.

The State of the Crater of Kilauea in August, 1889.—O. P. Jenkins.

The Moraines of the Maumee Glacier.—C. R. Dryer.

Probable Future of Petroleum in S. W. Indiana.—C. A. Waldo.

Observations on the Lakes of Indiana.—C. R. Dryer.

Some Unusual Forms of Lime Carbonate Deposition.—U. F. Glick.

The Top of the Matterhorn.—David S. Jordan.

Stone Characters of Nyssa.—John M. Coulter.

"Snake Cactus."—John M. Coulter.

The National Herbarium.—John M. Coulter.

Incandescent Gas Lighting.—W. DeM. Hopper.

In the evening President Branner delivered his presidential address upon the subject, "The Education of a Geologist." Following this was given a paper on the proposed meeting of the American Association for the Advancement of Science at Indianapolis,—Amos W. Butler,—which led to a general discussion of the requirements to make the forthcoming meeting of the American Association a success. Much interest was shown by all the members, and special efforts will be made to insure the second Indianapolis a very enjoyable one.

Tuesday morning, Dec. 31, the Academy convened at 9 o'clock. The treasurer filed his report, which was approved, after which 7 new members were elected. The following paper was read in general session: "The Effects of Trusts," by Jeremiah W. Jenks. Following this it was decided by the Academy, owing to the number of papers to be presented, to have the sessions in two sections, one devoted to Chemistry, Physics, and Mathematics, presided over by Vice-President Campbell; the other to Botany, Zoology, and Geology, presided over by Vice-President Hay. The following papers were presented before the former:

Dangers of the electric circuit.—John L. Campbell.

Apparatus for the determination of power consumption in friction and the cutting of metals.—Thos. Gray.

Thomson's portable magnetostatic electrical measuring instruments of long range.—Thos. Gray.

On the determination of the elasticity constants of materials by the deflection method.—Thos. Gray.

Preliminary report on the changes in density of wires on stretching. —Thos. Gray and C. Leo Mees.

The use of two mirrors for the determination of co-efficient of expansion in solids.—C. Leo Mees.

Cause of periodicity in thermometers, as discussed by Prof. M. A. Rogers.—C. Leo Mees.

Vapor densities of the volatiles metallic "Halids."—P. S. Baker.

The carbohydrates of the sweet potato.—W. E. Stone.

Oxidation by means of the fixed alkaline hydrates.—P. S. Baker.

Action of chloroform on aluminum chloride.—P. S. Baker.

Specific reactions for the penta-glucoses.—W. E. Stone.

The "Perkins Synthesis."—P. S. Baker.

Atomic weight of oxygen.—W. A. Noyes.

The height of the atmosphere.—W. J. Spillman.

Magnetic permeability of nickel at low temperatures.—A. P. Carman.

The uses of infinity and zero in algebra.—Rufus L. Green.

The potable water-supply of the City of New York.—A. E. Phillips.

Before the section over which Vice-President Hay presided the following papers were presented:

Explorations of the U. S. Fish Commission in Colorado and Utah.—David S. Jordan.

Explorations of the U. S. Fish Commission Steamer Albatross in the Pacific Ocean.—Charles H. Gilbert.

Explorations of the U. S. Fish Commission in Missouri.—Frank M. Drew and Louis Rettger.

Preliminary notes on the fishes of the Sandwich Islands.—O. P. Jenkins.

Some notes on Indiana reptiles and batrachians.—A. W. Butler.

Some rare batrachians.—W. S. Blatchley.

Fishes of Putnam county.—O. P. Jenkins.

Some habits of the crayfish.—C. W. Hargitt.

The occurrence of the badger in Indiana.—Amos W. Butler.

Notes on some fishes from the west coast of Africa, collected by Carl Stecklemann.—O. P. Jenkins.

On certain species of the genus *Chorophilus*.—O. P. Hay.

Some Indiana mildews.—M. A. Brannon.

Variations in plants from unripe seeds.—J. C. Arthur.

In the afternoon the following papers were read in this section:

The plants of Putnam county.—D. T. McDougal.

The Compositæ of Vigo county.—W. S. Blatchley.

Some structures in Epiphegus.—E. M. Fisher.

Mycorhiza and Epiphegus.—John M. Coulter.

Some remarkable floral variations.—C. W. Hargitt.

Some stem characters in Compositæ.—Harry D. Seaton.

The Academy then went into general session. The following subjects were presented:

Distribution of Cornus.—John M. Coulter.

On some plants new to the State list.—W. S. Blatchley.

Method of embedding and staining delicate vegetable tissues.—Douglas H. Campbell.

Germination of the macrospores of Isoetes.—Douglas H. Campbell.

Determination of lower plant forms.—Stanley Coulter.

Forest trees of Indiana.—Stanley Coulter.

Morphology of Siphonophores.—Louis Rettger.

Notes on Indiana butterflies.—Albert J. Woolman.

Investigations on relation between the intensity of stimulus and reaction-time.—W. J. Bryan.

The glacial geology of the Irondequoit region.—C. R. Duyer.

Remarks on the remains of a giant beaver found near Winchester, Indiana.—Joseph Moore.

Cremation.—Wm. B. Clarke.

Most of the papers were read in full, but few by abstract or title, and the discussions were good.

The total number of papers presented was 73.

The following officers were elected for the ensuing year.

President—T. C. Mendenhall.

Vice-Presidents—O. P. Hay, J. L. Campbell, J. C. Arthur.

Secretary—A. W. Butler.

Treasurer—O. P. Jenkins.

The next meeting of the Academy will be held at Greencastle, Ind., at some time in the spring to be determined by the Executive Board.

American Geological Society.—The following papers were read at the Toronto Meeting of the American Geological Society, on Thursday, August 29th, 1889:

J. D. Dana.—Areas of Continental Progress in North America, and the Influence of those Areas on the Work Carried on in Them.

"Progress" is the progress in rock-making; the "Areas" are those into which the continent is naturally divided as regards geological progress; and the "Work" is that of all the dynamical agencies concerned in the making of the beds in the rock series, including the biological agencies.—30 min.

G. K. Gilbert.—The Strength of the Earth's Crust.

It is believed by many students of dynamic geology that a district gradually loaded by sediment subsides, and that a district unloaded by degradation undergoes elevation, the process being quasi-hydrostatic. Certain observations in the basin of Great Salt Lake indicate that such results do not follow loading and unloading when the quantities involved are less than a certain amount.—30 min.

D. Honeyman.—Glacial Geology of Cape Breton.—20 min.

E. O. Hovey.—Observations on some of the Trap Ridges of the East Haven Region, Conn.

After a general description of the local geology, the author discusses the contact phenomena between the trap and the sandstone; the theories as to the age of the dikes; concludes that several of the ridges are intrusions, not extrusions.—30 min.

J. F. Kemp.—Trap Dikes near Kennebunkport, Me.

In this paper the local geology is described, the relations between the dikes and adjacent rocks are given, and the author discusses the microscopic structure and chemical composition of the rocks.—20 min.

P. Neff.—The Sylvania Sand in Cuyahoga Co., Ohio.

The writer discusses the value of this sandstone as a producer of oil and gas; from its distribution, and that of the Borea Grit, he concludes that an anticlinal reaching above water-line existed in Cuyahoga County prior to the Lower Carboniferous.—11 min.

J. W. Spencer.—I. Characteristics of Ancient Shores in the Region of the Great Lakes.—33 min.

II. High Continental Elevation Preceding the Pleistocene Period.

III. Origin of Boulder Pavements and Fringes.—12 min.

C. D. Walcott.—Study of a Line of Displacement in the Grand Canon of the Colorado, Arizona.

A description is given and attention called to a conclusion resultant upon the study of a line of displacement, in which the throw of a fault of pre-Cambrian age was partially reversed by a movement in the later Palæozoic, and again in the same line during Tertiary time.

H. S. Williams.—"The Cuboidos Fauna" and the Principles of Determining Equivalency in Separate Regions of the Globe.—20 min.

A. Winchell.—Pre-Silurian Rocks in North America.

This memoir will probably be postponed until the December meeting.

J. LeConte.—On the Origin of Normal Faults and of the Structure of the Basin Region.

SCIENTIFIC NEWS.

The Natural History Museum, Florence.—Florence, magnificently rich in works of art, is by no means poor in scientific collections, since among its public museums are included not only a splendid archæological one in the Via Colorura, well provided with Egyptian curiosities, and containing what is probably the most complete collection of Etruscan remains to be found in Italy or in the world, but also a Musia di Storia Naturale, attached to a school founded by Victor Emmanuele for instruction in the Natural Sciences.

The last-named museum is strongest in a point which is one of the weakest in all our American museums—in anatomical preparations in wax, representing the leading features in animal structure from the infusoria to man. In other respects this museum, though well arranged and tolerably complete, has no very salient features. The articulates have several small rooms, none too well lighted; the stuffed mammals are not very prominent; birds and their nests fill a large, well-lighted hall; fishes and reptiles occupy two halls and a gallery; but the interest for one accustomed to such collections commences with the osteological specimens, and culminates with the extensive series of preparations exhibiting the soft parts.

After leaving the purely osteological section, the visitor reaches that devoted to the lower animals—if it is now allowable for any man to declare that the human species, with all its long history of culture and inheritance of intelligence, is superior to creatures the highest of which resemble him in bone and muscle. Prominent among the animal preparations are exceedingly large scale models of the radulæ of various gastropods, models of Lumbricus, Hirudo, and other worms, showing the internal structure; magnified infusoria, with sections of the same; a very complete set of the anatomy of the torpedo, especially of the electric organs; sectional models of sharks and bony fishes; a set showing the anatomy of the common fowl, male and female, the growth of the egg in the ovary and uterus, and its develpment into a chick; the anatomy of the cat, male and female; and that of the sheep.

The most complete portion of the collection of models is, however, that relating to human anatomy. The osteology, the splanchology, the digestive, circulatory, respiratory, lymphatic and generative systems are here exhibited in the fullest manner possible without actual dissection; and every organ connected with each of these systems is treated to several models, representing it in various positions or in various states. The nervous system is, if possible, exemplified even more fully than the others. In each room complete figures, some erect, others recumbent, show the general appearance of the system of organs to which the room is devoted; while all around, in table cases, are placed a double series of models of the separate organs or parts. Thus around the hall devoted to the ligaments of the bones are grouped sections of the various articulations, while in the centre reposes a human figure with all articulations complete. Sections of the head at various levels, with vertical and partial sections, combined with others exposing portions of the face and neck, show the chief points of brain-structure, and the courses of the cranial nerves, including the various branches of the fifth, and Willis' accessory. Models of the arms, legs, back, pelvis, etc., show the limb and body muscles down to those of the various digits, the levator, ani, cremaster, etc. The muscles of jaws and face are shown in an extensive series of models. The general lymphatic system is exhibited by recumbent figures; the positions of the various viscera by several entire figures of both sexes, and many partial sections. The several senses are very thoroughly exemplified, as are many points of histological structure.

The entire museum, except one small private cabinet, is open free to both sexes and all ages every Tuesday, Thursday and Saturday, the authorities wisely judging that some knowledge of human structure is a proper and essential portion of the education of all young people. It is noticeable that young people, varying from mere children to twenty or twenty-five years of age, form the greater part of the visitors.—W. N. L.

Prizes to Biological Students.—From a desire to verify his own researches as to the causes of failing nutrition in aging organisms, the undersigned hereby offers three cash prizes of $175, $125 and $100 for the best three comparative demonstrations, by means of microscopical slides, of the blood capillaries in young and in aged tissues, canine or human.

By young tissues (canine) are meant tissues from animals between the ages of one and two years.

By aged tissues (canine) are meant tissues from animals not less than twelve years of age.

By young tissues (human) are meant tissues from subjects between the ages of ten and twenty years.

By aged tissues (human) are meant tissues from subjects not less than sixty-five years of age.

While a preference will be given to demonstrations from human tissues, it will be possible for work in canine tissues to take the first and, indeed, all of the prizes. But of two slides equally well done in all respects, one canine the other human, the latter will be given the preference. Canine tissues should be from large animals.

Twelve slides from young and twelve from aged tissues must be submitted by each competitor, together with a full description of the subjects, methods pursued, and every detail and circumstance which is likely to throw light upon, or account for any peculiarity. The slides are for comparison as to the condition of capillary circulation, the young with the old, and should be in numbered pairs, or groups from the same kind of tissuc. The term tissue is used in a general sense, e. g., pulmonary tissue, hepatic tissue, renal tissue, osseous tissue, muscular tissue, nerve tissue, alimentary tissue, etc.

No particular schedule of methods for injection, or staining, will be insisted upon, and no more definite directions or explanations will be given.

The slides, carefully packed and boxed, together with descriptive manuscript, can be sent by mail.

It is stipulated that the demonstrations which receive the prizes, shall become the property of the subscriber, for publication. All others will be returned, if desired.

No pseudonyms required. Accompany slides, in every case, with (real) name and address. Unless of known reputation as a biologist, a reference is respectfully solicited.

Reservation: no reward will be made unless work of at least ordinary merit is submitted.

This offer is made on the first day of January, 1890, and will remain open until the twentieth day of August, 1890.

Slides and manuscript will be examined and receipted for as soon as received.

The prizes will be adjudged on the first day of October, 1890.

These nominal prizes are offered less in expectation of results from the money as an agent, than in the hope that the offer may furnish a *point d'appui* for really needed work. Besides professional observers and students, there are in the United States a large number of amateur microscopists of acute vision and undoubted talent, who are at present playing with microscopes, as with toys, merely to see curious or pretty things. The time has come to concentrate observation upon the one proper object of biology, viz., the renovation and prolongation of human life. Address C. A. STEPHENS' LABORATORY,

Norway Lake, Maine.

The British Association for the Advancement of Science will meet at Newcastle-on-Tyne, September 11-19, 1889. Prof. Flower is the general president, and the sections will have the following chairmen: Geology, Prof. James Geikie; biology, Prof. J. S. Burdon-Sanderson; geography, Colonel de Winton; anthropology, Sir W. Turner.

It is proposed to hold a Botanical Congress in Paris in the second half of August. The secretary of the committee of organization is M. P. Maury, 84 Rue de Grenelle, Paris. Among the subjects to be made prominent in the Congress is the Geographical Distribution of Plants.

Prof. Kinkenberg, of Jena, died in March. He was well-known for his researches on the physiology of the invertebrata.

Dr. James Beard, who has paid special attention to the development of the fish-like vertebrates, is to be associated with the Scottish Fishing Board.

Mr. J. Reynolds Vaizey, a young English botanist, whose publications have been in the line of the morphology of mosses, died recently at Cambridge, England, from injuries received from falling into a fire while in an epileptic fit.

Flora, the well-known German botanical journal, will hereafter be published at Marburg, under the editorship of Prof. Karl Gœbel.

Mr. Arthur E. Shipley has been appointed teacher of comparative anatomy for medical purposes in the University of Cambridge.

Dr. Heinrich Ernst Karl von Dechen, the well-known geologist, died at Borm, Germany, February 15th, 1889, aged 89 years.

The Rev. John G. Wood, the popular English author on natural history, died at Coventry, England, March 3d, 1889, in his sixty-second year.

The address of B. F. Lowne, as president of the Queckett Microscopical Club, is given in the Journal of the Club for April. It deals with the history of the morphology of insects.

Wassili Mkolaewitsch Ulianin, the well-known embryologist and professor of comparative anatomy and embryology in Warsaw, died February 5th, 1889, in his forty-ninth year.

The Legislature of Georgia has recently re-established the Geological Survey of the State. Prof. J. W. Spencer, of the State University, has been duly appointed to take charge of the work. Two assistants are authorized, besides the chemist and other specialists. Georgia has not been as derelict in its survey as appears, for in the forties a survey was organized. Again from 1876 to 1879, the survey was in progress, but the results have never been published. So this is the third survey.

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REMARKS ON THE BRAIN OF THE SEALS.

BY E. C. SPITZKA.

ENGAGED for many years in collecting material for a monograph on the "Marine Mammalia," whose publication has been delayed by the obtaining of new specimens from unexpected sources, and partly by the desire to publish only well-matured and verified observations, I find myself compelled to anticipate my projected paper, in order to correct the manifest errors of the latest publications on this subject.

Dr. Fritz Theodor [1] makes the startling discovery that in the *Phoca* (*Calocephalus*) *vitulina* there is between the two cerebral hemispheres, dorsad of and separated by a gyral interval from the callosum, a second commissure, extending cephalo-caudad nearly as much as that great fiber-bridge. Such an observation would revolutionize all ideas hitherto accepted as to the signification and relations of the callosum, not to mention the peculiar position which such a profound deviation from the mammalian cerebral type would lead morphologists to assign the *Phocidæ*.

On examing Theodor's plate (x., Fig. 4) I find that his so-called "commissura suprema" is the saddest kind of a delusion. In making a medi-section of his seal's brain he sliced off a mesal gyrus, and, deceived by the cut surface, hastily assumed it to be a commissure. How carelessly this was done becomes evident

[1] Das Gehirn des Seehundes (*Phoca vitulina*: Dr. Fritz Theodor, Freiburg i. B., 1887. (The Brain of the Common Seal, by Dr. Frederick Theodor.)

on regarding his Figure 5 (Plate VIII.), where the cortical and gyral structure of the so-called commissure are apparent. Now, lest it might be assumed that he had a monstrosity[2] to deal with in a single specimen, we find that he had two, a younger and an older seal; and furthermore, his artist (Plate IX., Fig. 6) omits the so-called new commissure, furnishing a rather correct representation as I have found it in three brains of the same species.

From a thorough examination of the brains of two sea-lions (*Zalophus Gillespieii*) and three seals[3] (*Phoca vitulina*), I may state the following: The number and complexity of the gyri on the mesal face of the seal's and sea-lion's brain is as great as in the anthropoid brain, and in the frontal region rather more so. Where the falx does not intervene, the gyri are bound firmly together by the leptomeninges. Like all complexly convoluted brains, that of the seal shows considerable asymmetry. In transsection it can be readily seen, even in the sea-lion's brain, that the apices of the gyri of one side interdigitate with the gyri of the other, so that a strictly median section might shave off the former. If we add to this the presumable[4] distortion to which such a complex brain is necessarily exposed during its removal, the likelihood of such an occurrence becomes greatly increased.

If the intrinsic evidence of Theodor's paper, which is really self-condemnatory, did not suffice to show the fallacy of his claims of a *commissura suprema*, I would add the following:

1. In six phocidæ I have exposed the callosum from the mesal fissures, found it contrasting in its brilliant white with the deep gray, or rosy gray (according to age and species) of the cortical surface, as markedly as in man or the anthropoid apes.

2. I have found no other commissure dorsad of it, nor any

[2] Mesofusion of the gyri occurs in monstrosities with absent callosum and absent falx.

[3] A fourth seal was less perfectly studied, owing to the decomposition of part of the brain, although it also confirmed the gross points herein detailed. With the exception of that specimen, which I owed to the N. Y. Aquarium, and one purchased at a fishmonger's, all were obtained through the kindness of Dr. Conklin, Superintendent of the Central Park Menagerie, in a perfectly fresh condition, being removed from the animals within a few hours after their decease.

[4] We should hesitate to assume this if the very figures of Theodor did not positively prove manipulation to have far exceeded the allowable.

fusion of the mesal gyri, nor anything that could remotely suggest even a spurious commissure of the cerebrum.

3. I have made trans-sections of the seal's and sea-lion's brain (the latter being preserved and accessible), and found one, and but one, great[5] transverse commissure uniting the interior white substance of the two cerebral hemispheres of the phocidæ.

If his announcement, on so defective a basis, contradicted by the author's own artist, and positively controverted by careful observation, did not suffice to expose the fallacy of his revolutionizing[6] discovery, the collateral evidence involved in the exposure of the following errors would inculcate the need of caution in accepting the radical propositions with which his paper closes.

He states that the seal has no olives in the sense of the human olive. The seal is, however, noteworthy for the large size of the olivary protuberances. Theodor, in his wretched figure (Plate VIII., Fig. 2), represents the pyramidal columns of the oblongata as showing a roundish swelling laterad. It is to-day generally known to neuro-morphologists that the true pyramids are fascicular, that they can therefore exhibit no enlargement, followed by attenuation, except it be due to a spreading of the fibres, or the inclusion of some other body, such as a ganglion or a commissure. In the sea-lion the same enlargement is distinctly demarkated from the pyramid tract, although not much larger than in the bear. In the sea-lion, as in the bear and other land-carnivora, the hypoglossal nerve roots emerge laterad of the olivary eminence. In man and true apes they emerge mesad of the olive in the groove between the latter and pyramid.[7] In the true seals (*Phoca vitulina*) they emerge partly in the latter situation, and partly from the olivary eminence itself, thus show-

[5] I need not add that I found the pre-commissure developed, and though small, disproportionately to the atrophic olfactory lobes.

[6] It is but doing justice to the author to state that he seems to have been entirely unaware of the bearing of this alleged discovery.

[7] Trans-sections of the oblongata show a tendency of the hypoglossal nerve roots in man to break through the olive proper, but on the ectal face they are collected in a com mon fascicle.

ing a sort of transitional state. Tiedemann,[8] sixty-eight years ago, in a plate which for accuracy puts those of Theodor to the blush, represents the hypoglossal nerve taking the origin I have ascribed to it, omitting, however, the most cephalic rootlets, which are indeed very frail. Since Theodor cites Tiedemann, it is remarkable that he could have borne the latter's excellent plates in mind, and in conflict with the real facts designated the first cervical as the hypoglossal pair (Plate VIII., Fig. 2).[9] In removing the membrane it is very difficult to avoid tearing off the hypoglossal nerve roots, and it is doubtless due to this fact, and his erroneous naming of the first spinal as the last cranial nerve, that Theodor's non-recognition of the olive is due.

Although the older writers, particularly Tiedemann, have carefully delineated and described lobules of the cerebellum, and especially its vermiform lobe, Theodor in one sentence states that the seal has no *vermis cerebelli* in the sense in which a *vermis* is spoken of in the human cerebellum, and in another proceeds to describe it to be an exceedingly complicated body. Much dependence cannot be placed on his dissections and figures. I have never been able to remove a phocidan cerebellum intact without sacrificing the skull; for the lobulus appendicularis, measuring fully half an inch cephalo-caudal, as much transversely, and one-quarter of an inch dorso-ventral, is almost entirely embedded in bone, and connected with the main cerebellum through a small foramen by a pedicle not exceeding a line in diameter. Theodor has failed to preserve this morphologically important structure, and even to discover his failure to do so, although the most superficial acquaintance with the dog's or cat's brain should have directed his attention to it, particularly in view of his sweeping conclusions as to the phylogeny of the marine

[8] *Icones cerebri simiarum et quorundum mammalium rariorum*, Heidelbergia, MDCCCXXI., Plate II., Figs. 7 and 8. It is to be remarked that Tiedemann attributes olives (*olivæ vix conspicuas*) to the seal, but locates the figure reference laterad of these bodies. The trapeziums he correctly recognizes.

[9] While Tiedemann accurately exhibits the decided caudal direction of the cervical nerves from their origin, which is in remarkable contrast with that of the transversely running hypoglossal, Theodor tilts his nerve roots in the opposite direction. In every respect his figures are far behind Tiedemann's as to accuracy and interpretation.

and terrestrial carnivora.[10] These are expressed as follows: "The seals and (ordinary) carnivora are in their cerebral organization to-day widely separated, and their common origin must be sought in a remote geological period." [Pp. 90–91.]

Now the fact is that an examination of a series of brains beginning with the mink, the fresh-water and salt-water otter, and passing through the eared to the earless seals, would show about as beautiful a transition as a morphologist could well desire. It is misleading to establish a type in a specialized form. The Canidæ and Felidæ are as specialized in this way as the Phocidæ; the Viverridæ, particularly the Ursidæ are more typical carnivores. And on examining a bear's brain, Theodor would have found the same peculiarity of the Island of Reil he found in the seal, excepting the feature due to the peculiar vertical course of the Sylvian fissure in the latter.

Anticipating the more complete monographic publication now in preparation, and which it is intended to illustrate by photographs and other reproductions of both external and internal details, I would summarize the characteristic features of the seal's brain as follows: (1) It is a typical carnivore brain in every essential feature. Morphologically it does not present a single deviation from the type. All differences are due to the relative preponderance of some and relative atrophy[11] of other parts. Thus the olfactory lobe is reduced to such an extent that in some individual common seals the tract is deeply imbedded in the

[10] It seems almost comical that this author, convicted of gross inaccuracies both in his methods, observations and interpretations, should venture upon one criticism of the far more accurate and venerable Tiedemann, in which the former is precisely wrong. He states that the diameter of the Trigemius nerve is exaggerated by him as well as by Gratiolet. It so happens that my measurements in three individuals equal those of the latter, and slightly exceed those of the latter observer.

[11] In brain morphology one must distinguish between physiological peculiarities and intrinsic zoological features. Thus the atrophy in some and absence in other cetaceans of the olfactory bulb is a physiological atrophy; whereas the absence of the epiphysis cerebri would be a profound zoological anomaly. The greater or lesser size of the pyramid tract is in direct physiological parallelism with the voluntary innervation of extremities endowed with prehensile movement, and their absence, presence or development has not such profound significance as has the gyral *type* of the hemispheres, the cerebellum and the olives. It would be possible, therefore, to offer a classification of the higher mammalia based on the *type* of olivary or cerebellar coruscations; whereas the degree of pyramid development would be a less important determining factor.

sulcus, and even invisible in a part of its course, unless the sulcus be opened. In harmony with this the hippocampal lobule is relatively reduced, and remarkably flat. The auditory nerve is enormous, and with this the therewith connected trapezium, lemmiscus lateralis, posterior pair of the corpora quadrigemina and internal geniculate bodies are overgrown. There is a microscopically visible fluted tract on the caudal aspect of the thalamus running ectad from the latter bodies to the auditory cortical field of the hemisphere. It is the enormous hypertrophy of this field which crowds the Sylvian into its unusual vertical, nay, actually anticlinal, position.[12]

One of the most interesting proofs of the value of neuro-morphology in classification is offered by a comparison of the brains and spinal cords of the Cetacea,[13] Sirenia,[14] and Phocidæ. The phocidan brain is, as above stated, a physiologically aberrant, but morphologically genuine carnivore brain. The manatee has the brain of a hippopotamus. The Cetacea, in accordance with their to-day isolated position, have the most aberrant central nervous system of all, but to no other brain do they approach so nearly as to that of the Proboscidia, a group which, with the possible inclusion of other extinct and recent related forms, approaches more nearly the common ancestral trunk from which so widely divergent branches have sprung.[15] Zoological characters

[12] In reality the position of this fissure is dependent on two factors: the lower, corresponding to the cephalic part of the human, has sunk ventro-caudal through the retrogression of the sphenoidal lobe, and the upper (posterior part of the human) has been driven dorso-cephalal by the overgrown auditory cortical field. The same general impression can be conveyed by tilting the tempero-occipital lobe of a putty model of a bear's brain into a foreshortened skull model. Thus the frontal lobe will come to resemble the square and compact contour of the seal's brain. That such a mechanical process has been undergone by the latter is demonstrated by the evident violence to which the olfactory tracts and lobes have been subjected. In no other carnivores are the bulbs so far cephalad and the tracts bodily driven into the depths of the *sulcus rectus.*

[13] A decayed Beluga's brain, and a Phocæna from the N. Y. Aquarium, two beautiful ones of *Tursiops tursio* and one of *Delphinus delphis*, through Mr. Eugene Blackford, of this city. To Professor Wm. F. True, of the Smithsonian, I am indebted for aid in determining the species.

[14] The brain axis and cord of Professor Wilder's specimen, loaned by him.

[15] In stating this I am not misled by the superficial characters, such as the richness in gyri, or in fact any quantitative features. I am determined by the *type* of gyral development, the type of cerebellar foliation, and the character of the olive, which is of the

are more numerous, constant, and of classifying value in a complex organ such as the brain than in the spinal cord.[16] Yet even in this comparatively simple organ specific differences of structure are found, and accordingly the most atypical form is represented in the Cetacea. The ventral horn of gray matter is immensely overgrown, and the dorsal correspondingly atrophic; there is an enormous lateral horn present. On first sight this would appear to be an entirely novel structure, peculiar to the Cetacea; further examination shows that it is homologous with, though an overgrown representative of, a cell-group present in other mammals, which owes its prominence and peculiar position to the following factors: (1) The shrinkage of the neck of the dorsal cornu acts on the extreme ventral and lateral parts of the ventral horn as would the passing of an elastic band around a group of matches, spreading their ends apart; (2) the absence of the pyramid tract in the dorsal part of the lateral column causes an encroachment of the ventral part of the lateral column; (3) the dorsal (posterior) white columns are relatively reduced. To convert a human cord into a porpoise's there must be imagined a shrinkage of the posterior or dorsal white and gray matter, as well as the posterior or dorsal part of the lateral column, in other words, of the entire part of the cord which would lie behind a transverse line which in man leaves nearly as much in front (ventrad of) the central canal as behind (dorsad of) it. This line in the Cetacea would be a curve, and in accordance therewith the outline of the cord in the latter is not nearly circular or a rounded quadrangle as in man, but heart-shaped, the apex being represented by the shrunken posterior or dorsal segment, the bifurcate base by the overgrown halves of the ventral or anterior segment.[17] Although this remarkable deviation is in

compact, massive kind, in contradistinction to the slender lamina type characteristic of rodents, carnivores, apes and man, and whose higher development leads to crenulation. The increase of olivary ganglionic matter in the elephant and porpoise is by aggregation in bulk without crenulation; yet the latter presents true Ungulate features.

[16] The spinal cord of the gorilla in the dorsal region (Waldeyer) shows characters not found in the human cord, a fact long known to me, though not published, from the case of the chimpanzee.

[17] Guldberg has partly observed this, but many years subsequently to my published observations, with which he seems to have been unacquainted.

part due to physiological reasons, yet it is in so far a zoological one as the whole "physiognomy" of the dorsal segment of the cord in the Cetacea is more like that of the Ungulata than the Carnivora. A section of the spinal cord at the level of the foramen magnum has, in every genus, something distinctive, in every family something quantitatively different from other families, in every order something qualitatively and radically distinguishing it from nearly related orders. While, as already stated, such differences have not the profound morphological meaning which certain cerebral features possess, yet it is not from attaching any over-importance to the field to which I have devoted most of my dilettante studies that I venture to prophesy that when the minute and coarse anatomy of the nerve axis be once thoroughly known for each species it will be possible to offer a more correct classification of the Mammalia than any now extant, or any other based on a single criterion. It would not be difficult to enunciate many valuable data for classification furnished by a study of the nerve centres in Sauropsida and Ichthyopsida. Many peculiarities of the appendages of the brain among the former, such as the cartilaginous epencephalic hood of the Chelydra, and the cartilaginous rod attaching the oblongata to the basi-occipital bone in Thalassochelys, require and will repay further study. It is in view of the importance of registering only correct observations that I offer this provisional correction of such revolutionary pseudo-discoveries as those above criticised.

PLATE III.

Fig. 1

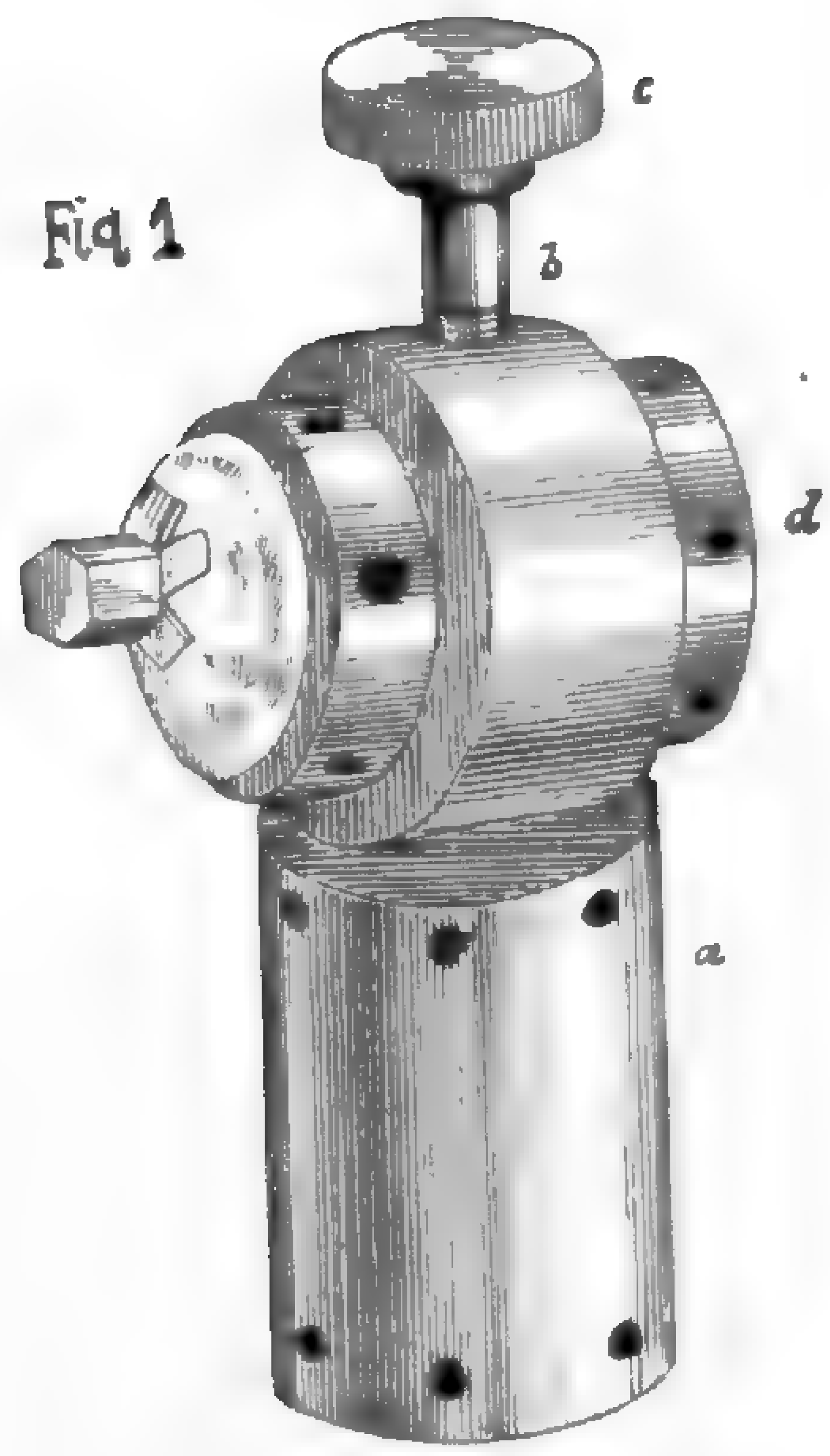


Fig. 2

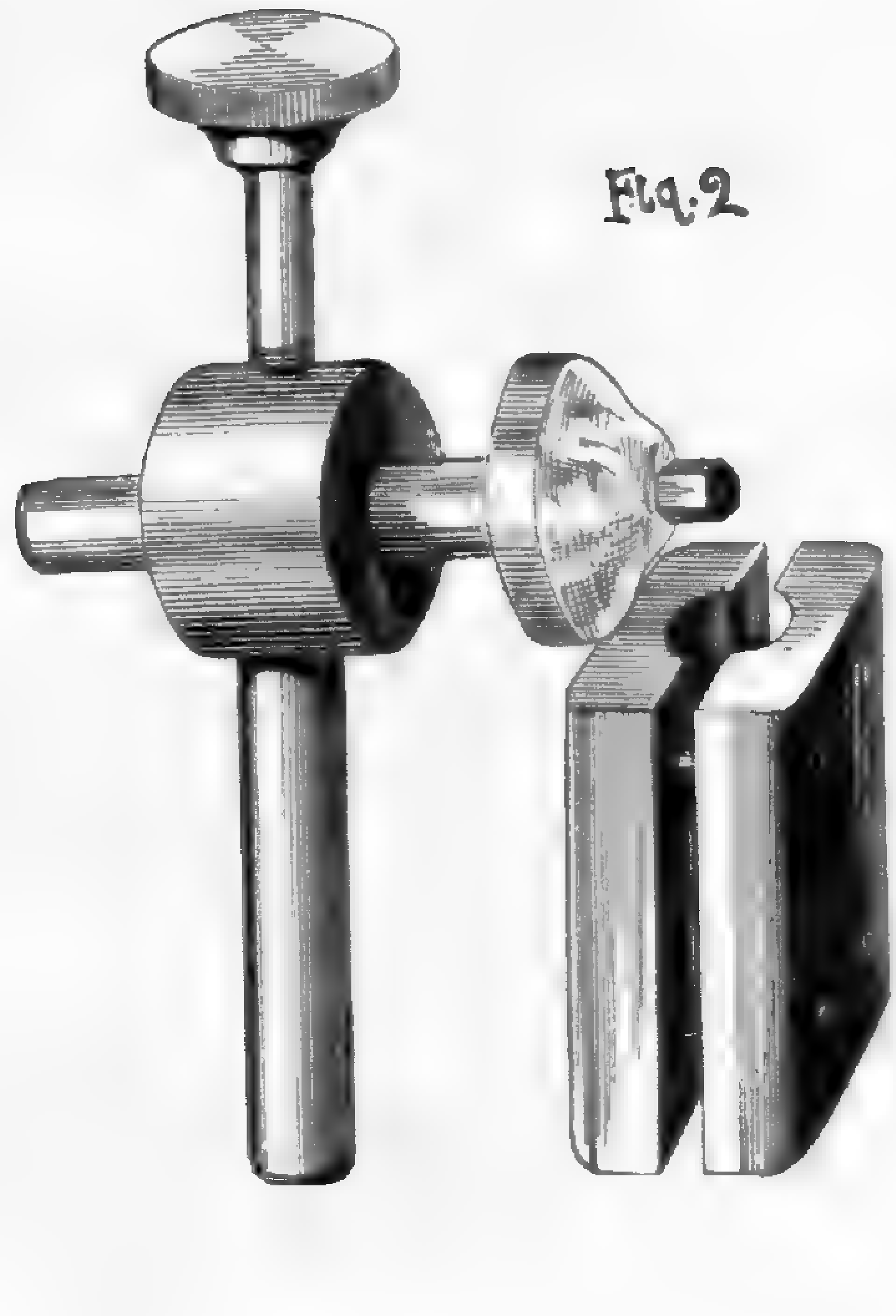


PLATE IV.

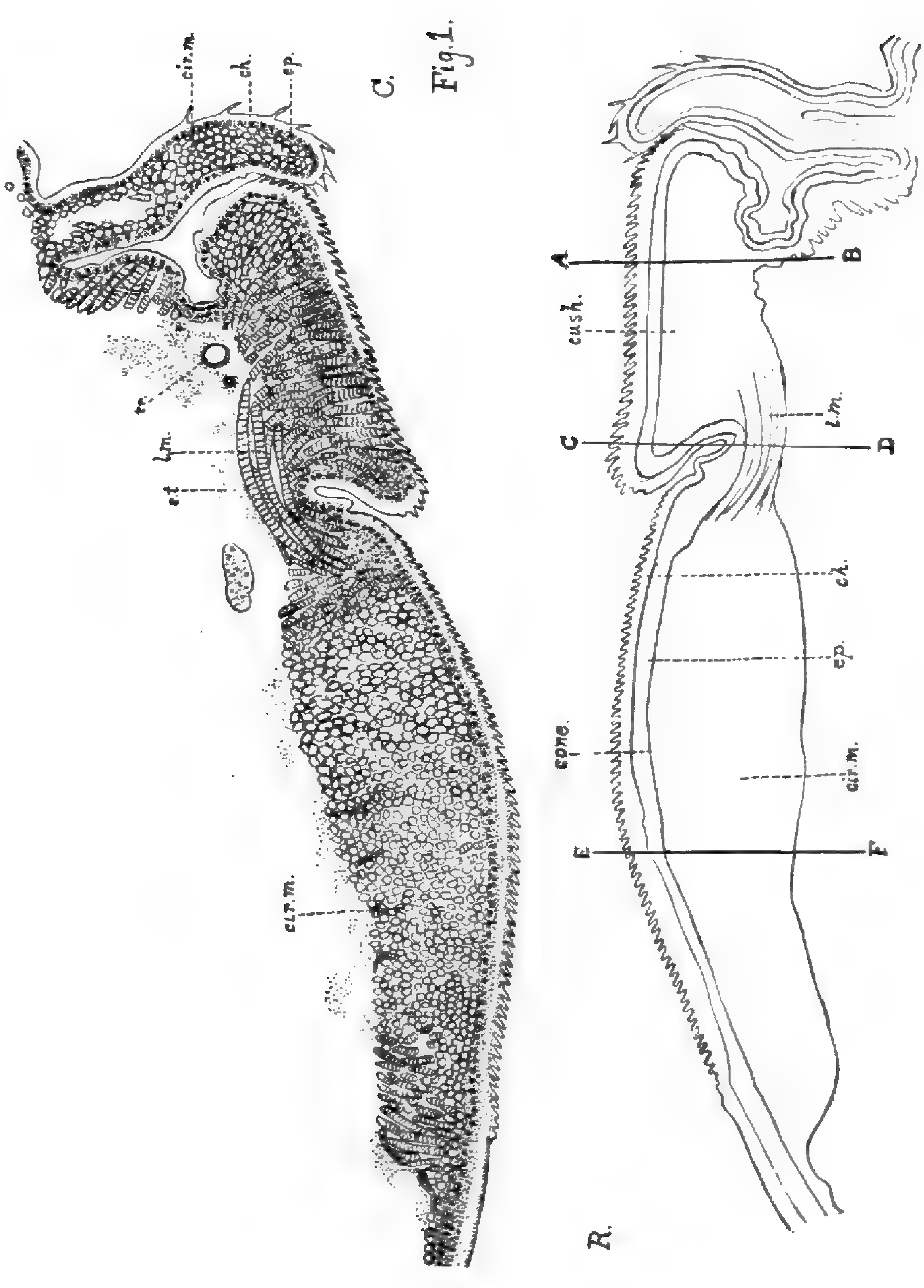


PLATE V.

Fig 2.

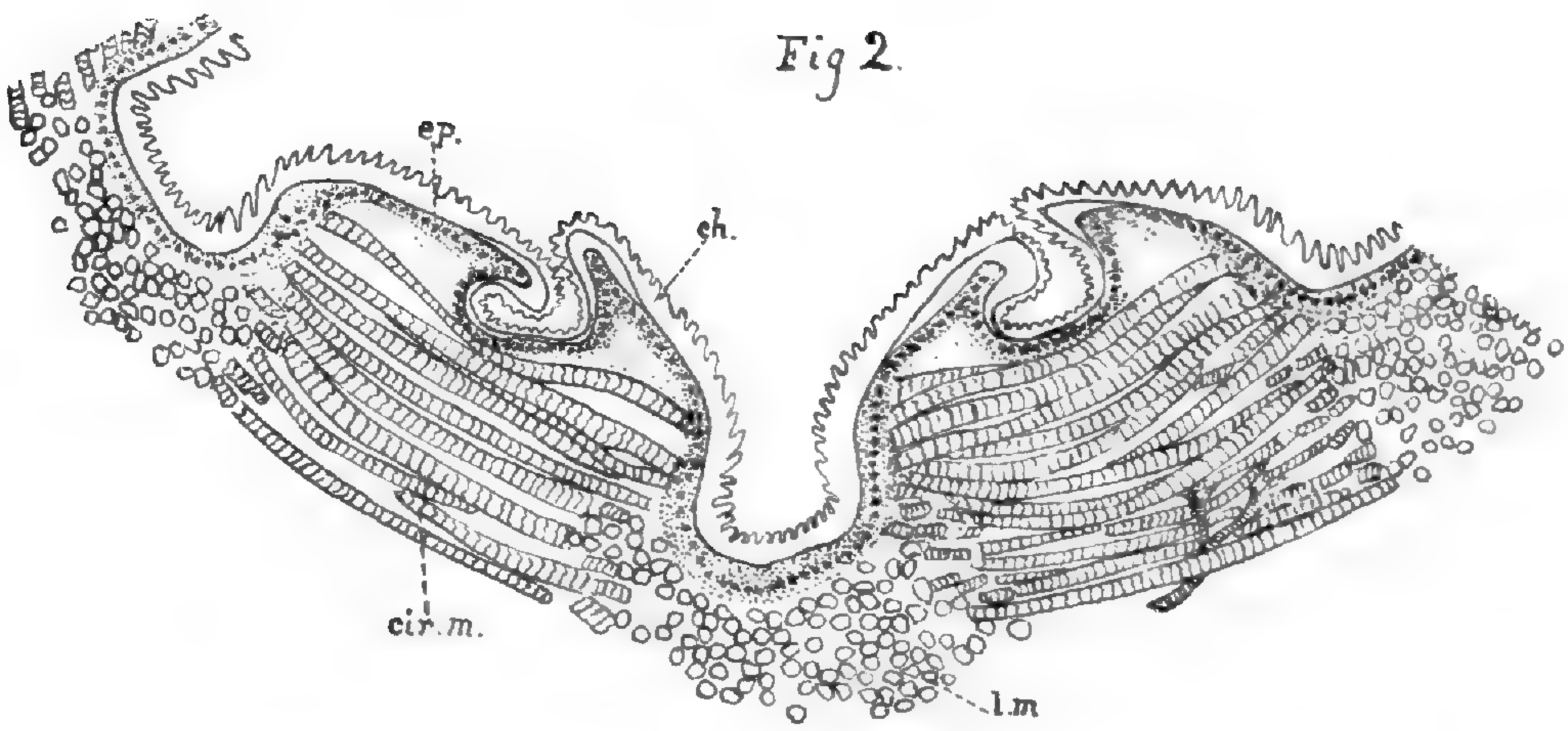


Fig. 3.

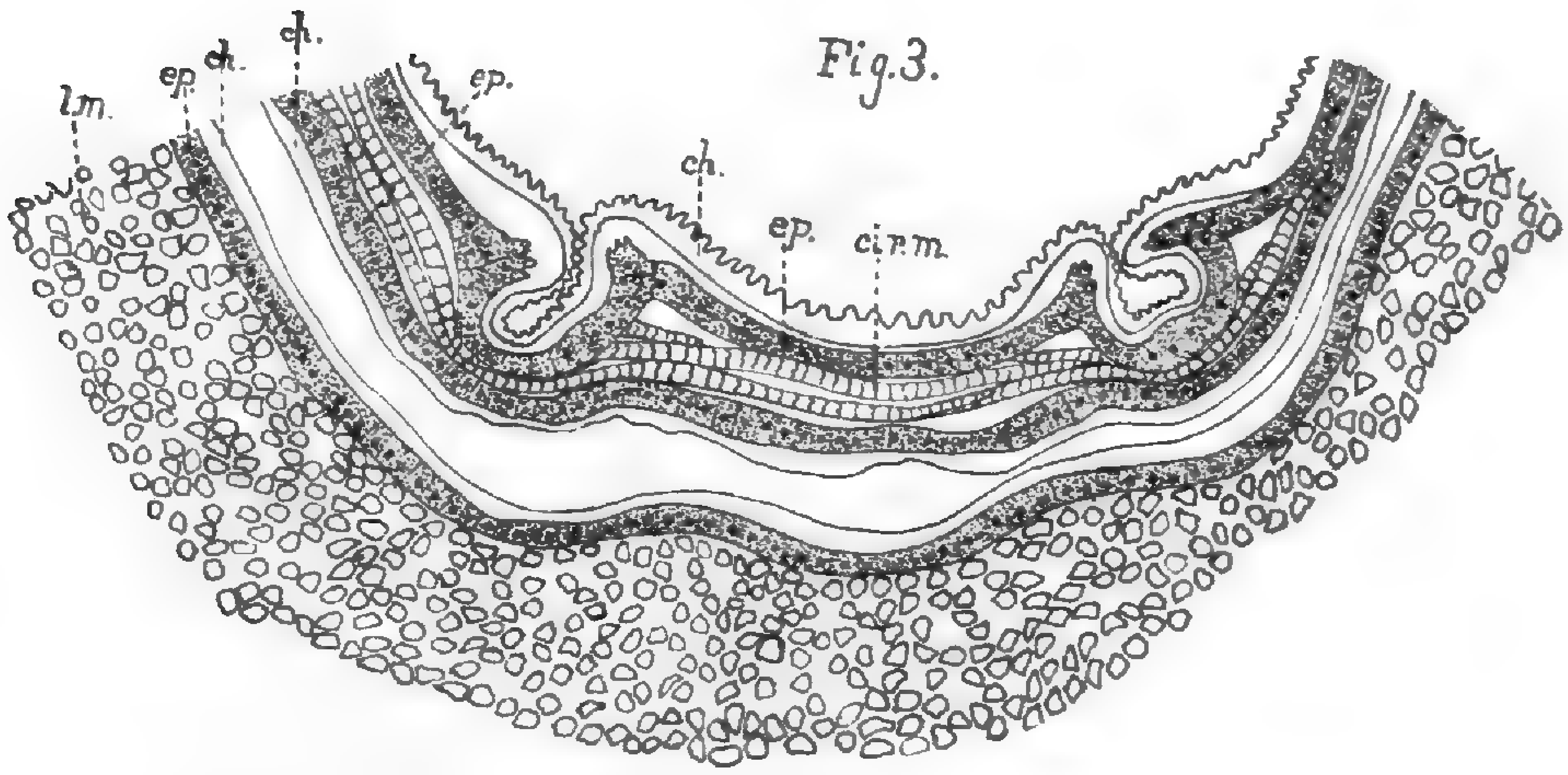
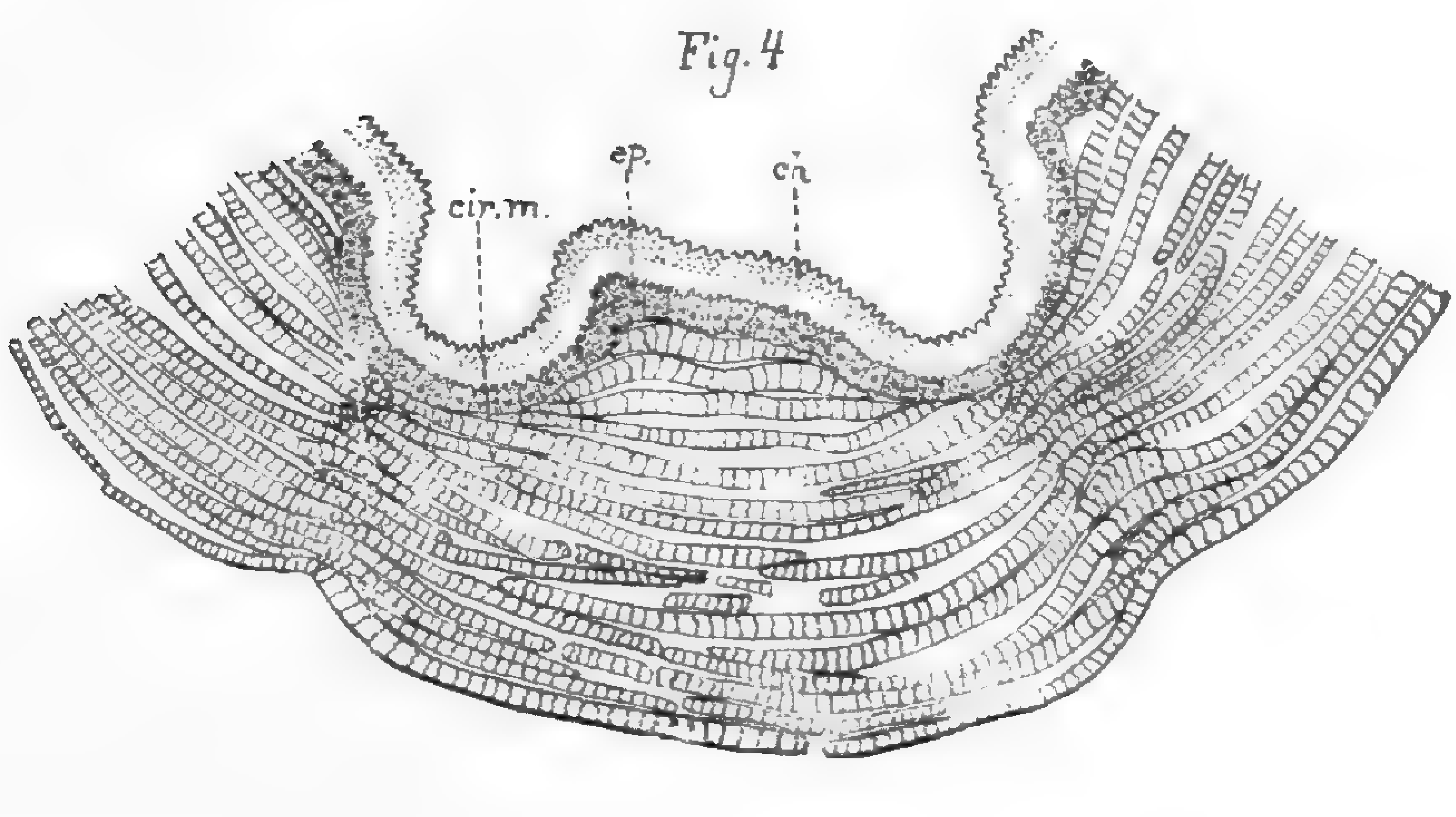


Fig. 4



INSTANCES OF THE EFFECTS OF MUSICAL SOUNDS ON ANIMALS.

BY ROBERT E. C. STEARNS.

(Continued from p. 29, Vol. XXIV., 1890.)

CATS AND MUSIC.

MR. GEORGE GUION, of Ventnor, Isle of Wight, referring to a cat owned by his friend, a Capt. Noble, says:

"If any one in her presence commences whistling a plaintive air Brownie will presently go to him, climb into his lap, and raising herself on her hinder legs will put her mouth close to that of the whistler. Captain Noble's view of the motive is, that the cat imagines the performer to be in pain, and thus endeavors to express her sympathy. One day when sitting round the table after dinner, we each for experiment attracted the animal in turn, who on the above supposition must have thought we were suffering from an epidemic, as each of us in succession exhibited the same symptoms. It is necessary that the air whistled should be of a plaintive character, as I found by commencing a lively measure, which I had to change. In my boyhood we had a cat which had a habit very similar. If I laid myself down on the sofa, and made a moaning sound, the cat would jump up and hover about me, as if anxious to find out what was the matter."

Another party writes: "Sometime since I had an ordinary tortoise-shell cat, which had a peculiar fondness for the tune known as "Rode's Air." One day I chanced to whistle it, when, without any previous training, she jumped on my shoulder, and showed unmistakable signs of pleasure by rubbing her head against mine, and trying to get as near my mouth as possible. I have tried many other tunes, but with no avail."

Captain Noble, of Forest Lodge, Maresfield, England, whose cat "Brownie" is referred to by Mr. Guion, in response to the incident above given says: "By-the-by, I don't know whether 'Rode's Air' is a lively or plaintive tune, but only one of the latter kind affected my poor old 'Brownie.' I used as a rule to whistle the 'Last Rose of Summer,' when I wished her to perform. I never could satisfy myself as to her motive in putting her mouth to mine. The most feasible conjecture that I was able to make seemed to be that she imagined me to be in pain, and in some way tried either to soothe me, or to stop my whistling."

F. C. R., of Gwasted, in commenting on one of the instances above related say: "We too have a cat which is very sensible of the whistling of tunes, and which will, even when with her young kittens, show great uneasiness immediately after the whistling commences, and rise and leave them to follow the person about, ending by trying to seek for the unaccountable sounds in the very mouth of the performer. Still, unlike the cat of 'Musicus,' she seems to experience more uneasiness than pleasure."

Then follows E. J. T., who says: I can give another instance from personal knowledge. A few years ago my brother had a favorite cat, which, when he whistled a tune, would follow him round the room, and climbing up on him would touch his mouth with her paw, and rub her head against his face, all the time purring with pleasure. I may add that this musical taste is *not* hereditary, for a grandchild of this cat, now in our possession, shows the greatest antipathy to music; a few notes on the piano or concertina are enough to rouse her from her slumbers on the hearth-rug, and drive her to the door, mewing loudly to be let out."

Another illustration is furnished by Mr. Oborn, relating to the power of music on English cats. He writes:

"I have a cat that has apparently great fondness for music. Whenever any of the family or a stranger commences playing on the piano, and if the tune is at all lively, she fondles and purrs and evinces the greatest pleasure imaginable, and sometimes becomes so excited that she will jump on to the keys and rub herself against the hands of the person playing."

A lady friend of mine residing in California has observed similar actions on the part of a cat, when the piano is playing in its presence. Whether a Thomas or Tabby cat I did not ask.

Another friend, a lady residing in Washington, D. C., at one time owned a cat that acted in a very peculiar manner upon hearing the music of a piano. When the strain was rather soft and low, the cat appeared to be pleased with it, would climb up into the lady's lap, reach up her head and rub it against the lady's shoulder or chin, but when in the course of the time a passage was reached that was in a high key, with considerable emphasis, pussy became intensely excited, and would put her head against the lady's cheek with a good deal of force, or jump down and run to the piano, and climb up on the person playing, and get up on the instrument in such a fiercely aggressive way that the performer, through fear of being scratched or bitten, would stop playing.

Referring to the effect of whistling upon a cat, as observed by E. J. T., Mr. George O. Howell says, "A relative of mine has a cat, a noble animal, rejoicing under the refined name of Thomas. This creature dislikes to hear any one whistle. But one morning, when he was fast asleep, I whistled loudly. It acted like magic. Thomas started up in an instant, looked very bewildered, and decamped from the room at full speed."

From dogs and cats, the canine and feline, let us turn to the porcine.

PIGS AND MUSIC.

"In old churches and cathedrals we sometimes find a carving on the miserere of a pig playing upon a bagpipe and the little pigs dancing around. This seems to indicate a popular notion (at least in times gone by) that pigs have no ear or taste for music; such a notion, however, seems to be not quite correct, for I once saw four or five great bony pigs standing at a garden gate, listening with the most evident pleasure to the sweet sounds of a wandering German band. They stood in a row, in perfect stillness, with heads bent a little on one side to catch the melody; and from time to time gave utterance to their delight in a gentle grunt of satisfaction. The melody that charmed their breasts was one which rose and fell in gentle and continual waves of sound; not very attractive perhaps to educated ears, but certainly riveting the attention of these untaught creatures, whose desires are commonly supposed to be confined to the quantity and quality of their food, rather than to the enjoyment of the purer delights of sweet sounds."

In proceeding with the domestic animals it will be seen that the bovine group are entitled to a share of attention.

MUSICAL COWS.

"That pigs are not the only animals who take a delight in musical sounds, may be proved by the following incident of which I was a witness on more than one occasion. Opposite to our house was a large field in which some twelve or thirteen cows were put during the summer months. One day a German band commenced to play on the road which divided the house from the field. The cows were quietly grazing at the other end of the field, but no sooner did they hear the music, than they at once advanced towards it, and stood with their heads over the wall attentively listening. This might have passed unnoticed; but upon the musicians going away, the animals followed them as well as they could on the other side of the wall, and when they could get no further stood lowing piteously, etc. * * * * So excited did the cows become, that some of them ran round and round the field to try and get out, but finding no outlet returned to the same corner where they had lost sight of the band, and it was some time before they seemed satisfied that the sweet sounds were really gone. It seems a strange coincidence that both the pigs and cows were charmed by music produced by a German band."

OXEN AND MUSIC.

"I have often noticed the power music has over oxen. The other day we had a brass band playing in our garden. In a field adjoining were four Scotch oxen; when the band struck up, they were at the far end of this, a nine-acre field, quite out of sight, the field being very uneven. They set off full trot to the garden wall, put their necks over, and remained so till the tune was finished, when they went back to graze; but as soon as it struck up again, they put their heads over again. This went on till the band left, after which they ate little all day, and were continually lowing."

Before leaving the bovines, it may be worth noticing that the most definite statement, the most direct and practical testimony we have as to the effect of music upon members of this group may be found in that famous book known as "Mother Goose's Melodies." Therein it is stated:

"There was a piper had a cow
  And had no hay to give her;
He took a pipe and played a tune,
  'Consider, Cow! Consider!'

"The cow considered very well,
  And gave the piper a penny,
And bade him play that other tune,
  'Corn-ricks are bonny!'"

It will be observed that she was a *hard money* cow, while the piper offered only notes!

"There are many anecdotes which show that the ox, or cow, has a musical ear. The carts in Corunna, in Spain, make so loud and disagreeable a creaking sound with their wheels, for the want of oil, that the governor once issued an order to have them greased; but the carters petitioned that this might not be done, as the oxen liked the sound, and would not draw so well without their accustomed music."

"Prof. Bell assures us that he has often, when a boy, tried the effect of the flute on cows, and has always observed that it produced great apparent enjoyment. Instances have been known of the fiercest bulls being calmed into gentleness by music."

It will be seen that a very liberal definition must be conceded to the terms music and musical sounds, when the creaking of a cart wheel is referred to as "accustomed music."[1] The instance here quoted may be more properly regarded as illustrating the relation of certain sounds to the ordinary routine, and said sounds having been continued for a long time, until they became a permanent factor in the experience of these animals, the discontinuance caused, perhaps, a feeling of strangeness and discontent.

SHEEP AND MUSIC.

The following pleasing anecdote of the power of music is given by the celebrated Haydn. "In my early youth," says he, "I went with some other young people equally devoid of care, one morning during the extreme heat of summer, to seek for coolness and fresh air on one of the lofty mountains which surround the Lago Maggiore, in Lombardy. Having reached the middle of the ascent by daybreak, we stopped to contemplate the Barromean Isles, which were displayed under our feet, in the middle of the lake, when we were surrounded by a large flock of sheep which were leaving their fold to go to the pasture.

"One of our party, who was no bad performer on the flute, and who always carried the instrument with him, took it out of his pocket. 'I am going,' said he, 'to turn Corydon; let us see whether Virgil's sheep will recognize their pastor.' He began to play. The sheep and goats, which were following one another towards the mountain, with their heads hanging down, raised them at the first sound of the flute, and all with a general and hasty movement turned to the side from whence the agreeable noise proceeded. They gradually flocked round the musician, and listened with motionless attention. He ceased playing, and the sheep did not stir.

"The shepherd with his staff now obliged them to move on; but no sooner did the fluter begin again to play than his innocent auditors again returned to him. The shepherd, out of patence, pelted them with clods of earth, but not one of them would move. The fluter played with additional skill; the shepherd fell into a passion, whistled, scolded, and pelted the poor

[1] But then Will Carleton's verses are sometimes called poetry.

creatures with stones. Such as were hit by them began to march, but the others refused to stir. At last the shepherd was forced to entreat our Orpheus to stop his magic sounds; the sheep then moved off, but continued to stop at a distance as often as our friend resumed the agreeable instrument.

"The tune he played was nothing more than a favorite air, at the time performing at the opera in Milan. As music was our continual employment, we were delighted with our adventure; we reasoned upon it the whole day, and concluded that physical pleasure is the basis of all interest in Music."

Having given much time to the domesticated quadrupeds, the domesticated bipeds, our friends who wear feathers, must be permitted to give their testimony.

I am again indebted to Prof. Davidson for many interesting anecdotes, all the more so as the instances recited have the authority of his personal knowledge, or that of others known to him as truthful and intelligent.

BIRDS AND MUSIC.

First relating to pigeons. "It must have been about 1841 when I had gotten rid of about fifteen pairs of pigeons of different varieties; but I retained a fine white 'hen pigeon' because we all felt a kind of attachment towards her,—the younger brothers and sisters and my mother. I was going through the task of learning the flute from my father's teaching; I had only a one-keyed flute, but of very sweet tone. One white pigeon had always made herself at home about the back part of the house, frequently leaving the large pigeon house and coming into the kitchen; but after the sale of all the other pigeons she was continually amongst our feet, and making close friends with one and all. In the course of my fluting we noticed that this white pigeon became very much excited over one particular tune, but as to others she seemed wholly unconcerned. So, to please the younger portion of the family, as well as my mother, I frequently cleared a space for the pigeon to perform in and commenced to play. She would begin to circle round and round in the most excited manner, in a space say six feet or more in diameter, crouching low, spreading out her wings, and cooing in the most intense tones. It was very interesting to us all, and the louder I played the more excited became the bird. She never exhibited any feeling for any other tune. Very frequently my mother would ask a neighbor or two in to see the performance, and to still further test the pigeon's idiosyncrasy, I would begin to play while she was outside, when she would instantly leave her corn and come in for the music. Two of my sisters write me that the tune was 'Rule Britannia,' and that the pigeon was then ten years old. Subsequently I purchased other pigeons and mated her, after which she evidently considered music too frivolous for such aged maternity."

(*To be continued.*)

REVIEW OF THE PROGRESS OF AMERICAN INVERTEBRATE PALEONTOLOGY FOR THE YEAR 1889.

BY CHARLES R. KEYES.

ALTHOUGH the number of titles is somewhat in advance, the results of studies in American invertebrate paleontology issued during the past twelve months do not compare as favorably as might be expected with those of previous years. Works of a monographical character have been numerically very limited; but a goodly proportion of the briefer papers foreshadow important publications now in a more or less advanced stage of preparation.

A very considerable number of reprints continue to appear entirely repaged. It is to be hoped that where this is found desirable the original pagination will also be allowed to remain for convenience in reference. The time and patience consumed in looking up the correct citations of repaged authors' editions detracts greatly from the value of these excerpts by thwarting the very purpose which they were designed to serve.

The small number of species described during the past year is rather surprising, but it clearly indicates that the species from the most accessible localities have been already described. It is with considerable satisfaction that the present trend of thought, as disclosed in the papers of the year, is noted; and that paleontologists have begun to appreciate more fully the direct bearing and close relations of the science to those branches dealing with the structure of animals and their distribution in time and space. The few morphological facts already brought out by the investigation of fossil forms is only suggestive of the vast and fertile field open to the student who directs his energies along these lines. Thus intimately connected with biology, the results of the study of the material already accumulated cannot but give most valuable aid in making out the phylogenetic history of the living zoölogical groups. And, indeed, the importance of this consideration cannot be overestimated in the attempt toward a complete phylogeny of organic beings. Viewed from an anatomical and embryological standpoint, the dead become rejuvenated; the "curious stones" live; the rocks disclose the great plan of life. More lasting, more useful, more worthy of contemplation are paleontological labors directed thus rather than to the indiscriminate multiplication of species, to the mere description of curiosities.

Not less important is the recognition of the mutual dependence of paleontology and stratigraphy for the attainment of the highest and most accurate results in generalizations. Heretofore these fields have been far too widely separated; and the work of one has been carried on practically independently of the other, with often very erroneous conclusions. But the present record shows that, in one instance at least, an intimate knowledge of both has been happily combined in the production of a very high grade of work.

In the Canadian *Record of Science* for July Henry M. Ami has a paper On a Species of Goniograptus from the Levis Formation, Levis, Quebec; and in the October number of the same journal, Additional Notes on *Goniograptus thureauni* McCoy, from the Levis Formation of Canada.

Charles Barrois, in the Faune de Calcaire d'Erbray (Mém. de la Soc. Geol. du Nord, tome III., April, 1889), discusses the relations of the American and European Devonian faunas; that of the region in question bearing a great resemblance to the North American Oriskany and Upper Helderberg.

Charles E. Beecher, in the Memoirs of Peabody Museum, Yale University, Vol. II., Part 1, has an important contribution to the knowledge of that rare group of silurian sponges, the Brachiospongidæ; and, in the September number of the *American Journal of Science*, a Note on the Spider *Arthrolycosa antiqua* Harger.

In the number for February 4, 1889, Vol. CVIII., of the *Comptes Rendus*, is a note on Les Blattes de l'epoque houillère, by Charles Brongniart.

Samuel Calvin describes a new species of Spirifera from the Hamilton Group near Iowa City; and Synonymy, Characters and

Distribution of *Spirifera parryana* Hall. Both in the Bulletin of the Laboratories of Natural History of the State University of Iowa.

H. J. Carter sketches the History of known Fossil Sponges in Relation to those of the Present, in which some general considerations respecting classification are brought out. Also, Further Observations on the Foraminiferal Genus Orbitoides of d'Orbigny. The first is in the October, and the second in the March, number of the *Annals and Magazine of Natural History.*

A valuable morphological memoir on the Development of some Silurian Brachiopoda, by J. M. Clarke and Charles E. Beecher, forms Part I., Vol. I., of the Memoirs of the New York State Museum. In the Forty-second Annual Report N. Y. State Museum the first author has: The Genus Bronteus in the Chemung Rocks of N. Y.; The Hercynian Question; and a List of Species constituting the known Fauna and Flora of the Marcellus Epoch in the State of New York.

William F. Cooper gives a Tabulated List of Fossils known to occur in the Waverly of Ohio. Bulletin Denison University, Vol. IV., pp. 123–130.

William H. Dall, in a paper on the Hinge of Pelecypods and its Development, with an Attempt toward a better Subdivision of the Group, seeks more immutable criteria than generally adopted, for the systematic arrangement of the class. *American Journal of Science* for December.

William Dawson has a Note on *Saccamia eriana* in the *American Journal of Science* for April; and on Fossil Sponges from the Beds of the Quebec Group of Sir William Logan, in the *Canadian Record of Science* for July.

In the *Annals and Magazine of Natural History* for March, P. Martin Duncan considers some Points in the Anatomy of the Species of Palæechinus; and a proposed classification. The genus is limited, and two North American forms referred to the group as now restricted.

A. F. Foerste notes some Cambrian Fossils from the Limestone of Nahant, Mass. Proc. Boston Soc. Nat. Hist., p. 291.

The Geological Department of the British Museum publishes Part I. of an exhaustive Catalogue of the Fossil Cephalopods, by

Arthur Foord. The portion issued embraces seven families, of which are carefully drawn up the characters of each genus.

James Hall discusses some Crustacean Tracks from the Potsdam Sandstone of Port Henry, N. Y., in the Annual Report of the New York State Museum. The State Geologist's Report was also issued separately in an edition of eight hundred copies.

C. L. Herrick describes about forty new species, and considers others, in Lists of Waverly Fossils. Bulletin Denison University, Vol. IV., pp. 11–60, and continued on pp. 97–123. In the *American Geologist* for February the same writer has Notes on the Waverly Group of Ohio.

Robert T. Hill publishes a chapter on the Palæontology of the Trinity Division in the Neozoic Geology of Southwestern Arkansas (Vol. II., Ann. Rept. Ark. Geol. Sur); Palæontology of the Cretaceous Formations of Texas, Part I.; and a Check List of the Invertebrate Fossils from the Cretaceous Formations of Texas.

In the Canadian *Record of Science* for April, G. J. Hinde writes on Archæocyathus Billings, and other Genera allied thereto or Associated therewith from the Cambrian Strata of North America, Spain, Sardinia, and Scotland; and in the July number of the same journal, on a New Genus of Siliceous Sponges from the Trenton Formation at Ottawa.

Alpheus Hyatt ably discusses the Genesis of the Arietidæ in the Smithsonian Contributions to Knowledge, No. 673.

T. R. Jones has some Notes on Paleozoic Bivalve Entomostraca: North American Species. (*Can. Annals and Mag. Nat. Hist.*, 6th Series, Vol. III.)

T. Rupert Jones and J. W. Kirkby publish a paper on Some Ostracoda from the Mabou Coal-field of Nova Scotia, in the *Geological Magazine* for June. The first author also describes some species of Palæozoic Ostracoda from Pennsylvania, U. S., in the *American Geologist* for December.

Charles R. Keyes has a list and some notes on the Löss (Post-Pliocene) fossils of the State, in an Annotated Catalogue of the Mollusca of Iowa (Bulletin of Essex Institute, Vol. XX.); Soleniscus, its Generic Characters and Relations, in THE AMERI-

CAN NATURALIST, May number; Variations Exhibited by a Carbonic Gasteropod, *American Geologist* for June; Note on the Distribution of Certain Lõss Fossils, *American Geologist*, August, 1889; Lower Carbonic Gastropoda from Burlington, Iowa, Proceedings Academy Natural Sciences, Philadelphia, for September 24, 1889; the American Species of Polyphemopsis, ibid.; Sphærodoma; A Genus of Fossil Gastropods, ibid.; The Carboniferous Echinodermata of the Mississippi Basin, *American Journal of Science*, September number; and The Sub-generic Groups of Naticopsis, *American Geologist* for October.

F. H. Knowlton describes a Problematic Organism from the Devonian at the Falls of the Ohio, in the *American Journal of Science*, March number.

Joseph Leidy, in the Ann. Rept. Geol. Sur. Pa., for 1887, has a Notice of Fossils in Caves and Crevices of the Limestone Rocks of Pennsylvania; chiefly vertebrates.

J. P. Lesley publishes as Report (P. 4) of the Second Pennsylvania Geological Survey, a Dictionary of the Fossils of Pennsylvania and neighboring States.

In the *American Geologist* for March Jules Marcou describes the Original Locality of *Gryphæa pitcheri.*

G. F. Mathew has: A Second Note on Stenotheca, in the *Geological Magazine*, May number; On the Cambrian Organisms in Acadia, in the Canadian *Record of Science* for July; and On Remarkable Organisms of the Upper Silurian and Devonian of New Brunswick, in the Transactions of the Royal Society of Canada, Vol. VI.

S. A. Miller has issued North American Geology and Paleontology, with a catalogue of the species described to date.

Kentucky Fossil Shells from the Silurian and Devonian rocks are described by Henry Nettleroth in one of the monographs of the Ky. Geol. Survey.

H. A. Nicholson discusses the Relations between the Genera Syringolites Hinde, and Roemeria Ed. & H., and the Genus Caliapora Schlüter, in the October number of the *Geol. Mag.*

A. S. Packard briefly notes some Recent Discoveries in the Carboniferous Flora and Fauna of Rhode Island, *American Jour-*

nal of Science, May; and in the Proceedings of the Boston Society of Natural History, Vol. XXIV., pp. 209–11, are some Palæontological Notes.

E. N. S. Ringueberg reviews the Calceocrinidæ, with Descriptions of New Species, in Annals of N. Y. Acad. Science, Vol. IV., 1889.

Ferdinand Roemer has a paper, bearing the date 1888, Ueber eine durch die Häufigkeit Hippuritenartiger Chamiden ausgezeichnete Fauna der oberturonen Kreide von Texas.

J. M. Safford and A. W. Vogdes, in the Proceedings Academy Natural Sciences of Philadelphia, describe New Species of Fossil Crustacea from the lower Silurian of Tennessee.

Charles Schuchert gives a List of Fossils occurring in the Oriskany Sandstone of Maryland, New York, and Ontario. Annual Report New York State Museum for 1888.

Samuel Scudder has the Oldest Known Insect Larva, *Mormolycoïdes articulatus*, from the Connecticut river Rocks. Mem. Boston Soc. Nat. Hist., Vol. III., No. 13.

N. S. Shaler notes the Occurrence of Fossils of the Cretaceous Age on the Island of Martha's Vineyard, in the Bulletin Museum of Comparative Zoölogy, Vol. XVI., No. 5.

In the *American Geologist* for August some New Characters of *Dophyphyllum simcoense* Billings are given by Will H. Sherzer.

Charles Wachsmuth and Frank Springer have, in the Proceedings of the Academy of Natural Sciences of Philadelphia, dated November 27, 1888, two morphological contributions on the Discovery of the Ventral Structure of Taxocrinus and Haplocrinus, and Consequent Modifications in the Classification of the Crinoidea; and Crotalocrinus: Its Structure and Zoölogical Position.

Charles D. Walcott has an important article in the May and July numbers of the *American Journal of Science* on the Stratigraphic Position of the Olenellus Fauna in North America and Europe. In advance sheets of the Proceedings of the U. S. National Museum for 1888, the same author describes New Genera and Species of Fossils from the Middle Cambrian; a Fossil Lingula Preserving the Cast of the Peduncle; and a New

Genus and Species of Inarticulate Brachiopod from the Trenton Limestone.

Charles A. White considers the Permian Formation of Texas in The American Naturalist for January; and Invertebrate Fossils from the Pacific Coast in Bulletin 51, U. S. Geological Survey.

J. F. Whiteaves, in Contributions to Canadian Palæontology, Vol. I., Part 2, has: On some Fossils from the Hamilton Formation of Ontario; Fossils of the Triassic Rocks of British Columbia; and on Some Cretaceous Fossils from British Columbia. In the Transactions Royal Society of Canada, Vol. VII., Descriptions of Eight New Species of Fossils from the Cambro-Silurian Rocks of Manitoba.

The Bulletin of the American Museum of Natural History, Vol. II., No. 2, contains, by R. P. Whitfield, Observations on some Imperfectly Known Fossils from the Calciferous Sandrock of Lake Champlain, and Descriptions of several New Forms; Additional Notes on *Asaphus canalis* Conrad; Description of a New Form of Fossil balanoid Cirripede from the Marcellus Shale of New York; and a Note on the Faunal Resemblance between the Cretaceous Formation of New Jersey and that of the Gulf States.

H. S. Williams has an abstract in the Proceedings A. A. A. A. for 1888 on the Use of Fossils in Determining the Age of Geological Terranes; and in the *American Geologist* for April, the Relation of the Devonian Fauna of Iowa.

N. H. Winchell notices the Discovery of Lingula and Paradoxides in the Red Quartzites of Minnesota, in the Bulletin Minnesota Academy of Natural Science, Vol. III.

Anthony Woodward, in the Journal of the New York Microscopical Society, gives a Preliminary List of Foraminifera from Post-Pliocene Sand at Santa Barbara, California.

Henry Woodward notes the Discovery of Turrilepas in the Utica Formation of Ottawa, Canada, in the *Geo. Mag.* for June.

E. O. Ulrich has some Polyzoa and Ostracoda from the Cambro-Silurian Rocks of Manitoba, in Contributions to the Micro-Palæontology of the Cambro-Silurian Rocks of Canada, Part 3; on Lingulasma, a new Genus, and Eight New Species of Lingula and Trematis, in *Amer. Geol.* for June; and in the same journal for April, Preliminary Description of New Lower Silurian Sponges.

Warren Upham mentions some Marine Shells and Fragments of Shells in the Till near Boston, in *American Journal of Science*, May number.

AUTOTOMY IN THE CRAB.

BY E. A. ANDREWS.

THAT crabs when roughly handled may throw off one or more legs at a point close to the body, is a fact well-known and often observed.

As little bleeding takes place in such cases, and as the crab may thus escape complete destruction, and is able to grow new legs, this power of self-amputation is of evident advantage to the species, and might at first sight be regarded as an intelligent act consciously performed by the crab under certain circumstances.

The experimental work of Léon Fredericq has, however, demonstrated that such amputations are merely reflex acts brought about by special mechanisms, and may be included with similar phenomena in other animals under the term "Autotomy."

From the various publications upon this subject we may abstract the chief facts relating to the crab, as given by the above author in his *Travaux du Laboratoire*, I.-II., 1887–8.

He there shows that this rupture of the limbs is not due to fragility, since the weight necessary to break off a limb is many times that of the crab's body, and the rupture thus produced is an irregular one, taking place generally at some joint of the limb, and not at the normal "plane of rupture."

That, moreover, this autotomy is not a voluntary act was shown as follows: A crab when fastened by one or more legs endeavors to escape, but does not hit upon the expedient of throwing off a fastened leg, though if even a free leg is seriously injured, the crab then amputates it. When the brain (supra-œsophageal ganglion) is removed, the self-amputation may still be brought about: the same result follows when the brain is thrown out of the experiment by anæsthetizing the animal with ether or chloroform.

Peripheral stimuli may be applied to the limb in various ways in order to bring about autotomy; thus crushing or cutting the segments of the leg (unless it be the terminal ones) is very soon followed by the falling off of the leg at a definite point near the body, while alcohol, etc., heat, or electric shocks applied to the limb produce the same result. In the latter case the time between the application of the shock and the resulting autotomy was measured and found to vary much.

The centre for the reflex throwing off of the legs is in the thoracic ganglion mass, since the removal of this mass destroys the autotomy, and since in one case electric stimuli applied to this mass brought about the ordinary autotomy!

Concerning the mechanisms by which the impulse going out from this centre is able to bring about the remarkable rupture of the limb at a definite place, the author points out the existence of a special groove around the limb of the crab, on the second segment from the body, and that this segment is moved in two directions by two muscles, raised upward by an extensor and brought downward by a flexor muscle. These two muscles are attached to the upper and lower borders of the second segment at the end towards the first, and pass into the first. When autotomy takes place the limb separates by a clear-cut plane passing across the second segment through the above groove; the stump or first segment, with a small ring from the second, is now held forcibly in an elevated position. Experiment shows that the flexor may be cut without destroying the power of autotomy, while when the extensor is cut autotomy does not take place.

The action of the extensor muscle in autotomy, the author explains as follows, with the use of the diagram reproduced in Fig. 1. The stimulus coming from the leg to the thoracic centre results in the sending out of stimuli to the muscles of the leg, the strong contraction of the extensor (*ex*) brings the leg forcibly against the carapace (*c*) or the fingers of the experimenter, etc., till the reaction produces strain enough to rupture the second segment (s) at the groove or weakest point (a).

Some observations made upon the region where autotomy takes place, or plane of rupture as we may call it, seem of interest in supplementing the above account from an anatomical point of view. In the crab Libinia the chitinous wall of the limbs is exceeding thick and strong, so that to break it at all—and it will not break with a clear-cut fracture—considerable force is required, so that it seemed to me quite puzzling that the crab could throw off its legs with a smooth, clear-cut fracture, and this by the application of some force acting inside a firm cylinder.

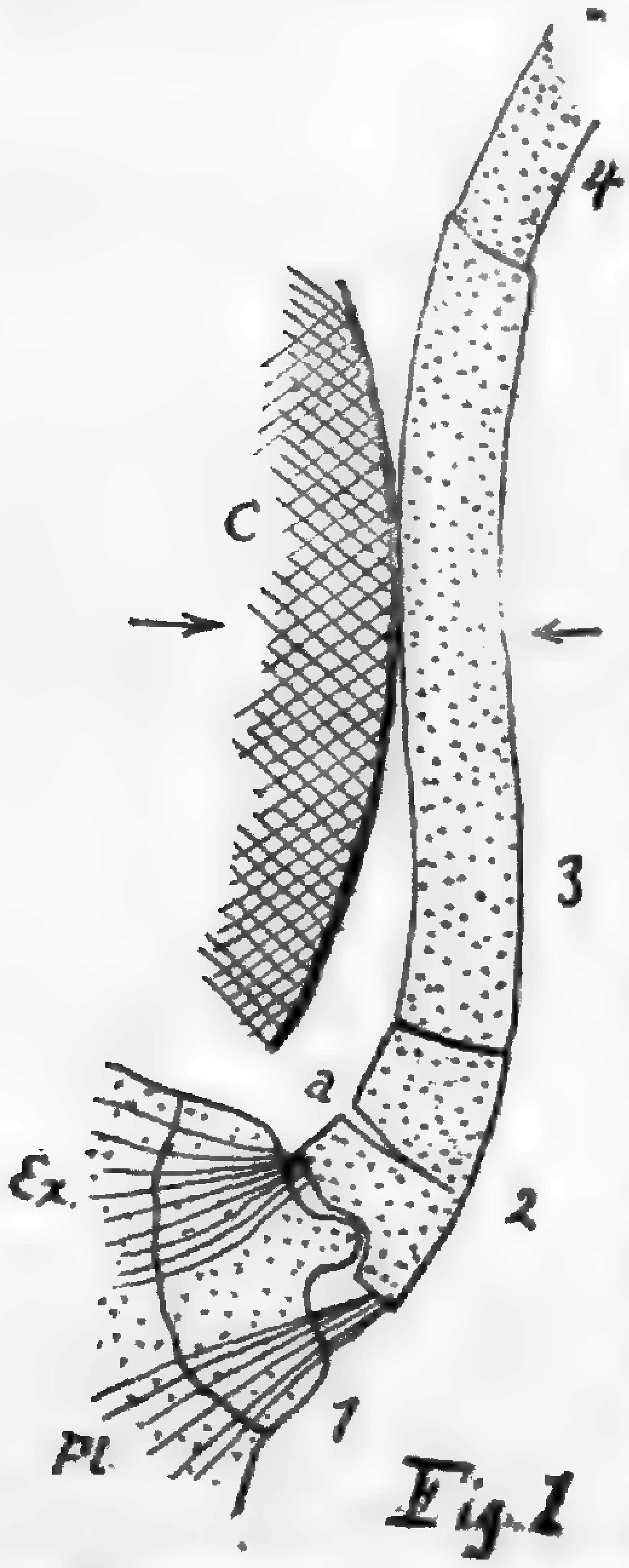


Fig. 1

Experiments made were confirmatory of the facts demonstrated by Léon Fredericq—that autotomy is a reflex act, and that apparently and *probably* it is brought about by muscular contraction forcing the limb against the thorax.

Examination of the second segment shows these two grooves around it (p and d, Fig. 2) differing in appearance, but both conspicuous from the absence of hairs and hair pores in the exoskeleton along these lines. When autotomy takes place the limb separates along the proximal line (p), and the exposed edges of the exoskeleton are smooth and sharp cut. The exposed surface of the soft central part of the limb is covered by a firm membrane except at the centre, where there is a rounded hole with a little torn tissue and blood exposed. After a time a chitinous layer appears over the end of the stump or short ring remaining as representative of the second segment. Though artificial rupture cannot ordinarily be brought about at this "plane of rupture," yet when the limb is

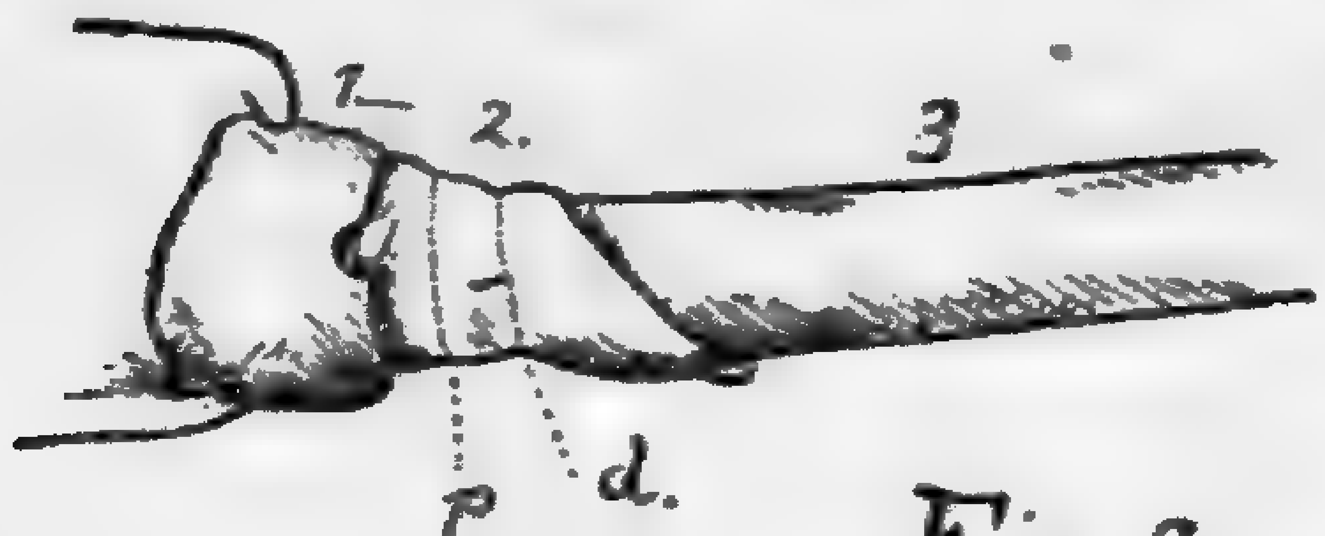


Fig. 2

decalcified in Perenyi's fluid, it readily separates there just as in autotomy.

Sections of this region of the second segment show that the exoskeleton presents a definite plane of discontinuity in the lamellar structure at the proximal groove (*p*, Fig. 2), this plane being at right angles to the length of the limb, but bending abruptly in the outer part of the exoskeleton, so that after autotomy the exoskeleton of the stump of the limb is somewhat rounded off at its outer edge (*x*, Fig. 3.) This plane of discontinuity is quite different from the pores that penetrate the exoskeleton, and connect with the peculiar scale-like "hairs" (*h*, Fig. 3.) Extending from this exoskeleton part of the "plane of rupture," there is a definite structure in the soft part of the limb forming a double annular curtain (*p*, *r*, Fig. 4), extending inward from the epidermis to the central nerve and blood vessels (*n* and *b*), and thus dividing the cavity of the second segment into a proximal and a distal part,—nearly separated from one another. This curtain is a membranous structure of which the distal part is more delicate, the proximal stouter and of a double nature. This proximal membrane is seen on section to remain upon the stump of the leg, as the conspicuous membrane mentioned above, after normal autotomy.

There is thus a definite "plane of rupture," or preformed mechanism consisting of a modification (*x*) in the exoskeleton (*ex*), and of a membranous ingrowth (*p*, *r*), which together account for the peculiar surface presented after autotomy takes place.

The explanation of the gradual acquisition by the crabs of this highly complex and perfected form of autotomy by natural selection presents difficulties which may, I judge, be lessened if we can show reasons for supposing that the mechanisms involved have their homologues in other animals, and have risen to their perfect expression in the crabs in connection with *change of function*.

Leon Fredericq has shown that the chelæ are thrown off easily, by autotomy, in the craw-fish, while the other legs are either thrown off with difficulty, in the lobster, or not at all, in his experiments on the crayfish. Examinations of these limbs showed that (as easily can be verified) the chelæ have, as in the crab, a groove on the second segment, while the other legs present a free joint at the corresponding point, making thus two segments in place of one, or seven in all in place of six in the chelæ.

Considering the relations of the crab to the Macrurans, there seems no doubt that the second segment in the leg of the former represents the fused second and third segments in the latter; the "plane of rupture" corresponds in position with the free joint between the second and third segments of the leg in the lobster or crayfish.

The appearances seen on sectioning this plane, may, I judge, be explained as a modification of a former free joint; the double membrane and line of discontinuity of exoskeleton representing the invagination of body-wall seen at an ordinary movable joint where tendons for attachment of muscles are formed.

As the lobster appears to have the power, though feebly developed, of throwing off the legs at the free joint between the second and third segments, and as this power is better developed in the chelæ, where fusion of the above segments has taken place, may we not suppose that the more perfect and ready autotomy in the crab has been gradually derived from the former conditions as a "change of functions" took place from a movable joint to a definite "plane of rupture"?

That this "plane of rupture" is found in the Megalops (as I infer frcm examinations of alcoholic specimens) does not, I think, invalidate the above conclusion.

Of the two grooves seen on the second segment of the crab's leg it is the proximal one that corresponds to the rupture plane of the lobster's chelæ; the distal one being represented in the lobster by a deep depression, possibly bearing some relation to the exopodite.

PLATE VI.

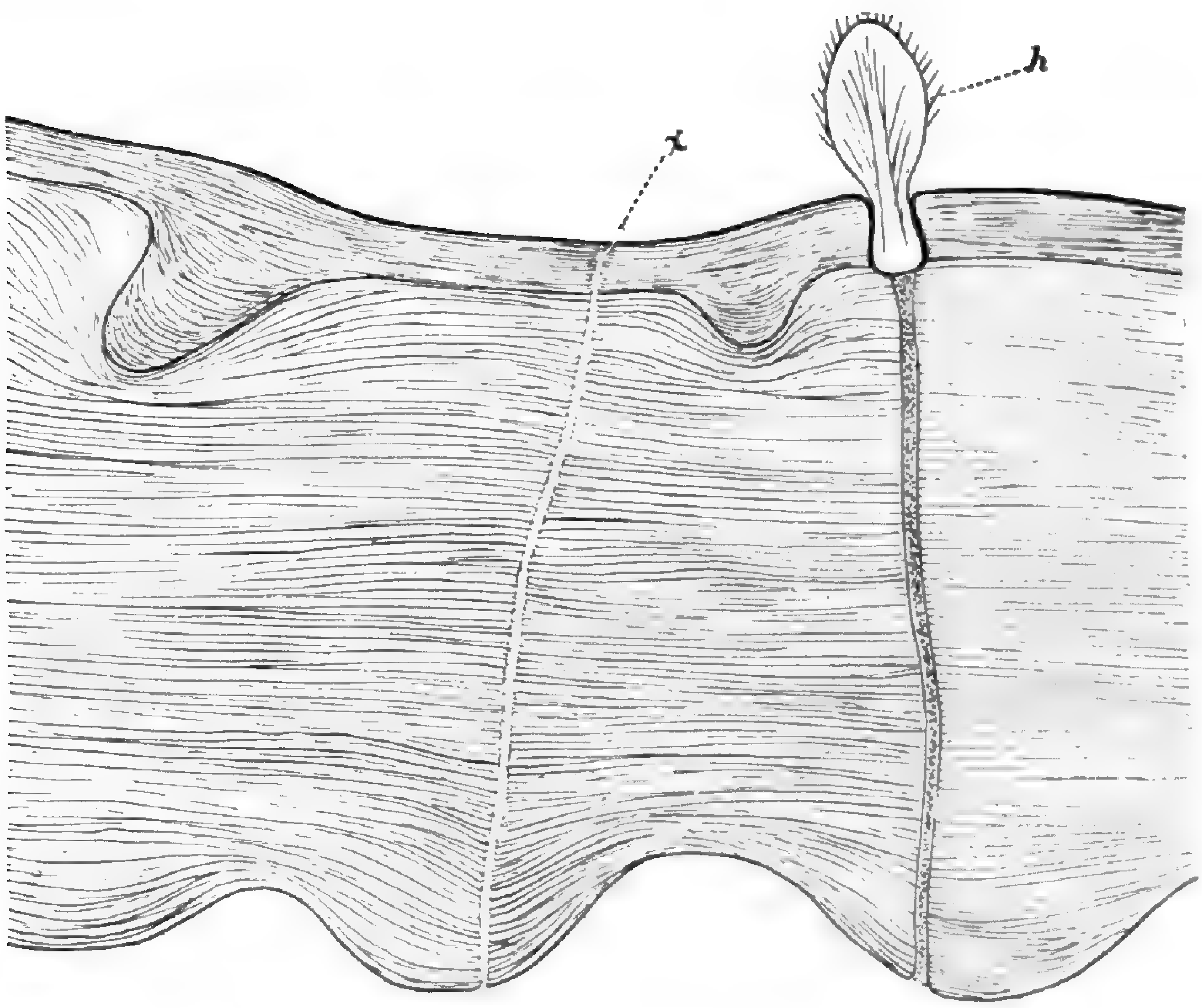


FIG. 3.

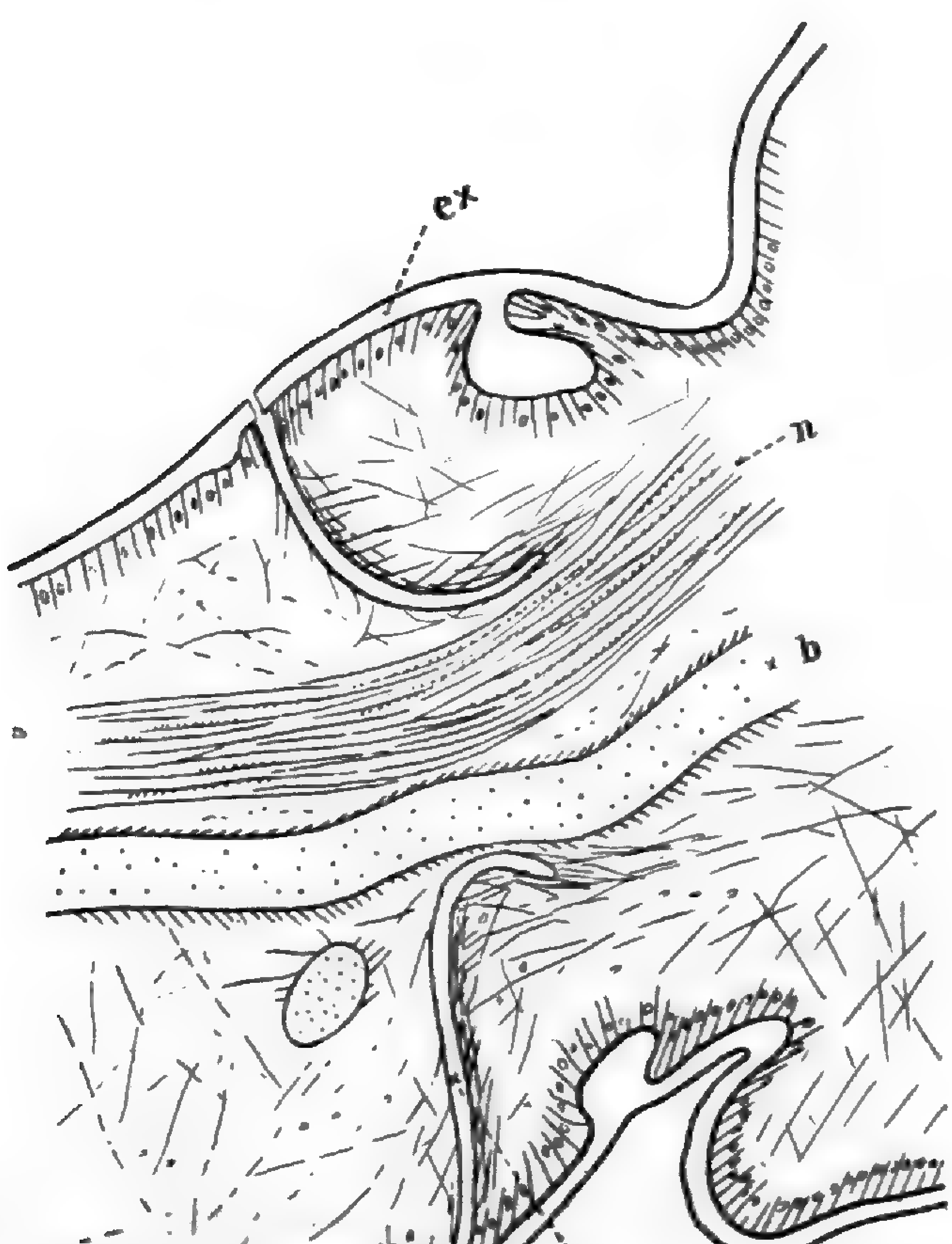


FIG. 4.

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 48. Vol. XXIV., 1890.)

PARSNIP CHERVIL. *Chærophyllum bulbosum* L.

THE roots of this plant, appearing almost like a short carrot, but generally smaller, are eaten boiled; a sub-variety has the roots nearly round.[1] The wild plant is described by Camerarius[2] in 1588, and by Clusius[3] in 1601, and is also named by Bauhin[4] in 1623. As a cultivated plant it seems to have been first noted about 1855, when the root is described as seldom so large as a hazel nut, while in 1861 it had attained the size and shape of the French round carrot.[5] It appeared in American seed catalogues in 1884 or earlier, and was described by Burr[6] for American gardens in 1863. It was known in England in 1726, but was not under esculent culture.[7]

The *Parsnip chervil*[5], *turnip-rooted chervil* or *tuberous-rooted chervil*, is called in France, *cerfeuil tubereux*, *cerfeuil bulbeux;* in Germany, *korbelrube*, *kerbelrube;* in Flanders and Holland, *knollkervel;* in Denmark, *kjorvelroe;* in Spain, *perifollo bulboso*.[8]

PATIENCE DOCK. *Rumex patientia* L.

This species is less acid than the common sorrel, and is occasionally grown for the same purposes. De Candolle[9] thinks it the *Rumex sativus* of Pliny. The name *monk's rhubarb*, or *rhabarbarum monachorum* of Tragus, 1552, indicates its presence in

[1] Bon Jard., 1884, p. 37.
[2] Camerarius. Hort., 1588.
[3] Clusius. Hist., 1601, II., 200.
[4] Bauhin. Pin., 1623, 161.
[5] Gard. Chron., 1861, 887, 906.
[6] Burr. Field and Gard. Veg., 1863, 31.
[7] Treas. of Bot., I., 74.
[8] Vilmorin. Les Pl. Pot., 1883, 79.
[9] Decandolle. Geog. Bot., II., 847.

the gardens of the monasteries, It was called *patientia* by Parkinson in 1640, and is noted by Turner[10] in 1538, as having in England the common name of *Patience.* It is noted as cultivated and its use as a vegetable in nearly all the early botanies, and is recorded in American gardens in 1806.[11] There are no varieties described.

Patience Dock or *Herb Patience* is called in France, *oseille spinard, patience, parelle, epinard immortel, choux de Paris, doche, dogue ;* in Germany, *Englischer spinat, winter-spinat ;* in Flanders, *blijvende spinazie ;* in Denmark, *engelsk spinat ;* in Italy, *lapazio, rombice ;* in Spain, *romaza, acedera espinaca, espianaca perpetua ;* in Portugal, *labaca ;*[12] in Norway, *have-syre; ;*[13] in the Mauritius, *patience.*[14]

PEA. *Pisum sativum* D.C.

The history of the garden pea is difficult to trace, as its separation from the field pea cannot be expected to have been noted in early and popular reference. The use of the seed as an esculent, however, dates from a very remote antiquity, as pease have been excavated from the ruins of ancient Troy,[15] and have been recovered from tombs at Thebes.[16] Its culture among the Romans is evident from the mentions by Columella, Pliny and Palladius.[17] There is every reason to believe from the paucity of description that peas were not then in their present esteem as a vegetable, and were considered inferior to other plants of the leguminous order. The first distinct mention of the garden pea that I find is by Ruellius[18] in 1536, who says there are two kinds of peas, one the field pea and trailing ; the other a climbing pea, whose fresh pods with their peas were eaten. Green peas, how-

10 Turner. Libellus, 1538.

11 McMahon. American Gar. Cal., 1806, 550.

12 Vilmorin. Les Pl. Pot., 395.

13 Schubeler. Culturpflanz, 81.

14 Bojer. Hort. Maur., 1837, 272.

15 Decandolle. Orig. Des. Pl. Cult., 272. ; Am. Antiquarian, Oct. 1880, 66.

16 Wilkinson. Ancient Egyptians.

17 Columella. Lib. II., c. 10 ; Lib. XI., c. 1. ; Pliny, Lib. XVIII., c. 31 ; Palladius, Lib. X., c. 6.

18 Ruellius. De Nat. Stirp., 1536, 439.

ever, were not a common vegetable at the close of the 17th century. The author of a life of Colbert, 1695, says: "It is frightful to see persons sensual enough to purchase green peas at the price of 50 crowns per litron." This kind of pompous expenditure prevailed much at the French Court, as will be seen by a letter of Madame de Maintenon, dated May 10, 1696. "This subject of peas continues to absorb all others," says she; "the anxiety to eat them, the pleasure of having eaten them and the desire to eat them again, are the three great matters which have been discussed by our princes for four days past. Some ladies, even after having supped at the Royal table, and well supped too, returning to their own homes, at the risk of suffering from indigestion, will again eat peas before going to bed. It is both a fashion and a madness."[19] In England garden peas appear to have been rare in the early part of Elizabeth's reign, as Fuller observes they were seldom seen, except those which were brought from Holland, and "these," says he, "were dainties for ladies, they came so far and cost so dear."[20] These references may, however, refer to peas out of season, but in 1683, Worlidge[21] says the meaner sort "have been long acquainted with our English air and soil, but the sweet and delicate sorts of them have been introduced into our gardens only in this latter age."

I propose, however, to only trace out the antiquity of the various forms which include varieties, not the history of the species, nor the varieties themselves. The varieties noted are innumerable, and occur with white and green seed, with smooth and with wrinkled seed, with seed black spotted at the hilum, with large and small seed; as well as with plants with large and small aspect; on dwarf, trailing and tall plants, and those with edible pods.

I. WHITE AND GREEN PEAS.

Lyte, in his edition of Dodonæus, 1586, mentions the trailing pea, or what Vilmorin classifies as the half-dwarf, as having round seed, of color sometimes white, sometimes green.

[19] Gard. Chron., 1843, 71.
[20] Glasspoole. Ag. of O., 1875, 520.
[21] Syst. Hort. By J. W. Gent., 1683, 197.

II. SMOOTH SEEDED.

Dodonæus, in his Frumentorum, 1566, describes this form under *Pisum minus*, a tall pea, called in Germany *erweyssen;* in Brabant, *erwiten;* in France, *pois;* by the Greeks, *ochron;* the pods containing eight to ten round peas of a yellow color at first, then green. This pea was called in England, *Middle Peason*, in 1591.[22]

III. WRINKLED SEED.

The first certain mention I find is by Tragus in 1552, under Phaseolus. These are also recorded in Belgian and German gardens by Dodonæus in his Frumentorum, 1566, under *Pisum majus*, the dry seed angular, uneven, of a white color in some varieties, of a sordid color in others. He calls them *roomsche erwiten, groote erwiten, stock erwiten*, and the plant he says does not differ from his *Pisum minus*, and indeed he uses the same figure for the two. Pena and Lobel in 1570,[23] describe the same pea as in Belgian and English gardens, under the name *An Pisum angulosum hortorum quadratum Plinii*, but the seed of a ferruginous and reddish color, and Lobel[22] in 1591 figures the seed, using the name Pisum quadratum, and it seems to be the Great Peason, Garden Peason, or Branch Peason of Lyte in 1586, as he gives Dodonæus' common names as synonyms. In 1686, Ray[24] describes this class under the name of Rouncival, and refers to Gerarde's picture of Pisum majus, or Rowncivall Pease, in 1597, as being the same. This word *Rouncival*, in white and green varieties, was used by McMahon[25] in America in 1806, and *Rouncivals* by Gardiner and Hepburn[26] in 1818, and Thorburn in 1828. The first good description of the seed is, however, in 1708, when Lisle[27] calls it honey-comb or pitted. Mr. Knight, a nurseryman of Bedfordshire, before 1726[28] did much for the

[22] Lobel. Ic., 1591, II., 66 and index.
[23] Pena & Lobel. Adv., 1570, 396.
[24] Ray. Hist., 1686, 892.
[25] McMahon. Am. Gard. Cal., 1806, II.
[26] Gardiner & Hepburn. Am. Gard., 1818, 59; Thorburn's Cat., 1828.
[27] Lisle. Husb., 1757, 169.
[28] Townsend. Seedsman, 1726, 2.

improvement of the pea, and sent out several wrinkled varieties Up to this time the wrinkled peas do not seem to have been in general esteem. The Knight pea, the seed rough, uneven and shrivelled, the plant tall, was in American gardens in 1821,[29] and quite a list of Knight's peas are under present cultivation.

IV. BLACK-EYED PEAS.

These are mentioned as of an old sort by Townsend[23] in 1726, and are grown now under the name of Black-eyed Marrowfat.

V. DWARF PEAS.

These are mentioned by Tournefort[30] in 1700, and are referred by him to 1665. I find no earlier distinct reference.

VI. HALF-DWARFS.

These are the ordinary trailing peas as mentioned by the earlier botanies, as for instance the *Pisum minus* of Camerarius, 1586, etc.

VII. TALL PEAS.

These are the forms described by the early botanies as requiring sticking, as the *Pisum majus* of Camerarius, 1586; the *Pisum* of Fuchsius, 1542; *Phasioli or faselen* of Tragus, 1552, etc.

VIII. EDIBLE-PODDED OR SUGAR PEAS.

The pods and peas of the large climbing pea are recorded as eaten, as also the green pods of the trailing form, by Ruellius[31] in 1536, and this manner of eating is recorded by later authors. We now have two forms, those with straightish and those with contorted pods. The first of these is figured by Gerarde[32] in

[29] Cobbett. Am. Gard., 1821.
[30] Tournefort. Inst., 1719, 394.
[31] Ruellius. l. c., 439.
[32] Gerarde. Herb., 1597, 1045.

1597, is described by Ray[33] in 1686, Tournefort in 1700, etc. The second form is mentioned by Worlidge[34] in 1683 as the *Sugar pease* with crooked cods, by Ray[33] as *Sickle pease.* In the Jardinier Français, 1651, Bonnefonds describes them as the Dutch pea, and adds that until lately they were very rare, and Roquefort says they were introduced to France by the French ambassador in Holland about 1600.[35] In 1806, McMahon includes three kinds among American esculents.

About 1683, Meager[36] names nine kinds in English culture; in 1765 Stevenson,[37] thirty-four kinds; in 1783 Bryant[38] names fourteen; 1806 McMahon[39] has twenty-two varieties; Thorburn's Calendar, 1821, contains eleven sorts, and his seed catalogue of 1828 had twenty-four sorts; in 1883 Vilmorin describes one hundred and forty-nine; in the report of the New York Agricultural Experiment Station for 1884, ninety-three varieties are described in full.

Peas and *peason* are named in America in 1535, 1540, 1562, etc., but we cannot be sure from the references whether peas or beans of the pea-shape were intended. In 1602, however, peas were sown by Gosnold[40] in the Elizabeth Islands off the coast of Massachusetts, were grown from French seed by the Indians of the Ottawa river in 1613,[41] were grown in excellent quality by the colonists of Massachusetts in 1629,[42] and in 1779 were among the Indian foods destroyed by General Sullivan in western New York.[43]

The *pea* is called in France, *pois;* in Germany, *erbse;* in Flanders and Holland, *erwt;* in Denmark, *haveoert;* in Italy,

[33] Ray. Hist., 1686, 891.

[34] Syst. Hort., 1683, 197.

[35] Gard. Chron., 1843, 71.

[36] Meager. Eng. Gard., 89.

[37] Stevenson. Gard. Cal., 1765, 90.

[38] Bryant. Fl. Dict., 1783, 305.

[39] McMahon. Am. Gard. Cal., 1806.

[40] Smith's Virg. Pinkerton Coll. XIII, 20.

[41] Parkman. Pion. of Fr., 352.

[42] Higginson. Mass. Hist. Soc. Col., 1st ser., I, 118.

[43] Conover. Early Hist. of Geneva, 47.

pisello; in Spain, *guisante;* in Portugal, *ervilha;*[44] in Norway, *ert;*[45] in Greece, *pizelia, aukos;*[46] in Russia, *gorock.*[47]

In Bengali, *matar,*[46] *burra-mutur;* in Ceylon, *rutagoradia;*[48] in Cochin China, *dau-tlon;*[49] in Egyptian, *besilleh;*[47] in Hindustani, *muttir,*[49] *matar, dana,*[46] *buttani;*[48] in India, *mutur;*[50] in Japan, *wan, nora mame;*[51] in Sanscrit, *harenso;*[48] in Tamil, *puttanie;*[49] in Telinga, *goondoo sani gheloo.*[48]

PEANUT. *Arachis hypogæa* L.

This is rather a plant of field than garden culture, yet it is included by Vilmorin among his kitchen garden esculents. It seems to be of New World origin, as jars filled with the nuts have been found in the mummy pits of Peru and Pachacamac,[52] as I have myself verified at the National Museum, and Bentham[53] inclines to the same belief, as the other known species of the genus, five in number, are all Brazilian. Garcilasso de la Vega,[54] who was a boy at the time of the conquest of Peru, speaks of this plant under the name of *ynchic*, called *mani* by the Spaniards. The first writer who notes it is Oviedo in his Cronica de las Indias, who says the Indians cultivate very much the fruit *mani;* a little later Monardes (1569) describes a plant which is probably this. Before this the French colonists, sent in 1555 to the Brazilian coast, became acquainted with it under the name of *mandobi*, which Jean de Lery describes.[55] It was figured by Laet in 1625,[55] and by Marcgrav in 1648[56] as the *anchic* of the Peruvians, the *mani* of the Spaniards.

44 Vilmorin. Les Pl. Pot., 423.
45 Schubeler. Culturpfl., 136.
46 Pickering. Ch. Hist., 283.
47 Heuze. Les Pl. Alim., II., 447.
48 Birdwood. Veg. Prod. of Bomb., 123.
49 Ainslie. Mat. Med., I., 297.
50 Speede. Ind. Handb. of Gard., 119.
51 Kæmpfer. Amoen, 835.
52 Squiers. Peru, 81.
53 Gray. Bot. U. S. Exp. Ex., 424.
54 G. de Vega. Royal Coun., Hak. Soc., Ed. II., 360.
55 Pharmacographia, 186.
56 Marcgravius. Bras., 1648, 37.

It was included among garden plants by McMahon in 1806, and Burr in 1863 describes three varieties, but Jefferson speaks of its culture in Virginia in 1781. Its culture was introduced to France in 1802,[57] and it was described among pot-herbs by Noisette[58] in 1829.

The peanut, earth nut, ground nut, grass nut, pindar, or earth almond, is called in France *arachide*, *pistache de terre*, *souterraine*, *anchic*, *arachine*, *feve de terre*, *noisette de terre*, *pistache d'Amerique*, *pois de terre*; in Germany, *erdnuss*, *erdeichel*; in Italy, *cece di terra*; in Spain, *chufa*, *cocahueta*, *alfonsigo*; in Portugal, *amenduinas*[59]; in the Mauritius, *pistache*.[60]

Birdwood[61] gives a Sanscrit name *boochanaka*; Hindustani, *moongphulli*, *booe-moong*; Tamil, *vayer*, *nelay-cordalay*; Telinga, *nela senaglu*, *veru-sanaga*; in Sumatra, *cachang-goring*. In Angola, *mpinda* or *ginguba*;[62] in Egypt, *foul sennar*, *sennar-bean*.[63] In Tagalo, *mani*; in Burma, *myae-bai*.

PENNYROYAL. *Mentha pulegium* L.

The leaves of pennyroyal are sometimes used as a condiment. Mawe,[64] in England, in 1778, calls it a fine aromatic, and it was among American pot-herbs in 1806.[65] It was in high repute among the ancients, and had numerous virtues ascribed to it by both Dioscorides and Pliny, and from the frequent reference to it in Anglo-Saxon and Welsh works on medicine, we may infer that it was much esteemed in northern Europe.[66] It has now fallen into disuse.

Pennyroyal, in old herbals *puloil royal*, a name derived from the Latin *puleium regium*, from its supposed efficacy in destroying

[57] Bon Jard., 1882, 685.
[58] Noisette. Man., 1829, 329.
[59] Vilmorin. Les Pl. Pot., II.
[60] Bojer. Hort. Maurit., 1837, 116.
[61] Birdwood. Veg. Prod. of Bomb., 117, 299.
[62] Montiero. Angola, 72.
[63] Pickering. Ch. Hist., 736.
[64] Mawe. Gard., 1778.
[65] McMahon. Am. Gard. Cal., 1806.
[66] Pharmacographia, 1779, 486.

fleas,[66] is called in France *menthe pouliot*;[67] in Germany, *polei;* in Holland, *poley;* in Italy, *pulegio;* in Greece, *gluphone* or *vlehoni;* by the Turks, *filis cun;* in Egypt, *hobag*.[68]

PEPPERMINT. *Mentha piperita* L.

Peppermint is grown on a large scale for the sake of the oil which is obtained by distillation, and which finds large use for flavoring candies and cordials, but especially in medicine. There are large centres of its culture in the United States, Europe, and Asia, but we are now concerned with its appearance as a pot-herb, for which it is grown to a limited extent, the leaves used for seasoning. It is spoken of as if not a garden plant by Ray,[69] in 1724, who describes two varieties, the broad and narrow leaved. In 1778 it is included by Mawe[70] among garden herbs; in 1806 noticed among American garden plants,[71] and is now an escape from cultivation. I find no notice of the peppermint preceeding 1700, when it is mentioned by Plukenet[72] and Tournefort,[73] and is noted as a wild plant only.

Peppermint is called in France *menthe poivree;* in Germany, *pfeffermunze;* in Denmark, *pebbermynte;*[74] in the Mauritius, *pepermenthe*;[75] in India, *beelluta* or *panee kula;*[76] in Egypt, *lemmane* or *na na;* in Bengali and Hindustani, *pudina*, also in Hindustani, *nana;* in Japan, *faki*.[77]

PEPPERS. *Capsicum annuum* L.

This plant is of American origin, and is first mentioned by Peter Martyr in an epistle dated September, 1493, wherein he says Columbus brought home "pepper more pungent than that

[67] Vilmorin. Les Pl. Pot., 354.
[68] Pickering. Ch. Hist., 199.
[69] Ray. Syn., 1724, 234, n. 7.
[70] Mawe. Gard., 1778.
[71] McMahon. Am. Gard. Cal., 1806.
[72] Plukenet. Almag. maut., 1700, 129.
[73] Tournefort. Instit., 1719.
[74] Vilmorin. Les Pl. Pot., 353.
[75] Bojer. Hort. Maurit., 247.
[76] Speede. Ind. Handb. of Gard., 183.
[77] Pickering. Ch. Hist., 671.

from Caucasus."[78] It is also mentioned as a condiment by Chanca, physician to the fleet of Columbus in his second voyage to the West Indies, in a letter written in 1494 to the chapter of Seville.[79] It had already existed in tropical and southern America under cultivation in numerous varieties. These have been described under many specific names by Fingerhuth[80] and other botanists, but those varieties at present under northern cultivation can all be referred to the annual species, although differing exceedingly in the form, color, and quality of their fruits. These varieties furnish a number of groups which are quite distinctly defined, and which seem in many cases to present specific characters, and these groups or types have existed unchanged now for several centuries, despite the different conditions to which they have been exposed.

In the varieties under our present cultivation, the only ones which I propose to notice, we have distinct characters in the calyx of several of the groups; and in the fruit being pendulous and erect, and it is worthy of note that the pendulous varieties have a pendulous bloom as well as fruit, and the erect varieties have erect bloom, and some heavy fruits are erect, while some light fruits are pendulous; and in the quality of the fruit, as for instance all the sweet peppers having a like calyx; and in the color of the fruit. While again there may seem at first to be considerable variability in the fruits even on the same plant, yet a more careful examination shows that this variability is more apparent than real, and comes from a suppression or distortion of growth, all really being of a similar type.

The history of the appearance of each of these groups can best be seen by the synonymy, which is founded upon figures given with the descriptions, and which is intended to be conservative rather than complete.

I. The calyx embracing the fruit.

(*a*.) Fruit pendulous.

[78] Irving. Columbus, III., 425, I., 238.

[79] Pharmacographia, 406.

[80] Fingerhuth. Monog. Gen. Capsici, 1832.

This form seems to have been the first introduced, and presents fruits of extreme pungency, and is undoubtedly that described as brought to Europe by Columbus.

It presents varieties with straight and recurved fruit; and the fruit when ripe is often much contorted and wrinkled.

Capsicum longum. D.C. ex., Fing., t., VI.

Siliquastrum tertium. Langer Indianischer pfeffer. Fuch., 1542, 733.

Siliquastrum minus. Fuch., l. c., 732.

Indianischer pfeffer. *Siliquastrum.* Roszlin, 1550, 214.

Indianischer pfeffer. Trag., 1552, 928.

Piper indicum. Cam. epit., 1586, 347.

Capsicum oblongius Dodonæi. Lugd., 1587, 632.

Piper indicum minus recurvis siliquis. Hort. Eyst., 1613, 1713.

Piper indicum maximum longum. Hort. Eyst., 1613, 1713.

Capsicum recurvis siliquis. Dod., 1616, 716.

Piper Calecuticum, sive Capsicum oblongius. J. Bauh., 1650, II., 943.

Siliquastrum, Ind. pfeffer. Pancov., 1673, n. 296.

Piper Capsicum. Chabr., 1677, 297.

Piment de Cayenne. Vilm., 1885, 151.

Long Red Cayenne. Ferry.

Mexican Indian, four varieties, one the exact variety of Fuchsius, 1542.

Siliquastrum majus. Fuch., 1542, 732.

Long Yellow Cayenne. Hend.

Capsicum longum luteum. Fing., t. VII.

According to Sloane [81] the following are additional synonyms as taken from non-botanical writers.

Poivre indic. cornu. Lery, 205.

Axi longum acre, Martyr. *Axi lungo.* F. Colon, Vit., 74.

Axi, or *West Indian Pepper.* Purchas, 1100, 1106.

White and red long pepper. Carder, ib., 1190.

Pepper growing on trees in a picked length running out. Layfield, ib., 1173.

Pepper growing in long cods. Smith's Obs., 54.

[81] Sloane. Cat., 1696, 39.

Red pepper like a child's coral two inches long. Ligon, 79.
Quein-boucoup. Thevet, Cosm., 938.

(*b.*) Fruits erect.

Capsicum annuum acuminatum. Fing., t. II.
Piper ind. minimum erectum. Hort. Eyst., 1613, 1713.
Piper ind. medium longum erectum. Hort. Eyst., 1613, 1713.
Piper longum minus siliquis recurvis. Jonston, Dendrog., 1662, t. LVI.
Piment du Chili. Vilm., 1883, 410.
Chili pepper. Vilm., 1885, 151.
Red Cluster. Vilm., Alb. de Cl.
Yellow Chili. Hend.

II. Calyx pateriform, not covering the flattened base of the fruit.

(*a.*) Fruit long, tapering, pendent.

Piper indicum sive siliquastrum. Pin., 1561, 12.
Capsicum actuarii. Lob. Obs., 1576, 172; ic., 1591, I., 316.
Capsicum majus. Lugd., 1587, 632.
Capsicum longioribus siliquis. Ger., 1597, 292.
Piper indicum. Matth. Op., 1598, 434.
Capsicum oblongioribus siliquis. Dod., 1616, 716.
Pepe d' India. Cast. Dur., 1617, 344.
Figures 13 and 14, counting in order. Piso, de Ind., 1658, 226.
Guinea pepper or garden coral. Pomet, 1748, 125.
Piper indicum bicolor. Blackw. Herb., 1754, n. 129, f. II.
Piment rogue long. Vilm., 1883, 409.
Long red capsicum or Guinea. Vilm., 1885, 150.

(*b.*) Fruit short, rounding, pendent.

Siliquastrum quartum. Fuch., 1542, 734.
Siliquastrum cordatum. Cam. Epit., 1586, 348.
Fig. 2 and 6. Piso, 1658, 225.
Piper cordatum. Jonston, Dend., 1662, t. LVI.
Capsicum cordiforme, Mil. Fing., t. IX.
Oxheart. Thorb.
New Oxheart. Thorb.

III. Calyx funnel form, not embracing base of fruit.

(*a*.) Fruit pendent; long.

Piper indicum medium. Hort. Eyst., 1613, 1713.
Piper siliquis flavis. Hort. Eyst., 1613, 1713.
Piper indicum aureum latum. Hort. Eyst., 1613, 1713.
Fig. in Hernandez. Nova Hisp., 1651, 137.
Piper indicum longioribus siliquis rubi. Swert., 1654, t. 35, f. 3.
Piper vulgatissime. Jonston, 1662, t. LVI.
Piper oblongum recurvis siliquis. Jonston, 1662, t. LVI.
Capsicum fructu conico albicante, per maturitakem miniato, Dill., 1774, t. 60.
Piment Jaune long. Vilm., 1883, 409.
Long Yellow Capsicum. Vilm., 1885, 151.

(*b*.) Fruit pendent; round.

Siliquastrum rotundum. Cam. Epit., 1586, 348.
Piper rotundum majus surrectum. Jonston, 1662, t. LVI. (as figured.)
Figure 5. Piso, 1658, 225.
Cherry Red, of some seedsmen.

(*c*.) Fruit erect; round.

Piper minimum siliquis rotundis. Hort. Eyst., 1613, 1713.
Capsicum cersasiforme. Fing., t. V.
Piment cerise. Vilm., 1883, 411.
Cherry Pepper. Burr, 1863, 621; Vilm., 1885, 152.

According to Sloane, l.c., this is the *axi rotundum* of P. Martyr, the *axi rotondo* of F. Colon, the *carive sive axi montense* of Laet, the *caribe* of J. Acosta, etc.

IV. Calyx funnel form, as large as base, but the fruit more or less irregularly swollen; not pointed; pendent.

Capsicum luteum. Lam. Fing., t. VIII.
Prince of Wales, of some seedsmen (yellow).
(Perhaps) *Capsicum latum Dodanæi.* Lugd., 1587, 632.
Capsicum latis siliquis. Dod., 1616, 717.
Capsicum siliquis latiore and rotundiore. J. Bauh, 1651, II., 943.

Piper capsicum siliqui latiori et rotundiore. Chabr., 1677, 297.

V. Calyx set in concavity of fruit.

This character is perhaps produced only by the swollen condition of the fruit as produced by selection and culture. As, however, it appears constant in our seedsmen's varieties, it may answer our purpose here.

(*a.*) Fruit very much flattened.

Piper indicum rotundum maximum. Hort. Eyst., 1613, 1713.

Solanum mordeus, etc., Bonnet Pepper. Pluk. Phyt., 1691, t. 227, p. 1.

Capsicum tetragonum, Fing., t. 10.

Piment tomato. Vilm., 1886, 413.

Red Tomato capsicum or American bonnet. Vilm., 1885, 154.

(*b.*) Fruit, squarish, angular, very much swollen, large.

This class includes the Bell, Sweet Mountain, Monstrous, Spanish mammoth, of Vilmorin; the Giant Emperor, Golden Dawn, etc., of American seedsmen. The varieties of this class seem referable to *Capsicum annuum rugulosum,* Fing., *C. grossum pomiforme,* Fing., and *C. angulosum,* Fing., but I have not as yet sufficiently studied them.

This class V. embraces the sweet peppers, and none other. A sweet kind is noted by Acosta [82] in 1604, and it is perhaps the *rocot uchu* of Peru, as mentioned by Garcilasso de la Vega.[83] Sweet peppers are also referred to by Piso [84] in 1648.

Occasionally *Capsicum baccatum* L. is grown, but the species is too southern for general use in the north. Its synonymy follows:

Capsicum, Piper indicum brevioribus siliquis. Lob. Obs., 1576, 172; ic., 1591, I., 317.

Capsicum brasilianum. Lugd., 1587, 633; Pancov., 1673, n. 297.

Capsicum minimis siliquis. Ger., 1597, 292; Dod., 1616, 717.

Piper siliqua parva brasilianum. J. Bauh., 1651, II., 944.

[82] Acosta. Hist., 1604, 266.

[83] Vega. Ray, Com., Hak. Soc. Ed., II., 365.

[84] Piso. Bras., 1648, 108.

Fig. 8. Piso, de Ind., 1658, 225.

Piperis capsici varietas, siliqua parva, etc. Chabr., 1677, 297.

Capsicum baccatum L. Fing., t. IV.

Small Red Cayenne. Briggs' Seed Cat., 1874.

I do not desire it to be understood that the classification used here is other than for convenience. It has no claims for scientific accuracy, as it is only based upon such garden varieties as are known to me, and not upon a complete study of the species of this genus. It will however suffice to show that no type of our modern varieties can be considered of recent origin, but that they are probably all derivatives from the ancient American culture.

The *pepper* or *capsicum* is called in France *piment, carive, corail des jardins, courats, poivre de Calicut, poivre d'Espagne, poivre de Guinee, poivre de Portugal, poivre d'Inde, poivre du Bresil, poivron;* in Germany, *pfeffer;* in Flanders and Holland, *spaansche peper;* in Italy, *peperone;* in Spain, *pimiento;* in Portugal, *pimento, pimentas.*[85]

[85] Vilmorin. Les. Pl. Pot., 408,

EDITORIAL.

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

THE press has taken hold of a question of vital interest to the science of this country, which too many of the scientific men themselves have been unwilling to touch. The New York *Herald* of Sunday, the 12th Jan., contains an exposition of some abuses which have been for a long time an open secret among the geologists and paleontologists of the country. It is unfortunate for the reputation of some of our scientific men that they have neglected the matter so long that its adjudication has now passed into the hands of the public. The matter should have been quietly disposed of among themselves, but it has now gone before a wider tribunal, in which the susceptibilities of individuals will be less considered. The question of scientific honesty and scientific property is at stake, and it is strange that scientific men everywhere in the country have not perceived that the personal reputation of every scientific man in the country is involved in the toleration of a state of affairs such as is described in the above mentioned interview.

The facts are now well known. A wealthy man who desires to pursue a scientific career, finding the labor of doing so distasteful, and the solution of the questions involved inconveniently difficult, employs a number of "assistants." It turns out that these assistants are not only expected to do the mechanical and clerical work necessary to the pursuit of original research, but also to perform the research itself, and to commit the results to paper. The manuscript thus obtained is issued by a reputable scientific journal, and by the United States Geological Surveys, as the work of the employer of these assistants, his name appearing on the title page, and credit for the authorship of the published contents being assumed by him.

We do not hesitate to say (and in so doing we express the opinion of a majority of scientific men), that while this mode of advancing scientific knowledge may be successful, it is disreputable and fraudulent. However, it is probable that there is no written law forbidding it, so that had this institution been content to remain a private one, it might have pursued its course for many years. But the reputation obtained in the manner above described, proved too impressive to be passed without special recognition. Between ignorance of the facts and pachydermatous consciences, the proprietor of the establishment which turned out such results was made president of the United States National Academy of Sciences. It became evident also that so worthy an adjunct in the advancement of science should have the recognition and financial aid of the United States. So the trader in brains became the paleontologist of the United States Geological Survey.

Both of these appointments do no credit to those who effected them. In the latter case the responsibility rests on a single man, the director of the Survey. The spectacle thus presented by two of the three leading scientific organizations of the United States Government, is one which should make every American blush.

Some work of the same kind as that produced by this establishment had been ordered by a previous congress, and the execution of it had been placed in the hands of the Geological Survey by the Secretary of the Interior. For eight years the Director of the Geological Survey has failed to carry out the orders of the Secretary, and the concurrent resolutions of Congress. To do so would be to anticipate some of the work of the new organization which had been adopted by the Survey. The man who hired others to do this work could not tolerate another man who did his own work so " near the throne." Besides, he could not do the work without the specimens used by his predecessor, the other man, and so he must get possession of them, although they are the private property of the latter. The materials on which the work ordered by Congress and the Secretary were to be based must be presented to the Government, and then the question of publishing the work would be considered! It is Naboth's Vineyard with two Ahabs. The modern Naboth, however, lived in the land of newspapers and of public opinion, and these have been heard from. Ahab has not yet obtained the vineyard.

—THE numbers of the NATURALIST for 1889 were issued (by the grace of the Leonard Scott Publication Co.) at the following dates, so far as they have appeared. January, March 1st; 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, 1890. The numbers for the present year, it is anticipated, will be issued on time.

RECENT LITERATURE.

"Challenger" Voyage.—W. P. Sladen's Asteroidea.[1]—The thirtieth volume of the Challenger Reports is a double one, consisting of 935 pages of text, and of 118 plates and a map. The report does not confine itself to the star fishes collected by the Challenger, but includes also those taken by the Lightning, Porcupine, Knight-Errant, and Triton. In the Challenger collection were 268 species belonging to 84 genera, and of these 184 forms are described as new. The total number of new species described in the work is 196, besides 15 forms that are considered as only varieties. Mr. Sladen reduces Perrier's 52 genera to 49, three of the genera proving invalid or synonymous, and the Challenger Expedition furnished examples of 38 of these previously known genera. So large a number of new genera have been described that the synoptic list of all known species of recent Asteroidea, given at the end of the Report, enumerates 137 genera and 810 species.

The long list of of abyssal Asteroids brought to light by the Challenger and other deep sea expeditions, has opened a new chapter in the history of the Asteroidea, and Mr. Sladen has attempted a classification upon a new basis, more in accordance with morphological characters than preceding ones. The fundamental points of structure selected by Mr. Sladen are: (1) those which adapt the organism for the functions of respiration and excretion; (2) the character of the ambulacral skeleton; and (3) that of the ambital skeleton.

For the first he chooses the organs called "papulæ" by Stimpson, transparent membranous cæca which penetrate the body wall, and permit an exchange by osmosis with the free fluid without. These papulæ may be confined to a limited area on the abactinal surface, never passing beyond the boundary of the supero-marginal plates (Ste-

[1] Voyage of H. M. S. Challenger. Report on the Asteroidea collected during 1873-76. By W. Percy Sladen, F.L.S., F.G.S. Vol. XXX. 1889.

nopneusia); or they may pass beyond this boundary, and occur upon the lateral walls and actinal surface (Adetopneusia). Mr. Sladen regards the former group as the more primitive, and states that the young of the second group pass through a stage which represents that of the adults of the first.

The production of the ambulacral element in some star-fishes is much more rapid than general growth, thus producing a crushing together of the plates in the direction of the length, in some cases carried to such an extent that the tube-feet in each furrow become quadriserial. This last character is not looked upon as of sufficient importance to define the primary subdivisions of the class. The group in which this ambulacral crowding occurs is called Leptostroteria, while the group in which ambulacral development proceeds *pari-passu* with that of other parts of the body, is the Eurystroteria, and is by Mr. Sladen considered the older. Embryology supports this view.

The ambital skeleton, formed of the marginal plates and their supplementaries, is looked upon as one of the most important systems of plates in determining form and superficial character. Here there are also two distinct modes of growth, that in which these plates increase rapidly, and continue to develop throughout the life of the star-fish (Phanerozonia), and that in which these plates do not increase in size, but, on the contrary, become relatively smaller as other parts increase (Cryptozonia). The Phanerozonia are regarded as the more primitive, especially as the young of a cryptozonate asteroid is phanerozonate.

Two orders of the Euasteroidea are thus formed, the one, Phanerozonia, combining also the stenopneusid and eurystroterid characters; while the other, Cryptozonia, combines the adetopneusid and leptostroterid characters. In the first order are placed the families Archasteridæ, Porcellanasteridæ, Astropectinidæ, Pentagonasteridæ, Antheneidæ, Pentacerotidæ, Gymnasteriidæ, and Asterinidæ; while in the Cryptozonia are those of Linckiidæ, Zoroasteridæ, Stichasteridæ, Solasteridæ, Pterasteridæ, Echinasteridæ, Heliasteridæ, Asteriidæ, and Brisingidæ. The Asterinidæ, with their comparatively small marginal plates, approach the Linckiidæ, in which the plates are large for the group. Mr. Sladen's classification is certainly the clearest that has been as yet formulated, and it is cheering to note that its author views all classification as nothing more than a working key of our views of affinity.

Not less than 109 species and varieties were found at depths of from 500 to 2500 fathoms. In most cases the actinal and abactinal aspects of two to four species are given on one or more plates, and are succeeded by magnified details of the more important external characters.

RECENT BOOKS AND PAMPHLETS.

ALLEN, HARRISON.—The Anatomy of the Nasal Chambers. Reprint from the *New York Medical Journal*, Feb., 1889. From the author.

BAUR, G.—Paleohatteria Credner and the Proganosauria. Extract from the *Am. Journ. of Science*, Vol. XXXVII., April, 1889. From the author.

BLYTT, A.—On Variations of Climate in the Course of Time. Reprint from Christiana *Videnskabs-Selskabs Forhandlinger* 1886, No. 8. From the author.

BOETTGER, O.—Ein neue Pelobates aus Syrien. Separatabdruck aus dem *Zoologischen Anzeiger*, No. 302, 1889. From the author.

BOULE, MARCELLIN.—Les Prédécesseurs de nos Canidés. From the author.

CLARKE, F. W.—Report of Work Done in the Division of Chemistry, 1885–86. Bull. of U. S. Geol. Survey, No. 42. From Department of the Interior.

DÖDERLEIN, L.—Das Skelet von Pleuracanthus. Separatabdruck aus dem *Zoologischen Anzeiger*, No. 301, 1889. From the author.

DUMBLE, E. T.—Texas Geological and Mineralogical Survey, 1888. From W. T. Cummins.

ECCLES, R. G.—Descent and Disease. Reprint from the *Brooklyn Medical Journ.*, Feb., 1889. From the author.

EVERHART, EDGAR.—Infant Food. Read before the Texas State Geol. and Scientific Ass., May 17, 1887. From the author.

FRENZENY, P.—The Bucking Horse. From the author.

GARMAN, H.—On the Anatomy and Histology of a New Earth Worm (*Diplocardia communis*). Extract from Bull. Illinois State Laboratory of Nat. Hist., Vol. III. From the author.

GEGENBAUR, C.—Über die Occipital Region und die ihr Benachbarten Wirbel der Fische. From the author.

HALE, HORATIO.—The Development of Language. Reprint from Proceedings of Canadian Institute, Vol. VI. From the author.

HIGLEY, W. K.—Reptilia and Batrachia of Wisconsin. Reprint from Vol. VII. of the Trans. of Wis. Acad. of Sciences, Arts and Letters. From the author.

HOUGH, WALTER.—An Esquimo Strike-a-Light from Cape Bathurst, British Am. Extract from the Proceedings U. S. National Museum, Vol. XI., 1889. From the author.

HOWES, G. B. and A. M. DAVIS.—Observations upon the Morphology and Genesis of Supernumary Phalanges, with especial reference to those of the Amphibia. Extract from the Proceedings of the Zool. Soc. of London, Dec. 4, 1888. From the author.

IRELAND, WM.—Eighth Annual Report of the State Mineralogist for the year ending Oct. 1, 1888. From the author.

KÜNTZ, GEORGE.—On Two New Masses of Meteoric Iron.—Mineralogical Notes. Extracts from *Am. Journ. Science*, Vol. XXXVI., 1888.—Precious Stones. Abstract from Mineral Resources of U. S. Calendar, 1887. Meteoric Iron from Arkansas, 1886. Extract from U. S. Nat. Museum, Vol. X. From the author.

LAWRENCE, G. N.—Remarks upon Abnormal Coloring of Plumage Observed in Several Species of Birds. Extract from *The Auk*, Vol. VI., Jan., 1889. From the author.

LECHE, WILHELM.—Uber Einen Jungen Menschlichen Embryo. Biologiska Föreningens Förhandlinger, Verhandlungen des Biologischen Vereins in Stockholm, Band I., Mars., 1889, No. 6. From the author.

LINTNER, J. A.—Cut-worms. Bull. of the New York State Museum of Natural History, No. 6, Nov., 1888. From the author.

MANIGAULT, G. E.—On the Probable Source of the Phosphorus in the South Carolina Phosphates. Proceedings of the Elliott Society. From the author.

MEYER, OTTO.—List of Scientific Publications (printed as manuscript). From the author.

MEYER, OTTO, and SAMUEL PENFIELD.—Results Obtained by Etching a Sphere and Crystals of Quartz with Hydrofluoric Acid. Report from Trans. Conn. Acad., Vol. VIII., 1889. From the authors.

NASON, F. L.—New York Minerals and their Locality. Bull. New York State Museum of Nat. Hist., No. 4, August, 1888. From the author.

NEWTON, E. T.—On the Skull, Brain, and Auditory Organ of a New Species of Pterosaurian (*Scaphognathus purdoni*), from the Upper Lias, near Whitby, Yorkshire. Extract from Philosophical Trans. Roy. Soc. London, Vol. 179 (1888), B. From the author.

PHILLIPS, HENRY.—Subject Register and Supplemental Index of Papers Published in the Trans. and Proc. of the Am. Philosophical Soc. From the compiler.

POHLIG, HANS.—Sur la Structure de la Coquille des Discina. Extrait du Bull. de la Société Belge de Geologie, Tome II., 1888. From the author.

RILEY, C. V.—The Hessian Fly an Imported Insect. Extract from the *Canadian Entomologist*, Vol. XX. From the auhor.

RILEY, C. V.—Poisonous Insects. Extract from the Reference Handbook of the Medical Sciences, Vol. V., 1887. From the author.

SEELEY, H. G.—On *Pareiasaurus bombidens* (Owen), and the Significance of its Affinities to Amphibians, Reptiles, and Mammals.—On Parts of the Skeleton of a Mammal from Triassic Rocks of Klipfontein, Fraserberg, South Africa, illustrating the Reptilian Inheritance in the Mammalian Hand. Extract from Philosophical Trans. of the Roy. Soc. of London, Vol. 179 (1888), B. From the author.

SHUFELDT, R. W.—Comparative Data from 2,000 Indian Crania in the the U. S. Army Medical Museum. Reprint from the *Jour. of Anat. and Physiology*, Vol. XXII. From the author.

SMITH, E. F.—Peach Yellows. A Preliminary Report, Bull. No. 9, Department of Agriculture. From J. M. Rusk.

SPENCER, J. W.—Glacial Erosion in Norway and High Latitudes. Extract from Trans. Roy. Soc. Canada. From the author.

TRAQUAIR, R. H.—Notes on *Chondrosteus acipenseroides* (Agassiz). Extract from the *Geol. Mag.*, June, 1887. From the author.

TOPINARD, M. P.—Les Dernières Etapes de la Généalogie de l'Homme. Extrait de la *Revue d'Anthropologie* du mois de Mai, 1888. De l'auteur.

VASEY, GEORGE and B. T. GALLOWAY.—A Record of Some Work of the Division. Bull. No. 8, U. S. Department of Agriculture. From Norman Coleman.

WHITEAVES, J. F.—On Some Cretaceous Fossils from British Columbia, the Northwest Terr. and Manitoba. Extract from Geol. and Nat. Hist. Survey of Canada. From the author.

WHITMAN, C. O.—First Annual Report of the Marine Biological Laboratory, 1888. From the Director.

WIEDERSHEIM, R.—Zur Urgeschichte des Beckens. Besonderer Abdrucklaus den Gesellschaft zu Freiburg i. B., Band IV., Heft 3.

WILLIS, BAILEY.—Changes in River Courses in Washington Territory due to Glaciation. Bull. of U. S. Geological Survey No. 41. From the Department of the Interior.

WILLIAMS, H. S.—On the Fossil Faunas of the Upper Devonian—The Genesee Section, New York. Bull. of the U. S. Geol. Survey, No. 41. From the Department of the Interior.

WINCHELL, ALEX.—Conglomerates Enclosed in Gneissic Terranes. Reprint from *The Am. Geol.*, March, 1889. From the author.

WOLTERSTORFF, W. VON—Die Amphibien Westpreusses. Separatabdruck aus den Schriften der Naturforschenden Gesellschaft in Dantzig. N. F. VII., Bd. 2, Heft, 1889. From the author.

WOODWARD, A. S.—A Comparison of the Cretaceous Fish-fauna of Mt. Lebanon with that of the English Chalks. Extract from the *Ann. and Mag. of Nat. Hist.*, Oct., 1888. From the author.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Tertiary and Cretaceous of Alabama.[1]—The long sections furnished by the rivers of Alabama, have been the principal sources of our knowledge of the Cenozoic and Mesozoic geology of that State, and it is to Professor Eugene Smith, of Tuscaloosa, that we are indebted for the greater part of our recent knowledge of the subject. He gives the following synopsis of the formations included in the memoir:

Tertiary, Eocene)	Upper.	White Limestone.	Coral Limestone (?Vicksburg),	150
			Vicksburg (Oolitoidal),	140
			Jackson,	65
	Middle.	Claiborne,		140–145
		Buhrstone,		300
	Lower.	Lignitic.	Hatchetigbee,	170
			Wood's Bluff,	80–85
			Belle's Landing	140
			Nanafalia,	200
			Matthew's Landing and Naheola,	130–150
			Black Bluff,	100
			Midway,	25
Cretaceous.	Ripley,			250–275
	Rotten Limestone,			1000
	Eutaw,			300
? Cretaceous.	Tuscaloosa,			? 1000
				424

The Tuscaloosa formation (McGee) is of uncertain age, some reasons for placing it within the Jurassic system having been adduced. This is the formation which has described by some of the geologists of the U. S. Geological Survey under the name of Potomac. Mr. McGee's name, having priority by many years, must be adopted.

[1] On the Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee and Alabama Rivers; by Eugene A. Smith and Lawrence C. Johnson. Bulletin U. S. Geological Survey, 1887, No. 43.

The report concludes as follows (p. 138): "Thus our preliminary observations suggest the movements, and in some cases the positions, of the Cenozoic and Mesozoic shore-lines, and enable us to say that the breaks in stratigraphic and paleontologic continuity in these formations are apparent rather than real, and are due to simple and readily determinate continental movements."

Professor Smith has for many years studied and reported on the geology of Alabama, largely at his own expense. He had already planned and partly finished the explorations recorded in this report, when the U. S. Geological Survey, in the face of promises made by the director to the contrary, sent a new and inexperienced man to do the same work; a highly improper proceeding, whether viewed from the standpoint of justice or of economy. The result is the double authorship which appears on the title page, although the work was really done by Smith, Langdon and Aldrich. The only part of the report in which the views of Professor Smith were not adopted is the coloration of the geological map (p. 134). Here the Mesozoic and Cenozoic beds are colored with tints employed by all other geologists for certain paleozoic formations, in accordance with the method adopted by the present U. S. Geological Survey. This system, which reverses the coloration at present in use by other civilized nations, has no reason for existence, and has already received the condemnation of all disinterested critics. Professor Smith will issue a copy of the map with the conventional colors at some future day.

The memoir is illustrated by a large number of process-cuts of good quality.

A. Smith Woodward on Cœlorhynchus[1] Agassiz.—Among the most interesting of undetermined Ichthyodorulites are some straight, long, slender, round, ribbed spines, met with in the Upper Cretaceous and Tertiaries, and originally described by Agassiz as the rostral bones of sword-fishes under the names of Cœlorhyncus. Their dermal nature was first pointed out by Williamson, who published a detailed microscopical description; and the fragments of the fossil have since been recognized from various parts of the world.

It seems evident that Cœlorhynchus is the spine of a cartilaginous fish, that probably occupied a forward position upon the back; and, if the interpretation of Mr. Willett's fossil be correct, the genus must pertain either to the sharks or to the Chimæroids. The microscopical structure of the fossil accords with this supposition, although some-

[1] *Annals and Magazine of Natural History*, September, 1888.

what anomalous, and as the dorsal spines in no true shark are destitute of a smooth inserted base, Mr. Woodward refers the fish provisionally to the Chimæroids. The extinct members of the latter order do not all possess dorsal spines of the normal type observed in the living Chimæra, as shown by Dr. von Zittel's Chimæropsis; and the possibility of the problematical spines under discussion pertaining to the same group is thus rendered more worthy of consideration. In any case the name Cœlorhynchus is obviously inappropriate, as well remarked by Williamson; but it has yet to be determined whether the dentition of the same fish has not already become known under some other suitable generic title.

Geological News.—Paleozoic.—R. H. Traquair (*Geol. Mag.*, Jan., 1889) compares Homosteus Asmuss, Asterolepis Hugh Miller, with Coccosteus Agassiz. The dorsal plates of the two genera correspond closely, but no undoubted remains of a ventral carapace of Homosteus have yet been found.

J. W. Gregory describes in the January number of the *Geological Magazine* a new species of Protaster from the Upper Silurian of Victoria, Australia.

Turrilepas, Woodward, first described from the Wenlock limestone and shale of Dudley (England), has been found by Mr. Arvi in the Utica formation of Ottawa, Canada. This cirripede has four rows of asymmetrical plates, with more than eight plates in a row.

Echinocaris whidbornei and *Beyrichia devonica* are added to Devonian fossils by Prof. T. R. Jones and Dr. H. Woodward. Both are Entomostraca. (*Geol. Mag.*, Sept., 1889.)

Mr. R. Etheridge has sent forth a catalogue of the fossils of the British Islands, stratigraphically and zoologically arranged. The first volume contains the paleozoic forms. In the preface to his catalogue Mr. Etheridge gives some interesting figures. In 1822, only 752 extinct species of all classes in the animal and vegetable kingdoms were known and described. In 1854, 1,280 genera and 4,000 species were catalogued by Prof. J. Morris; at the close of 1874, 13,300 forms had been described, and for the most part figured; and now the census of the British Fossil Fauna and Flora comprises 3,750 genera and 18,000 species, all recorded in monographs and serial works. The species included in this volume, ranging from the Cambrian to the close of the Permian, amount to 6,022, and are included in 1,588 genera.

Devonian.—In the transactions of the New York Academy of Science, Prof. Newberry publishes a brief description of a series of fossil fish from the lenticular calcareous concretions in the top of the Erie shale in the Valley of the Cuyahoga, near Cleveland, Ohio.

1. *Cladodus* n. sp., a shark six feet or more in length, and with a diameter of body of about eight inches.

2. Actinophorus, nov. gen., a long slender ganoid, and *Actinophorus clarkii*, n. sp., a slender fish about two feet in length by two and a half inches diameter at the pectoral fins.

3. *Dinichthys curtus;* of medium size.

4. *Dinichthys terrelli* (?) Newb.

5. *Dinichthys tuberculatus*, n. sp.

At a meeting of the New York Academy of Sciences, April 16, 1888, Professor Newberry described at length a species of Rhizodus found in the mountain limestone at Alton, Ill., which evidently represents a species of Rhizodus much like *R. hibberti* Ag., which he named *R. anceps*.

Mesozoic.—Mr. R. Lydekker describes and figures in the September issue of the *Geological Magazine* an imperfect left pectoral paddle of *Ichthyosaurus intermedius* showing traces of the integuments. Such specimens are very rare.

The British Museum has recently acquired a remarkably well-preserved female specimen of *Rhinobatus bugesiacus*, the gigantic ray from the lithographic shales of Bavaria. It is about five feet long, and complete in all important respects.—*Geol. Mag.*, Sept., 1889.

M. A. F. Mariori describes *Deliostrobus sternbergii*, a new genus of Tertiary Coniferæ.—*Ann. Sci. Geologiques*, 1889.

Mr. J. Carter, in describing *Palæga mccoyi* (*Geol. Mag.*, May, 1889) states that up to date scarcely thirty fossil species of Isopoda are known to science. The new species occurs in the Cambridge upper greensand.

A new form of Pinna, another of Prodromus, and the echinid *Eodiadema granulata*, are added to the fossils of the Lias by Mr. E. Wilson and W. D. Crick.—*Geol. Mag.*, July, 1889.

According to *Petermann's Mitteilungen*, Prof. A. Wichmann found upon the small island of Saniamo, off the coast of Timor, numerous mud volcanoes; and on that of Rotti, at the southwest end of Timor, he discovered, in two mud volcanoes, some ammonites and belemnites, the first Jurassic fossils yet found in the archipelago.

Dr. Rüst (Palæontographia, 1888,) describes the radiolarians that have been found in Cretaceous strata. In Germany these organisms are very abundant in some of the lower beds, though scarce in the higher. From the Cretaceous and Jurassic of Germany 165 species, in 74 genera, are now known.

Cretaceous.—Smith A. Woodward has published a Synopsis of the Vertebrate Fossils of the English Chalk. As a result of observation and comparison, he gives fifteen species of Reptilia, and eighteen Pisces. Of the latter, twenty-three belong to the order Selachii, eight to the Chimæroidei, twelve to the Ganoidei, thirty-six to the Teleostei, and two doubtful.

M. Paul Levy (*Ann. Sci. Geo.*, 1889) contributes a memoir upon the phosphates of France and other countries, including an account of recently discovered beds, and notes upon their uses in agriculture, and their assimilation by plants. Phosphates occur in the oldest rocks, in sedimentry strata, and in metamorphic beds. They have been found in the Archean of Canada, in Estremadura (Spain), in Norway, at Caylux, Lot, etc., in France; in all these cases under the form of apatite. The beds most worked in France are the Lias, lower Cretaceous, and upper beds of the Mesozoic era. M. Levy believes that the infiltrating water which has separated the phosphates from the carbonates is of interior origin, and has worked from below upwards, and in this belief he differs from many geologists, both French and English. The excavations made in the chalk by the waters have, in M. Levy's opinion, been filled by the descent of superior beds.

M. H. Lasne has contributed to the Annals des Sciences Geologiques for the current year a description of the geology of the department of Indre, with a map showing the geological structure. This region, which furnishes abundant phosphates, is interesting from the number of stages that can be observed in a limited space. There are ancient and eruptive crystalline rocks, Triassic and Rhaetic, Sinemurian, and Lias (rich in vertebrates and molluscs). The phosphates of the Lias of this department are in reality composed of fluo-phosphate of a composition identical with that of apatite—$CaFl_3$ (P_5, $3CaO$). He assumes that these materials were dissolved in the Liassic sea, and were deposited at the same time with the carbonate of lime by the departure of the carbonic acid. Above the phosphate-bearing Lias lie the Toarcian, Bajocian, and Bathonian, and Tertiary strata of Eocene and Miocene date, as well as in some places Pleistocene beds.

The first volume of a Catalogue of the Fossil Fishes in the British Museum, by Mr. A. S. Woodward, has recently been issued. It contains nearly five hundred pages, 17 plates and 15 wood-cuts, and is really a systematic work upon the extinct Elasmobranch fishes. These fishes are divided into the two orders Ichthyotomi (Cope) and Selachii. In the former are included the families Pleuracanthidæ and Cladodontidæ. Thirteen generic names are grouped in the genus Pleuracanthus. The Spinacidæ are classed with the Tectospondyli, or concentric suborder of the Selachii, which has twelve families, while the Asterospondyli, or radiate suborder, has but six.

The first part of a catalogue of the fossil Cephalopoda of the British Museum, with 344 pages and fifty-one wood-cuts, is the work of A. H. Foord, F.G.S. The present volume embraces the seven families Orthoceratidæ, Endoceratidæ, Actinoceratidæ, Gomphoceratidæ, Ascoceratidæ, Potioceratidæ, and Cyrtoceratidæ, which all together are but a part of the sub-order Nautiloida.

Jurassic.—R. Lydekker (*Geological Magazine,* Decade III., Vol. VI., No. 297, p. 119, March, 1889) describes two vertebræ from the Wealden of the Isle of Wight. These specimens clearly indicate a small Dinosaur allied to the genus Cœlophysis.

Cenozoic.—M. Forsyth Major has sent to the *Comptes Rendus* an account of a bed of fossil bones discovered in Samos, and of Lower Pliocene age. Among the mammals are many specifically identical with those of Pikermi, in Attica, Baltavar, in Hungary, and Maragha, in Persia; but there are also some new types, among them an Orycteropus, the only species yet known outside of the Ethiopian region; a large pangolin, estimated to be nearly three times the size of the West Africa *Manis gigantea;* and a ruminant referred by the author to the Giraffidæ, and stated to connect Helladotherium with the existing giraffe. There is also a large ostrich.

E. T. Newton describes (*Geol. Mag.*, Jan. 7, 1889) *Clupea vectensis* from the Ogliocene strata of the Isle of Wight.

Prof. W. Dames has described in the Proceedings of the Berlin Society of Natural Sciences a new kind of sawfish from the Eocene of Birket-et-Qurun, in Egypt. The rostral teeth of this *Amblypristis cheops* differ from those of the existing Pristis in their shortness and great relative breadth.

The Marquis G. de Saporta (*Annales des Sciences Geologiques*, 1889,) contributes an article upon the fossil plants of Aix, in Provence, studied stratigraphically and paleontologically. The plates illustrative of the shells of the Aix group accompany the memoir.

Additions to the vertebrate fauna of the Preglacial Forest Bed of the Norfolk coast increase through the rapid denudation carried on by the North Sea, and Mr. E. T. Newton has in the April issue of the *Geological Magazine* described *Cervus rectus* n.sp., and recognised the presence of *Bison bonasus, Phoca barbata,* the narwhal, the beluga and the porpoise.

H. H. Howorth, M. P. (*Geol. Mag.*, July, 1889) states his belief that in the mammoth age the Arctic Ocean either did not exist, or was very small, the greater portion of its area being occupied by land upon which trees would grow. The continents would therefore be united by land, and an ample bridge provided. This land area would partially account for the warmer climate.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In his report on the geology of the Rainy Lake region, Dr. Lawson[2] gives a petrographical description of the rocks comprising the Laurentian, Coutchiching and Keewatin groups in the neighborhood of the above-named lake in Canada. The rocks of the Keewatin series are principally bedded traps and greenstones, altered from traps by metasomatic and dynamic metamorphism, and greenstones of clastic origin, hornblende schists and other foliated rocks. The effect of pressure is shown in the broken condition of many of the crystals in the rocks; crushed and sundered plagioclase, apatite, hornblende, leucoxene, tourmaline and quartz are all described and figured. Between the hornblende schists and the Laurentian gneisses the author recognizes phenomena which he believes to be due to contact action. If this supposition is found to be a correct one, the fact affords a striking confirmation of the view that the gneisses under the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Geol. and Nat. Hist. Surv. of Canada. Annual Report for 1887. Pt. F.

Keewatin are of eruptive origin. The Coutchiching series embraces mica-schists and other lighter colored schistose rocks between the lowest members of which and the gneisses are also evidences of contact action. Among the lighter schists are granulites and sericite-porphyroids. In the Laurentian a hornblende-syenite gneiss occurs, and in it several pieces of twinned sphene were observed.——The two craters Mte. Cimino and the Lago di Vico [3] in central Italy, though but parts of the same great volcano, like Mts. Somma and Vesuvius, have during their different periods erupted different kinds of lava. The lavas of Cimino have an andesitic habit. They are to be classed with the mica and augite andesites, the latter of which contain porphyritic sanidine and olivine. The younger crater, Lago di Vico, has poured forth leucite bearing rocks, of which leucitophyre, leucite-tephrite, leucite-basanite and phonolites are the prevalent types. A leucite-trachyte, placed by Rosenbusch among the phonolites, is the latest lava of the older crater. It is an intermediate type between the predominant lavas of Cimino and those of the later Lago di Vico. Besides the lavas, the former crater cast forth sanidnite bombs and calc-silicate bombs, containing garnets and vesuvianite.——In a brochure on the Obere Weilerthal, E. Cohen [4] gives an interesting account of the eruptive and sedimentary rocks occurring in the Weilerthal south of the rocks made famous by Rosenbusch under the name Steigerschiefer. Those described by Cohen are granite, gneiss, quartzite-schists, phyllites, granite, porphyry, augite porphyry and minettes. In the granite is a brown hornblende in prismatic crystals. Their specific gravity varies between 3.082 and 3.140, and their composition is as follows:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	H_2O
Darker var.	51.36	4.14	2.17	10.04	11.91	17.14	1.86	1.38
Lighter var.	51.82	4.17	2.34	9.84	12.18	17.18	1.34	1.13

Many of the other rocks described present interesting features, but none of great petrographical importance.——An examination [5] of the northern slopes of Cader Idris, Merionethshire, Wales, discloses interbedded slates, tuffs, and massive eruptive rocks of considerable interest. Among the sedimentary rocks is the well-known pisolitic ironstone, in which the pisolitic structure is now represented by magnetite crystals in a cement of green iron silicate. This structure was originally pro-

[3] W. Deecke, *Neues Jahrb. für Min.*, B. B. VI., 1889, p. 205.

[4] Abh. zur Geol. Specialk. v. Elsass-Lothringen, B. III., H. III., p. 137.

[5] *Quar. Journ. Geol. Soc.*, August, 1889, p. 432.

duced by the tendency of some carbonate to form concretionary masses around grains of sand or small shells. The original carbonate has for the most part disappeared, leaving the magnetite as a pseudomorph. Among the eruptives is a rock that the author calls eurite, following d'Aubuisson,[6] although it would seem that the name quartz-keratophyre would sufficiently well characterize it. The rock is a bluish-gray compact substance with a specific gravity of 2.64. It contains quartz and feldspar crystals, wisps of biotite and spherulites of granophyre, more particularly around the porphyritic crystals, in a groundmass composed principally of a chloritic substance. Its analysis shows it to contain a soda-rich feldspar:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	Loss
72.79	13.79	3.32	tr.	1.94	.62	2.99	4.12	1.08

——In his description of the section Tanneberg of the geological map of Saxony, Dalmer[7] mentions two rocks of some interest. The first is a sericite-gneiss, composed of quartz, plagioclase and sericite, with a breccia-like structure produced by pressure. The quartz and plagioclase are shattered, and the broken pieces are reunited by a cement of secondary quartz and sericite. The second is a chlorite-gneiss, consisting of orthoclase, albite, chlorite and quartz. This occurs in varieties of different degrees of coarseness. As it becomes finer in grain it loses feldspar, and assumes muscovite, until finally it approaches in structure and composition the phyllites of the region.——Kendall[8] gives a list of the basic dykes on the island of Mull that contain the glassy selvages known as tachylite. It has been observed that the thickness of this glass band is always greatest in that portian of the dyke in contact with the most compact rock. A new type of tachylite, called by Groom[9] carrockite, is associated with gabbro at Carrock Fell in the Lake District, England. It consists of a green glass enclosing spherules of quartz, feldspar, and granular aggregates of augite, and porphyritic crystals of the same minerals.—Prof. Bonney[10] has examined certain banded micaceous schists from Morlaix, Brittany, which he thinks are the result of pressure and contact action. The rocks were originally stratified sands and muds, that were crumpled and foliated by pressure, and in which a light and a dark mica, chiastolite and andalusite were developed. By the subsequent intrusion of gran-

[6] Traité de Geognosie, 1819, p. 117.
[7] Erl. z. Geol. Specialk. des Königr. Sachsen Blatt, 64.,
[8] *Geol. Mag.*, Dec., 1888, p. 555.
[9] *Geol. Mag.*, Jan., 1889, p. 43.
[10] *Quart. Jour. Geol. Soc.*, Feb., 1888, p. 11.

ite all traces of their fragmental origin were obliterated; the rock became crystalline, and a few additional minerals were produced.——The first occurrence of glaucophane as a consitutent of British rocks is noted by Blake[11] in an altered diorite from a quarry near the Anglesea Monument, Anglesea. The rocks consists of chloritized glaucophane, grains of epidote, a rutile quartz and calcite. The glaucophane is present in elongated prisms, which form a felt around epidote, and are included in the quartz.

Mineralogical News.—*Morphological and Physical Properties.*—The possibility of the selection of half the planes of the monoclinic hemi-pyramid in such a way as to fulfill the conditions of hemihedrism has been shown by Williams.[12] If two of the planes intersecting in the plane of symmetry be allowed to develop to the exclusion of the other two, there results an apparent hemimorphism, which in reality satisfies all the conditions of hemihedrism. The monoclinic plane of symmetry remains, so that the character of the hemihedrism is the inclined-faced. Planes belonging to this hemihedral form are exhibited in pyroxene from Piedmont, Orange, and St. Lawrence counties, N. Y., and from Canaan, Conn. The habit is always hemimorphic.——In a recent paper Mügge[13] records some interesting observations on parting planes in several minerals. He describes rutile from the Urals in which the usual cleavage parallel to $\infty P\infty$, is wanting, its place being taken by a parting parallel to $\frac{3}{2} P\infty$, but whether as a result of twinning or not, Mügge is unable to decide. The author thinks that this variety of rutile is identical with the mineral from Polk county, N. C., described by Des Cloizeaux[14] as a dimorphous form of rutile. A garnet from Arendal, Norway, possesses cleavages parallel to the dodecahedral face, and contains acicular inclusions of cyanite with their $\infty P\bar{\infty}$ faces parallel to the ∞O faces of the garnet, and their *c* axes parallel to the edges of these faces. The mineral occurs in a schistose dioritic rock whose hornblende constituent has a well-developed parting parallel to $P\bar{\infty}$. Parting parallel to an octahedral face, in many members of the spinel group, is declared to be the result of polysynthetic twinning. Calcite, with a parting parallel to $\infty P2$, galena with twinning lamellæ parallel to $4O$, and breunerite, with $-2R$ $2R$ as the twinning plane, are also mentioned.——Boracite from

[11] *Geol. Mag.*, 1888, p. 125.

[12] *Amer Jour. Sci.*, Aug. 1889, p. 115. Cf. AMER. NATURALIST, Nov. 1887, p. 1025.

[13] *Neues Jahrb. f. Min.*, etc., 1889, I., p. 231.

[14] *Bull. Soc. franc., d. Min.*, IX., 1886, p. 184.

Lüneburg, Hanover, contains the new planes $\infty O\frac{5}{3}$, $\infty O\frac{13}{3}$, $\infty O\frac{17}{8}$. ——Beginning with the Le Bel and Van t' Hoff theory with regard to the connection between the structure of the molecule (*i. e.*, the arrangement of the atoms within the molecule) and the activity of circularly polarizing substances, and applying the principles of this theory to the Sohacke-Wulff[15] theory of crystal structure, Becke[16] is forced to conclude that this theory of crystallization is not satisfactory, since it does not account sufficiently well for the close relation that exists between the crystallization of a body and its chemical nature. Becke thinks that the symmetry of crystals is intimately dependent upon the symmetry of arrangement of the atoms within the molecules. If this be true, all circularly polarizing bodies should possess an unsymmetrical molecule, which should reveal itself through the unsymmetrical character of its crystallization. Becke publishes a list of all the circularly polarizing substances known, and discusses in detail the crystallization of grape sugar, since this has been regarded as a triclinic substance, without evidence of hemimorphism or hemihedrism—the only two modes of crystallization that can yield enantiomorphous, *i. e.*, unsymmetrical figures. As a result of measurements of crystals of pure sugar, Becke concludes that it is monoclinic with $a : b : c = 1.735 : 1 : 1.908$. $\beta = 97° 59'$, and hemimorphic in the direction of the c axis (really hemihedral, as indicated by Williams, ref. above). It is therefore enantiomorphous. The symmetry of its form corresponds with that of other circularly polarizing bodies, and corresponds also with the unsymmetrical structure of its chemical molecule, shown by recent synthetical methods. Two of these unsymmetrical molecules may be so arranged as to yield a crystal with one plane of symmetry (holohedrally developed monoclinic form), and four to produce forms with three planes of symmetry (orthorhombic forms). The symmetry of crystal forms thus depends primarily upon the distribution of the atoms within the molecule, Von Goldschmidt,[17] carrying out this idea more fully, attempts to simplify the discussion of the chemical relations of the silicates by making certain assumptions with regard to the conditions necessary to the mixture of molecules in groups of isomorphous silicates. He regards the particles as the primary constituent of the molecule, just as the atoms are the constituent parts of the molecule. Chemistry he defines as relating to molecules and their composing atoms; crystallography as relating to crystals and their composing particles. Isomorphism is the

[15] AMERICAN NATURALIST, 1889, p. 221.

[16] *Min. u. Petrog. Mitth.*, 1889, p. 464.

capacity of analogous particles to form similar crystals. Similar or analogous particles are those built on the same plan, though different in composition. Starting with these general ideas the author discusses the character of the particles forming the silicates, and concludes by applying his deductions to the explanation of the formulas of the most important silicates.——The examination[18] of senarmontite crystals in thin sections parallel to the cubic, octahedral and dodecahedral faces, shows that the apparently simple crystals are combinations of six orthorhombic crystals, and that the optical anomalies so frequently observed in the mineral are due to this intergrowth, or to twinning. Unlike the double refraction of some other apparently regular minerals, the anomalous action of senarmontite is not in the least affected in a temperature as high as 360°.——Mügge[19] has reinvestigated the subject of pressure twinning in sphene, and finds the twinning plane to be in the zone between ∞ P and —P (DesCloizeaux's position), and not to coincide exactly with —2P, as determined by Williams. He ascribes the striations frequently observed in the sphene of plutonic rocks to pressure, but is not able to produce them by artificial means. ——As a result of measurements made in crystals of zinc obtained by slow distillation of the metal in a vacuum, Williams and Burton[21] have calculated the axial ratio to be $a : c = 1 : 1.3564$. The crystals are hexagonal, with a probable rhombohedral symmetry, and isomorphous with arsenic, antimony, bismuth, and tellurium.——In the pyroxene from Pinzgauer, Cathrein[22] has discovered the forms $\frac{3}{2}P\overline{\infty}$, $P\overline{4}$, $\frac{1}{5}P\grave{2}$, all of which are new to the species. In amethyst from the Zillerthal he has found the new planes

$$\tfrac{7}{5}R,\ +\frac{+P\frac{12}{11}}{4}\ \text{r. l.},\ +\frac{\frac{9}{10}P\frac{9}{8}}{4}\text{r, and } \frac{\frac{9}{8}P\frac{9}{7}}{4}\text{l}$$

while the forms most common to the mineral are absent.——The new plane $\frac{7}{16}P$ is recorded by Cèsaro[23] as occuring on topaz from Saxony.

Miscellaneous.—Retgers[24] has made a careful examination of the heavy solutions used for separating rock constituents with the endeavor

[17] *Zeitschrift. für Min.*, XVII., p. 25.

[18] Prendel, *Min. u. Petrog. Mitth.* XI., p. 7.

[19] *Neues Jahrb. f. Min.*, etc., 1889, II.. p. 89.

[21] *Amer. Chem. Jour.*, XI., p. 219.

[22] *Zeits. f. Kryst.*, XVII., 1889, p. 19.

[23] *Bull. Soc. Franc. de Min.*, XII., p. 419.

[24] *Neues Jahrb. f. Min.*, 1889, II., p. 185.

to obtain modifications with a specific gravity greater than 3.6. His investigations result in the discovery that methylene-iodide will dissolve iodine and iodoform, and yield a liquid with the density of 3.6. For separating minerals with a greater density than this, he suggests the use of fused silver nitrate. At 198°, this salt melts to a colorless liquid, with the density 4.1. A mixture of the nitrate and iodide of this metal give a yellow oily liquid at a temperature of 65°–70°, whose specific gravity (5) is greater than that of any other substance, that has yet been proposed for the purpose desired. The author declares that these liquids serve as convenient means for separating the heavier minerals of rocks, and he gives directions for manipulating them.——The origin of most of the siliceous sinter deposited by the geysers in the Yellowstone Park is stated by Mr. Weed[25] to be due to a secretion of silica by algæ and mosses. Waters too poor in silica to form deposits of this substance by cooling or evaporation, are often dammed back by thick jelly-like accumulations of silica, separated from the water by plant life, which is quite abundant in some of the hot springs. The geyserites and similar bodies are produced by evaporation.

[25] *Amer. Jour. Sci.*, May, 1889, p. 351.

BOTANY.[1]

Peridial Cell Characters in the Classification of the Uredineæ.—In the genus *Roestelia* peridial cell characters are frequently given considerable prominence, and surely frequently add to the certainty of our identification. The question then naturally arises, why are not such characters valuable in the related genus *Æcidium*, where if anywhere in the *Uredineæ* we need all possible characters for certainty in identification.

The characters most frequently used are position and size of æcidia, size and outward appearance of spores, and most important of all, on what host plant. All are very variable, even the latter and most important one, many rusts sometimes occurring on the same host, and frequently the same rust on many hosts. The position—hypoplyllous, amphigenous, or epiphyllous—is changeable, determined, I think, largely by the character of the leaf, as I have shown elsewhere. The size of the æcidia varies also with a change of host-plant and immediate conditions of moisture and heat, as do also the æcidiospores.

What are the peridial cells? They are very likely, as usually supposed, slightly modified chains of æcidiospores loosely attached into a surrounding pseudo tissue layer for protection. This is readily believed when we observe that the peridial cells usually partake, more or less of the character of the æcidiospores, in shape, thickness of wall, roughness or smoothness, etc., and from their breaking apart readily into chains appearing much as the æcidisopores. Believing thus that the peridial cells are developed from the æcidisopores what would seem more natural than that we should examine and describe them as we do the æcidiospores.

In the examination of Uredineæ I have noticed that while the peridial cells are usually very similar in shape and size (yet no more so than the æcidiospores), they are frequently quite characteristic.

In *Æcidium pentstemonis* for instance, the peridial cells are angular, subrotund-elliptical, thick walled, smooth, 19–22 by 22–31 μ., while in the Æcidium *Puccinia tanaceti* D.C., on *Artemisia cana* and *A. canadensis* they are subrotund-angular, 15–21 by 19–26 μ., being very similar to the last, but distinguished by size, being in general smaller. In *Æcidium compositarum* Mart. var. *lygodesmiæ* Webber, they are angular-elliptical and usually strongly tuberculate, distinguished from the pre-

[1] Edited by Prof. C. E. Bessey, Lincoln, Neb.

ceding by shape and character of the surface. In *Æcidium euphorbiæ* Gmel. they are similar to those of the preceding species, but the cells are shorter (15–20 by 19–25 μ.), and not so strongly tuberculate. In many species characteristic differences may be be found. Why not describe them?—HERBERT J. WEBBER, *Lincoln, Neb.*

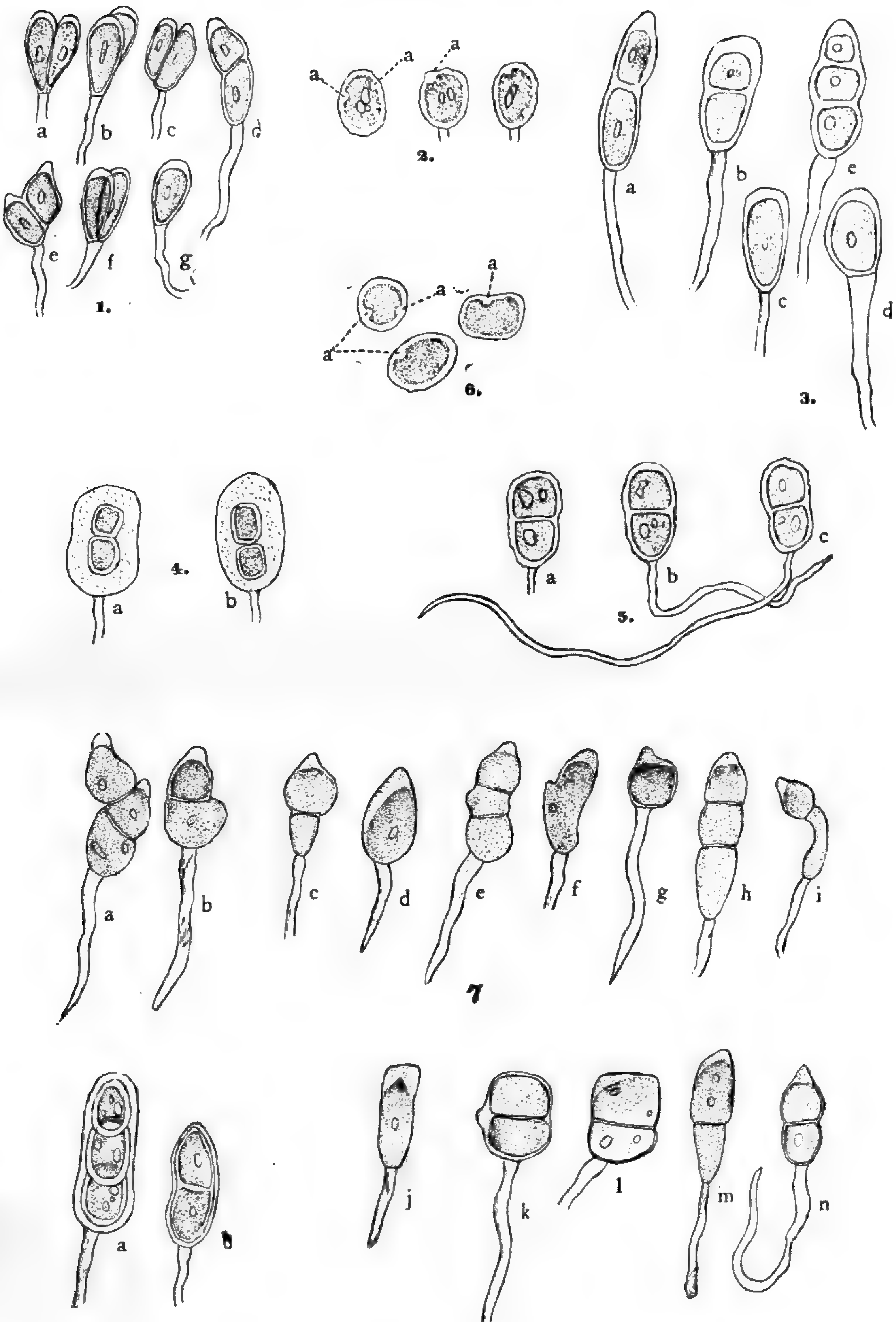
Peculiar Uredineæ.—An abnormal fruit or seed, as a double apple or walnut, is always noted with curiosity by the most untrained observer; so are also such stable but uncommon developments as the navel-orange. Among lower plants the microscopic spores frequently present peculiarities as curious as these, yet although examined usually by careful observers only, they are seldom noted with anything more than usual interest.

In working over Nebraska Uredineæ I have observed a few curious variations from the usual forms that I think deserve particular mention.

Puccinia flaccida B. & Br. (Pl. VIII., Fig. 1, Teleutospores; Fig. 2, Uredospores), a very peculiar species, presents the greatest and most uniform or stable peculiarity from the normal Puccinia, if I may so express it, of any species that it has been my fortune to examine. My specimens were collected at Lincoln, Nebraska, Oct. 13, 1889, on Barnyard-grass (*Panicum crus-galli*). The sori are amphigenous, linear-oblong, small and rather inconspicuous. The teleutospores are frequently one-celled (Fig. 1, *g.*), and in this case are of nearly the same size as the two-celled spores. The septi of two celled spores are in various positions, from almost horizontal to vertical. I have never found onewith a strictly horizontal septum. They are quite frequently almost vertical, each cell attached in part to the pedicel (Fig. 1 *a.* and *f*). In this case they appear as double Uromyces spores. In fact the species seems to me to more resemble a Uromyces than a Puccinia, the one-celled spores, which are always plentiful, being the normal form, and the two-celled spores, with the nearly vertical septi, double spores. About as near an approach to the normal Puccinia as usually occurs is represented by Fig. 1, *d*, and even here the partition is quite oblique.

Burrill, in "Parasitic Fungi of Illinois, Uredineæ," p. 202, says of this: "A most peculiar species. From two-thirds to three-fourths or more of all the teleutospores are septate, presenting the most varying and aberrant forms. So far as we are informed this has not been previously reported from America, but a comparison with specimens kindly furnished by Dr. M. C. Cook of *Puccinia flaccida* B. & Br. from Ceylon, leaves no doubt of the specific identity. The American specimens only differ in possessing more undivided and, upon an average, narrower teleutospores, with somewhat thicker pedicels."

PLATE VII.



The uredospores of this species also illustrate an interesting feature, sometimes occurring among Uredineæ,—the so-called "*germ pores*" (Fig. 2, *a*), two or more hyaline points in the wall of the spore. The spore thus greatly resembles a pollen grain, the points being very likely analogous to the similar thickenings on the pollen grain, furnishing a spot for the breaking through of the tube in germination.

This peculiar feature is found also in the uredospores of *Puccinia prenanthis* (Pers.) Fuckel (Fig. 6, *a*, from specimens collected at Anselmo, Nebraska, July 8, '89). The æcidium of this species is also peculiar, from its lack of genuine pseudoperidium. In the place of the usual pseudoperidium a pseudoparenchymatous hyphæ mass occurs. This is probably the *Æcidium hemisphericum* Pk.

In *Puccina sporoboli* Arthur, (Fig. 3) I find one-, two- and three-celled teleutospores. This species is peculiar in that some of the sori bear only one celled teleutospores (Fig. 3, *c*, and *d*), while others bear only the normal two-celled teleutospores (Fig. 3., *a* and *b*), and still others produce a sometimes almost equal mixture of one- and two-celled teleutospores, with frequently also three-celled ones (Fig. 3, *e* represents a three-celled teleutospore measuring 26.6 by 14.4 μ.) This peculiarity of one- and two-celled spore-sori I find only on specimens growing on *Sporobolus vaginæflorus*, collected at Lincoln, Nebraska, October 13, 1889. Other specimens of the same species on *Sporobolus asper* and *Sporobolus cryptandrus* have only the two-celled teleutospores. Dr. Arthur in the original description from specimens on *Sporobolus heterolepis* mentions the same peculiarity.

Puccinia tanaceti D. C., var. *actinellæ* Webber, on *Actinella acaulis* furnishes in the same sorus a remarkable variety of teleutospores, the contortions being almost as various as those of *Puccinia flaccida*, though not so frequent. Fig. 7, *an*, shows some of the various forms of the teleutospores; (*a*) is a three-celled spore with two apical apices, the upper cell seems as if grown from the side of the middle cell; (*b*) is almost normal, with basal ceil large; (*c*) with large apical cell; (*d*) one-celled; (*e*) three-celled, 21 by 50 μ.; (*f*) one-celled, with side point, 19 by 45 μ.; (*g*) one-celled, 26 by 28 μ.; (*h*) three-celled, 19 by 76 μ.; (*i*) curved, lower cell abortive; (*j*) one-celled, 19 by 53 μ.; (*k*) large, truncate, with side point, 38 by 45 μ.; (*l*) large truncate, 30 by 42 μ.; (*m*) normal spore, 19 by 70 μ.; (*n*) normal spore, 22 by 49 μ.

The teleutospores of the genus *Uropyxis* are exceedingly interesting and important as being one of the main proofs from spore resemblance that the Uredineæ are degraded Ascomycetes, the teleutospore stage being the homologue of the spore fruit, the teleutospore of the ascus and the teleutospore cells of the ascospores. The clear outer pellicle here greatly increases the resemblance to the ascus. A few weeks ago while examining *Uropyxis petalostemonis* (Farl.) D. By., a three-celled teleutospore was observed (Fig. 8, *a*). The resemblance of the normal form to the ascus is plain, but here it was indeed striking, the walls of the cells were so plainly distinct from the pellicle and that of one cell from the other cells. The spores could plainly be seen to overlap as they lay surrounded by the clear pellicle, the spore sac or ascus.

In many teleutospores, if not in all, an outer surrounding sac entirely separate from the enclosed spores may be differentiated. It may readily be seen by heating the spores for a few moments before mounting in nitric acid. In spores thus treated the wall swells out, leaving the spores within clearly distinct. Brownian movement may frequently be seen between the separated wall and the spores, indicating that it is not merely a swelling of the wall, but a separating, the space created being filled with a fluid. A teleutospore of *Puccinia jonesii* Pk. treated in the above manner is represented by Fig. 4, *a*. Three of the normal spores are shown in Fig. 5. Another peculiar feature of this species is its long and exceedingly fragile pedicels (Fig. 5, *b* and *c*). They were described by Peck originally as exceedingly short (Fig. 5, *a*), the mistake being caused undoubtedly by their easy deciduous character. In type specimens, it was only by long soaking and repeated attempts that I obtained the pedicels attached (See Ellis, N. A. F., No. 1448). In Nebraska, specimens on *Musenium tenuifolium* while fresh, I with but little difficulty, found them attached.

Spores of *Puccinia nigrescens* Pk., a typical Puccinia, treated in nitric acid, presented the same peculiar swollen appearance (Fig. 4, *b*).

Typical Puccinia spores prepared as above greatly resemble spores of Uropyxis. Schröeter, in Hedwigia, 1875, p. 65, separated *Puccinia amorphæ* Curt. from Puccinia, placing it from the distinct outer hyaline layer of its spores in a new genus, which he called Uropyxis. To this genus one more species, *Uropyxis petalostemonis* (Farl.) De Toni. has since been added. Some mycologists think the difference between the two genera too slight to justify distinction. The difference at most is but slight, and when we treat Puccinia spores with nitric acid as above the distinction vanishes entirely. Are we then to consider Uropyxis as distinct from Puccinia merely because the spore is surrounded by an outer *distinct* layer, while in Puccinia the outer layer occurs but is indistinct?—Herbert J. Webber, *Lincoln, Neb.*

Grasses of Box Butte and Cheyenne Counties, Nebraska.—On August 21st, 1889, I started out from Alliance, Neb., on a short trip of observation to determine particularly the grass flora of southern Box Butte and northern Cheyenne counties.

Alliance is about four miles east of the 103d meridian west of Greenwich, directly on the line of the 42d parallel. The town lies on a broad level plain, which appears to have been at one time the bed of a lake. Southward and eastward, from eight to ten miles distant, are the sand hills. To the west is the broad valley of Snake Creek, a creek which, like nearly all of the streams of this region, flows from the sand, rushes rapidly forward a few miles, and disappears, losing itself in the sand. North and northwestward the land rises toward Pine Ridge. The only apparent outlet of this lake basin is toward the east, in a pass through the sand hills.

On this level plain, parched and barren under the August sun, the principal grasses found were Gramma, *Bouteloua oligostachya* Torr., and its near relative *Bouteloua hirsuta* Lag., Buffalo-grass, *Buchloë dactyloides* Engelm., wild wheat grass, *Agropyrum glaucum* R. & S., and two others, very common, but of no agricultural value, a Beard-grass, *Stipa* sp.—near *comata* Trin., and prairie wire-grass, *Schedonnardus texanus* Steudel. The great bulk of the prairie grass was Gramma, and I was told that it is *the* pasture grass of the region.

On the morning of the day named, I went in company with Mr. Nelson Fletcher, of Alliance, to a natural meadow of about 350 acres, lying in the Snake Creek valley, just at the foot of the sand-hills southeast of the town. The ground was wet but not swampy, and the rank plant growth which covered it formed a pleasing contrast to the sweltering sandy slopes around the meadow. The chief grass was *Agropyrum glaucum*, which differed from the form found around Lincoln in having longer and less harsh leaves. Mixed with it were *Andropogon scoparius* Michx., *A. provincialas* L., *Muhlenbergia glomerata* Trin. *Elymus canadensis* L., and *Panicum virgatum* L.

With these grasses were tall golden rods, purple blazing stars, and white-flowered asters, altogether making a brilliant flowery oasis in a sandy desert. The growth was very even, from 2½ to 4 feet high. Mr. Fletcher said that although no hay is cut on the open prairies enough is obtained from these natural meadows, and it is hay of very good quality, so that the average price ranges from two to four dollars per ton.

About a mile east of this meadow stood what appeared to be a large field of corn, but on nearer approach it proved to be Reed grass *Phrag-*

mites communis Trin. This grass and cat-tail flags and rushes were quite common in the swampy meadows and around the numerous small lakes of the sand-hill region.

Along the valley of Snake Creek I found in addition to those already mentioned *Andropogon nutans* L., *Oryzopsis cuspidata* Beuth., *Sporobolus airoides* Torr., *S. vaginæflorus* Vasey, *S. asperifolius* N. & M., *S. asper* Kth., *Panicum capillare* L., *Setaria glauca* Beauv., *S. viridis* Beauv., *Deyeuxia canadensis* Beauv., *Distichlis maritima* Raf., and *Spartina cynosuroides* Willd.

In the sand-hills around Alliance the principal grasses are *Andropogon hallii* Hack., *A. provincialis* Lam., *A. nutans* L., *A. scoparius* Michx., *Sporobolus asper* Kunth, *Oryzopsis cuspidata* Bedth., *Bouteloua oligostachya* Torr., *Deyeuxia canadensis* Beauv., *Eragrostis tenuis* Gray, *Stipa comata* Trin., and on the higher hills, and particularly noticeable on the edge of the "blow-outs," *Muhlenbergia pungens* Thurb. In the clear white sand in the "blow-outs" *Redfieldia flexuosa* Vasey is found quite abundantly.

The best grazing grasses are Gramma and Buffalo-grass. Wild wheat grass is good for hay but not for pasture.

I did not find any Sand-burs. They are not needed, for Mammillaria and other cacti make life a burden.

From Alliance I went west along Snake Creek valley twelve or fifteen miles, then southwest through the extreme western extension of the sand-hills till I struck the old Black Hills trail at the head of Red Willow cañon, and thence down the Red Willow southeastward to the Platte. The only new find was *Munroa squarrosa* Torr., on the Platte side of the divide.

From the Camp Clarke, on the Platte, where the old Sidney-Black Hills trail crosses the river, I went south to Court House Rock and Pumpkin Creek. The rock is a great mass of light brown argillaceous sandstone, which rises about 300 feet sheer above the valley.

The ridge stretching westward, of which Court House Rock was once a part, at one time bore a forest of pine and cedar. Now there are only some stumps and a few scattered trees to show what has been before. In the cañons at the foot of Court House were *Rhus aromatica* Ait. var. *trilobata* Gr., and a number of woody shrubs and vines.

On the summit of the rock I found *Oryzopsis suspidata* Benth., *Agropyrum glaucum* R. & S., *Aristida purpurea* Nutt., a form with an erect culm rising from a mat of convolute wiry radical leaves, *Bouteloua racemosa* Lag., the first that I had seen, *B. oligostachya* Torr., and *Muhlenbergia pungens* Thurb.

By the side of the creek, at the base of the rock, I found *Eatonia obtusata* Gray, *Elymus canadensis* L., *Panicum virgatum* L., *P. crus-galli* G., and *P. crus-galli* var. *hispidum* Gr., *Aristida purpurea* Nutt., *Bouteloua oligostachya* Torr., *Munroa squarrosa* Torr., *Oryzopsis cuspidata* Benth., *Sporobolus airoides* Torr., and *Cenchrus tribuloides* L.

The Sand-burs have probably been introduced in the Pumpkin creek valley in the wool of sheep which have been herded there.

Notes.—I did not find *Munroa* north of the Platte river valley. *Andropogon hallii* grew on the foot hills between Camp Clarke and the Court House ridge. These hills are sandy but are not true "sand hills," as that name is applied in the West.

Distichlis maritima is the chief pasture grass of the Platte valley in this vicinity! Other grasses, *Buchloë*, *Bouteloua oligostachya*, *Spartina cynosuroides*, *Agropyrum glaucum*, *Hordeum jubatum*, *Setaria glauca*, *S. viridis*, *Munroa squamosa*, and *Panicum crus-galli* also occur, but by no means as abundantly as the Distichlis.

I visited from fifteen to twenty of the islands in the river at this point. I found two grasses other than the common Platte valley species. They were *Glyceria distans* Wahl., and *Sporobolus depauperatus* Torr. The characteristic plant of these islands is *Shepherdia argentea*, a small shrubby tree known as the Buffalo-berry.—Jared G. Smith, *Lincoln, Neb.*

ZOOLOGY.

The U. S. Fish Commission.—Anthozoa and Echinodermata of the Gulf Stream Slope of the New England Coast.—At various times during 1882, Prof. A. E. Verrill has given to the world notice of the remarkable marine fauna, to a great extent tropical in character, occupying the outer slope of the continental plateau off the southern coast of New England. The abundance of animal life on these banks may be judged from the fact that at a single haul, made on September 1, 1881, over ten thousand specimens were procured. In Prof. Verrill's words "a large number of species, belonging to various zoological groups, in this region are found living gregariously, in vast numbers, at particular spots, while they may not occur at all, or only sparingly, at other stations in similar depths, and apparently identical in temperature and character of bottom."

Among the discoveries of new and rare species during 1881, are the following Anthozoa: *Urticina longicornis*, *U. perdix*, *U. callosa*, *U. consors*, *Actinurus saginatus*, *Adamsia sociabilis*, all new species; *Pennatula aculea*, Dan. and Kov.; *P. borealis* Sars.; *Balticina finmarchica*, Sars.; *Anthroptilum grandiflorum*, Verrill; *Bathyactis symmetrica* Moseley; *Sagartia abyssicola* Verrill. In all thirty-three species, including seven *Pennatulaceæ*. *Adamsia sociabilis* always starts life upon a small shell, usually a *Cavolina*, occupied by a hermit-crab (*Hemipagurus socialis*, Smith), but eventually secretes a chitinous pellicle and absorbs the shell. *Flabellum goodei*, a very fragile coral which is tolerably common, has the power of restoring itself from mere fragments, and the same has been noted in *Parasmilia lymani* Pourtalis. The present year has yielded a remarkable new pennatulid (*Distichoptilum gracile*, Verrill), and two Gorgonians; *Acanthogorgia armata* V., dredged at 640 fathoms, and *Paramauricea borealis* V., from 234 fathoms; the former, when living, was bright orange, the latter pale salmon.

Pennatula borealis, previously known only from a few Norwegian specimens, has been taken both by Gloucester fishermen and the U. S. Fish Commission, at depths varying from 120 to 350 fathoms. The largest one was 21½ inches high nnd 5¼ broad. Some of the Actinians are very large,—*Urticina callosa* is four to seven inches high, and six to ten wide. Occasionally a barrel of large Urticinæ or of *Bolocera tuediæ* Gosse has been brought up at a single haul.

Acanella normanii V., a pretty bush-like gorgonian, was very abundant at some stations, as were also *Pennatula aculeata*; *Flabellum goodei*, and, in one spot, the usually rare *Anthomastus grandiflorus* V. One of the most striking instances of commensalism was that of *Epizoanthus paguriphilus* V., upon the previously rare hermit-crab *Parapaguras pilosimanus* Smith. The polyp forms the habitation of the crab out of its own tissues, and neither polyp nor crab have hitherto been found living separate. *Bathyactis symmetrica* has a wider bathymetrical and geographical range than any other known species, as it has been found off Florida, off the Azores, in the South Atlantic, at depths of from 1900 to 2650 fathoms; in the South Indian Ocean, from 1600 to 1950 fathoms; in the Malay Archipelago and West Pacific, in from 360 to 2440 fathoms; east of Japan, in 2300 to 2400 fathoms; off Valparaiso, in 1375 fathoms; on the New England coast, 225-252 fathoms.

The species of Echinodermata dredged in 1881 were in all forty-eight, twenty-two of which had not previously been found upon our coast; twenty-six may be considered as arctic, twenty-two are European, and fourteen or more have been taken off Florida or in the Gulf of Mexico.

Among these forms were *Dorocidaris papillata* (this was previously not supposed to occur north of the Gulf stream, off the coast of Florida); *Schizaster canaliferus* L. Ag., somewhat different from the type, probably a geographical variety, *Brissopsis lyrifera* Ag.; *Phormosoma sigsbei* A. Ag., *Archaster bairdii* sp. nov., in general appearance like *A. parelli* and *A. agasszii*; *Ophioglypha aurantiaca* sp. nov; *O. confragosa* Lyman, the type specimens of which were dredged by the Challenger off the La Plata in 600 fathoms; *Amphiura macilenta* sp. nov., very abundant off Martha's Vineyard; *Toxodora ferruginea,* a new genus and species of holothurian; *Asteras briareus* sp. nov., *Ophioglyphia sarsii* Lütken, which occurs in two varieties, one abundant in shallow water, the other, with less prominent disk-scales, common in the depths of the Bay of Fundy and off Nova Scotia; *O. signata,* sp. nov., not rare in deep water; and *Antedon dentatum,* first described by Say from Great Egg Harbor, N. J., as *Alectro dentata.*

At one spot two or three barrels of *Ophoglypha sarsii* came up at one haul; and *Archuaster agassizii* occurred in great numbers in one spot, at 337 fathoms.

The work of 1882 has obtained nearly all the species found in 1881, with the addition of the following: *Solaster earllii,* Verrill, a Diadema-like sea-urchin with nine arms, and of a bright scarlet color; *Lophaster furcifer; Astrogonium granulare, Astrophyton lamarckii,* also bright orange; *Asteronyx loveni* M and Tr., found upon a pennatulid at 700 fathoms; a new Ophioscolex, and *Rhizocrinus lofotensis.*

That the arms of an Ophiuran can be restored after they have been broken, or entirely lost, is well-known; but Prof. Verrill has seen cases in which the entire dorsal disk, with the contained viscera, had been lost and more or less restored. The species exhibiting this strange power was *Amphiura abdita* V., and the specimens were taken among *Zostera* at Noank, Conn. The dorsal disk is soft and swollen, and easily torn away, leaving only the jaws connecting the arms. In some the new disk, though perfect in form, had not reached more than one-third or one-half the diameter of the old one. Prof. Verrill thinks it probable that his *A. macilenta* is the true young of this species.

The headquarters of the U. S. Fish Commission, during both 1881 and 1882, were at Wood's Holl, Mass. During 1882 only five trips were taken to the Gulf Stream slope, but these were successful ones. The total number of Invertebrata now on the lists of the fauna of this belt is about 575, and this neither includes the Foraminifera nor the Entomostraca, which are numerous, and but few of the sponges. Of those determined, about 265 are Mollusca, including 14 Cephalopods;

85 are Crustacea; 60 Echinodermata, and 65 Annelids. About 75 species of fishes have also been found here. Many species, especially Crustacea, common in the two previous years, were scarce or absent in 1882. This, as well as the great destruction of the tile-fish (Lopholatilus) was, in Prof. Verrill's opinion, probably caused by a very severe storm that occurred in this region, which "by agitating the bottom water, forced outward the very cold water that, even in summer, occupies the great area of shallower sea, in less than 60 fathoms, along the coast, and thus caused a sudden lowering of the temperature along this narrow *warm zone* where the tile-fish and the crustacea referred to were formerly found."—W. N. L.

The Ectoderm of Spongilla.—According to one group of authorities the ectoderm of the larval sponge is transformed directly into that of the adult, while others claim that during metamorphosis the ectodermal larva entirely disappears. To ascertain the real facts in the case, Otto Maas contrived apparatus whereby a single embryo of spongilla could be kept constantly under observation during all its stages until sometime after attachment, and he concludes (*Zool. Anz.*, No. 316) that the larval ectoderm is transformed directly into that of the adult. At first the cells are columnar; after becoming attached the animals increase rapidly in size, which is accompanied by a flattening of the ectoderm, which is now cubical and growing flatter and flatter; the cell boundaries disappear, but always a sharp focusing will reveal a double contour. The ectodermal tissue is visible and the layer appears as an extremely thin hyaline membrane. Götte's sections in which no ectoderm was visible are interpreted as artificial products, the delicate ectodermal pellicle having been torn away in spots in the processes of preparation.

Copulatory Marks in Spiders.—There are very few instances in the animal kingdom of easily recognized marks of copulation. The cases of spermatophores protruding from the female genitalia, the male copulatory organs adhering in the female of the honey bee, and occasional male palpus sticking in the epigyne of spiders, and the hardened secretion forming a sort of pocket on the abdomens of certain butterflies (Parnassia, etc.), are all noticeable from their peculiarity. Dr. Bertkau finds that in spiders of the genus Argenna a similar sign occurs. Immediately after copulation the opening to the spermathecæ becomes covered with a little white or slightly rosy lid, which may be retained for a considerable time, even months. The origin of the secretion which produces these lids is utterly unknown, nor is it known whether it is produced by male or female.

New Glands in the Hemipterous Embryo.—It is well known that in the insect embryo traces of rudimentary appendages occur on the abdominal segments, but the histology goes to show that these evanescent structures on the first abdominal segment have lost their ambulatory function and have taken on another. One series of investigators believe that they are gills, the other as sense organs or glands. Mr. W. M. Wheeler has studied homologous structures in Cicada and Nepa, and finds (*Zool. Anz.*, 317) that in these forms there is no protruding appendage, but in its place a swollen ectodermal patch composed of greatly elongate epithelial cells, flat on the free surface and extending itself into the interior of the body. Proceeding from these cells was found a secretion which varied in character (in hardened specimens) in the two forms studied. In Cicada it formed a vacuolated transparent mass; in Nepa it formed a brush-like mass of elongate threads, apparently a thread to each secreting cell. There was apparently no connection with the nervous system, so that these organs in the Hemiptera must be regarded as glandular. Concerning the functions of these and other similar glands, it is difficult to say, but it is possible that they may fall among the category of silk-glands, and play a part in making these forms nauseous mouthfuls for insectivorous animals.

Abdominal Appendages of Lepismida.—Oudeman shows that there is a regular succession in the appearance of the ventral abdominal appendages in the Thysanurous form, *Thermophila furnorum.* In the smallest forms only the pair belonging to the ninth segment are present; increase in size brings the eighth pair, while only the full grown individuals have appendages on seventh, eighth, and ninth segments. Oudeman thinks this adverse to the view that these are rudimentary appendages homodynamous with the others.

The Segmentation of the Vertebrate Brain.—Mr. C. F. W. McClure attacks (*Zool. Anz.* 314) this oft-studied problem from another standpoint. He finds, in studying Amblystoma, Anolis, and the chick, that there is an evident segmentation of the nervous centre, it being divided, in an early stage, into segments or neuromeres, which alternate with the mesodermic somites. This segmentation extends into the cranial region, and embraces the whole of the brain, the fore-brain consisting of two (possibly a portion of a third), the mid-brain of two or three, and the hind-brain of six or five neuromeres, a total of ten, which correspond with the line of division between the nine mesodermal somites recognized by Van Wijhe in the head.

The Origin of the Pelvis.—Wiedersheim, in a preliminary account of the origin of the vertebrate pelvis (*Bericht d. Naturf. Gesellschaft*, February, IV., 1889), claims that the key to the first appearance of this structure is to be found in *Lepidosiren annectens*. Here the fibrous tissue of two pairs of myotomes in front of the cloaca through a process of chondrification reach a higher condition of connective tissue. These cartilaginous zones fuse in the *linea alba abdominis* to form an unpaired plate, thus affording a solid support for the free extremities. This process, which occurs again ontogenetically in the lowest urodele Batrachia, finds a parallel in the chondrification of a number of myotomes in the thoracic region of certain perennibranchiate Batrachia,—*i.e.*, in the rudiments of hyaline cartilage ventral ribs. The sternum of the Batrachia also falls in the same morphological category.

The vertebrate pelvis also owes its first appearance to the conversion into cartilage of a pair of abdominal myotomes—or to use the terms of human anatomy, of the *inscriptiones tendineæ* of the ventral body muscles.

The Stapedial Bones.—Dr. C. K. Hoffman claims (*Zool. Anz.*, 310) that the stapes in the reptiles arises from two sources. The otostapes arises from the outer layer of periotic mesoderm as a strong lateral process. At about the same time the hyoid arch is prolonged into a medial projection, the hyostapes, which unites with the otostapes to form the stapes, while the connection with the hyoid is lost. Hoffman thinks that similar relations can be traced in the Mammalia. The stapes proper is the otostapes, and the os lenticulare is the hyostapes. The fact that the facial nerve innervates the stapedial muscle on the lenticular portion lends probability to this view.

Frogs Eating Snakes.—(January NATURALIST, p. 74). If Mr. H. L. Roberts will turn to page 348 of my "Naturalist's Rambles About Home," he will find that I have described in full an instance of a frog (*Rana pipiens*) swallowing a snake. More recent observations have convinced me that such an occurrence is not as uncommon as might be supposed, considering the fear usually exhibited by a frog when a snake approaches.—CHARLES C. ABBOTT, *Trenton, N. J.*

Voice of Hyla andersonii.—The specimen of this beautiful batrachian referred to by Dr. Peters in the January NATURALIST is still in excellent health, and occasionally utters its characteristic cry, which should not be described by the word "peep," for this suggests a similarity to the cry of the Pickering's Hyla, which shrilly "peeps." The *andersonii* utters a single note, better described by the syllable "keck," which it usually repeats three or four times. It is not a frog-like note at all, but much resembles the call of the Virginia rail (*Rallus virginianus*). If the collector follows up any "peeper" in the marshes, he will not discover additional specimens of *Hyla andersonii*.—CHARLES C. ABBOTT.

The Trochlearis Nerve in Lizards.—Contrary to his earlier view, Hoffman now finds (*Zoöl. Auz.*, No. 310) that the trochlearis of the lizard at an early stage possesses a ganglion, and that it in all respects resembles one of the truly segmental nerves. This ganglion aborts at about the time of the deposition of the retinal pigment. He asks the question if this is not to be regarded as the first segmental nerve of the hind brain? In snakes, birds, and teleosts he finds no ganglion at any stage of development. He also suggests that the present distribution of the trochlearis may be secondary, and that formerly it was connected possibly with the occluding organs of the parietal eye.

Bats in the Wyandotte Cave, Indiana.—In the summer thousands and tens of thousands of bats assemble in Wyandotte cave, in Crawford county, and in other caves. A man living near Wyandotte cave, who had observed them for years, said that frequently in the early dusk of evening, he had seen a column of these flying animals from thirty to sixty feet in width and from two to three miles in length move from the mouth of the cave in a straight line going in a northwesterly direction. In a short time another column would move toward another point of the compass, and then perhaps another, each as long as the first, and, as long as within his observation, without straggling, and guided as by some reason or instinct that led these small-brained creatures to a known haunt or point. In the morning they would return, not in solid column, as they departed, but in large flocks or droves, passing into the cave, where they would be seen no more until the next evening. "Faneuil Hall" is a spacious corridor in Wyandotte cave, forty feet wide and eighteen to twenty feet high. Here daylight ends and darkness begins. Here we see the first of cave life. Here are clusters of bats which sleep in the daytime, hanging by their hind feet with their heads downward. They hibernate in myriads in the winter, attached to the sides and roof by their hind feet. The surface of the stone being porous affords great attachment to their claws, while the peculiar construction of their feet makes the grasp of their claws stronger the more and the longer the weight is attached to them. They collect in clusters, so that they are in contact with one another, and the animal heat thus retained assists in their comfort. The cave temperature ranges from 58° in the fall down to 52° or 53° in the spring, and the cave "breathes" semi-annually at the autumnal and vernal equinoxes, having a discharge of warm air in the fall, and an inflow of cool air during the winter. In the cooler weather the bats are not satisfied with a single layer, but are attached like swarms of bees, hanging down. The highest temperature in the highest part of the cave is 66° in the winter. This cave is floored in two stories. Passing on one goes through numerous halls, corridors, arches, and domes, which are occupied to a greater or less extent by these Chiroptera. For reasons known to themselves alone some of the rooms are favored spots, while others are rarely occupied by them.

The southern route in the cave was discovered in 1850, and was unvisited up to that time by quadrupeds like raccoons and opossums, because the opening was too small for them to pass through. The current of air passing in was very slight, and the temperature uniform. This made it a favorite place for these furry flyers. The second hall, "Bats' Lodge," as it is named, is a spacious room in which the bats delight to assemble for council purposes, it would appear, as well as sleep. I saw the ceiling largely covered with clusters of them crowded closely together. Disturbed by our entrance, the room was filled with their slight, plaintive, whining, whispering voices and the disagreeable odor of their bodies. My first visit was in the early autumn. The results noted were taken in December, when the outer world was cold enough to close the Ohio river with ice, and the thermometer at the mouth of the cave was from six to twelve degrees below zero. The bats were evidently hibernating, and, although somewhat torpid, yet, when disturbed, in falling they dropped a distance of six or eight feet, their bodies rarely fell to the ground. Recovering the use of their wings, they would fly back to one of the clusters. There are two kinds of bats in Indiana—the red bat and the common black bat. The red bat is the Southern type, and is rare, only occasional specimens having been taken.—John Collett, in *Indianapolis Journal.*

Zoological News.—General.—Volume XXX., part I, of the *Quarterly Journal of Microscopical Science* contains an index extending from 1853 to 1888; an Index to the Transactions of the same society from 1844 to 1852; and to the Proceedings of the Dublin Microscopical Society from 1865 to 1880.

Sponges.—Von Lindenfeld thinks that the collared endoderm cells of the sponges are never free, but are imbedded in a ground substance from which they are capable of some protrusion. He also thinks that the "membrane" recently described by Dendy and Sollas in certain sponges is, in reality, but the free surface of this ground substance.

Worms.—*Otoplana intemedia* is a new turbellarian described by Dr. du Plessis as combining many features. It has no eyes, but has an otocyst in front of the brain, ciliated pits on either side of the otocyst like those of the nemertines, long, symmetrically placed tactile hairs on each side of the body; the surface of the body is covered with sticky cells (Klebzellen); there is a single median posterior sexual opening; and the alimentary canal is dendrocœlous.

Mollusca.—Pelseneer (*Zoöl. Anz.*, 309) denies that the hooks of the pteropod molluscs have any morphological value, a view at variance with that expressed by Schalfejeff.

The thirtieth volume of the Challenger series concludes with a supplementary report upon the Polyzoa, and is by Mr. A. W. Waters. It consists of 41 pages and 3 plates.

Fishes.—Prof. A. C. Haddon writes to *Nature* (Jan. 17, '89) that apparently the tail in Periophthalmus is an efficient organ of respiration. He also describes the methods of fishing for turtles with the suckfish or remora, employed by the natives on the shores of Lowes Straits.

The American genus Carpiodes (Catostomidæ) has been found in Australia.

Reptiles.—Dr. G. Baur, in his Osteological Notes on Reptiles (*Zoöl. Anz.*, No. 296), calls attention to the fact that in *Podocnemis dumeriliana* the neck vertebræ possess the same saddle-shaped articulation of the centra which hitherto has not been found outside the group of birds. Baur also characterizes anew from osteological details the Trionychidæ, Sternothæridæ, Podocnemidæ, as well as adding some notes on other families. He maintains, contrary to Boulenger, the distinctness of Erymnochelys from Podocnemis.

Arthropoda.—Mr. F. A. A. Skuse recently described before the Linnæan Society of New South Wales a new genus (Batrachomyia) and two new species of flies closely allied to Oscinis, which are peculiar in laying their eggs beneath the skin of frogs.

A comparative study of the alimentary canal of the larvæ and imagines of the Ephemeridæ is interesting, since these forms take no nourishment in the adult condition. Fritze (Bericht Naturf. Gesellsch. Freiburg, IV.) has made such a study, carefully detailing the histology of several species in all stages. His results in brief are that at no time is the alimentary canal rudimentary, but that at the time of metamorphosis it becomes emptied of food, and is then distended with water, so that the columnar epithelium of the mesenteron is stretched into pavement epithelium. Later the water is replaced with air, which is serviceable in lessening the specific gravity of the perfect insects.

Birds.—A short note in the March *Geologist*, by W. K. Parker, tends to somewhat rehabilitate the old and still popular idea that swifts and swallows are related. Though Mr. Parker places the former among the Picariæ, he says that they are on the passerine verge of the group, and have an ægithognathous palate, *i. e.*, the vomer is fused with the floor of the nasal labyrinth. The proportions of the wing in the group vary greatly, as may be seen from the following measurements of its members in two of the largest Cypselidæ:

	Humerus.	Ulna.	Manus.
Macropteryx mystacea,	24 mm.	29 mm.	47 mm.
Chætura caudaca,	17 "	24 "	57 "

Swifts and humming-birds, like passerines, have no second phalanx on the "pollex," nor a third on the index.

Aphriza virgata affords Dr. Shufeldt material for an essay regarding the osteology and taxonomy of the snipe, plovers, oyster-catchers, and surf-birds (*Jour. Morph.* II., Part 2). He concludes that the existing classifications do not properly represent the relations of the Limicoline birds, and that the Aphriza and Arenaria should each be raised to family rank.

Mammals.—Mr. Robert Gray (*Zoölogist,* March) relates the discovery of a herd of narwhals asleep, with the spiracles under water in many cases; and states his conviction, which is that of many intelligent whalemen, that the Cetacea habitually sleep under water, and either wake to breathe, or do so by reflex motions. Whales have been seen to emerge from under fields of ice without air-holes, and they disappear from the surface with some regularity. It is only when the water is smooth that Cetaceans have been found asleep on the surface.

J. E. Harting (*Zoölogist*, March, 1889) states that the roebuck is still found wild in Dorsetshire, and that there are a few near Wigton, in Cumberland; otherwise, it is now almost entirely confined to Scotland. Even in Dorset its presence is due to a reintroduction. A curious fact in the life history of the roe is that, though the rutting season is in August, the ovum lies dormant until December, when it developes at the normal rate. Occasionally a female roe has horns.

The discovery in the Hebrides of *Mus hibernicus*, a species which, like *Mus decumanus*, has the tail shorter than the head and body, and the ears relatively small, forms the subject of the first article in the *Zoölogist* for June, 1889. It is a smaller and more elegant animal than *M. decumanus*, with finer fur, of a dark silvery gray, almost black tint, upon the back. The far of the sides is paler, and the under surface is silvery mouse-gray.

In the September issue of the same periodical Mr. T. Southwell states his belief that *M. hibernicus* is a hybrid.

Alphonse Milne Edwards has recently described a peculiar marsupial from New Guinea, under the name *Dactylopsia palpator*, remarkable for the enormous length of the fourth digit of the hand, which nearly equals the elongate third digit of the Malagassy Aye-Aye.

PHYSIOLOGY.[1]

Nature of Knee-jerk.—There are two theories of the nature of the knee-jerk phenomenon: one regards the process as entirely peripheral, the muscle fibres being directly stimulated to contraction by the twitch of the tendon; the other regards the action as reflex. Objections to both exist; to the peripheral theory, especially the fact that the reflex arc must be functional; to the reflex theory, the fact that the time necessary is very short—only about one-fourth that of other reflex actions. Dr. Lombard, who made an elaborate study of the phenomenon in 1887,[2] brings forward the results of experiments to prove the tenability of the reflex theory.[3] These experiments were made on

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

[2] See *American Journal of Psychology*, Vol. I.

[3] *Journal of Physiology*, Vol. X, p. 122.

twenty-five students, in whom the knee-jerks resulting from the blows of a hammer, the force being known and constant, were recorded on a drum. The peripheral theory assumes that the tension of the muscle determines its ability to respond to mechanical stimuli, and that this tension depends on tonus impulses originating in the spinal cord. These assumptions are without proofs, and the theory is opposed by facts. "The knee-jerk may be present when muscle tonus appears to be wanting, and may be absent in the case of men who apparently have a normal amount of tonus. When the knee-jerk is lacking, it cannot be restored by any amount of tension which can be artificially supplied to the muscle. The tonus theory does not explain the difference which always exists in the size of the successive knee-jerks, for it is found experimentally that the size of the knee-jerk is not influenced by slight variations in the tension of the muscle; nor can the changes in the amount of the knee-jerk be attributed to alterations of the irritability of the muscle dependent on fine variations in tonus, because experiments show that the irritability of the muscle does not change within short intervals of time. The peripheral theory does not explain the reenforcements of the knee-jerk [*i.e.*, the increase of the latter when it is accompanied by voluntary motion in some part of the body or by sensations], because reenforcing acts, unless very violent, do not alter the tension or irritability of the muscles. The discovery of Mitchell and Lewis, that muscular contraction called out by electrical stimulation cannot be reenforced, is inexplicable by the peripheral theory, though readily explained by the reflex theory. Finally, occasionally the flexors, as well as the extensors, of the knee are seen to contract in response to the blow on the ligamentum patellae. This contraction of the flexor muscles is of reflex origin, and there is little reason to doubt that the extensors are irritated by the same reflex process. The idea that the flexors are mechanically stimulated by the strain brought on them by the sudden extension of the knee is untenable, because we know that muscles are not irritated by slight strains on their tendons, and the flexors are seen to contract when the knee has extended so little as to bring almost no strain upon them; moreover, in spite of the fact that the muscle irritability does not change within short intervals of time, small knee-jerks may be seen to be accompanied by marked contractions of the flexors, and, immediately after, large knee-jerks by little or no flexor contraction."

——Pick[1] finds histological evidence in favor of the reflex theory.

[1] Archiv f. Psychiatrie, XX., 3, p. 896; cf. Centralblatt f. Physiologie, 1889, No. 12, p. 272.

In a paralytic the left knee-jerk was wanting, and the right was present with motor reinforcement only. Post-mortem investigation of the spinal cord revealed marked degeneration of fibres in the region of the entering posterior roots of the lower dorsal and upper lumbar sections on the left side, less on the right side; the fibrous portion of Clark's columns was more atrophied on the left than the right, also the left posterior roots in places. This confirms Westphal's localization of the centre for the knee-jerk.

Heat-centres.—The localization and even the existence of heat-centres in the human central nervous system is still in dispute. According to Ott,[1] six such centres, injury to which is followed by increase of temperature, have been localized in the lower animals. These are the cruciate in the region of the fissure of Rolando, the Sylvian, at the junction of the supra and post-sylvian fissures, the caudate nucleus, the region about the corpora striata, a point near the median line between the corpora striata and the optic thalami, and the anterior inner end of the optic thalami. Ott has collected a number of clinical cases as evidence of similarly located heat centres in man. The high temperature usually following lesions of the spinal cord, medulla oblongata, or pons varolii, is explained as due to a removal of the influence of the thermotoxic centres allowing spinal thermogenesis to become exaggerated.

——At a recent meeting of the Neurological Society of London, when pyrexia was under discussion, Victor Horsly[6] gave some results of observations on the differences of temperature of the two sides of the body as symptomatic of cerebral lesions. He states that in 18 cases lesions of the "corpus striatum frontal plane of the hemisphere," which reaches the brain surface in the ascending frontal gyrus, was followed as a rule by increased rise of temperature in the opposite side of the body; lesions in other parts of the hemisphere were not so followed. He deprecated the use of the term "heat-centres," until the matter had been more fully investigated by experiment.

At the same meeting Dr. W. Hale White[7] gave an account of his researches on the influence on bodily temperature of lesions of the corpora striata and optic thalami. Rabbits were used for experiment, and the lesions were made by trephining the skull and inserting a wire in such a manner that portions of the central ganglia could be de-

[5] Brain, Part XLIV., 1889, p. 433.

[6] British Medical Journal, Vol. I. for 1889, p. 1406.

[7] *British Medical Journal*, Vol. I. for 1889, p. 1401.

stroyed without seriously damaging the upper part of the brain. Neither etherization nor trephining and pricking the dura mater caused long-lasting rise of temperature. Lesions of the white matter alone seemed incompetent to produce a rise of temperature. Twenty-three lesions of the corpora striata alone were followed in all except two cases by a rise averaging fifty-eight hours in duration, and equaling from 3° to 5.2° F. Nine lesions of the optic thalami alone caused a rise of 2°+ to 3°+, and averaging forty-two hours in duration. The nerve fibres that modify the temperature apparently do not cross in the rabbit, this animal thus differing from man.

Function of Mammalian Sympathetic Ganglia. — In 1887 Dr. W. Hale White published [8] the results of microscopic examinations of the superior cervical ganglia of man and numerous lower mammals, which tended to show that this ganglion gradually degenerates the higher one goes in the animal scale. He has since made further observations on this and other sympathetic ganglia.[9] As regards the superior cervical ganglion, in adult man the nerve cells as a rule were pigmented, granular, shrunken, non-nucleated, and degenerate in appearance, the degeneration being greatest in old persons; in children and fœtuses, the cells were like normal nerve cells; in twenty-one species of lower mammals, the cells were also like normal nerve cells, except in one of the Catarrhine apes, where slight evidences of degeneration existed. As regards the semilunar ganglia, thirty-three human specimens, three taken from children, showed normal nerve cells, while twenty-four adult ganglia showed degeneration; of eighteen lower mammals, all possessed cells of the normal type. In human thoracic ganglia, a few nerve cells possessed slight granularity and pigmentation, and this was more marked in aged individuals. The author draws the following conclusions:

"Firstly: That in lower mammals and young human beings the collateral ganglia (if we may judge from the superior cervical and semilunar) are functionally active, but that in monkeys there are evidences of the commencing loss of their function, which has completely disappeared in the human adult. Secondly: That in man the function of the lateral ganglia is maintained well into adult life, and only begins to disappear in old age."

[8] *Journal of Physiology*, Vol. VIII., p. 66.

[9] *Journal of Physiology*, Vol. X., 1889, p. 341.

ANTHROPOLOGY.

Congresses, National and International, held in Paris during, and a part of, the French Exposition of 1889.—There were about 120 such congresses; all such as would otherwise have been held in France, and many of those which would otherwise have been held in other countries in Europe, were held in Paris, in 1889.

The Congress of Archælogie and Anthropologie Prehistorique was the most important from the American standpoint of Archæology. There were enrolled 420 members. Of the foreigners there were Belgians, 56; English, 32; German, 28; Italian, 26; Danes, 13; Austrians, 11; Hollanders, 7; Portuguese, 13; Swedes, 8; Swiss, 7; Russians, 6; Finns, 6; Spaniards, 4; Americans, 5; though not all were present.

The first three seances of the congress were devoted to the questions relative to glacial phenomena, the formation of river valleys, and the classification to be made in prehistoric anthropology and paleontology during the quarternary epoch. The ancient theories relating to these questions, the latter especially, were maintained by Dr. Gosse, of Geneva, and Mortillet, of Paris. Their opponents were Mr. Evans, of London, and Monsieur Gosselet, of Lille. Dr. Schliemann occupied an afternoon in the discussion of his celebrated discoveries in Asia Minor. Mons. J. de Morgan rendered him much assistance in demonstrating the antiquity of the men of that epoch and locality by relating his discoveries in Armenia; a part of which antiquities the National Museum has just purchased from his brother, H. de Morgan. Interesting papers and discussion were read and had on the subject of the age of bronze and stone in Denmark, the antiquities of the Canary Islands, the Megalithic Monuments of Tunis, the Lacustrian of Roumania, the engraving and sculpture in southern France, particularly at the cavern of Mas d'Azil. The papers were read respectively by Dr. Sophus Muller, MM. Derneau, Hamy, Butzurneau, and Judge Piette. My own papers were those relating to the periods, paleolithic and neolithic, in America, and that on the subject of the gravels of Trenton in which Dr. Abbott has discovered paleolithic implements. MM. Fraipont and Lohest gave most interesting descriptions of their celebrated discoveries in the Grotto de Spy, Belgium. Dr. Topinard described his studies in the color of hair and eyes of the people of France. There were interesting papers and discussions by the Portuguese, Spaniards, Russians, Scandinavians, and Belgians.

The French Exposition was immense. It was a great success from an artistic, educational, financial, and expositional standpoint. It could scarcely be otherwise, for the French people and government were in perfect harmony, and thoroughly interested and determined in their efforts. They commenced with sufficient appropriations and in ample time to make it so. The total number of paying entries exceeded 25,000,000 persons; the average entries upon ordinary days were from 140- to 160,000, while on *fête* days, Sundays, extra music, illumination, fireworks, etc., the attendance ran up without effort to 250,000 and even 350,000.

I took with me 397 objects belonging to prehistoric America. One hundred and sixty-five were paleolithic implements which I had gathered up in the District of Columbia, a few weeks before sailing, for this purpose. I did not expect to bring these back, but I intended to use them for purposes of donation, exchange, etc. One hundred and eight of them were arrow- and spear-points, having the same destination. Eleven specimens, and one box containing uncounted and unnumbered specimens, were chips and flakes from Flint Ridge, and obsidian from the Pacific Slope, intended as a donation to M. de Mortillet, who is making a collection of this material, and has obsidian flakes and cores from almost every part of the world. Forty-five were plaster casts of the peculiarly shaped Indian objects of the United States, which were denominated by Dr. Rau as "Ceremonial." There were also a series of casts of pipes. Seventy-one were objects from the collection of Mr. W. K. Moorehead, and represented the celebrated discovery made last April in the Porter Mound, Roos County, Ohio. Twenty-eight were impressions of pottery, showing the decoration. Twenty-nine specimens were hard stone, and were intended, with the Moorehead collection, to be returned to me at Washington. The others were intended for gift or exchange. They proved exceedingly interesting to the prehistoric anthropologists who were in attendance upon the various congresses. I first endeavored to make a display of these objects in the halls used by the congresses, but found it to be unsuitable, and, by the advice of those who had the greatest knowledge and interest in the matter, I took them to the exposition, purchasing two glass-top cases, black in color, and respectable in appearance, and there displayed the entire collection. This was in accordance with the recommendation of Dr. Hamy, MM. Cartailhac, Boban, and others.

I directed that at the close of the exposition the objects remaining were to be disposed of as follows:

The principal portion of the paleolithic specimens were to go to the Musée of St. Germain, though several individual objects were to be given to MM. de Mortillet, Cartailhac, Capitan, d'Acy, and Boban. The plaster casts of the ceremonial and other curious objects peculiar to the United States will go to the Trocadero Museum in charge of Dr. Hamy.

I do not know whether any of these objects will figure in the catalogues of the exposition, but I was assured that all inspection and visits by the jury for the award of prizes had been made before my display was set up.—*Thomas Wilson.*

British Museum.—We landed in England on the 4th day of September, and spent the rest of our time until the 2d of October there and in Ireland. I visited the British Museum, and had several conferences with Mr. Franks, who is the Curator of the Department of Ethnology and Prehistoric Archæology. I had known him before, and my visit was very satisfactory. His department is being enlarged, and he will have room for a better and finer display. That portion of his department relating to prehistoric man has fewer objects than the same department in the National Museum; but it occupies greater space, and is consequently displayed to better advantage.

Mr. Franks receives an annual appropriation for the *purchase* of specimens for his department of £1,200, equal to $6,000, besides a fund left by Mr. Christy, of which Mr. John Evans and Mr. Franks are trustees, the income of which, however, I do not know. The Christy fund has furnished many of the objects in the Museum. It, with some aid from the Museum, I believe, has lately purchased the magnificent collection of Mons. Peccedeau de Lisle, of Toulouse, France, comprising a full series of the cavern implements and objects of France, and including his great find at the cavern of Bruniquel, being the largest part of the known examples of sculptured and engraved bone and horn and ivory objects belonging to the paleolithic period. I did not wish to ask the prices paid for this collection, but when I examined it at Toulouse the lowest price at which it could have been purchased was 40,000 francs, equal to $8,000. It is now displayed in the paleolithic room at the head of the stairs in the British Museum. It contains the three well-known and unique sculptures in the round, of ivory and reindeer horn, two representing a reindeer and the other a mammoth. There are many other drawings and engravings etched or engraved upon bone or stone, some of which show great artistic power. The report of this department in Parliamentary

Paper No. 229, 1888, says: "This acquisition renders the collection at the Museum of ancient cave remains the most complete that is known to archæologists."

I visited the Kensington Museum and the Museum of Natural History, now presided over by Prof. W. H. Flower. Prof. Flower was president of the British Association at Newcastle this year, and his address was devoted to the organization of museums so as to produce the greatest benefit for students and for the public.—*Thomas Wilson.*

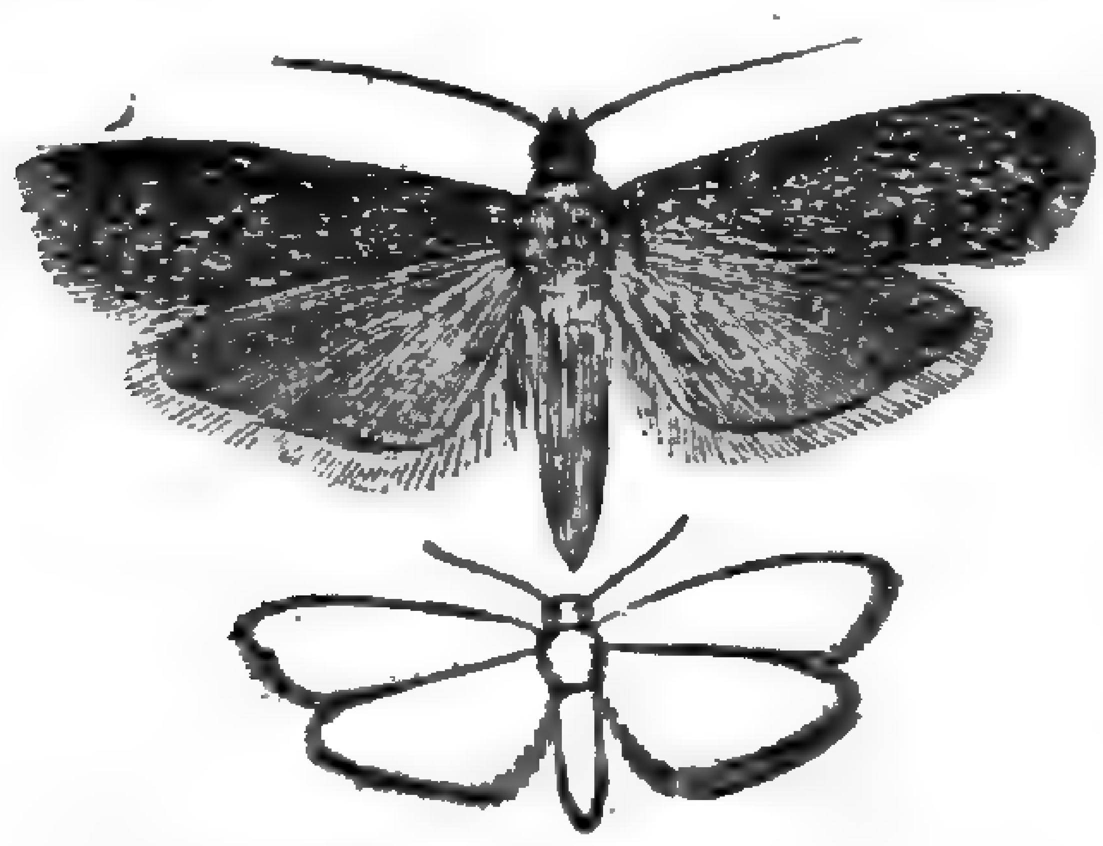
ENTOMOLOGY.

The Flour Moth.—A new insect pest has recently made its appearance on the continent of America. It is known as the flour moth (*Ephestia kuhniella*), and its ravages, as its name indicates, are seen in the destruction of flour, in which it weaves its webs, and upon which the caterpillar feeds. As it is very destructive, and increases with marvelous fecundity, it is of the utmost importance that every precaution should be taken to prevent its spread.

The flour moth is indigenous to the Mediterranean, and a few years ago it would have been likely to stay there. But increasing commerce has its attendant dangers. Experience has shown that as trade in the milling industry enlarges, weed and insect pests, confined at one time to a certain locality, have spread to places far distant. The flour moth has probably come to America with importations of seed wheat, or in bags in which flour has been exported, and which before their return may have been stored for a time in some place infested by the insect.

The color of the fore-wings of this moth may be generally described as of rather pale gray, with darker transverse markings. The hind wings are peculiar for their whitish semi-transparency, with a darker line from the point along a part of the fore edge. The accompaning illustration will convey a general idea of the appearance of the moth.

An examination of the flour infested by the insect shows a mass completely spun together with the web. Giving the result of his investigations, an expert tells us he found it so matted together that, after pulling some lumps of it away, he found that the rest hung down in rag lumps or clots, so felted together that little flour remained in a loose state. From a mass of these clots, containing two or three cubic



(a). Moth (imago) magnified.
(b). Outline, showing natural size.

Moth (imago) slightly magnified; sessile or quiescent.

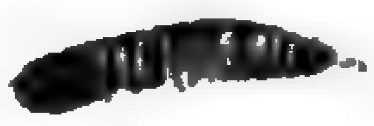
inches, only a teaspoonful of flour could be obtained by repeated shakings. The mass was filled with live caterpillars, living and dead chrysalids, and remains of dead moths. Going on to describe the appearance of these caterpillars, he says:

Caterpillar (larva), natural size.

"The caterpillars varied in size from two-eighths up to five-eighths of an inch in length, and correspondingly in color, the younger ones being of flesh or pale red color, and the largest almost white; the shape cylindrical, somewhat slender, with sixteen feet,—that is, three pairs of claw-feet, four pairs of sucker feet, and a very well-developed pair besides beneath the tail, by the help of which, although the largest of the larvæ were sluggish, the younger traveled nimbly, and could move backwards or forwards at pleasure, or were able to attach themselves at once to a foreign substance, as the finger or hand. The head yellowish brown, darker in front, and with dark brown jaws; a transverse patch on the segment next the head, this rather pale yellowish brown, with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch. Along the back, excepting towards the head and tail, were four small dark dots on each segment above, two on each side the centre. On the segments near the head the spots were arranged more transversely, and at the tail, immediately above the sucker-feet, was a brownish, oval or somewhat triangular patch (the anal plate). On the preceding segment one transverse row of spots varied somewhat in different specimens; the largest was in the middle, with a smaller one on each side, occasionally one below, which would make five altogether; but sometimes the lowest pair was absent, sometimes the middle large spot was not entire; conjecturally the marking differed with the age of the caterpillar. On the preceding, that is, the eleventh segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment.

"The caterpillar was slightly sprinkled with pale hairs or fine bristles, and had such a capacity for catching and retaining a covering of flour that I was obliged perpetually to remove it with the moistened tip of a finger to obtain a clear view of the markings.

Chrysalis (pupa), natural size, but stripped from the film of flour surrounding it.



Cocoon as it appears in most instances.

"The chrysalis, which was lying in a silken cocoon of spun-up flour, showed the chief points of the form of the coming insect plainly—the color bees-wax below, shading to reddish-brown on the back, and reddish-brown also at the end of the somewhat prolonged, slightly-curved tail, which ended bluntly or cylindrically; the eyes of a darker shade of red. There were remains of dead, partly developed moths or chrysalids in the box, but I could not make sure whether, as thought not unlikely by Professor Zeller, these had been destroyed by their caterpillar brethren—the size and power of their jaws make the cannibal habit appear very probable. I had not opportunity of observing how long the chrysalis state lasts before the moth appears from the chrysalis condition, but this time is given by Professor Zeller as three weeks."

From all that can be learned of the habits of this insect it would appear that it is unceasing in its ravages where the temperature is suitable, in fact that it is an all-the-year-round pest. The pupa stage being short, its multiplication is very rapid. How rapid is shown by the fact that a large warehouse, 75 feet long, 25 feet wide, and four stories high, became literally alive with moths in the short space of six months, while thousands of cocoons were found adhering to the walls, ceilings, and joists, and in every crack, crevice, and nail-hole, necessitating a thorough cleansing of the entire building and its contents, the burning of a great deal of the wood-work, and the disinfecting of the whole place to destroy any germs that might possibly have escaped.

The first appearance of the flour moth in Canada that I can learn of was in March, 1889, when it was observed in a mill in Ontario. Little attention was paid to it, as its dangerous character was not known; but by and by the moths began to appear in greater numbers, and soon small worms were observed in the flour. Alarm began to be felt, and it was suspected that these worms came from the moths which had been seen in the mill. In July the bolting cloths, elevators, and some other parts of the machinery, were carefully cleaned and washed. In about four days after starting again, the bolts, elevators, etc., were found to be in a worse state than ever, full of webs, moths, and worms. The mill was shut down and a more thorough cleansing set about. But it was found that every crack and crevice was alive, and as the character of the moth was entirely new, an application was made to the Government for assistance. A number of visits were made to the infected mill by the authorities, and an order in council was passed by the Government ordering the Provincial Board of Health for Ontario to suppress the pest. The machinery was taken down and thoroughly steamed; the building was swept and subjected to the fumes of burning sulphur; the loose wooden parts, such as elevator spouts, etc., were burned, and paper bags, boxes, and any goods suspected of being infected, were similarly disposed of. Even the mill-stones and iron rollers were thoroughly steamed by placing them in a tight box with a pipe from the boiler. After about two months' loss of time, and a large outlay for new machinery, stock, etc., the mill was pronounced free from infection and ready to go to work again. As may be supposed, its proprietors have taken such precautions as will prevent the pest gaining a footing should it again make its appearance. They have provided a steam stand-pipe, with hose leading to each flat of the mill, so that live steam can be turned on sufficient to kill anything.

The importance of dealing promptly with the Flour Moth whenever and wherever it appears, has led the Ontario Government to issue a bulletin, in which the following precautions are suggested to prevent its introduction, and means of eradication pointed out should it appear: (1) no milled goods, such as Italian semolina, Indian cassava, and Brazilian tapioca, should be allowed to enter the country, especially from Mediterranean ports, without being quarantined in a warm place for a number of months, so as to give time for the ova, if present, to hatch; (2) all bags used for transporting flour, meal, or grain should be prevented from entering the country till they have been thoroughly boiled or steamed so as to kill any germs; (3) millers, exporters and importers of flour or grain should familiarize themselves with the appearance and habits of the moth at its various stages, and take measures to destroy individual specimens before they have time to multiply. Should the pest have made its appearance the following measures are recommended: (1) Destroy the moths by closing all apertures and burning sulphur night after night in all parts of the building; (2) search for the larva or caterpillar in all packages of flour and meal, and if any are found superheat in a dry kiln by spreading it out in a thin layer so the heat can reach all parts; (3) do not under any circumstances sell infected flour to dealers, but have it steamed and fed to hogs; (4) where webs are found it may be considered that the larva has reached the chrysalis stage, and the cocoons, or little masses of flour glued together, being little rolls about three-quarters of an inch long, should be gathered up and burned. It must be remembered, however, that the larva has a habit of retiring to some crevice where it may be impossible to reach it, in which case watch should be kept for the moths as they emerge from the chrysalis, and they should then be killed. In such case sulphur fumes should be used. When the larvæ have gained possession of any part of the machinery, superheated steam must be used.

Where the use of sulphur might be attended with danger, chlorine fumes may be used with equal benefit. Infested places may also be sprayed with a solution of corrosive sublimate, consisting of one drachm to each gallon of water, or with a soap emulsion consisting of two gallons of kerosene, one of water and half a pound of whale oil soap. The solution of soap should be heated and addded boiling-hot to the kerosene, and then thoroughly mixed by means of a force-pump and spray-nozzle. One part of this emulsion should be used with nine parts of water. Prof. Riley, who gives the above formula, lays great stress upon having kerosene properly emulsified when used as an insecticide.

By adopting the above precautions this pest, which if allowed to go on unchecked soon becomes worse than any of the plagues of Egypt, may be kept down. The prompt measures already taken have to all appearance stopped its spread in Canada, but it is liable to appear again at any time. It has been seen in the United States but does not appear to have done any mischief. With the intimate trade relations which exist between the two countries its spread in one would soon be followed by its appearance in the other. Eternal vigilance is the price of freedom from its ravages, and attention having been called to it, millers and others likely to suffer should be on the alert.—J. J. Bell, *Brockville, Canada.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—Prof. W. Putnam, the president, announced the death of Leo Lequereaux, of Columbus, O., a corresponding member. Dr. Thomas Dwight read a paper on "The Joints and Muscles of Contortionists," illustrated by stereopticon. He said that there were contortionists in ancient Egypt, but very poor ones. Those of Greece and Rome were better, but those of modern times have still more ability. He showed some pictures of mediæval and modern contortionists in different positions, and said that for backward contortion no very great variation from the normal in anatomical structure was required, but there must be a large amount of gristle in the spinal column, as is the case in all children. In forward work, however, an abnormal structure is required, as the contortionist must have the power to partly dislocate his joints in order to get his limbs into the required positions. The performers of both classes must be able to relax the antagonistic muscles,—that is, those that pull in an opposite direction to which it is desired to bend.

Secretary Fewkes then read a communication from Prof. G. Frederick Wright, of Oberlin, in regard to a little carved figure of a man that was thrown up from a depth of three hundred and twenty feet below the surface of the ground, while boring for an artesian well at Nampa, I. T. This was accompanied by an opinion from Prof. S. F. Emmons, that the formation from which the figure came was older than any other where human implements have previously been found. The gentlemen who took part in the discussion were Profs. Putnam, H. W. Haines, Edward S. Morse, S. H. Scudder, and E. D. Cope, and Mr. Warren Upham. Prof. Cope stated that the formation underlying the lava bed in that part of Idaho, is the Pliocene lacustrine deposit, which he had called the Idaho Terrane. The general opinion seemed to be that the image was authentic, and that it was carved in the late tertiary period by a member of a race that was far advanced in development for so remote a period. Mr. Scudder was the only speaker who dissented from this opinion.

American Geological Society.—The annual meeting was held December 26–28, 1889, at the American Museum of Natural History, New York. The following papers were read December 26th: Some Additional Evidences Bearing on the Interval between the Leading Glacial Epochs; T. C. Chamberlain, Madison, Wis. The Tertiaries of Massachusetts; N. H. Shaler. The Laramie Group; J. S. Newberry, New York. On Glacial Phenomena in Canada; Robert Bell, Ottawa, Canada. Orographic Movements in the Rocky Mountains; S. F. Emmons, Washington, D. C. Note on the Serpentine of Syracuse; Geo. H. Williams, Baltimore, Md. Remarks on the Surface Geology of Alaska; I. C. Russell, Washington, D. C. Origin of the Rock Pressure of Natural Gas in the Trenton Limestone of Ohio and Indiana; Edward Orton, Columbus, Ohio. On the Tertiary Deposits of the Cape Fear River Region; William B. Clark, Baltimore, Md. Note on the Pre-Palæozoic Surface of the Archæan Terranes of Canada; Andrew C. Lawson, Ottawa, Canada.

December 27th.—The Structure and Origin of Glacial Sand Plains; William M. Davis, Cambridge, Mass. Glacial Features of Parts of the Yukon and Mackenzie Basins; R. G. McConnell, Ottawa, Canada. Post-Tertiary Deposits of Manitoba and the Adjoining Territories of Canada; J. B. Tyrrell, Ottawa, Canada. A Moraine of Retrocession in Ontario; G. Frederick Wright, Oberlin, Ohio. The Southern Extension of the Appomatox Formation; W. J. McGee, Washington, D. C. The Value of the Hudson River Group" in Geologic Nomenclature; Charles D. Walcott, Washington, D. C. The Calciferous Formation in the Champlain Valley; Ezra Brainerd and H. M. Seely, Middlebury, Vt. The Fort Cassin Rocks and their Fauna; R. P. Whitfield, New York. The Stratigraphy of the Quebec Group; R. W. Ells, Ottawa, Canada. Geological and Petrographical Observations in Southern and Western Norway; Geo. H. Williams, Baltimore, Md. Cretaceous Plants from Martha's Vineyard; C. D. White, Washington, D. C. The Sandstone Dikes of the Forks of Cottonwood Creek, in Tehama and Shasta Counties, California; J. S. Diller, Washington, D. C. On the Relation between the Mineral Composition and the Geological Occurrence of the Igneous Rocks at Electric Peak and Sepulchre Mt., Yellowstone National Park; Jos. P. Iddings, Washington, D. C. On Certain Peculiar Structural Features in the Foothill Region of the Rocky Mountains near Denver, Colorado; Geo. H. Eldridge, Washington, D. C. Illustrations of the Glaciers in the Selkirk Mts. and Alaska; A. S. Bickmore, New York.

December 28th.—Some Results of Archæan Studies; Alexander Winchell, Ann Arbor, Mich. Significance of granitoid oval areas in the Laurentian; C. H. Hitchcock, Hanover, N. H. Porphyritic Granite; B. K. Emerson, Amherst, Mass. The internal relations and taxonomy of the Archæan of Central Canada; Andrew C. Lawson, Ottawa, Canada. The Crystalline Schists of the Black Hills of Dakota; C. R. Van Hise, Madison, Wisconsin. On the intrusive origin of the Triassic Traps of New Jersey, with special reference to Watchung Mountains; Frank L. Nason, New Brunswick, N. J. The Geology of the Crazy Mountains, Montana; J. E. Wolff, Cambridge, Mass. The Cuboides Zone and its Fauna, A discussion of methods of correlation; H. S. Williams, Ithaca, N. Y. On the Pleistocene Flora of Canada: Abstract; Sir William Dawson and D. P. Penhallow, Montreal, Canada. The Fiords and Great Lake Basins of North America considered as evidence of preglacial continental elevation and of depression during the glacial period; Warren Upham, Somerville, Mass. On the Genus Spirifera and its inter-relations with the Genera Spiriferina, Syringothyris, Crytia, and Cryotina: Abstract; James Hall, Albany, N. Y. On some Ancient Shore-lines and their history; F. J. H. Merrill, New York. Geology of the Boston Basin; W. O. Crosby. On the Collection and Preservation of Geological Photographs by the American Geological Society, and the facilitation of their exchange among its members; J. F. Kemp, Ithaca, N. Y. On the Metamorphic Rocks of south-eastern New York; F. J. H. Merrill, New York. Experiments with Cave Air for cooling and ventilating rooms; M. H. Crump. On some Porphyries of the Plain of Mexico, read by title; Persifor Fraser, Philadelphia, Pa. On the Horned Dinosauria of the Laramie, read by title; E. D. Cope, Philadelphia, Pa. On Pot-holes north of Lake Superior unconnected with existing streams; Peter McKellar, Fort William, Ontario.

The following is an abstract of some of the more important papers read at the meeting.

ON GLACIAL PHENOMENA IN CANADA. Robert Bell, Ottawa, Canada.—Advantages offered by the Dominion for the study of these phenomena. Questions as to interglacial periods. Preglacial or interglacial river valleys. Boulder Clays ploughed by subsequent glaciers. Almost universal glaciation east of the Rocky Mountains. Progressive recession northward of the general glacial condition. Surface decay preceding the glacial period. Directions of striæ and drift transportation. Effects of regional changes of level in the northern part of the continent. Different origins of lake basins. Influence of geological conditions on glacial erosion in the production of geographical features. Did other forms of ice play any part? Examples peculiar to glacial action. Various proofs. Groups of general courses of grooves in different directions. Various forms of moraines, belts, trains, heaps, beds, and areas of boulders. Erratics remarkable for size, position, etc. Climate and fauna in post-Pliocene times. The paper was illustrated by photographs and diagrams.

The Structure and Origin of Glacial Sand Plains. William M. Davis, Cambridge, Mass.—Sand Plains are delta-like deposits of stratified gravel and sand, formed in bodies of standing water at the margin of the melting ice of the last glacial epoch. Their growth was rapid compared to the backward melting of the ice-front, and the pits in their surface mark the location of isolated blocks of ice, which their sands surrounded.

Note on the pre-Palæozoic Surface of the Archæan Terranes of Canada. Andrew C. Lawson, Ottawa, Canada.—Observations along the northern limit of the Palæozoic show that the surface of the Archæan was, at the time of the deposition of Cambrian or earlier formations, to a large extent as hummocky and *roches moutonnées* as it is to-day. Hence this feature cannot, as it is generally supposed, be due to conditions of glacial epoch except to a very limited extent. Slight reduction of the Archæan surface since early Palæozoic, but enormous previous denudation. Origin of material of post-Archæan formation.

Glacial Features of Parts of the Yukon and Mackenzie Basins. R. G. McConnell, Ottawa, Canada.—This paper contains a brief description of the glacial deposits observed along the Liard and Mackenzie Rivers, and includes notes on the silting up of a southern arm of Great Slave Lake, on the height of Erratics along the eastern flanks of the Rocky Mountains, on the absence of Boulder Clays from the valleys of the Porcupine and the Yukon, and on the former existence of a great lake at the confluence of these two streams.

Remarks on the Surface Geology of Alaska. I. C. Russell, Washington, D. C.—The writer wishes to call attention to, first, the formation of the Tundra; second, to the absence of residual clays and other evidences of rock decay and the absence of glacial records along the Yukon and Porcupine Rivers in Alaska.

Post-Tertiary Deposits on Manitoba and the Adjoining Territories of Canada. J. B. Tyrrell, Ottawa, Canada.—The area stretching from the Archæan nucleus in the eastern portion of Manitoba, to near the foot of the Rocky Mountains, has, in preglacial times, had a very irregular surface, which was planed by the passing of the continental glacier, and the irregularities filled often to great depth with unstratified till. This till, or ground moraine, forms the present surface throughout large districts; but it is covered in many places by stratifieds ands, silts, and gravels deposited in the beds of larger or smaller fresh-water lakes. The paper describes the character of the till, the direction in which the glacier forming it has moved from the Archæan nucleus, and some of the moraines, drumlins, kames, etc., that it has left in its course; also it states evidences of the recurrence of glacial conditions, and the positions of a number of lakes in which the subsequent deposits were laid down.

A TERMINAL MORAINE IN ONTARIO. G. Frederick Wright, Oberlin, Ohio.—In the Report of Progress upon the Geological Survey of Canada, published in 1863, pp. 908, 909, the Artemisia gravel is described as a belt of loose gravel extending from Owen Sound to Brantford, and thence in an easterly and northeasterly direction, passing about half way between Lake Ontario and Lake Simcoe, following the highest ground of the peninsula, and being in general about 950 feet above the sea. Lakes with no visible inlet are described as occurring near the greatest elevation. The object of the paper is to give the results of personal investigations during the past summer along this line, demonstrating its morainic character. Many facts which some have attributed to a northern depression at the close of the glacial period receive simple and sufficient explanation from the morainic character of this deposit.

THE SOUTHERN EXTENSION OF THE APPOMATTOX FORMATION. W. J. McGee, Washington, D.C.—The Appomattox formation was applied in 1888 to a widespread deposit of orange-colored sands and clays, with occasional intercalations of gravel, developed on and between the Rappahanock, James, Roanoke, and Appomattox rivers in eastern Virginia, and widening and thickening southward. Recently the same formation has been traced through the Carolinas, Georgia, Alabama, and Mississippi; and has been found to constitute the prevailing surface deposit in these States. It is a marine or brackish water deposit, yielding no fossils save fragmentary cones and bits of lignite. A considerable part of the Orange Sand of Dr. Hilgard belongs to the formation. It lies unconformably upon the Grand Gulf (Miocene?) strata of Alabama and Mississippi as upon the fossiliferous Miocene of eastern Virginia and North Carolina, and it is overlain unconformably by Plistocene deposits in various localities. Although its age has not been determined palæontologically, it forms, by means of its vast extent and uniform character, a great datum formation from which the stratigraphy of the Coastal plain may be reckoned.

THE TERTIARY DEPOSITS OF EASTERN MASSACHUSETTS. N. S. Shaler, Cambridge, Mass.—The main points concern the origin and distribution of these strata. The writer endeavored to show that there has been in that district, since the Miocene time, a large amount of true mountain-building action; and also that a part of the deposits are of Glacial origin.

THE VALUE OF THE TERM "HUDSON RIVER GROUP" IN GEOLOGIC NOMENCLATURE. Chas. D. Walcott, Washington, D. C.—This paper embraces: Description of the rocks referred to the Hudson River group in the valley of the Hudson; comparison of the Hudson River section with the section in Loraine, Jefferson county, N. Y., and the Cincinnati section of southern Ohio; some observations on the use of the names "Hudson River," "Lorraine," and "Cincinnati."

THE CALCIFEROUS FORMATION IN THE CHAMPLAIN VALLEY. Ezra Brainerd and H. M. Seely, Middlebury, Vt.—This paper describes the series of Champlain Valley rocks, and presents the results of the authors' study of the Calciferous and its relations to the groups above and below. The observations have led to important conclusions, involving serious modifications of the section as generally accepted.

THE STRATIGRAPHY OF THE QUEBEC GROUP. R. W. Ellis, Ottawa, Canada.—The author discusses, first, all the structure as found in the southeastern part of the province adjoining Maine and New Hampshire, including the crystalline and metamorphic rocks and their associated formations; and subsequently the unaltered Quebec group as developed along the south side of the St. Lawrence. He contrasts the views formerly held regarding the stratigraphical position of the several divisions with those now believed to be the correct interpretation. The new views of structure of the St. Lawrence area have been largely confirmed very recently by the work of Prof. Lapworth and others from the palæontological standpoint.

GEOLOGICAL AND PETROGRAPHICAL OBSERVATIONS IN SOUTHERN AND WESTERN NORWAY. George H. Williams, Baltimore, Md.—The regions studied in southern Norway are of typical eruptive rocks breaking through horizontal and unaltered Silurian beds, and therefore unexcelled as examples of contact metamorphism. The localities visited in western Norway, on the other hand, are greatly disturbed and have been subjected to extensive regional metamorphism. In each case, both eruptive and sedimentary masses have been involved, but neither have so completely lost their original characters by metamorphism as to be incapable of identification. The two main points which it is desired to illustrate are: I. The similarity of effects produced in the same original material by the contact action of eruptive rocks and by orographic disturbance. II. The power of orographic forces (regional metamorphism) to produce the same product from rocks originally the most diverse in origin and structure. Illustrated by maps, diagrams, and specimens, both macroscopic and microscopic.

NOTE ON THE SYRACUSE SERPENTINE. George H. Williams, Baltimore, Md.—Additional and recently secured evidence of the eruptive nature of this rock, which is interesting as being the only representative of its class known in the undisturbed strata of New York.

THE SANDSTONE DIKES OF THE FORKS OF COTTONWOOD CREEK IN TEHAMA AND SHASTA COUNTIES, CALIFORNIA. J. S. Dilier, Washington, D. C.—The distribution of the dikes was shown by a map, their mode of occurrence described and illustrated by lantern slides; their mineralogical composition, microscopical structure, and chemical composition discussed and compared with that of the mesozoic sandstones with which they are associated; and a theory of the origin of the dikes proposed and discussed.

ON THE RELATION BETWEEN THE MINERAL COMPOSITION AND THE GEOLOGICAL OCCURRENCE OF THE IGNEOUS ROCKS AT ELECTRIC PEAK AND SEPULCHRE MT., YELLOWSTONE NATIONAL PARK. Jos. P. Iddings, Washington, D. C.—An occurrence of intrusive rocks and contemporaneous extravasated rocks having similar chemical composition and different mineral composition and structure.

ON OROGRAPHIC MOVEMENTS IN THE ROCKY MOUNTAINS REGION. S. F. Emmons, Washington, D. C.—After giving a brief abstract of the views which have hitherto been put forward in regard to orographic movements in the Rocky Mountains region, the writer proceeds to give his present views, founded on observations made in the field during the past ten years, which partially modify the views already held, and add to the list of movements two important and widespread movements, which hitherto have not been generally recognized. These occurred, the one during the Carboniferous, the other during Jurassic times. Evidence of the former is found beyond the boundaries of Colorado in Wyoming at the North and New Mexico on the South. The latter was even more widely felt and may have affected the greater part of the continent. Although the data are extremely imperfect, the writer has thought it advisable to present the facts which he has at his command, believing that when the attention of geologists is called to them, they may be able to detect further evidence, where, without this suggestion, they might not look for it.

On Certain Peculiar Structural Features in the Foothill Region of the Rocky Mountains near Denver, Colorado. Geo. H. Eldridge, Washington, D. C.—The paper describes a type of geological structure discovered by the writer, which may prove of common occurrence along the base of the Rocky Mountains. The type consists in a succession of nonconformities appearing one after another at various geological horizons, the explanation of which is found in the forces acting in the general uplift of the Colorado Range, from which have been developed certain secondary forces, which have, from point to point, brought about the elevations upon which the nonconformities depend.

On the Intrusive Origin of the Triassic Traps of New Jersey; with Special Reference to Watchung Mountains. Frank L. Nason, New Brunswick, N. J.—That these traps are intrusive in their origin is proved: I. By the peculiar monoclinal structure of the sandstones, which are produced by longitudinal fractures extending parallel (a) to the major axis of the trap ridges, and (b) to the major axis of the Archæan region. II. By the finding of *Estheria ovata* in repeated lines along the Delaware River, and in lines reaching N. E. and S. W. across the State. III. By the lines of cross-fracture extending N. W. and S. E. across the formation, which are proved (a) by showing a repetition of the slates and gray sandstones at Weehawken and Shady Side; (b) by showing that the Pequannock River flows in a fault; (c) by showing that the streams of the Archæan region flow in faults parallel to the "crescents" of the trap.

Association of American Anatomists.—The second annual meeting was held at the University of Pennsylvania, Thursday, December 26, 1889. The following communications were made: President's Address; by Joseph Leidy, M.D., of Philadelphia, Pa. Address of the Chairman of the Executive Committee; by Harrison Allen, M.D., of Philadelphia, Pa. Muscular Anomalies of the Infra-Clavicular Region; by Frank Baker, M.D., of Washington, D. C. On Plant Anatomy and Physiology; by W. P. Wilson, M.D., of Philadelphia, Pa. Brief Remarks on the Form and Probable Function of the Blood Plaque, with slides and photographs; by George T. Kemp, Ph.D. Presentation of Histological Specimens; by George A. Piersol, M.D., Philadelphia, Pa. The Supra-Sternal Rib; by D. S. Lamb, M.D., of Washington, D. C. A Demonstration; by Horace Jayne, M.D., Philadelphia, Pa. A Paper,—title unannounced; by Wm. Browning, M.D., Brooklyn, N. Y. The Relation of the Thalmus to the Parocœle (lateral ventricle), especially in the Apes; by Burt G. Wilder, M.D., Ithaca, N. Y. Nuclear Anatomy of the Cetacean, Manatee, Phocidæ, and Hippopotamus Cord; by E. C. Spitzka, New York.

Friday, Dec. 27th.—The Spinal Nerves of the Cat (advance communication); by T. B. Stowell, Ph.D., Pottsdam, N. Y. The Transition from Stratified to Columnar Epithelium; by Simon H. Gage, Ithaca, N. Y. A Series of Casts of the Duodenum, with remarks; by Thomas Dwight, M.D., Boston, Mass. The Preparation and Preservation of Anatomical Specimens for Museums (illustrated with specimens); by J. L. Wortman, M.D., Washington, D. C. Notes on Dwarfs; by Frank Baker, M.D., Washington, D. C. Olecranon Perforation; by D. S. Lamb, M.D., Washington, D. C. The Physical Theory of the Genesis of the Long Bones and Articulations; by John A. Ryder, M.D., Philadelphia, Pa. Individual Skeletal Variations; by Frederick A. Lucas, Washington, D. C. Medico-Legal Studies on the Human Skeleton; by Thomas Dwight, M.D., Boston, Mass. On the Value of the Studies of Variation; by Harrison Allen, M.D., Philadelphia, Pa. The Heart as a Basis of Intrinsic Toponymy; by Burt G. Wilder, M.D., Ithaca, N. Y. Presentation of Specimens; by Geo. McClellan, M.D., Philadelphia, Pa.

Saturday, Dec. 27.—Presentation of Specimens; by S. J. J. Harger V.M.D., Philadelphia, Pa. Presentation of Specimens; by John B. Deaver, M.D., Philadelphia, Pa. Presentation of Specimens; by A. H. P. Leuf, M.D., Philadelphia, Pa. Volunteer contributions. Inspection of Veterinary Department.

The following officers were elected: President, Joseph Leidy, M.D.; First Vice President, Frank Baker, M.D.; Second Vice President, Fanueill D. Weisse, M.D.; Secretary and Treasurer, A. H. P. Leuf, M.D.; Executive Committee, Harrison Allen, M.D., Chairman, Burt G. Wilder, M.D., William Towles, M.D., the President and Secretary.

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ON CERTAIN PECULIARITIES IN THE FLORA OF THE SANTA BARBARA ISLANDS.

BY J. WALTER FEWKES.

THE study of the distribution of terrestrial life on islands has always been a prolific one in theoretical discussions of the origin of species. Darwin and Wallace both drew from this source most interesting conclusions in regard to their theories, and from it are still derived some of the most suggestive facts bearing on questions of geographical distribution, migration and preservation of genera and species.

This is particularly true of oceanic islands separated from continents by wide expanses of the ocean or of chains of islands connecting continental land-masses. The peculiar assemblage of life in Saint Helena, the Galapagos or the Bermudas contribute most important data to the general discussions of the derivation and modification of faunas and floras in isolated tracts of land in the ocean. It thus happens that the study of islands has always had a profound fascination to the investigator of the variations of life on the earth's surface.

As a general thing the terrestrial life of continental islands resembles that of the neighboring land-masses. The very contiguity would seem to imply a colonization of one from the other, and therefore a resemblance, since the ease with which genera and species can be transported across intervening water is an all sufficient cause for a similarity. While there is evidence that the basins of the great oceans have always been approximately the same as they are at present, the fringes of the continents, or the platforms upon which continental islands rest, have, from time to time, suffered changes of elevation which, in many instances, have raised the intervening sea bottom above the surface of the water, and thus have brought about a means of communication for the life of continents and neighboring islands. In this case it is not necessary to call in the aid of various means of transportation across intervening bodies of water, straits and sounds, for the commingling of the two floras and faunas. Prehistoric man in his early migrations, no doubt, was profoundly affected by a law of distribution similar to that which influenced animals and plants. Using islands as stepping stones he may thus, before he had the hardihood to attempt the ocean in navigation, have even passed from one continent to another at a time when portions of the shallower ridges of the ocean floor now submerged were elevated above the sea. In this way, for instance, he may have migrated on dry land from northern Europe to Greenland and then to the North American continent, or, in a similar way, across what is now Behring Strait and the Aleutian Islands from Asia into Alaska. The possibilities of inter-communication between lands not separated by the abysses of the ocean for races of man, animals and plants are very great, and can only be read in the light of the great geological changes which have occurred on the margin of continents in which elevation and depression have undoubtedly taken place.

Islands which have become separated from the continents by submergence of the land, or by erosion and a cutting out of an intervening channel, preserve, in a measure, the fauna and flora of the adjacent continents, but they are independently affected in somewhat different ways by the struggle for existence of their inhabitants. New conditions may arise or old ones may persist which may or may not lead to the preservation of organic forms which have been exterminated on the adjoining continent. Inter-communication, however, between the two has always had an influence in neutralizing the changes which might otherwise occur.

It may, on the other hand, happen, when islands preserve uniformly the past conditions of the mainland for a longer time than the continents, that their fauna and flora resemble an older assemblage of life of the land of which they are a part, and with which they were formerly connected.

It is believed that the Santa Barbara islands illustrate this latter statement. Climatic changes have, it is thought, taken place on the mainland which have changed the enviroment[1] to that extent that animals and plants once found there have succumbed and disappeared, while these conditions have remained more constant on the islands, where, as a consequence, the destruction of certain organisms has not been so rapid.

It may be borne in mind, however, that the causes which have led to the restriction of certain plants or animals to circumscribed localities in other parts of the world are not all understood. This restriction or local distribution may be due to general or to local causes, yet the former may at times be called to aid when the latter are insufficient. In New England, for instance, a local distribution of certain plants in limited areas often occurs and no explanation can be discovered for their limitation. It must, therefore, be with diffidence that one finding peculiarities in the flora of certain islands ascribes those characteristics to far-reaching rather than local influences. Especially must one use caution in the study of phenomena in which more facts are necessary. The following paper, however, uses the data given by others, but with this precaution, knowing that such speculations may be overturned by new observations and more extended studies bearing on the pecularities of the flora of the islands.

Of the later geologic phenomena which have been called in to account for the present distribution of animals and plants, the glacial period is one of the most important. Possibly too great influence has been ascribed to it on account of the nearness of this period to the present, which it might be expected to most

[1] In environment are included organic as well as climatic changes. The organic environment makes itself felt in a struggle for existence, which counts for as much as, if not more than, climatic changes.

profoundly affect. Looking back into the past, it is the first climatic change which offers great differences of condition from the present.

One of the consequences of the advance and retreat of the great ice sheet which once covered the northern latitudes of North America, is its influence on the distribution of terrestrial life. It is argued that the advance of this ice sheet must have forced southward hardy animals and plants which, when brought into competition with southern species in a struggle for existence, led, through inheritance, to important modifications in the general aspect or facies of the fauna or flora of any given region. In a somewhat like way a retreat of the ice sheet towards the north may be supposed to have enlarged the area for life, and to have drawn with it those organisms which find colder latitudes more congenial to their lives, and thus opened a way to changes in the character of the life inhabiting the areas vacated by them. The survival of Alpine floras and faunas on mountain tops finds a ready explanation in a distribution brought about primarily by the latter of these causes, viz.: the retreat of the glacial ice sheet to the polar regions, and the resemblance of the conditions of those high altitudes to formerly existing in the valleys.

In a discussion of the causes of the peculiar flora of the Santa Barbara Islands pointed out by Prof. Greene, Prof. LeConte[2] has adduced the aid of the glacial period and ascribed this pecularity to the survival of an old flora on the islands, while that of the neighboring continent has been more or less modified by a struggle with hardy denizens forced into it by glacial conditions. His reasoning on this point seems to me cogent and conclusive in general, but not wholly adequate in the special case of the peculiarities of the flora of the Santa Barbara Islands. It is believed that he is right in the supposition that the present flora of Santa Cruz more closely resembles that which once existed on the contiguous coast than it does the present flora of the same locality. The remoteness of the continental glacier as indicated by its terminal moraine must have been great from the region under discussion, and the possibility of its influence on the equilibrium

[2] *Amer. Journ. Arts and Sciences.* Vol. XXXIV.; pp. 457–461.

of life so far away is small. It may be well to look about in order to discover, if possible, other causes nearer the locality for an explanation of this destruction of continental species and the survival of older characteristic genera on the neighboring islands. I think there are other and possibly more effective causes which have had a profound influence in Southern California in this direction.

When hardy[3] species were driven south by glacial cold, they were certainly more fitted to survive in the cold climate than the denizens of a warmer climate which they encountered, simply because the climate was colder. But when the glacial cold was mitigated the animals and plants of warmer climates were more fitted to survive, and in a struggle for existence would be stronger than the "hardy" or those fitted for glacial cold or comparatively low temperatures. Then their influence would be greatest. As the character of the insular flora was less affected than the main land by the hardy animals, we may also suppose it to be less affected than the main land by the return of the warm climate animals at the restoration of a more genial climate. Consequently, not only glacial cold but subsequent milder temperature have acted in unequal degrees upon the inhabitants of islands and main land. If there was a return of conditions of climate similar to that of the Pliocene, like plants to those of the insular flora might be expected to reappear. But a new influence has made inself powerful in modifying environment. The main land has become more desiccated than it formerly was. From the nature of their position the islands are not as profoundly affected by this influence as the continent. Like a huge Briaræus desiccation has spread itself over the south-west, so that, while its influence is exerted on the insular flora, it is not in as marked a manner as on the main land. So potent is this influence that it cannot be lost sight of, and is even as important as glacial cold. We must not forget, also, the profound influence on climate, and, consequently, on the facies of organic life, which the out-pouring of

[3] More suited to live under conditions of glacial cold. "Hardy" genera may, under condition of heat or dryness, become feeble. The word as here used, means organisms which are more fitted to live in cold climates.

the great lava beds may have had. As glacial cold had its influence, the heat resulting from these out-pourings was not without its effect.

The great arid deserts of our south-west, which extend into California, and make their influence felt even to the coast, have had a most important influence in the determination of the character of the fauna and flora of Southern California. This influence has exerted itself in much the same way as the cold[4] of the glacial epoch. The drying up of great tracts of land necessarily led to a crowding of the denizens of the tract thus desiccated into regions not so greatly affected. The result of an influx of individuals intensifies there a struggle for existence, and leads to extermination of less fortunate or weak genera and species. The regions most distantly removed from the most arid regions would necessarily be least affected by the increased desiccation, and on these out-posts of the continents, the islands, where the environment is least modified by this climatic change, we can look for the survivors of the old faunas and floras. The results arrived at by this *a priori* reasoning are exactly what Mr. Greene finds in the distribution of the plants on the Santa Barbara Islands. From his study of the plants of these islands, more especially Santa Cruz, the following, among other conclusions, are derived:

1. Forty-eight out of two hundred and ninety-six species of plants collected are peculiar to these islands, and twenty-eight are peculiar to Santa Cruz.

2. All the species are distinctly Californian and those species which are now found in small numbers in a straggling condition on the neighboring mainland are very abundant on the island.

3. The genus Lavatara, of which eighteen species are known in the Mediterranean region, and one from Australia, is represented by four species on the island of Santa Cruz. *There is not another known species from the American continent.*

There is also a significant fact which is believed to bear on our discussion, viz.: the distribution of land shells on the islands and the neighboring mainland. Indefatigable collectors of West

[4] Waiving the question of whether the glacial period was or was not one of great cold.

Coast shells have not been able to collect land shells near Santa Barbara, and yet on the neighboring islands many of these mollusks are found, notably, a peculiar species of Helix, which, unfortunately, is rapidly being exterminated by the sheep. The presence of these shells on the island, and their absence on the mainland, I suspect, point the same way as the peculiar distribution of the plants, and seem even as significant of the character of the change in the climatic condition of the environment.

The arguments which have been advanced by others to support the proposition that our arid deserts were once better watered than at present, are not necessary to quote here. That these deserts were not always as dry as at present seems to me proven, and the zoological facts in the distribution of the island life look indeed as if such a desiccation has left its mark on the distribution of genera and species.

In view of the distance of the land of Southern California from the sources of glacial cold,[5] it seems difficult to suppose that the equilibrium of life in this low latitude was much affected by this temperature. There are marks of local glaciers on the flanks of the Santa Inez Mountains, and the observer has not to go far from Santa Barbara to find what may be regarded as their moraines, but traces of a continental glacier are believed not to exist in this low latitude. These local glaciers may have driven hardy forms into the valleys by their advance, but it is hard to suppose that to this cause alone a comprehensive change in the flora or fauna has resulted. Desiccation of the climate, however, is a phenomenon of wide distribution in the south-west, and its influence must have been far reaching and great enough to lead to wide-spread modifications in the facies of faunas and floras.

If we ascribe the preservation of the older or partial Pliocene flora in the Santa Barbara Islands to their still retaining a moist climate from the vicinity of the ocean, it may be asked why the adjoining coast, by its situation, is not also acted upon by the same influence? Why are not these same plants protected there as well as on the island, since the vicinity to the ocean may have

[5] Evidence has been rapidly accumulated that the intensity of the so-called glacial cold was not great.

exerted the same influence? To this it can be answered that in places they are so protected, and Mr. Greene has mentioned instances where these insular forms still exist. These scattered localities are not regarded as points where the island genera have migrated to the mainland and there obtained a footing, but as preserving the same congenial influences which have made it possible for them to survive on the islands. It seems to the author that the theory that the preservation of these scattered remnants of the old life is exactly what would result in places on the shore. They are remnants of a flora once widely distributed throughout California.

These straggling colonies of characteristic insular flora are found, according to Mr. Greene, in isolated patches in San Diego and San Bernardino counties. These are supposed by him to be incipient colonizations on the mainland from the islands. Prof. LeConte, on the other hand, regards these patches as survivors of the Pliocene indigenes which have not followed the fate of their relatives, and the situation of these patches of older life in the southern counties, according to the latter, is "just what we might expect, for the main invasion [of hardy forms resulting from the influx due to the glacial cold] was from the north." There seems no valid objection to considering these survivors as remnants of the flora of a former geologic period sheltered by environment from destruction, but the causes which have led to the modification of their associates may not wholly be due to the influences of the glacial period. The other influence is continental desiccation.

The islands have, no doubt, been affected by the dessication of the continent, but not in the same degree as the mainland. Their fauna has changed, no doubt, since they were connected with the mainland and the mammoth was found on both, but not to the same amount. The sea, with its fogs and local evaporation, has counteracted, in a measure, the drying up, which has been most marked at a distance from the sea.

In conclusion, while accepting in the main the theory that glacial cold has had an influence, I would suggest that the main cause of the peculiar flora of Santa Cruz Island, observed by Mr.

Greene, is the change which has come to Southren California by the desiccation of the land. The islands, less acted upon than the main, from position and the neighborhood of the ocean, have, on that account, preserved a flora possibly like the Pliocene once found on the adjoining continent. As the environment changed on the main-land many of the genera died out, but they still persist where conditions are less modified because offset by local causes.

It does not seem necessary to suppose that the islands are remnants of a new centre of distribution of life, or that it is wholly explanatory of the pecularity of the flora to ascribe the extinction of the same plants which now exist on Santa Cruz to a struggle with hardy varieties forced southward by glacial cold. The drying up of the climate is a potent factor which had a great influence and is sufficient, with other causes, to bring about great changes. As high mountains may be regarded as preserving an Alpine flora left in a congenial position by the retreating glacier, so the Santa Barbara Islands may, in a somewhat different way, present us a life preserved in sheltered points by the drying up of the neighboring sections of the continent which has less strongly affected the islands than the main-land.

But neither of these causes alone is adequate to explain the peculiarities of flora or fauna in any circumscribed locality. There are many influences at work, and causes even which may have their origin far away from the regions which they effect. To analyze this nexus of influences is next to impossible. In a broad way we may say that the present facies of the fauna and flora of any circumscribed locality is primarily the result of environment, and where environment changes organic forms must change, while, when it remains constant, less modification is the result. A marked climatic change such as followed the drying up of a great area of such extent as has taken place in our southwest, leaves its mark on the organisms near and remote from it.

Two questions must be answered positively to make our reasoning logical. Has a desiccation taken place? and is it as great on the islands as on the main? Both of these questions are believed to be capable of definite answers. Desiccation has taken place, and it has not been as great on the islands as on the adjoining continent. There remains at least one fact to be determined, and for its acceptance additional research is certainly necessary. The flora of the Santa Barbara Islands is said to differ essentially from that which at present exists on the neighboring main-land of California. What is the relation of the present flora of California to that of the Santa Barbara Islands, and what was the flora of the main-land, especially in the Pliocene Age? Has there been an intercolonization of islands and continents since that glacial period? These are questions to be answered, but the most important one of all is, "Are any of the plants of the islands peculiar to them?" The above paper accepts the observations of others that they are. It seeks to point out a cause more potent than any yet suggested, to account for peculiarities of this insular flora if such peculiarities exist.

THE TEETH AS EVIDENCE OF EVOLUTION.

W. C. CAHALL.

IN the August number of *Lippincott's Magazine* appeared a paper by W. G. A. Bonwill, entitled "Why I Deny Evolution." The argument is based upon the structure of the teeth and their relation to the human jaw.

It would be as incomplete to confine your argument in support of the law of gravitation to a single phenomenon, *e. g.*, shooting stars, as to rest your plea for evolution upon the human jaw. It is manifestly unjust to the proper appreciation of a great doctrine like Evolution to deliberately deny oneself the great wealth of evidence furnished by Geology, Embryology, Rudimentary Organs, and the Comparative Anatomy of the several organs of the animal economy; yet it would be equally unfair to Dr. Bonwill to meet his argument upon any other ground than that upon which his argument is based, the human jaw.

At the same time the law of gravity, if a true one, ought to explain the phenomena of shooting stars, although it might fail to convey a proper conception of its grandeur and universality; so should evolution afford a full explanation of the complexity and adaptability of the teeth and jaw, and this I firmly believe can be readily done.

Before we proceed with a presentation of the other side of the question, it might be well to offer a few good-natured criticisms of Dr. Bonwill's definitions and claims.

I take issue with his very first sentence, "It must be creation or evolution—creation by some personality placing a perfect organic being at one master-stroke into life and action; or by some impersonality, from the lowest point of life, by slow development reaching higher and higher in the scale of being until man has been reached."

I deny that such a view of evolution is the only one which can be entertained. That the evolution of life upon this planet was the outcome of an impersonal nature, acting by forces strictly physical and without a directing mind, is the belief held by the materialistic school exclusively. To classify all evolutionists as materialists would do the greatest injustice to many of the most eminent scientists in this country and Europe. These men see nothing inconsistent in the belief in evolution as a method by which a personal Creator accomplished his ends, and the account of Moses.

The late Dr. Asa Gray, of Cambridge, accepted as authority throughout the whole scientific world to a degree perhaps never attained by any other American, voices this school when he says: "I am scientifically—and in my own fashion—a Darwinian; philosophically, a convinced theist; and religiously, an acceptor of the creed 'commonly called the Nicene,' as the exponent of the Christian faith."

So when Dr. Bonwill declares: "It must be creation or evolution," he could more correctly have written: "It must be creation *by* evolution." This is theistic evolution.

I also take exception to the loose and unscientific manner with which Dr. Bonwill uses "organs" and "organisms" as words of synonymous or identical meaning. Nothing is farther from the truth. These words have as distinctive and individual a meaning as any words in scientific usage, conveying totally different ideas. An *organ* is a part of a body capable of performing some especial work, while an *organism* is the whole body, a unit or entity, which the various organs in their mutual relationship compose. That this is not my definition, devised for a purpose, the nearest scientific dictionary will confirm. Ordinarily the misuse of scientific language might result from an oversight and be of little or no importance, but here it is not so, for Dr. Bonwill's leading argument stands or falls with this definition. We will assume that the question which he quotes from Mr. Darwin to be correct: "*Demonstrate* to me a complex organism that can be made in any other way than as I say, by slow, slight modifications, and my argument falls to the ground." To this query of Darwin's he replies: "I have duplicated by design and intelligence the most complex organ in the human body, and made it perform the same function as the natural organ." The organ he refers to here is a set of teeth. There is no evidence here but of entire satisfaction that when he has made a set of teeth, or a "complex organ" as he calls it, he has met the demand of Darwin for a "complex organism." If the words "organ" and "organism" are not identical in meaning to Dr. Bonwill's mind, why does he upon the same page as the above use such language as this: "I claim to have made a demonstration of the construction of a complex organism—the human teeth—according to these laws; a demonstration which accounts for all the functions of the natural organism." "I claim that if I am able to form such a complex organism by a single act of creation, I must be greater than nature, or must have anticipated her by millions of years." "I claim that this organism could not have been made from that in any other existing type of animal or combination of animals." Dr. Bonwill promises to put in book form these arguments. It will be well, before he fulfils this promise, that he should learn that a *complex organism* is something more than an artificial set of teeth.

He claims, and he puts it in italics, "*I claim to have discovered that the lower jaw of man is an equilateral triangle, and that all races have it, and that it has so existed from the advent of the first man.*" Also, "that it belongs exclusively to man." He claims that as an equilateral triangle in a hexagon is the equal of a circle, and as a circle is the embodiment of perfection of form, it is a natural deduction that the human jaw cannot be evolved higher or a more perfect form conceived. Such is the discovery which he has made and which he classes with the law of gravitation, a claim, to say the least, which cannot be characterized as modest.

I will give his own words: "I claim that as Newton discovered that geometry and mechanics governed the formation and action of the astronomical worlds, I have an equal right to the discovery of the relation of the same laws to the structural organic world."

If the human jaw be the perfect instrument claimed for it, and beyond the reach of further evolution, this would not, as he holds, prevent the contrary hypothesis; that it is the end towards which nature has tended by evolution through successive forms of life, from the simpler to the more complex.

That the human jaw is an equilateral triangle is an interesting anatomical observation, and Dr. Bonwill, if he is the first to notice it, should have all credit for discovering the fact; and that the teeth are perfect in position and adaptibility to their intended purpose, goes without saying. But to stop to even enumerate all the observations bearing upon the relation of the various organs to the principles of geometry and mechanics would tire the reader, and the evolutionist of all people would be the last to deny the perfect adaptability of the organs to their destined use, for it is this they bring in evidence as to the truth of evolution.

The intimate relation of the eye to optics, of the ear to acoustics, of the lungs to pneumatics, of the heart to hydraulics, of the digestive organs to chemistry, and the attachments of muscles to bones to the physics of levers, are familiar to every student of anatomy and physiology.

To discover that the human jaw and teeth are so perfect an instrument that human ingenuity cannot conceive of any improvement, but must crudely imitate the pattern nature furnishes when artificial assistance is needed, is no exception; is it not the same with the human eye, the ear, the hand, the foot? A manufacturer of artificial legs might with equal justice claim that he has discovered that the line of junction of the human foot to the leg was a right angle; that all races have it, and that it has so existed from the advent of the first man; that it belongs exclusively to man; that a right angle is the quarter of a perfect circle, and the only angle which will equally divide both a circle and a half circle; that consequently the human foot was a special creation, and could not have been evolved from something lower, and could not have been evolved into something higher; that he had made an artificial leg, which performed all the functions of the natural one, even to the complex movements of the ankle-joint, so perfectly as to deceive all beholders; that—*ad infinitum et ad* ——

Is it not already evident that such a line of reasoning may lead one to the most absurd conclusions?

There is one other question which has no direct bearing upon the argument from the teeth, but which I notice because Dr. Bonwill makes so much of it. He claims that since according to the first law of motion a body once set in motion will continue to move in a straight line forever unless deflected by surrounding bodies, and made to describe an orbit; and as no world ever did go in a straight line, but began at once to move in a circle or ellipse, "it is plain that it never began the universe by making one world at a time and throwing it into space, it being absolutely necessary that there should be at least three worlds in order to counterbalance each other, and make the first law of motion a fact."

There are some arguments which, like a two-edged sword, cut both ways. If such a condition of things be true, I would like an explanation of the first chapter of Genesis, which both Dr. Bonwill and I believe, where we are told that the Lord created the earth, gave it globular form, made dry land appear, and vegetation grow, for *three days before* the sun, moon and stars werecalled forth.

He further says, "I claim that as all organic life has such a struggle for existence, and as nature has to be always on the alert to select, that it is as much as an organ or an organism can do to keep itself up to the standard of healthy action; that *death to the weakest* is rather the rule than "survival of the fittest."

Has not the Doctor here given away his whole case? What is the "survival of the fittest," if it is not by the *death of the weakest.*

Evolution as a process of nature is not the hasty generalization of a single science; rather a greater part of all the sciences have become but widely different yet converging avenues of approach, along which the student travels naturally to the central hypothesis, which has now become the dominant factor in all scientific investigations. It lies at the foundation of the new astronomy of the sidereal and solar systems; geological study of the strata furnishes indubitable evidence of the appearance upon the earth of forms of life of the simplest nature, succeeded by forms of constantly-increasing complexity; comparative anatomy teaches how from the three elementary layers of the blastodermal cells every tissue and organ of every animal is developed along identical lines; comparative botany tells the story; embryology, under the microscope, is daily showing that every highly-organized being is passing through that identical evolution of structure from the simple to the complex which the special creationists deny to nature at large; rudimentary organs are so many interrogation marks, unanswerable on any other ground than that of evolution; sociology is carrying the question into the study of government of the human kind collectively; and the first chapter of Genesis, when read in the light of the evolution hypothesis, reveals a sublimity of conception and accuracy of description never before realized. Testimonies so different, yet confirming each other, appeal with a force like the result of an algebraic problem, which, when tested and confirmed by several different methods, possess an accumulative proof of geometrical rather than numerical ratio. But in our present view of the question the accumulative evidence is lost, for we are confined to a single line of inquiry.

The order of the Vertebrates, as classified by zoologists, accord with the order of succession as found by geology, and are divided into five great sub-divisions, viz: Fishes, Amphibians, Reptiles, Birds, and Mammals.

Only in the vertebrates do we find calcified teeth. In the fishes, some of the lower orders have teeth only partially calcified; which, in fact, appear simply as horny excrescences upon the mucous covering of the mouth. Even teeth such as these did not, like Minerva from the brow of Jove, spring into being, full-formed. If it were found that the teeth, or any other organ, appeared fully-formed, and suddenly, serious objections might then be made against evolution. Nature takes no leaps, but everywhere, in everything, takes some tissue, already existing, and by slight modifications transforms it into some complex organ. So we find that even the simple teeth of the fishes can be traced back to simpler structures in the Invertebrates. Upon the approximating folds of the radiate-shaped mouth of the sea-stars are hardened papillæ and spicules which function as *masticating organs.*

Coming higher in the scale we find the mouths of the Crustacea provided with a firm chitinous framework, with ridges, spicules or setæ forming tooth-like processes opposite each other and moved by muscles. These serve as an efficient apparatus for the comminution of food and are called the *masticatory stomach.*

Among the Mollusca, the mouths of several varieties are provided with jaws, covered with a cuticular membrane, on which are small teeth or hooks directed backward. When this membrane is protruded these teeth are erected, and when drawn back they come together like pincers and hold the prey.

The comparative anatomy and gradation of teeth may be seen by the table on page 232.

Evidence from Paleontology.—The diversity of size, structure and specialized function of the teeth of the Mammalian family are directly traceable to the mode of obtaining food.

The constant use of one variety of food has so developed one portion of the teeth, and atrophied, through disuse, the other portion, that the mouths of the existing families of the Mammalia present teeth of quite contrasting appearance. Yet the ancestors of the animals whose teeth now so clearly separate them into the piscivorous, carnivorous, insectivorous, herbivorous and omnivorous families, did not so widely diverge. The early Tertiary mammals, whether they were herbivorous or carnivorous, possessed the full number of forty-four teeth, which appears to have been the typical number. While the present adult cud-chewing animals no longer possess the incisors and canines in the upper jaw, those ancient ruminating mammals, the Dicobune, Dichodon, and Anoplotherium, had incisors and canines in both upper and lower jaws.

The elephant has the incisors of the lower jaw absent, the premolars absent, the true molars united into compound organs of great complexity, and the upper incisors developed into tusks, while its great prototype, the Dinotherium, possessed permanent premolars in both jaws, the true molars simple, and had the incisors in the lower jaw. Another example is found in the bear of the present, which has the third true molar absent, while its ancestor, the Amphycyon, has the entire set intact.

Evidence from Embryology and Rudimentary Organs.—Prof. Goodsir has discovered that in the embryos of the modern ruminating mammals, calves, for instance, the rudiments of the canines and of the incisors of the upper jaw appear, but do not pass beyond the rudimentary stage after birth.

An organ which is not in use atrophies, and an animal which has no use for certain teeth loses them. Nature conserves, but wastes not.

The organs may be preserved in the embryos, because the embryo passes through all the stages through which the species passed in its evolution.

In the whalebone whales there are varieties which have the full set of teeth germs to form during fætal life, and even to calcify, but become completely absorbed before birth; in others, where some of the teeth remain in the jaw, they are covered up by the gum during the entire life of the animal; in others still, the teeth of the upper jaw alone are rudimentary and functionless, being imbedded in the gum.

VERTEBRATES.

Fishes.	Amphibians.	Reptiles.	Birds.	Mammals.
1. Teeth grading from erect horny spicules up to calcareous.	1. Teeth usually calcareous.	1. Teeth always calcareous.		1. Teeth always calcareous.
2. Teeth arranged in rows, two or three in number, and are situate not only upon the jaws, but also, in the ganoids for instance, upon the palatines, vomer, parasphenoid, and onhyoid and branchial arches.	2. Teeth also found upon palatine and vomer, but rarely on the parasphenoid.	2. Among Reptilia, the Ophidia and Sauria alone have teeth on the palatine and pterygoid, while the Crocodilia have teeth only upon the maxillary bone.	2. The Birds have no teeth, but since there are fossil forms which possess them, and since the embryoes of some present birds show teeth in rudimentary form, it is evident that the teeth have been lost to those now extant simply through non-use.	2. The teeth of Mammals are confined to maxillary bones.
3. In some fishes the teeth are fixed in the buccal membrane without support by underlying cartilage and bone, and partly movable; in others, when united to the bone, it is usually through ossification of the bone to the tooth, very rarely a process of bone projects into the tooth.	3. The rule among the Amphibia is for the teeth to be fused (anchylosed) to the bone.	3. The teeth are independently formed. In some of the lower forms (the pleurodont Lizards) the teeth are attached to the side of the jaw; in others, the acrodont Lizards and Crocodilini, they are embedded in the alveoli.		3. The teeth are *entirely* fixed in the alveoli.

4. Teeth are in great numbers; in single, double, or triple series, and are constantly being shed and renewed throughout life. In the shark's mouth may be seen a row of teeth, when broken or worn away, replaced by a second row either just in front or behind the first, which in turn is replaced by the third, and so on indefinitely.	4. In the Amphibia and Reptilia there is a prodigal renewal of the teeth, though not to the extent which obtains in the fishes.	4. Mammals have but two sets of teeth, the milk and the permanent set.
5. Since the teeth of fishes are for seizing of prey and not for masticating it, their usual form is conical and inclined backward.	5. For the same reason the teeth of Amphibia and Reptilia are likewise conical and bent backward. There is one exception in the Lizard family, where the teeth are differentiated and thus approach the classification common among the mammalia.	5. The teeth, with few exceptions, are differentiated into the incisors, canine and molars, one or the other of these predominating as the mammal's habit of feeding has modified them.
6. The lower jaw is of cartilage and attached to the skull by a loose cartilaginous ligament, which allows only an up and down motion.	6. Among the Amphibia and Reptilia the lower jaw (sometimes bony and sometimes partly cartilaginous) is attached to the skull loosely through an intermediate bone, the tympanic bone, which allows an extraordinary separation of the jaws, as in snakes when swallowing their prey, but which precludes the chewing of food and which allows only the simple vertical motion of the jaw.	6. The lower jaw of all mammals articulates directly to the skull, but there is great diversity of motion of the jaw in the Mammalia. In those of carnivorous habit, whose food and mode of eating are similar to the fish and reptiles, there is the simple hinged motion in a vertical plane; in the herbivorous animals, whose food requires to be ground before swallowing, have developed a lateral, sliding motion of the molars one upon the other; while in the omnivorous, both of these motions are preserved.

In the embryos of some birds the rudiments of teeth are distinctly traceable, yet in no class of birds extant do the teeth pass beyond this rudimentary stage. How can these rudimentary organs be explained by believers in special creations? Surely not, as is usually explained, "in order to complete the scheme of nature" or "for the sake of symmetry," for if these be the reasons, why do not the rudimentary teeth appear in the embryos of all birds, of turtles, and of some ant-eaters, where they are not present at any age? On the other hand, how clear the question becomes in the light of evolution by natural selection! As Darwin has so aptly put it; "The unity of type is explained by unity of descent."

Nor can rudimentary organs be explained by assuming them of some use to the animals. On the contrary there are some of positive harm to the possessor. Confined to the teeth as we are by the present discussion, we can still find an instance here, and in no less an animal than man himself. There are in the upper jaw two small premaxillary bones which in the lower animals remain distinct and separate throughout life, but in man early become fused with the larger maxillary bones. It is from this premaxillary bone that the upper incisors spring. Now in a certain proportion of cases these premaxillary bones do not become united in man, but remain separated. This is the condition in that repulsive malformation known as hare-lip, from its resemblance to the condition found normally in the hare family. Now does it not seem reasonable to suppose that, if man were a special creation, he would have been created without a premaxillary bone? In view of this defect, while man does possess a marvelously complete apparatus, it is thus far not a *perfect* mouth.

Dr. Bonwill makes the claim that, since the jaw of man is an equilateral triangle, it is the most perfect of mouths. The perfection here must be comparative rather than absolute. It is no more perfect in its way than the jaw and teeth of the serpent, the well developed canines of the Carnivora, and the grinding molars and lateral motion of the jaw of the Herbivora, are in their way. Each is no more perfect for its use than the others are for theirs. But even within the question of the perfect angle of the human jaw there is something suggestive of evolution, for among the mammals there is every gradation from the long jaw with its acute anterior angle and narrow base to the ampler anterior angle and broader base of the human jaw. There is a constant shortening and recession of the jaw as we approach man, and even in the races of man himself, we see the same gradation, for in the inferior races, such as the Negro and Australian, the lower jaw protrudes farther than does that of the superior races. But even the perfect, equilateral triangular jaw of modern man is being transformed into something different by civilization.

Darwin in the "Descent of Man" remarked that "it appears as if the posterior molar or wisdom-teeth were tending to become rudimentary in the more civilized races of man."

From a careful study of 1,249 skulls, of which 844 were of the highly civilized modern races, 277 of modern inferior races, and 128 were of the Romans, Etruscans, Phœnicians, and other nations of antiquity, Prof. Mantegazza furnishes corroborative evidence of this tendency, for he finds that the wisdom teeth are more frequently absent in the superior than in the inferior types, the percentage of absence being more than twice as great in the former as in the latter. He concludes that at a period more or less remote the third molar will disappear from the human jaw.

It has been also observed that the third molar or wisdom tooth is smaller than the other molars in man, and the same has been found true of the chimpanzee and orang, the apes which most closely approximate man.

In the superior races of man the wisdom teeth frequently remain imperfectly developed beneath the gum, and when they emerge early decay, and they have only two separate fangs, while in some inferior (Melanian) races these teeth are usually sound, and generally have three fangs, thus more nearly approaching the typical mammalian third molar.

This loss of size of the wisdom teeth is due, according to Prof. Schaaffhausen, "to the posterior portion of the jaw being always shortened in the more civilized because they use soft cooked food, and use their jaws less."

So the great law of the equilateral triangle, which Dr. Bonwill has discovered, and ranks beside the immutable law of gravitation, and which he believes impossible save by a special creation, bids fair to be undone by man himself, and to be superseded through civilization by a jaw of greater anterior angle and of broader base.

INSTANCES OF THE EFFECT OF MUSICAL SOUNDS ON ANIMALS.

BY R. E. C. STEARNS.

(Continued from page 130.)

ANOTHER anecdote relating to

PIGEONS AND MUSIC

is recorded by Goodrich.

"Bertoni, a famous instructor in music, while residing in Venice, took a pigeon for his companion, and, being very fond of birds, made a great pet of it. The pigeon, by being constantly in its master's company, obtained so perfect an ear for music that no one who saw his behavior could doubt for a moment the pleasure it took in hearing its master play and sing."

The Rev. Mr. James also furnished us with the following:

"I have a canary of the feminine persuasion who is particularly fond of music. Immediately I begin to play upon the flute she chirps about as if enjoying the music. If I open the cage-door and leave her, she will come as near to me as possible, but not attempt to fly to the music; but if I put her upon my desk, and lay the flute down, she will perch upon the end, and allow me to raise the instrument and play. I often take her into the church and play there upon the organ, and she will perch upon my fingers, notwithstanding the inconvenience of the motion of the hands, and chirp in evident delight at the sweet sounds."

Following in the train of the domestic animals the hare furnishes an intermediate link between the same and the true *feræ naturæ*.

HARES AND MUSIC.

One Sunday evening five choristers were walking on the banks of the river Mersey, in England. Being somewhat tired, they sat down and began to sing an anthem. The field where they sat had a wood at its termination. While they were singing a hare issued from this wood, came with rapidity toward the place where they were sitting, and made a dead stand in the open field. She seemed to enjoy the harmony of the music, and turned her head frequently, as if listening. When they stopped she turned slowly toward the wood. When she had nearly reached the end of the field they again commenced an anthem, at which the hare turned around and ran swiftly back to within the same distance as before, where she listened with apparent rapture till they had finished. She then bent her way toward the forest with a slow pace, and disappeared."

SEALS AND MUSIC.

Mr. Laing, in his account of a voyage to Spitzbergen, mentions that the son of the master of the vessel in which he sailed, who was fond of playing on the violin, never failed to have a numerous auditory when in the seas frequented by seals, and they have been seen to follow a ship for miles when any person was playing on deck.

HYENAS AND MUSIC.

Sparman furnishes the following story: "One night at a feast near the Cape a trumpeter who had got himself well filled with liquor, was carried out of doors in order to cool and sober him. The scent of him soon attracted a spotted hyena, which threw him on his back and carried him away to Sable Mountain, thinking him a corpse and consequently a fair prize. In the meantime our drunken musician awoke, sufficiently sensible to know the danger of his situation and to sound his alarm with his trumpet, which he carried at his side. The beast, as it may be imagined, was greatly frightened in its turn, and immediately ran away."

THE WOLF AND THE PIPER.

A story is told of a Scotch bagpiper, who was traveling in Ireland one evening, when he suddenly encountered a wolf that seemed to be very ravenous. The poor man could think of no other expedient to save his life than to open his wallet and try the effect of hospitality. He did so, and the savage beast swallowed all that was thrown to him with such voracity that it seemed as if his appetite was not in the least degree satisfied. The whole stock of provisions was, of course, soon spent, and now the man's only resource was in the virtues of his bagpipe. This the monster no sooner heard then he took to the mountains with the same precipitation with which he had left them. The poor piper did not wholly enjoy his deliverance, for, looking ruefully at his empty wallet, he shook his fist at the departing animal, saying, "Ay! are these your tricks? Had I known your humor, you should have had your music before your supper."

The flight of the wolf before "the virtues" of a bagpipe may be interpreted as evidence of highly æsthetic sound sense in the said animal.

HIPPOPOTAMI AND MUSIC.

The enterprising and lamented Clapperton informs us that, when he was departing on a warlike expedition from Lake Muggaby, he had convincing proofs that the hippopotami are sensibly affected by musical sound:

"As the expedition passed along the banks of the lake at sunrise," says he, "these uncouth and stupendous animals followed the drums the whole length of the water, sometimes approaching so close to the shore that the spray they spouted from their mouths reached the persons who were passing along the banks. I counted fifteen, at one time, sporting on the surface of the water."

ALLIGATOR AND MUSIC.

"When the late Dr. Stimpson and I were in Florida in 1869, some person gave him a young alligator. The specimen was about two-and-a-half feet from tip of snout to tip of tail. To secure the beast we made a halter of a piece of bedcord, say three feet long, tying one end around its neck and the other to the leg of the table in the room we slept in. While sitting before a pitch-pine fire in the evening, discussing the events of the day, by way of variety we serenaded that alligator with vocal performances of a high order. Our musical efforts produced, so far as we could perceive, not the slightest effect; the poor brute knew that he was tied, and that it would be useless to try and get away"

From the gigantic and uncouth let us return to the more attractive and familiar animals belonging to certain groups of the Rodentia, some of which are almost domestic through the proximity of their habitat to that of man.

SQUIRRELS AND MUSIC.

In Dr. Merriam's charming volume, in treating of the gray squirrels,[1] he says: "They were extremely fond of music (in the mort comprehensive sense of the term), and it affected them in a peculiar manner. Some were not only fascinated but actually spellbound by the music-box or guitar. And one particularly weak-minded individual was so unrefined in his taste that, if I advanced slowly, whistling "Just before the Battle, Mother," in as pathetic tones as I could muster for the occasion, he would permit me even to stroke his back, sometimes expressing his pleasure by making a low purring sound. This was a gray, and I several times approached and stroked him as above desceibed. I once succeeded in getting near enough to a black to touch him, whereupon he instantly came to his senses and fled. When listening to music they all acted much in the same way. They always sat bolt upright, inclining a little forward (and if eating a nut were sure to

[1] *Sciurus carolinensis leucotis.*

drop it), letting the forepaws hang listlessly over the breast, and, turning the head to one side in a bewildered sort of way, assumed a most idiotic expression.

MICE AND MUSIC.

In 1804 Dr. Samuel Cramer, of Virginia, communicated to Dr. Barton the following very curious account of the influence of music upon the common House Mouse. He said: "One evening in the month of December, as a few officers on a British man-of-war in the harbor of Portsmouth were seated around the fire, one of them began to play a plaintive air on the violin. He had scarcely performed ten minutes when a mouse, apparently frantic, made its appearance in the centre of the floor, near the large table which usually stands in the ward-room,—the residence of the lieutenants in ships of the line. The strange gestures of the little animal strongly excited the attention of the officers, who, with one consent, resolved to suffer it to continue its singular actions unmolested. Its exertions now appeared to be greater every moment. It shook its head, leaped about the table, and exhibited signs of the most ecstatic delight.

"It was observed that in proportion to the gradation of the tones of the soft point the ecstacy of the animal appeared to be increased, and *vice versa*. After performing actions which an animal so diminutive would at first sight seem incapable of, the little creature, to the astonishment of the delighted spectators, suddenly ceased to move; fell down and expired without evincing any symptoms of pain." [2]

The anecdotes herein submitted are more entertaining than important; they contribute but little to our enlightenment on the main point. As a totality they are sufficient to show that an interesting field of inquiry is offered to us, that experiments are worth the making, and that only by carefully devised experiments can satisfactory data be obtained.

[2] The *Phila. Med. and Phys. Jour.*, Vol. 1, 1804, as quoted by Dr. Merriam in his "Mammals, etc."

In reviewing the examples here brought together; those whcih relate to the effect of flute notes on sheep and pigeons are usefully suggestive, as furnishing a hint; *first*, as to an instrument, and *second*, indicating a class of sounds worth experimenting with.

The interest exhibited by pigs, oxen, and cows in the more complex musical sounds, or combinations of sounds, such as would be classed under the second definition, is shown by some of the examples. We have no information as to the character of the instruments, or the tunes, or sounds. The simple fact is proven that these animals were attracted by instrumental music, and the inference is that the sensations produced were pleasurable.

As to how far the behavior of the dogs in some of the cases given may be attributed to or regarded as the effect of music, or considered as nothing more than a manifestation of impulse or spontaneous activity which takes a hand in whatever is going on at the time; it is evident that this is a question for future determination.

We have all noticed the pleasure exhibited by these animals when the master puts on his hat and goes out for a walk, a drive, or a hunt. We have seen them racing with each other, with horses in the field, when both horses and dogs seem to derive pleasure from the performance, and to be acting under the impulse which finds birth in exuberant vitality, or simple, healthful life. It would seem that the example of motion excites to action, and the sight of a swiftly moving railway train or a locomotive tempts and stimulates them to trials of speed.

In the Lake Superior region, where I lived thirty years ago, in the winter season, which meant, at that time, five months' isolation from the rest of mankind, the mail-bags were carried once a fortnight by dog-trains in charge of three or four Indians or half-breeds. There were generally three or four sleds, with as many dogs to each. The dogs were gaily decorated with bits of bright-colored flannel and ribbons, and bells were added for sound and show. Upon arriving at the summit of a hill about half a mile from the centre of the camp, they halted for a breathing spell. I shall never forget the lively scenes that always followed these brief halts, when men and dogs started down the slope towards my office, at full speed; the Indians whooping at the top of their voices, and the dogs adding to the tumult by their vociferous and joyful barking, and the merry jingle of the bells.

Here man and beast were moved by a common impulse, which found relief, expression, and pleasure in intense activity and noise. They had shared together, as companions and friends, the fatigue and dangers and monotony of a long journey over dreary reaches and wastes of snow, and through the gloom of silent forests, and now had reached the end which gave them rest, food, and security.

It is hardly worth the time to further consider the illustrations here brought together, as they are for the greater part not sufficiently circumstantial to furnish a deduction of any real value; they are rather like straws in the air which indicate the course of the wind, or blaze-marks on the trees that indicate a path to be followed.

References:

The paragraphs beginning page 26, line 16; p. 127, l. 23; p. 128, l. 8; p. 236, l. 9; p. 237, l. 4, 19, 26; p. 238, l. 4, 23; are taken from Goodrich's little book, "Anecdotes of the Animal Kingdom," 16 mo., Boston: 1848. P. 26, l. 23, 28; p. 123, l. 1, 19; p. 124. l. 29; p. 125, l. 18, 27; p. 126, l. 10, 29; from *Science Gossip*, various years to 1875. P. 27, l. 6; p. 28, l. 4; letter from Rev. Mr. James, March 24, 1884. P. 27, l. 17; letter from Prof. Davidson, March 22, 1885. P. 28, l. 18; correspondence of *Globe-Democrat*. P. 239, l. 17; from "The Mammals of the Adirondack Region," by C. Hart Merriam, M.D., N. Y.: 1884. Published by the Author.

GENESIS OF THE ACTINOCRINIDÆ.

BY CHARLES R. KEYES.

THE crinoids belonging to the family Actinocrinidæ reached their greatest development and expansion during the lower Carboniferous period. In the American rocks the variety and number of these forms is indeed remarkable, perhaps nowhere equaled in any other age or region.

As regards the distribution of the group in time and space, and the phylogenetic history of the camarate forms in general, many pregnant suggestions have recently been offered by certain terranes in the Mississippi valley. But until quite lately attention has been turned in other directions than towards the solving of these problems; to the purely geologic considerations, and to the description of species. That such a large number of specific and higher terms should have been proposed, many of which are now regarded as invalid, is not surprising when it is remembered that serial comparisons were made only in exceptional cases, and that most of the forms show great variation, even now often offering more or less difficulty in definitely limiting the several sections. More recently efforts have been turned towards the structural features of the different groups, with most gratifying results towards a better understanding of the class. For a long time previous the lack of a sufficient variety and quantity of well-preserved examples of the occurring species had greatly embarrassed all efforts of this kind; and in many cases had led to very erroneous conclusions concerning the real structure of various parts of the skeletal arrangement. Late finds, however, have in great measure removed many of the difficulties that earlier would have very much hindered any attempts towards a satisfactory solution of the two questions already alluded to. They have also supplied enough additional data to render profitable the consideration anew of the entire stratigraphy of the Carboniferous rocks of the broad continental interior, with the manifest result of a much better defined subdivision of the series than that now existing.

Geologic Distribution of the Actinocrinidæ.—More than three-fourths of the total number of genera of Actinocrinidæ are represented in America, distributed in time as shown in the accompanying chart, the relative expansion of each genus being also indicated. As compared with the ages preceding, the lower Carboniferous is here greatly exaggerated in order to show more clearly the relationship of the several zoological groups, for it was during this time that the greatest diversity of form, structure and general ornamentation occurred; in fact it was the culminating period of crinoidal life in America. Continuous lines are drawn where the record is complete and the transitions fully shown, while the dotted lines indicate the relation of the different types according to the evidence at present known, and probably coincide very closely with the real courses of divergence. The scheme is, then, to represent in a graphic way the relationship of the genera as now understood, rather than to construct a genealogical tree, with which attempts of this kind are often confounded. In the present instance some of the earlier, more generalized forms have not as yet been made known. There are also good grounds for believing that some of the generic types are considerably older than actual observation shows. In other groups, more particularly, there is abundant evidence pointing to a much higher antiquity of the leading generic types than is generally supposed. This is especially true of many widely distributed living organisms whose ancestry has lately proved to be very ancient.

Elements of Classification.—The most generalized type of the family Actinocrinidæ has dorsally a single ring of basal plates, three in number and of equal size, succeeded by a second circle of subequal pieces, six in number—the five radial and the primary anal plates. As in all camarate crinoids, the brachials for a considerable distance are incorporated into the calyx by means of interradial ossicles, and in the free portion of the rays they are biserial and closely interlocking. Ventrally five orals can, with a few exceptions, be made out; they are usually surrounded by a greater or less number of smaller pieces. The anal aperture may be a simple opening immediately back of the orals, or at the end of a long ventral tube.

The fundamental modifications in the arrangement of the various plates give trustworthy criteria for the basis of genera; while the ornamentation, relative size and shape of the calyx ossicles form very satisfactory features for the distinction of species. The taxonomic values attached by different paleontologists to the various characters are not the same. This difference of interpretation, however, appears to arise largely from inattention to the ontogenetic history of the living forms of the class. But this diversity of opinion, happily, is rapidly lessening, with the prospect of a speedy agreement, at least in the main features, as to the relative worth of the separate structures in classification.

General Morphological Changes.—Before passing, however, to morphological details, it may be well to call attention to some widely-spread variations recorded. Briefly summing up, then, the statements recently[1] made in a general consideration of the most marked anatomical features displayed by the Carboniferous crinoids of the Mississippi basin, it may be said that these organisms, from the beginning of the lower carboniferous to the close of the Keokuk, showed: (1) a wonderful and extremely varied development of different structural characters; (2) a constant increase in size and massiveness of test; (3) a peculiar change in ornamentation, which, from the delicate style of the earlier forms, gradually grew more and more bold and rugged; and (4) many curious modifications in minor particulars.

These striking and wide-spread phenomena point to very decided changes in surroundings, such as might have resulted from a gradual decrease in the depth of the sea, a slight diminution, in the density of the water and the introduction of fine sediment in consequence of the nearer proximity to the drainage courses of the young continent, or marked alterations in the coastal contour of the neighboring mainland. There probably were acting also numerous other though less apparent influences. Indeed, these suggestions find substantiation in the stratigraphy

[1] Keyes: Carb. Echin. Mississippi Basin, *Am. Jour. Sci.*, Sept., 1889.

of the region, which gives every reason to believe that the changes went on quietly, yet at a rather rapid rate. The great abundance of individuals at this time may be due, in part at least, to the withdrawal of their more motile enemies because of the unsuitable physical impositions already mentioned. The comparatively rapid changes of environment thus imposed would force rapid modifications in the structure of the various individuals in order to secure a more perfect adaptation to the new conditions. And when these physical changes went on with still greater rapidity structural adjustment was unable to keep pace, and soon ended in the extinction of the group. The unfavorable conditions at a somewhat later period are further shown in the neighboring districts where a few types still persisted, small, depauperate and few in numbers.

Generic Considerations.—The Actinocrinoids are first known in the upper Silurian. They early showed signs of departure from the primitive form; and developed chiefly along two divergent lines. The one group continued to the Burlington with but slight tendencies to modification in general structure; the other soon broke up into a number of more or less well-marked sections, each of which rapidly expanded into new generic types, until about the close of the Keokuk, where, with a single exception, they became extinct. The present account will therefore make mention of the following groups as comprising the Actinocrinidæ: Periechocrinus, Megistocrinus, Amphoracrinus, Alloprosallocrinus, Agaricocrinus, Dorycrinus, Gennæocrinus, Eretmocrinus, Batocrinus, Actinocrinus, Teleiocrinus, Physetocrinus, Strotocrinus and Steganocrinus.

The general structure of the forms has already been alluded to, but some minor anatomical points in various genera may require further consideration. The first of the sections above referred to includes only two types—Periechocrinus and Megistocrinus. These genera differ from the other members of the family chiefly in the relatively large calyx, rather small branching arms, the large number of interradial plates, and in the structure of the ventral surface. In Periechocrinus the plates are smooth and thin; in Megistocrinus rather thick and more or less highly oramented. The anal interradius has three ossicles in the second tier, with many smaller pieces in the succeeding rows.

Amphoracrinus, in the general construction of the calyx, closely approaches some forms of Agaricocrinus, but its arms are very different, resembling more those of the preceding group. There are also other important distinctions. The earliest Agaricocrinus appears in the Kinderhook. At the beginning of the Keokuk a curious differentiation in some of the forms took place, giving rise to Alloprosallocrinus, of which but a single species is as yet known. The genus first mentioned is characterized by the flattened or concave dorsal region of the calyx, the free arms being given off low down on the margin of the basal plane. The rays are somewhat separated, especially on the posterior side, where a vertical row of anal plates is very noticeable. Ventrally, the calyx is greatly protuberant, and sometimes inflated not unlike that in Amphoracrinus.

Dorycrinus is the direct lineal successor of Gennæocrinus, from which it should, perhaps, not be separated generically. The anal structure links it closely with Agaricocrinus. It differs, however, in having the general arrangement of the calyx more like Batocrinus, and in a less massive arm structure. The long spines, so conspicuous on the ventral plates of some species, seem to be merely greatly exaggerated developments, homologous with the large nodosites on similar plates in Agaricocrinus.

Extreme forms of Eretmocrinus differ from those of Batocrinus principally in the long, lanceolate arms and inflated ventral parts. But the gradations are very complete, and it is often difficult to separate the forms of the two groups. In Batocrinus, the long anal tube, like that of the typical form of the family, is very prominent. The arms are short; the plates in the second tier of the anal interradius three in number, and the orals large and well defined.

Actinocrinus and the genera following have only two pieces in the second anal tier. In the leading genus two rather well-defined sections are recognized: one with the arms equi-distant around the margin of the calyx; the others with the arms in clusters, imparting a strongly quinquelobate symmetry. The small number of brachials below the free arms is also very noticeable when compared with the four groups yet to be considered. Teleiocrinus departs from the type just mentioned in having a greater number of the lower brachials incorporated into the calyx, and forming a more or less pronounced decagonal rim just above those of the second order. In this respect it approaches somewhat towards Strotocrinus, but the latter has a very different ventral structure. Physetocrinus and Strotocrinus both differ from Actinocrinus in the structure of the ventral side, while the anal opening is a simple aperture in the test. The first of these types has the ventral portions of the calyx greatly elevated; the second nearly flat, while the rim is enormously developed, and the terminal free arms are not given off until the twelfth to fifteenth order of brachials. The calyx of Steganocrinus is most like that of the lobed section of Actinocrinus, but the radial extensions are most remarkable, and give rise to a very large number of free arms.

Geologic Development.—Inasmuch as the different phases passed through during the known existence of several of the genera mentioned have already been referred to elsewhere,[2] it is hardly necessary to take up here each group sepapately. It will suffice simply to consider somewhat in detail the geologic history of one of the leading generic types,—Actinocrinus,—which will also indicate the general course of development pursued by the other members of the family.

As yet the genus Actinocrinus is not known before the earliest part of the Lower Carboniferous—the Kinderhook. The forms from this horizon thus far discovered have all a more or less globular calyx, with the arms equidistantly distributed. The ornamentation has already assumed two very distinct phases. In the one, delicate ridges or small confluent nodes pass from the central portion of each dorsal plate of the calyx to the center of adjoining ossicles; in the other, the ridges are very inconspicuous, and the plates are strongly convex on the outer surface. These two styles of sculpturing continue during the existence of the group; but the first gradually loses its identity, while the second

[2] Wachsmuth and Springer, Proc. Acad. Nat. Sci., Phila., 1878.

becomes greatly intensified. In the earlier species the free arms are slender, growing much stouter in the Burlington and Keokuk, and in the latter often also branching one or more times. This development is accompanied by an increasing massiveness of the calyx plates and a change of the simple convexity of the ossicles into great, rude nodosities. Another marked feature is the tendency for the rays to separate from one another above the second brachials, forming prominent radial extensions before giving off the free arms. At the same time the interradial areas become somewhat more depressed. The quinquelobate calyx is thus produced; the form upon which the genus was was founded. In general it may be said that the earlier forms were of small size, delicately constructed and ornamented, and that they gradually became very much larger and more massive, with a rough, rugged ornamentation.

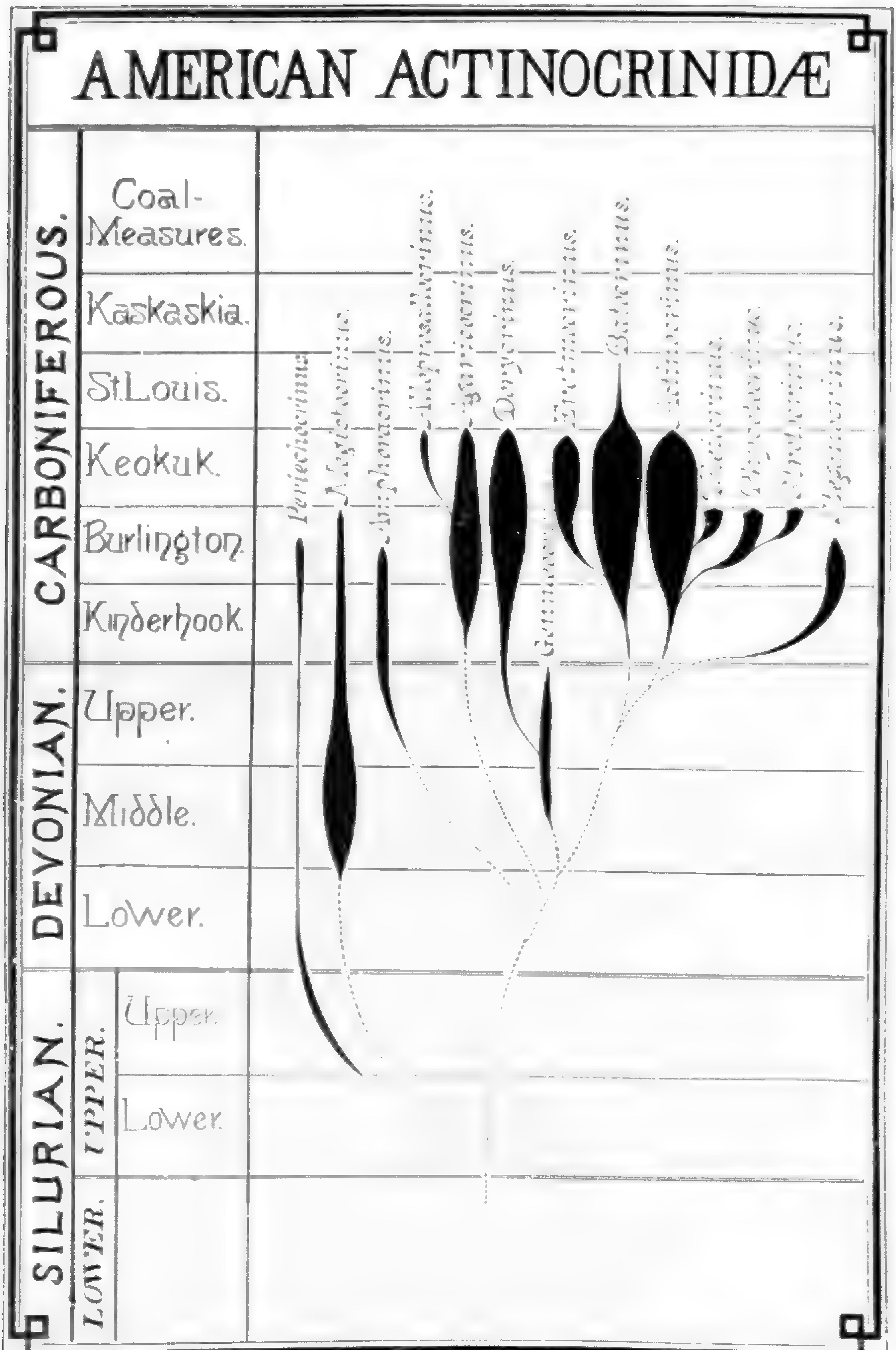
The more striking points in the development of the anatomical features in Actinocrinus, as here briefly traced, apply to the other genera here mentioned, and also to the members of other related families. Besides, Dorycrinus developed huge vertebral spines; Batocrinus, an immense disk-shaped calyx; Eretmocrinust broad lanceolate arms; Strotocrinus, a large rim stretching out laterally from above the tertiary brachials; and Steganocrinus, monstrous radial extensions, from which the free arm sprung.

Generic Relationships.—As previously stated, Periechocrinus and Megistocrinus are closely related, but differ considerably from other members of the family. Their recorded history also extends over a much longer period than that of the other twelve genera. Periechocrinus occurs first in the Niagara,—large, thin plated forms, nearly devoid of ornamentation, and having tall obconic calyces, with long arms branching one or more times. The evidence of this type in the American Devonian is as yet rather meager, though in Europe abundant testimony of its existence in rocks of similar age is not lacking. The forms found in the Lower Carboniferous present a somewhat different aspect from those of the earlier periods, having the calyx very much shortened and proportionately broadened at the base of the free arms, besides differing in several other respects.

On the other hand, Megistocrinus, with its thick, heavy plates, boldly sculptured, and having a very depressed calyx, reached its greatest development in the middle Devonian. It continued, though in greatly lessened numbers, to the upper part of the Burlington, where it became extinct. Both genera appear to have a larger number of dorsal interradials, especially on the anal side, than any other of the Actinocrinoid genera.

Amphoracrinus approaches Agaricocrinus in the flattened dorsal cup, the high, often inflated, ventral portions, and in the shape and arrangement of the plates of the aboral side. The anal side and arms connect it with Actinocrinus and Periechocrinus: with the former by the possession of usually only two ossicles in the second tier, by the absence of the marked vertical row of anal plates, and by the presence of a short sub-central anal tube; with the latter by the peculiar structure of the free arms.

Agaricocrinus is remarkable for the greatly depressed form of the calyx, the dorsal cup being nearly flat, or, as in some of the later species, decidedly concave. Its resemblance to Amphoracrinus has been referred to above. In anal structure it is identical with Dorycrinus, having the same arrangement of plates, and a similar vertical rounded ridge near the top of which is the simple anal opening. The arms are exceedingly stout, somewhat like those in certain forms of Actinocrinus from the lower part of the Burlington limestone, but very much heavier. Agaricocrinus, Amphoracrinus, and Dorycrinus probably began to diverge from the more typical members of the family and from each other about the same time, and this apparently took place during the middle or lower Devonian. In the upper part of the Burlington or early Keokuk a small group of forms departed somewhat from the typical species. These have been placed under Alloprosallocrinus, though it is doubtful whether the differences are great enough to render a separate generic term useful. The chief point of distinction is the position of the anal opening, which is placed at the end of a short ventral tube, instead of being a simple aperture in the test, as in Agaricocrinus. It seems, however, that much more importance has been hitherto


AMERICAN ACTINOCRINIDÆ
CARBONIFEROUS.
Coal-Measures.
Kaskaskia.
St. Louis.
Keokuk.
Burlington.
Kinderhook.
DEVONIAN.
Upper.
Middle.
Lower.
SILURIAN.
UPPER.
Upper.
Lower.
LOWER.
Periechocrinus.
Megistocrinus.
Agaricocrinus.
Dorycrinus.
Eretmocrinus.
Batocrinus.

placed upon this structure in classification than it probably deserves, as will be referred to later.

Dorycrinus is directly traceable to a certain group of Devonian crinoids for which the name Gennæocrinus has been proposed. The latter genus embraces a few small forms, mostly from the Hamilton rocks. The species of Gennæocrinus, as for example *G. cassedayi* Lyon, are connected with Burlington and later Dorycrinus by such forms as lately have been found in the Kinderhook beds of Central Iowa, and which have been described by Wachsmuth and Springer as *D. immaturus* and *D. parvibasis.* Dorycrinus, in combining the features of both, unites closely the Batocrinoid and Agaricocrinoid groups. It agrees with the first in the peculiar construction of the posterior side, in the simple anal opening, and in the radial grouping of the arms; with the second in the shape and structure of the calyx, and in the somewhat flattened distal portions of the arms, in this respect approaching certain Eretmocrini. In the earlier, more generalized forms the close resemblance of Dorycrinus, Agaricocrinus and Eretmocrinus or Batocrinus is far more striking than with later varieties which have become so greatly differentiated. The most prominent features, perhaps, to be noted in this connection are the monstrous ventral spines, often reaching a length of three to five inches, as in *D. mississippiensis* Roemer, and *D. roemeri* M. and W.; the immense basal expansion, as shown by *D. missouriensis* (Shumard) and *D. cornigerus* (Hall); and the stout, heavy stalks with large, conspicuous nodal joints.

Eretmocrinus differs from its nearest related genus—Batocrinus—of which it is manifestly an offshoot, chiefly in having long, flattened, lanceolate arms, a somewhat different ventral structure, and usually a more or less well defined lateral extension of the basals. The genus was rather short-lived, appearing in the Burlington and becoming extinct before the close of the Keokuk.

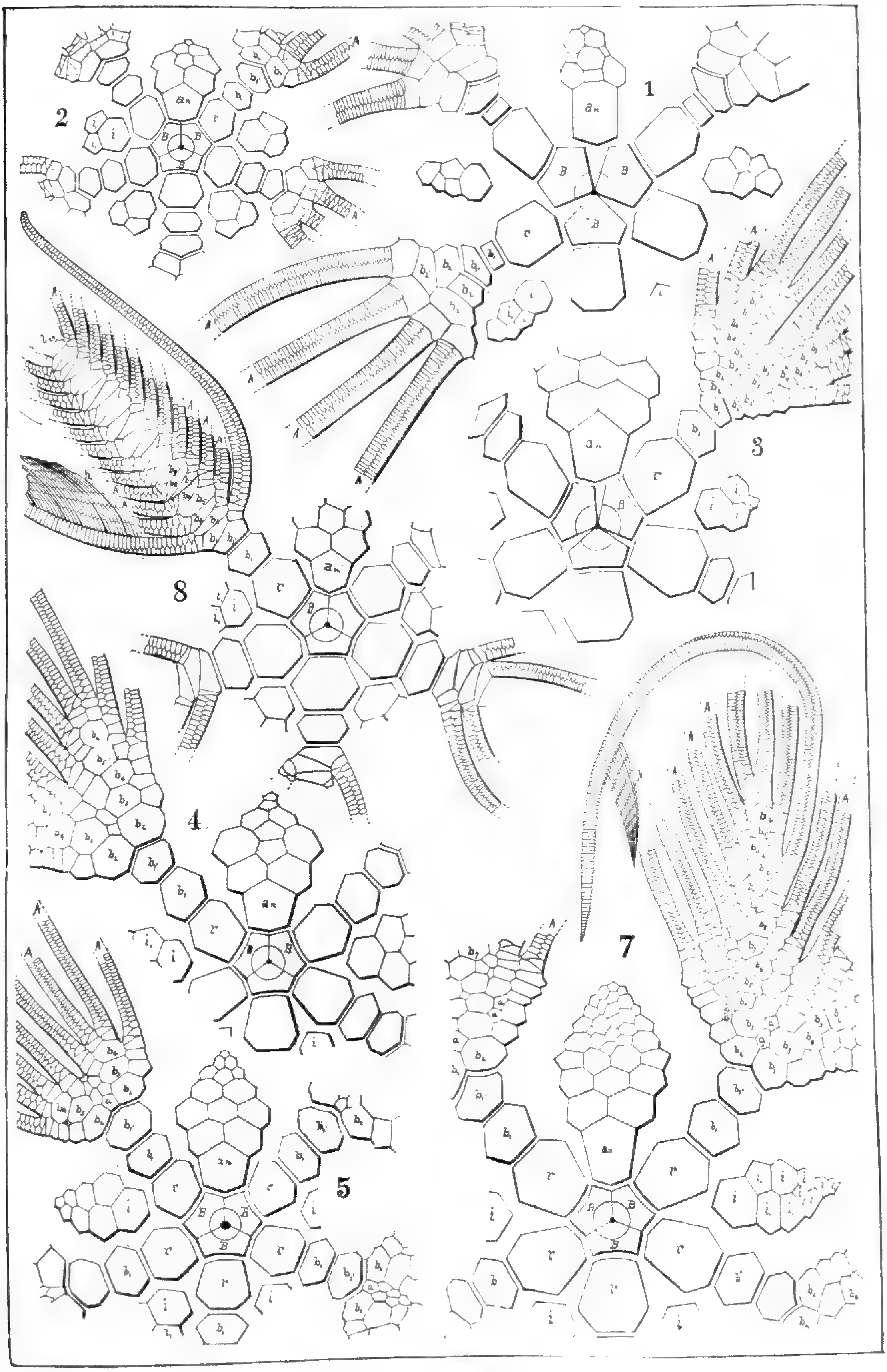
Batocrinus is one of the most characteristic and widely spread forms of the family occurring in the lower Carboniferous. Its relations to the other genera have already been considered elsewhere and need not be repeated here.

Actinocrinus is the type of a most remarkable group. The earlier forms bear a close resemblance to those of Batocrinus, but the possession of only two plates in the second anal tier serves readily to distinguish the two genera. As yet it has not been found to occur below the Carboniferous. It early shows a marked tendency to differentiation along the radial lines, assuming most wonderful phases, which culminated in Teleiocrinus, Strotocrinus, and Steganocrinus. The more primitive forms of Actinocrinus have the free arms, as they leave the calyx, nearly at equal distances from one another, In certain species, however, the arms of one ray begin to separate from those of the adjoining rays. Interradial plates still further increase the distance between the clustered free arm bases of the several rays, until finally the calyx has become strongly quinquelobate. The first section gradually diminished in numbers and disappeared in the upper part of the Burlington; but the second continually grows more and more prominent, and ultimately attains huge dimensions before the extinction of the group.

In the upper portion of the Burlington appears a small group of crinoids—Teleiocrinus—possessing all the characters of Actinocrinus except that the lower branchials for some distance have become larger, and appear like calyx plates. These are all firmly anchylosed, and do not give off the fine biserial arms until the fifth or sixth order of brachials. The calyx thus possesses a more or less well-defined lateral extension passing around above the branchial of the second order. This has led to the union of this group with Strotocrinus; but the rim, though very striking and very similar in each, appears to be a separate development in the two genera, rather than different stages of the same feature. In the ornamentation, the ventral structure, and the possession of a very long anal tube the affinities of Teleiocrinus are manifestly much nearer the typical representative of the family than Strotocrinus.

The Physetocrinus type begins to make its appearance in the Kinderhook as a derivative of Actinocrinus. The earliest known divergence, perhaps, is shown best in *A. ornatissimus* W. and Sp. from the lowest member of the lower Carboniferous. In this

PLATE VIII.



AMERICAN ACTINOCRINIDÆ.

form the radial portions of the calyx have already commenced to become somewhat lobate, and the arms to grow longer and more slender. The plates of the ventral side are all quite small, the ovals indistinguishable from the surrounding ossicles; while the pieces around the anal tube are still smaller, indicating that this structure was very short, and in many cases probably did not pro ject much above the ventral dome. The ornamentation of both also presents a close similarity. Some forms of *A. orpusculus* Hall, from the lower part of the Burlington limestone, also show the Physetocrinus facus, but in a much less merked degree Physetocrinus appears to be the line along which Strotocrinus developed into the unique, short-lived forms which are found only in the upper part of the Burlington.

With the calyx alone under consideration Steganocrinus would be immediately referred to Actinocrinus, but the immense, narrow, radial extensions from which spring the free arms are certainly distinctive enough for generic separation. Although in this character the genus, at first sight, departs so far from the other groups of the family, it will be seen on closer examination that the departure is only another phase of what is shown in Strotocrinus, a devergence beginning a little earlier and in a little different direction.

Summary. Several interesting points are disclosed in the foregoing sketch of the American Actinocrinidæ, which have an important bearing upon the consideration of fossil faunas in general. The conclusions here arrived at apply, in the main, to other families of crinoids as well as to the gastropods and other paleozoic forms, though not to so apparent an extent. Considerable information has already been obtained illustrating these phenomena in the groups last mentioned, and will be the subject of future reference.

(1.) It is clearly indicated that a large proportion of the genera date back much further geologically than actual observation shows.

(2.) At times in the phylogenetic history of a group variations appear to go on with broad and rapid strides, and the organisms survive through rapidly changing physical conditions.

When the changes of environment became too rapid, the forms either ceased, to exist or retrograded, became depauperate and finally extinct. Admirable illustrations are found in Batocrinns, Dorycrinus, and especially in the Hexacrinoid genus Dichocrinus.

(3.) Variation may go on in one portion of an organism without materially affecting other parts. This is well shown in Steganocrinus as compared with Actinocrinus, and among the the Platycrinidæ in Eucladocrinus and Platycrinus, in the Rhodocrinidæ by Gilbertsocrinus and Rhodocrinus.

(4.) The Actinocrinidæ show a decided tendency throughout their existence to increase the distal extent of the rays. In some forms it was accomplished by the simple branching of the free arms, as in Megistocrinus, certain Amphoracrini, and a few Actinocrini; by the lateral expansion of the arms, as in Eretmocrinus; or by radial extension of the calyx branchials, as, notably, in Teleiocrinus, Strotocrinus and Steganocrinus. The number of free arms was thus increased from twenty or thirty in the earlier species of Actinocrinus, to forty to sixty in Teleiocrinus, one hundred to one hundred and twenty-five in Strotocrinus, and from one hundred and fifty to two hundred in Steganocrinus.

Explanation of Figures.

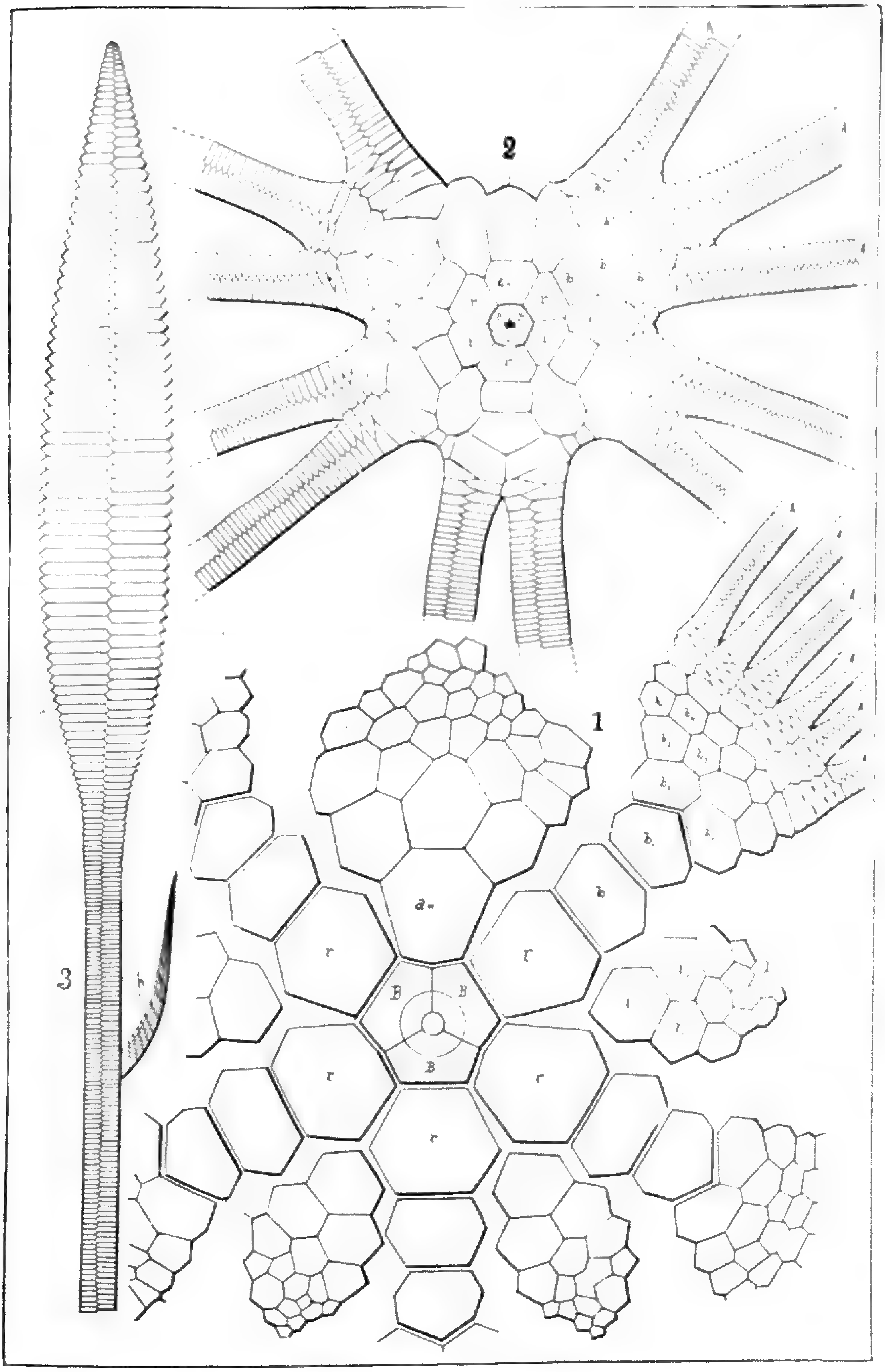
Plate VII.—Graphic representation of the generic relations and distribution in time of the American Actinocrinidæ.

Plate VIII.—Dorsal surfaces of Actinocrinidæ. *B*, basals; *r*, radials; *b*, branchials; *A*, free arms; *i*, interradials; *an*, primary anal plate; *p*, pinnucles; *a*, interaxillaries.

1. *Batocrinus pyriformis* (Shumard). 2. *Actinocrinus proboscidalis*, (Hall.) 3. *A. multiradiatus* (Shumard.) 4. *Teleiocrinus umbrosus* (Hall.) 5. *Physetocrinus ornatus* (Hall.) 7. *Strotocrinus regalis* (Hall.) 8. *Steganocrinus sculptus* (Hall.)

Plate IX.—1. *Megistocrinus evansi* (O. and Sh.) 2. *Agaricocrinus wortheni* (Hall.) 3. Free arm of *Eretmocrinus remibrachiatus* (Hall.)

PLATE IX.



American Actinocrinidæ.

EDITORIAL.

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

ACCORDING to Captain Boutelle, U. S. A., superintendent of the National Yellowstone Park, that reservation is fulfilling the purpose of its existence better than ever before. Since the capture and conviction of depredating hunters has become assured, this class of persons have concluded to let the Park alone. Men who might have once played the part of poachers have now become persuaded that it is to their advantage to permit the game in the Park to increase, and furnish a supply for the surrounding region, which will thus continue to be the best hunting ground in America. Captain Boutelle informs us that the large game has become exceedingly tame, the black-tailed deer and wapiti scarcely moving out of the way of the parties who patrol the Park. Bison and moose are also increasing. The immunity from hunters has also encouraged the multiplication of the carnivora. The chief increase is in bears, both black and silver-tip. The slop-barrels and pig-pens of nearly all the hotels are nightly visited, says the Captain, by one or two bears, who divide the supplies with the swine, sometimes eating with them from the trough. So long as they find the necessary douceur, the pigs do not suffer; but if the tax is not paid, an execution is issued and a pig seized to satisfy the debt. Puma and wolverine are also increasing; so that unless some permission to reduce the numbers of the carnivora is obtained, the non-carnivorous game must suffer.

Superintendent of the Fish Commission Col. Macdonald has also determined to experiment on the adaptability of the Park as a fish preserve. Professors Jordan and Gilbert have been examining the distribution of fishes in the Park and the character of its waters, with a view to the introduction of white-fish and grayling, as well as some additional species of trout. It will probably be necessary to introduce also some herbivorous fishes to serve as a food-basis, as some Catostomidæ, which may be found at similar altitudes of the adjacent regions. Such species (*Catostomus labiatus* e.g.) are found in the Snake River of Idaho, and could be easily procured.

The wisdom of Dr. Hayden in proposing and of Congress in directing the reservation of this tract is abundantly vindicated. It will be well if the Yosemite Park of California can be made equally useful as a game preserve. The time will come when a similar preserve for the game of our Eastern Region will become important. The wild country about the head of some of the eastern tributaries of the Tennessee River in North Carolina furnishes good localities for such a reservation.

RECENT LITERATURE.

A New Text-book of Animal Physiology.[1]—This book, intended "for students of human and comparative (veterinary) medicine and of general biology," is unique in several respects. The subject is treated from the standpoints of general biology and the theory of evolution, and an attempt is made to introduce the comparative method into physiology. There is no doubt that this fundamental idea is the correct one, and that physiological processes, to be fully understood, must be considered as evolutions. That this aspect of the subject has not been greatly accentuated is doubtless due to the fact that physiology has been so long and so universally recognized mainly as the handmaid of hygiene and medicine, hence of necessity *par excellence* human. A change in this respect is inevitable, and is already begun. Investigations of the vital processes, of the mechanics, the physics, the chemistry of the bodies of a few of the higher animals, with especial reference to the human mechanism, have been pushed far within a few years. But a slowing—not a stoppage—of such investigations must, sooner or later, take place; and investigators will more and more ask themselves how have these wonderful and complex vital, these mechanical, physical, and chemical processes of the highest animal body come

[1] A Text-book of Animal Physiology, by Wesley Mills. Pp. 700; New York: D. Appleton & Co., 1889.

to be? Any attempt, like the present, to bring about this change is to be welcomed and commended.

The book begins with a discussion of questions of general biology, such as the cell, yeast, protococcus, amœba, fungi, bacteria, vorticella, hydra, classification of animals, and theory of evolution. Starting then from the ovum and spermatozoon, reproduction is fully treated; a short discussion of the prominent theories of heredity completing the subject. A chapter on the chemical constitution of the animal body, and one on physiological research and physiological reasoning, are followed by a full and orderly treatment of each of the systems of organs found in the body.

Facts are intentionally stated with not too great, sometimes with insufficient, detail, and are discussed impartially, intelligently, and broadly. Occasional want of clearness and disregard of the rules of rhetoric may be remedied in a second edition. Caution is constantly expressed against the acceptance of purely physical, mechanical, and also simple explanations of vital processes, as witness: "The complexity of vital processes is great beyond our comprehension." "The laws of physiology cannot be laid down in the rigid way that has prevailed to so large an extent up to the present time." "And if in this, the best-studied case [secretion in the salivary glands], mechanical theories of vital processes utterly fail, why attempt to fasten them upon other glands, as the kidneys or the lungs, or, indeed, apply such crude conceptions to the subtle processes of living protoplasm anywhere or in any form?" The author's doubts are suggestive. One cannot repress the thought, however, that much of the discussions is written for and is more fitting for the professional physiologist than the inexperienced student. The latter is everywhere made "expectant of progress." Self-observation, testing of facts wherever possible on one's own body, is constantly urged, as well as the comparative study of animal mechanisms. The illustrations are abundant, generally well-chosen, and excellently reproduced. The original diagrams are valuable. The causation of the heart-beat—a field in which the author himself has worked—is well summed up. Gaskell's idea of the cardiac vagus and sympathetic, as respectively anabolic and katabolic, is practically accepted; and the same physiologist's views as to the nature and relations of the cranial, spinal, and sympathetic nerves are given and commended. The discussion of the influence of the nervous system on metabolism is original and interesting. Throughout the book the author has thought his own way. His doubts and his frequent lack of acceptance of conventional ideas will call forth opposition, but his work is suggestive and stimulating.

Johnson's "How Crops Grow."[2]—Twenty-two years ago the first edition of this book appeared, and immediately took a place among the necessary things for the student of plants. It gave, in compact form, an introduction to the chemical composition, structure, and physiology of the higher plants. It was the only American book which took note of the later work of the German investigations in plant anatomy and physiology. It was deservedly popular, and brought its author great credit.

Now, after these years of trial, it is revised and reprinted, the new matter rendering necessary an entire resetting of the whole. In some parts the modernization of the work has been quite notable, in others this is not as marked, while some portions have been allowed to remain as they were left when first written. In the chapter treating of the volatile part of plants, the changes are most marked and interesting. Here eight classes of "proximate principles" are recognized, as follows: Water, the carbohydrates, the vegetable acids, the fats and oils, the albuminoid or protein bodies and ferments, the acids, the alkaloids, and the phosphorized substances. In the treatment of the carbhoydrates, three sub-divisions are recognized, viz.:

(a) *The Amyloses*, having the formula $(C_6H_{10}O_5)N$, and including cellulose, starch, inulin, glycogen, the dextrine, and the gums (the latter including the pectin bodies).

(b) *The Glucoses*, having the formula $C_6H_{12}O_6$ and including levulose (fruit sugar), dextrose (grape sugar), galactose, mannose and arabinose.

(c) *The Sucroses*, having the formula, mostly, $C_{12}H_{22}O_{11}$, and including saccharose (cane sugar), maltose (malt sugar), lactose (milk sugar), and raffinose.

The vegetable acids fall into several groups, viz.: The *fatty acids* (acetic, butyric, etc.), and the *oxyfatty acids* (glycollic, lactic), both of which are monobasic, and the *dibasic acids* (oxalic, malic, tartaric, citric, etc.). The treatment of the protein bodies is likewise practically new, to which nearly twice as many pages are given in the new book as were assigned to it in the old one.

Passing over much that is new in succeeding chapters, we take up the second part, devoted to the structure and physiology of the plant.

[2] How Crops Grow; a Treatise on the Chemical Composition, Structure, and Life of the Plant, for Students of Agriculture, with numerous illustrations and tables of analyses, by Samuel W. Johnson, M. A., Professor of Theoretical and Agricultural Chemistry in the Sheffield Scientific School of Yale University; Director of the Connecticut Agricultural Experiment Station; Member of the National Academy of Science. New York: Orange Judd Company, 751 Broadway. 12mo., pp. VI. and 416.

Here the changes are fewer. The antiquated term "spongiole" is still preserved (p. 257), though for what purpose is not clear. The root-cap, immediately following, is not properly described. On page 310 we still find the statement that about 100,000 stomata "may be counted on an average-sized apple leaf," when, as a matter of fact, it has been known that there are more than that many *on each square inch.* Morren's figures are 246 per square millimeter (*Pringheim's Jahrbüchen für wissens. Botanik,* Vol. IV., p. 190), and these are equivalent to 158,670 per square inch.

The paragraphs on fertilization and hybridization have been entirely rewritten, while that on species has undergone a significant change. Twenty years ago our author wrote the original pamphlet in such away as to involve "original and permanent differences between different species." Then he cautiously admitted a short paragraph about "Darwin's Hypothesis," which he said "is now accepted by many naturalists;" but he says further, in a deprecatory tone, "our object here is not to discuss this intricate question," etc., etc. In comparing these cautious, not to say timid, references in the first edition to the modern idea of the evolution of species, with the treatment of the subject in the new book, one is able to realize the progress we have made in the last score of years. Now the old doctrine is spoken of in the *past tense!* "Such supposed original kinds were called species" (p. 325). A little further on, in referring to the present view, we find this: "On this view a plant species comprises a number of individuals, among which we are unable to distinguish greater differences than experience shows us we should find among a number of plants raised from the seed of the same parent." A very good definition of a species is this. CHARLES E. BESSEY.

New Hand-Books of Paleontology.[3]—The rapid development of the science of Paleontology in recent years, has been naturally followed by the production of text-books which are designed to bring the subject within reach of students and readers. The three works here referred to have the advantage over many similar publications of being the production of experts in the science, and not of mere

[3] *Elemente des Päleontologie von Steinmann und Döderlein;* Strassburg, 1890, 8vo, pp. 829.

Handbuch des Paleontologie, herausg. von Prof. K. A. von Zittel mit Wirkung von Dr. A. Schenk. I. Abth., Paleozoölogie. III. Band; 3 Lief. Reptilen, 1st part, pp. 437–632, 1889.

Manual of Paleontology for the use of Students; by R. A. Nicholson and R. Lydekker; 2 vols., 8vo., pp. 1654; William Blackwood & Sons, Edinburgh and London, 1889.

compilers with no critical knowledge. We have already reviewed the numbers of Professor von Zittel's work as they have appeared, and we now direct attention to the part which includes the first half of the Reptilia. In the arrangement of the class he adopts the following ordinal groups and names: Ichthyosauria, Sauropterygia, Testudinata, Theromora, Rhynchocephalia, Lepidosauria, Crocodilia, Dinosauria, Pterosauria. On this we observe that the name Sauropterygia is antedated by the Plesiosauria of DeBlainville, and Lepidosauria by both the Squamata of Merrem and the Streptostylica of Stannius. In the treatment of the subject Dr. von Zittel has incorporated the latest information from all sources, and has produced the best summary of it now extant. The work meets our approval more entirely than the parts devoted to the fishes and the Batrachia. In the Testudinata we find the results of the recent work done by Dr. Baur, and in the Theromora much is derived from the writings of Seeley. Lydekker is extensively quoted for the Plesiosauria, and American authors are used where necessary. The illustrations are numerous and excellent.

The work of Dr. Döderlein is more compact than that of von Zittel, the families being represented by a few selected genera, no attempt being made to enumerate all of those which are known. The result is a work of less utility to the special student, but of more practical value to the reader who wishes to know only the *capita rerum*. The system of the fishes is considerably in advance of that of the other text-books, since the supposed order of "Ganoidea" is not adopted, and the division Teleostomi is accepted as one of the primary divisions of fishes, a position to which it is undoubtedly entitled. We find the system of the Reptilia a little less full than that of von Zittel, but that of the Batrachia is less open to criticism. The Mammalia are excellent, and the latest information has been incorporated.

The Manual of Drs. Nicholson and Lydekker is of especial importance as the only work of the kind in the English language. We had occasion to review unfavorably the first edition of the work a few years ago, but we must give a different reception to this new third edition. The book has been completely rewritten, and greatly improved in every respect. The department of Vertebrata is, in fact, a new work, the excellence of which is guaranteed by the authorship of Dr. Richard Lydekker. The illustrations are numerous and good, and there is very little in the science which is not in some way referred to in the text. For any but the use of the book as one of reference, many of the genera are too briefly mentioned. The work is not without faults. The systematic, especially that of the fishes, is frequently not quite up to the requirements of the subject, and the arrangement of the subject-matter is disorderly. We find also an unexpected number of errors of statement in points of American paleontology, as in stratigraphical and geographical position, and in opinions expressed by American authors. We regret that both Drs. Lydekker and Döderlein have reproduced figures of the skeleton of "*Uintatherium ingens*" Marsh; since this fossil is said to consist chiefly of a drawing, modeled after the *Loxolophodon mirabilis* Marsh. C.

RECENT BOOKS AND PAMPHLETS.

MARK, E. L.—Trichinæ in Swine. Extract Twentieth Report Mass. State Board of Health. From the author.

GARMAN, H.—Animals of the Waters of the Mississippi Bottoms. From the author.

MERRIAM, C. HART, AND BURROWS, W. B.—The English Sparrow in North America. Dept. of Agriculture Bulletin, No. 1. From the author.

RYDER, JOHN A.—The Origin and Meaning of Sex. Ext. Proc. A. N. S., Phila. From the author.

SMITH, S. I.—Oscar Harger. From the author.

MCMURRICH, J. P.—A Contribution to the Actinology of the Bermudas. Extract Proc. A. N. S., Phila., 1889. From the author.

MAURICE, CHARLES.—Étude Monographique d'une Espèce d'Ascide Composée (*Fragaroides auriantiacum*). Liege, 1888. From the author.

WOOD, MASON J.—A Catalogue of the Mantodea. Indian Museum.—Contribution to our Knowledge of the Embidæ; An Asiatic Species of Corydalus; Trachea in Rhynchæa. Ext. Proc. Zool. Soc., London.—Species of Parathelphusa; New Species of Portunidæ; Structure of Scolopendrella; New Genus and Species of the Rutelidæ; Mode in which Young Astacidæ attach themselves to the Mother; Parantirrhœa Marshalli. Ext. *Ann. and Mag. Nat. Hist.*—Morphological notes bearing on Origin of Insects: Stridulating Organs in Scorpions; Note on *Mygale stridulans*. Ext. Entom. Socy., London.—New Species of Parathelphusa. Ext. Proc. Asiatic Socy. of Bengal.—New Genus and Species of Land Crabs; Superorbital Chain of Bones in Wood Partridges; Indian and Malayan Thelphusidæ; New Species of Raninidæ. Ext. Jour. Asiatic Socy. of Bengal. All from the authors.

MINOT, C. O.—Uterus and Embryo. Ext. *Jour. Morph.* From the author.

KORSCHELT, E.—Functionen der Wanderzellen im Thierischen Körper. Extract *Naturw. Wochenschr.* From the author.

WALCOTT, C. D.—Stratigraphic Position of the Olenellus Fauna. Ext. *Am. Jour. Science and Arts.* From the author.

FEWKES, J. W.—On a method of Defence among Certain Medusæ. Ext. Proc. Bost. Soc. Nat. Hist., 1889. From the author.

PHILLIPS, HENRY.—An Attempt towards an International Language, by Dr. Esperanto. N. Y., H. Holt & Co., 1889. From the author.

THOMAS, CYRUS.—The Problems of the Ohio Mounds. Washington, Bureau of Ethnology, 1889. From the author.

DYBOWSKI, B.—Studien über Saügethierzähne. Ext. Verh. z. b. Gesellsch., Wien, 1889. From the author.

NORMAN, A. M.—On a Crangon, some Schizopoda and Cumacea new to or rare in the British Seas. Ext. *Ann. and Mag. Nat. Hist.*, 1887. Notes on British Amphipoda, Pts. I. and II. Ext. Saun. 1889. From the author.

WHEELER, W. M.—Two Cases of Insect Mimicry; Two New Species of Cecidomyid Flies Producing Galls on *Antennaria plantaginifolia.* Ext. Trans. Wisc. Nat. Hist. Socy., 1889. From the author.

BEDDARD, F. E.—On Certain Points in the Anatomy of the Accipitres; Note on the Germ Cells in the Integument of *Æolosoma tenebrarum;* On the Oligochætous Fauna of New Zealand; Some Notes on the Anatomy of the American Tapir. Ext. Proc. Zool. Socy., 1889.—Notes on Certain Species of Æolosoma; On the Possible Origin of the Malpighian Tubules of the Arthropoda. Ext. *Ann. and Mag. Nat. Hist.*, 1889. From the Museum.

BRUNER, L.—Report of the Entomologist. Ext. Rept. of the Nebraska State Board of Agriculture, for 1888. From the author.

LINTON, EDWIN.—Notes on Entozoa of Marine Fishes of New England. Ext. Rept. U. S. Fish Commission for 1886. From the author.

STOWELL, T. B.—The Soft Palate of the Domestic Cat. Ext. Proc. Am. Socy. Micros., 1888.—The Glossopharyngeal Accessory and Hypoglossal Nerves in the Domesic Cat. Ext. Proc. Am. Phil. Socy., 1888. From the author.

General Notes.

GEOGRAPHY AND TRAVEL.

Africa.—Lake Tanganyika.—According to Mr. E. C. Hore, Lake Tanganyika, although there is one African lake the water of which stands at a higher level, has the highest watershed in the continent, and the depression which is enclosed by this watershed, including the hilly table-land of Unyamwezi, may be regarded as the central basin of Africa. The crest of this steep watershed hugs the lake on its western side, but on the eastern is at a considerable distance from it, surrounding the hilly plateau inhabited by the Wanyanwezi. Until recently there was no natural outlet to this lake, but of recent years the waters seem to have risen higher than ever before, until they at length burst open.an outlet at a low point upon the eastern shore, where the strata were soft. This gap is the Lukuga River, about which so much has been written, and through it the surplus waters of the lake flow to add their volume to that of the Congo. The barrier once burst, the lake waters have continued their work of cutting down the soft clay, and evidently will continue to do so until the hard rock is reached. At the time of the visit of Commander Cameron, the lake seems to have been higher than it had ever been before, for its recession reveals the stumps of trees that once flourished around the margin. The water level is now eighteen feet lower than it was in 1878; and while of the lower ten feet of this space five is occupied by the stumps of dead trees, the lower five feet is without trees, showing that the present level is lower than any previous one. The Lukuga is now flowing more slowly than it has been. Much of the scenery around the lake is of the grandest description, as might be expected from its position at the bottom of a long north and south chasm. Severe storms sometimes arise, which the natives ride out by jumping overboard and holding on by the boat.

Around this lake, besides the apparently more ancient inhabitants, the Wanyamwezi, who have a horror of water, are grouped representatives of all the African families, the Bantu or Kaffir, the negro, the Semitico-Africano, the dwarfs, and that unclassified group to which the Masai belong. Most of these tribes are expert in the management of their canoes, and thus contrast strongly with the original inhabitants.

The Bissougas.—E. Stallibras (Proc. Roy. Geog. Soc.) gives an account of the Islands of Bijouja, or Bissouga, situate upon the West African coast, in the deltas of the Jeba, Bolola, and Cassini rivers. The largest of these, Orango, is twenty miles long by ten in width, and others are Kanabek, Formosa, Corbelha, and Karashe. All these consist of decomposed volcanic soil, and are thickly covered with wood. Other islands near the Jeba mouth are Bissao, Bassis, and Jatt, while near that of the Bololo are Bissagua, Biafares, Bulama, &c., many of them at present unexplored.

The Portuguese established a fort on Bissao about 1703, but it was afterwards abandoned. In 1792 the English established a colony at Point Beaver, but it proved a complete failure. After this they started a colony upon Bulama, but the islands were by the arbitration of the United States adjudged to Portugal, and the English left in 1868. The present condition of the islands, according to our author, is not flourishing, yet they have a submarine cable.

Stanley's Discoveries.—The letters of Mr. Stanley, published in all the papers, have made the principal points of his discoveries during his last expedition so familiar to every one that it seems superfluous to go over the same ground. Yet there is something strangely fascinating in the encounter, at the head of the Albert Nyanza, and on the eastern flank of the Semliki, which connects that lake with the smaller and more southerly one which Stanley would have us call the Albert Edward, of a snow-capped mountain, believed by its discoverer to be the same as the almost fabulous Mountains of the Moon. Whether subsequent researches will confirm or invalidate Stanley's conclusions in this matter remains to be proved, but in the meantime we can be certain that another peak of 15,000 feet in height is added to those which recent years have revealed in the heart of Africa, and also that another affluent of the great river has been discovered.

The Congo Railway.—Captain Thys has, in a recent issue of the Proceedings of the Royal Geographical Society, given some interesting particulars regarding the Congo Railway, which is to commence at Matadi, a point that can be reached by steamers, and will finish at Ndolo, above the uppermost rapid. The cost of this railroad is said to have been most liberally estimated, yet will not exceed £1,000,000. The most formidable difficulties are encountered in the first twenty-six kilometres of the road, the total length of which will be 435 kilometres.

The Italian Protectorate.—In the partition of the coasts of Africa among the European powers, with undefined claims extending into the interior, Italy has not been forgotten. Her territory around Massowah has been extended to 18.2 N. Lat., while it stretches southward to the southern boundary of Baliata, and thus contains 200,000 inhabitants. The Habab, Beni Amer, and other tribes are also said to have recently recognized the Italian protectorate.

On the Somali coast her protectorate extends from the Zanzibar district of Warshekh in 2.30 N. Lat., to Wadi Nogal in 8.3 N. Lat. It is also said that the Sultan of the Midjertin-Somal, whose territory reaches from Ras Hafim, has placed the northern part of his dominions under the protection of Italy.

Lake Rudolph.—Von Hohnel, arguing from the accounts given by Sr. Borelli and Count Teleki, considers it provable that the River Omo of the former falls into Lake Rudolph, discovered by the latter. Lake Rudolph extends from 2.16 to 4.47 N. Lat., and has an area of about 3050 square miles. It is surrounded by a flat desert country, but towards the north the level varies, and at this end enter two perennial streams, the Bass and the Niam-niam. The Niam-niam is about 100 yards wide in its lower course, and has a slight current, while the Bass, the lower course of which is parallel to the former river, has a width of about a mile and a quarter, but is shallow, and has no perceptible current. At the southern end of the lake two streams also enter, but these are dry save in the wet season. Their names are the Irrquell and Kecio. The lake has no outlet, and it is the Niam-niam which is believed to be Borelli's Omo. The description given by Borelli of Lake Shambara, into which he traced the Omo, does not accord with Lake Rudolph, but Lake Shambara is said to have an outlet, and Von Hohnen believes that the Omo flows through it into Lake Rudolph or Basso Narok. A few miles north-east of Lake Rudolph is a smaller lake, one-eighth the size of the former, and known as Basso Ebor or Lake Stephanie. This also has no outlet, and is rapidly drying up.

In the *Zeitschrift der Gesellschaft für Erdkunde* (Berlin), Paul Reichard gives a long account of the Wanyamwezi of the plateau east of Tanganyika, their physical characters, customs, and modes of life.

The French geographers are greatly elated that at last, after most of the difficulties of the way have been surmounted by others, a French traveler, M. Trivier, has crossed the African continent, passing up the Congo by Stanley Pool and Tippoo-Tib's quarters, and debouching at Mozambique. The editor of the *Revue Géographique*, in recounting the details of the trip, has some remarks to make respecting the probable ulterior objects of Stanley's expedition—remarks that seem not unlikely to be founded on fact.

Captain V. Nicolasis is contributing to the *Revue Géographique* a series of articles upon West and South Madagascar.

Asia.—The Bahrein Islands.—M. J. Theodore Bent (Proc. Roy. Geog. Soc.) gives a description of the Bahrein Islands in the Persian Gulf, upon the Arabian coast. The pearl fisheries of these islands have been famous from the days of Nearchus until now, and who has not heard of the subaqueous springs of fresh water upon their coast?

Mr. Bent was, however, impelled to investigate the group from archeological reasons, his object being to search some of the numerous mounds which are to be found in them, notably in Bahrein itself. This island is twenty-seven miles long and ten wide, Moharek is five miles in length, and has a width of half a mile, while the rest are mere rocks. Among these are Sayeh, Khasafeh, Manaweh and Arad, the latter a Phœnician name. Bahrein has a population of about 8,000, and the group is governed by an hereditary Sheikh, who is now under the protection of Britain. Bahrein has many subterranean springs, related in their nature to those which in some places rise under the surface of the gulf. The first European nation to put in an appearance at this group was the Portuguese, who came under Albuquerque in 1506, and whose power lasted until 1622, when Shah Abbas, assisted by an English fleet, took Hormuz and Bahrein. The islands fell into the power of the Arabs in 1711.

The extensive group of mounds, some of which were explored by Mr. Bent, is situated near the village of Ali, and examples reach a height of forty feet. After digging through hard earth for fifteen feet, a layer of loose stones two feet thick was met with, then one of decayed palm branches. Under these a two-story tomb, the lower chamber higher than the upper, was discovered, and its structure was so similar to that of Phœnician tombs in general as to lend support to the idea that these islands were either the original home of that people, or at least one of their earliest settlements. The upper chamber contained fragments of ivory, bits of a statue of a bull, circular boxes, etc., in a word the treasures of the deceased, whose body was buried in the lower chamber where traces of bones were found, together with the decayed remnants of drapery and remains of the wooden pins used to fasten it to the walls.

The Prejevalsky Expedition.—The Russian exploring expedition, formerly conducted by the lamented Prejevalsky, is now under the command of Col. Pievsoff, who is continuing the work energetically. Letters have been forwarded to the Royal Geographical Society by Lieut. Roborovsky. The expedition left Prjevalsk May 13th, and after passing Silvkina ascended the Barskounski Pass, traveled for a week over an elevated sirt 10,000 to 11,000 feet above the sea, crossed the Tauskan Daria, and then proceeded towards Yarkand. The Kashgar Daria no longer reaches the Yarkand, but is lost in irrigation canals at Marat-bash. The flat banks of the Yarkand are bordered with a belt of vegetation fifteen to twenty miles in width on each side, including two species of poplar and Holostachus. Many ruins of old and unknown cities are to be found in these deserts, the thickets abound in tigers and boars, and wild camels graze on the barkhans around.

The town of Yarkand consists of an old Mahometan city with thirty to forty thousand inhabitants, and a new Chinese city. The water is very bad and there is much goitre. Passing Khoten Col. Pievtsoff has reached Nia, where he will winter, and then search for a route into Tibet over the Taguz-Daban range, some of the peaks of which were estimated by Prejevalsky at 22,000 to 23,000 feet.

A large portion of the November number of the Proceedings of the Royal Geographical Society is occupied by the diary of the journeyings of David Linsday in the interior of Australia, which he crossed from north to south, keeping within the boundaries of the colony of South Australia somewhat to the west of Queensland. The account is accompanied by a map of the route with the survey lines given. There is also a glossary of native words.

Dr. Hagen traces the Malays to West Sumatra, and believes that the present natives of the interior of the large islands (the Dyaks of Borneo, etc.) were the first emigrants from the original site, and crushed out the negritos in the countries occupied by them. This migration was followed by others, the last emigration of the Malays taking place about the twelfth to the fifteenth century. The purest Malay type is to be seen in the Battas and Allas of Sumatra.

A series of articles by A. de Leanarde upon the country of the Amur and the Ossory is completed in the *Revue Geographique*, of January, 1890.

A recent issue of the Proceedings of the Royal Geographical Society, gives the heights of some of the principal summits of New Guinea. Mount Victoria, ascended by Sir W. Macgregor on the 11th of June, 1889, is 13,121 feet hig; Mt. Albert Edward, 12,500; Mt. Scratchley, 12,000; Mt. Knutsford, 11,157; Mt. Douglas, 11,-796; Mt. Griffiths, 11,000; and Mts. McIlwraith and Morehead, ten to eleven thousand feet.

Europe.—Cyprus.—The British governor of Cyprus, Sir R. Biddulph, gives in the Proceedings of the Royal Geographical Society an interesting account of that recent acquisition of the British Empire.

The peculiar form of the island is due to the existence of two ranges of mountains; the one long and narrow, hugging the northern shore at a distance of only about two miles, and the other broader and shorter, placed somewhat to the westward of the former, and considerably to the south. The space between these two ranges is occupied by a broad fertile plain known as the Mesaorea. The northern range terminates westward at Cape Kormakiti, and eastward at Cape San Andrea. One of its highest peaks, Kornos, is 3105 feet. An abundant stream, issuing at a height of 870 feet on the southern side, waters the thriving village of Kythrea, and another, issuing on the northern slope, waters the two flourishing villages of Lapithos and Caravas. The southern range is not only more extensive than the northern, but its summits are loftier. The eastern point of this range is the Mountain of the Holy Cross, crowned by the monastery of Santa Croce, and conspicuous from the harbor of Famagusta. This peak is less than three thousand feet, but Mt. Machera to the westward is 4674; while Mt. Adelphe, still further to the west, is 5305 feet, aud the culminating point, Mt. Troonos, still more to the west, is 6406 feet. This extensive mountain area, which in some places is more than twenty miles wide, was once covered with forest, but the greater part of this has been cut down, to the great detriment of the fertility of the island, so that most of the woods now remaining are west of the summit of Mt. Troodos, in the western and widest portion of the range. A few moufflon still exist in the wildest parts of these mouutains. Most of the rivers flow only after the rains. The largest are the Pediæus, which rises on the northern slope of Mt. Machera, and passes by the capital, Nicosia, and the Idalia, which has its sources on the eastern slopes of the same mountain. Both of these fall into the sea near the ruins of the ancient town of Salamis, and not far from Famagusta. Another stream, rising on the slopes of Mt. Adelphe, enters the sea on the western shore, near the populous village of Morrphou.

The chief causes of the disappearance of the forests are recent, and are indiscriminate wood-cutting, and goats. The island has more goats in proportion to population than any other part of Europe. It is also cursed with a peculiar small species of locust, which a few years since devastated the crops most fearfully, but has, during the last three or four years, been very successfully and energetically fought. The population of Cyprus under Venetian rule is said to have been two millions, though one seems more probable. At the present time, though numbers have increased under British rule, there are not more than 186,000, one-fourth of whom are Mahometans. This island has always been famous for its wines, for the sake of which Sultan Selim sent an army against it, and after an heroic resistance, ceasing only when the city of Famagusta had been sacked, and its brave defender Bragadino flayed alive, succeeded in reducing it under Moslem sway. One million six hundred thousand gallons of this wine are still made annually, but in a most primitive fashion, and four-fifths of this is exported. The whole of the land is divided into small holdings, of which there are 600,000 in all, so that there are more than three to each individual. The houses are, as a rule, built of sun-dried bricks. The capital, Nicosia, has 12,000 inhabitants; Larnaca, on the eastern coast, has 7,000; and Limassol, the southern port, has 6,000. The most interesting ruins are those of three castles of the times of the crusaders, and the oldest complete existing monastery is that of Santa Croce.

The Caucasus.—The Caucasus, with its peaks higher than the Alps, and a glacier system to which that of the better known mountains offers no comparison, is now the favored climbing-ground of Alpinists. During 1889, five elevated passes were crossed by Messrs. David Freshfield and Captain Powell. Among these, that of Saluinan-Chiran is at an elevation of 13,622 feet; while two others attain heights of 14,300 and 13,000 feet respectively. Mr. Herman Woolley ascended Dych-tau (14,923), and the eastern peak of Misahirgi-tau (16,100); while Vittorio and Erminio Sella climbed Elbruz and Malatau (15,351; this was the first ascension); also, together with Messrs. D. Freshfield and Powell, the peak of Leila (13,300).

Arctic Regions.—According to Dr. W. Kukenthal and A. Watter, the existing maps are in error regarding the two or three islands which form King Charles' Land. The latitude of these islands is 78.30 to 78.57 N., and the longitude 26.20 to 26.30 E. The east coast should thus be set back about 11 minutes.

The geology of King Charles' Land is allied to that of Spitzbergen. In the land lakes there are many insects and crustacea, but the mammals are only the usual ones of the arctic regions; bear, walrus, and seal are plentiful. There are a few mosses, which form the only vegetation.

The *Zoölogist* (Jan.) gives an account of the birds of Jan Mayen, translated from a paper by Dr. Fischer, of Vienna. This island is located in latitude 70.49 to 71.8 N., and longitude 7.26 to 8.44 west, and is 600 miles due north of the Faroe Isles. In color and character it much resembles Spitzbergen. At one part there are two volcanoes in close proximity, and at the northern end rises the mountain of Beerenberg, 6870 feet in height. Plants are scarce, and though many migrants visit the island, only sea-birds breed there regularly. Among the birds are *Falco candicans* and *F. peregrinus*, *Nyctea nivea*, *Erithacus rubecula*, *Saxifraga œnanthe*, *Turdus pilaris*, and *T. musicus*, *Motacilla alba*, *Anthus aquaticus*, and *Linota hornemanni*,—the latter a true Arctic species. Many waders occur, and here is the most northern recorded habitat of *Rallus aquaticus*. Many swimmers breed here, but only *Fulmarus glacialis* stays here all the year.

Mr. Thoruddsen, who is himself a native of Iceland, has recently devoted his time to the exploration of this still imperfectly known large island. In 1889 he explored the region of Fiskivotn, a waste between Hecla and Vatna Jokul, before for the most part unvisited. East and north of Hecla he found a new obsidian district. Crossing the Tunguaa, he visited the true crater lakes of Fiskivotn. In the district between these lakes and the Vatna Jokul there is no plant life; the entire area is covered with lava floods, with a large amount of volcanic sand. Lake Thorisvatn in this region is the second largest lake in the island. After a day's journey in an utterly desolate district, M. Thoroddsen discovered the sources of the Tunguaa, and south of this, between three ranges of before unknown hills, he found a long and narrow lake.

Miscellaneous.—No. 143 of the *Zeitschrift Gesell. f. Erdkunde* contains Dr. Polakowsky's account of the Central American State of Honduras, the first of a promised series upon these republics. This republic, which has a population of 331,917, is loaded by a large debt incurred on account of the inter-oceanic railway.

Mexico now has 4700 miles of railway, Brazil 6000, Peru 3000, Chili 1630, the Argentine Republic 4700, and the smaller republics about 1500 miles, making a grand total of about 17,000 miles of railroads in operation in South America.

Sir F. de Winton also states that the railway mileage of Australia reaches 11,000.

GEOLOGY AND PALEONTOLOGY.

Seeley's Researches on the Organization, Structure, and Classification of the Fossil Reptilia.[1]—The Royal Society of Great Britain granted Prof. H. G. Seeley a sum to be expended in prosecuting researches among the extinct Reptilia, and the results obtained up to the present time are embodied in the memoirs now before us.

The first is on that ancient form, both geologically and in the literature, the *Protorosaurus speneri*. From the upper Permian of Germany, no form is more worthy of investigation, but the character of the matrix is such as to render the elucidation of the characters of the skeleton difficult. Dr. Seeley concludes that the genus Protorosaurus has no affinity with any form of reptiles known to him. His figures and descriptions add much to our knowledge of its characters, and, as a result, its place appears to me to be nearer to other genera of Permian age of Europe and South Africa. Accordingly I have (NATURALIST, October, 1889) placed it with them in the Theromora, to which location its characters distinctly point.

The second paper describes that remarkable form *Pariasaurus bombidens* Owen, from the Karoo Series of South Africa, which is of Permian or Triassic age. The new investigation is based on a nearly perfect skeleton in the collection of the British Museum, and the information furnished elucidates the systematic position of the genus almost completely. Dr. Seeley concludes that it belongs to the Theromora "Anomodontia"), and to a subdivision of that order which he calls the Pareiasauria. The characters of this suborder are as follows (p. 292, Philos. Trans., 1889, p. 292): "Occipital" condyle "basioccipital; no temporal vacuities; no median bar to interclavicle."[2] He shows that the ribs are single-headed, and attached to the diapophyses

[1] I. On *Protorosaurus speneri* Von Meyer (1887). II. On *Pariasaurus bombidens* Owen (1888). III. On *Theriodesmus phylarchus* Seeley (1888). IV. On the Anomodont Reptiles and their allies (1889). All from the Philosophical Transactions of the Royal Society, 1887–9.

[2] For scapular arch of Diadectes, see Proc. Amer. Philos. Society, 1883, p. 635.

only, and that intercentra are present. This reference by Dr. Seeley is essentially final, the only question being the minor one of the name of the suborder. In all important respects Pareiasaurus agrees with the Diadectidae, hitherto known only from the Permian formation of North America, and must be placed in the same sub-order. In the American forms the temporal fossa is overroofed in the same manner, and the ribs are single-headed. The articular face of the diapophysis is, however, prolonged downwards to the level of the centrum in the Diadectidæ, though it originates entirely from the neural arch. Both types must be placed together in the suborder Cotylosauria, a name which has priority over Pariasauria. To the same order must be referred the genus Phanerosaurus Von Meyer, from the Permian of Saxony. In his studies of the relations of the intercentra to the vertebræ and the occipital condyle, Dr. Seeley has quite overlooked my own conclusions, with which he agrees, which I published in 1884[3] and 1886[4].

The memoir on the Theromorous reptiles ("Anomodontia") covers a wider range than those above mentioned, and concludes with some general conclusions as to the systematic arrangement of the order. Especially important is the description of the scapular arch in Procolophon, which turns out to have a well-developed coracoid and separate epicoracoid, which, with the clavicle and interclavicle, give the most monotrematous shoulder-girdle yet seen in the Theromora. Other important contributions are the descriptions of limb-bones and shoulder and pelvic girdles in Dicynodon, Hyorhynchus, Eurycarpus, etc. There is more information as to the characters of the skeleton of the South African Theromora to be found here than in any memoir yet published. In the systematic, several new divisions are introduced. The first, the Procolophonina, may turn out to be included in Baur's Proganosauria; but it is manifestly as well distinguished from the Pelycosauria, Cotylosauria, Anomodontia, and Placodontia as these are from each other. For the entire order Dr. Seeley uses the name Anomodontia, which we think should be restricted to the group to which Professor Owen originally gave it, viz.: the Dicynodontia of Seeley. The Gennetotheria (Seeley) do not seem to me to be distinguished from the Theriodonta of Owen, with which the Pelycosauria is more or

[3] AMERICAN NATURALIST, p. 37, On the Batrachia of the Permian period of N. America.

[4] Transac. American Philosoph. Society, p. 243, On the Intercentrum of the Terrestrial Vertebrata.

less coëxtensive, especially after the removal from them of the Cotylosauria.

The affinity to the Mammalia which Professor Owen saw in the humerus, and which I have pointed out in the skull, shoulder-girdle, fore-limbs, and hind-limbs and foot, is confirmed by Seeley's researches. He finds a fore-limb and foot of what he believes to be a veritable mammal in the same beds of the Cape, which is the subject of his third memoir, and which he refers to a species and genus under the name of *Theriodesmus phylarchus*. The probability of this determination being correct appears to me to be strong. The humero-cubital articulation is mammalian, and there is nothing in the pes forbidding the association. Dr. Bardeleben thinks that it has a præpollex with metacarpal and phalange. On this interpretation there is one large *os centrale*.

We are gratified to learn that Dr. Seeley has accepted the position of Director of the Geological Survey of the Cape, and we feel sure that important discoveries await him there in his chosen field.

E. D. Cope.

Devonian.—The *Geological Magazine* for January has some pretty full notes by Dr. R. H. Traquair upon some Devonian fishes from Scaumenac Bay and Campbelltown, now contained in the Edinburgh Museum. Most of the species have been described by Professor Whiteaves, but these notes give much information upon the Ctenodontidæ, Cephalaspidæ, Acanthodidæ, Holoptychidæ, Pleurichthiidæ, Palæoniscidæ, etc.

Mesozoic.—S. Nitchin gives an account of the Jurassic beds of the Himalayas and Middle Asia. The principal development of the Jurassic in the Himalayas is on the north-east slopes of the southern crystalline chain near Spiti and Niti, where dark crumbling shales known as the Spiti shales rest on beds said to be Lias and Rhætic. Phosphatic concretions are abundant, and ammonites plentiful. Opinions differ about the parallelism of the horizon, but it is generally thought that these shales are of the age of the Kelloway and Oxford clays. Nitchen thinks them more recent, and states that their fauna approaches nearest to that of the Tithon and Kimmeridge. The fauna of the Russian Jurassic is near that of Cutch.

Professor A. Pavloff believes that the Upper Jurassic of Russia is so near that of England that a common classification might be adopted. He describes as new three species of Cleostephanus, viz., *C. blaki*, *swindonensis* and *stenomphalus*.

M. G. Cotteau, after having described the Cretaceous echini of France, has now commenced with those of Spain. In Vol. VII., No. I., of the *Ann. de Sci. Nat.*, he treats of those collected in Oregon by M. Maur. Gourdon. The species are in great part identical with those previously described from French rocks.

Tertiary.—The *Revue Géographique* for January contains an account of the defile of the Dànube by Attila de Gerundo. The writer believes that parts of this defile, which is 143 kilometres in length, were ancient valleys, and that a series of dislocations, the localities of which are marked by cliffs, at length opened a passage of communication between the Hungarian Sea and the Roumanian Bay of that larger inland sea of which the Black Sea is a remnant. Through this strait the waters of the sea poured, silting up the Roumanian Bay, until, when the outer sea retreated, the current swept the strait clear of sediment, and the Hungarian Sea ceased to exist, being replaced by the river network that at present exists.

A new edition of Dr. Burmeister's work upon the fossil Mammalia of the Argentine Republic, with considerable additions, has been recently issued. The Equidæ differ from all other Pampean ungulates in having the premolars longer than the true molars. Dr. Burmeister places the more generalized species of fossil horses in the genus Hippidium, which is distinguished from the modern Equus by the shorter and more curved crowns of the cheek teeth, which are of more simple general structure. The shape of the narial apertures also differs from that of the existing horses, the limbs are shorter, and the limb-bones stouter. In its teeth Hippidium approaches Hipparion, but the anterior pillar of the cheek teeth is connected with the anterior crescent, which is not the case with the latter genus. The Pliocene *Equus stenonis* of Europe forms a connecting link between Hippidium and Equus. Additional remains of *E. curvidens*, *E. argentinus*, and *E. andium* are described, also a new Hippidium from Tarija in Bolivia. An entire skull of *Megatherium americanum* shows that our previous knowledge of the osteology of that animal was incomplete. In front of the short nasals this skull exhibits a large prenasal reaching almost to the premaxillaries, and there is also, projecting from the upper part of the maxillary, a lateral process coming forward into the nasal aperture. Probably the prenasal became united to the nasal in the adult. Another ossification extends upwards and backwards from the end of the premaxillary towards the prenasal. These two ossifications are the remains of the complete bony arch exhibited by *Mylodon darwini*, which has been on this account generically separated under the name of Gryptotherium. Dr. Burmeister maintains the distinctness of *Mastodon andium* from *M. humboldti*, the latter attaining a larger size, and having more complex teeth; moreover, the dentine in the first species is always red, while in the second it is white. Remains of *Macrauchenia patachonica* and *M. paranensis* are also described. From the muscular impressions still remaining on the skull it is inferred that the nose was produced into a short proboscis, as in the existing tapir.

According to Dr. Roth's recent description of the structure of the pampean deposits, they contain in different proportions river, wind, lagoon, and coast beds. The coast deposits contain sand and marine shells; the lagoon beds are darker in color, and are much inferior in extent and thickness; while the river deposits, which contain large pebbles near to the mountains, become gradually finer as they recede from them. The beds formed by the few streams rising in the pampas themselves have round, smooth limestone concretions, as well as smooth fragments of bone. The æolic layers have vertical root-like tubes and irregular limestone concretions. The uniform character of the pampas loess does not, therefore, arise from its uniform origin, but from its long subjection to identical influences, to its transformation under the growth and decay of vegetation, and to wind and rain. Water carrying down and packing loose matter often makes the loess of the lower parts harder than that of the higher. In Entre Rios Dr. Roth observed that marine beds, probably of Miocene age, were lying over the typical Pampean, whence he concludes that the formation of the pampas loess commenced in Eocene times, grew in intensity in the diluvial, and is continuing at the present time.

In the *Geological Magazine* for January Mr. H. H. Howorth puts forward the theory that in the mammoth age the great Siberian rivers flowed southward into the central lake-sea.

BOTANY.

Memoirs of the Torrey Botanical Club.—Nearly a year ago the first number of the Memoirs appeared containing Professor Bailey's Studies of Carex. In August following, the second number was issued, containing the Marine Algæ of the New Jersey Coast and adjacent waters of Staten Island, by Isaac C. Martindale. The list is an annotated one, and is based on notes and collections made by the author during a period of twenty years. It embraces 91 genera, 183 species, and 41 varieties.

The third number of the Memoirs reached subscribers late in January. It is devoted to an account, by Richard Spruce, of a collection of the Hepaticæ, collected by Dr. H. H. Rusby on the Eastern slope of the Bolivian Andes in 1885–6. The paper bears the title "Hepaticæ Bolivianæ, in Andibus Boliviæ orientalis, Annis 1885–6, a cl. H. H. Rusby, lectæ." Twenty-two genera, and 97 species are noted; of the latter no less than twenty-five are here described for the first time.

The Missouri Botanical Garden.—The first annual report of the director, Dr. William Trelease, sets forth the objects contemplated and provided for in the will of Mr. Shaw, the founder of the garden. They are briefly as follows:

1. To continue the ornamental features of the garden.
2. To add to its botanical usefulness by additions to the growing plants.
3. To provide for a system of correct labeling.
4. To provide fire-proof quarters for the Engelmann herbarium, and also for additions to the general herbarium.
5. To improve and enlarge the botanical library.
6. To secure a botanical museum.
7. To assist in the completion of the flora of North America, by the publication of monographs.
8. To ultimately provide for research in vegetable histology, physiology and pathology.
9. To make the garden useful for horticultural instruction.
10. To take steps looking to the early appointment of six "garden pupils."

11. Eventually to appoint "associates" to the director, who are to be specialists in some department of Botany.

From surveys made it appears that in the garden proper there are 9.4 acres; in the Arb:retum, 20.5; in the Fruticetum, 8; Old Vegetable Garden, 3.5; Grove, 0.6; Lawn, 2.7; making in all 44.7 acres.

We may hope to see, in time, an American Kew at St. Louis.—CHARLES E. BESSEY.

Ellis' "North American Fungi."—About the middle of February centuries XXIV. and XXV. of this great distribution of the Fungi of North America were distributed to subscribers. It is needless to speak of the fine specimens, or of the neatness with which the mechanical work has been done, for these are already well known to most readers of the NATURALIST.

Century XXIV. contains a few Basidiomycetes (about twenty pieces), the remainder being mostly Ascomycetes. Among the latter is an interesting new species, *Plowrightia symphoricarpi*, occurring on *Symphoricarpus occidentalis* in Montana. Botanists will recognize in this a congener of the familiar Black Knob of the plum.

Century XXV. contains about twenty-five Urdineæ and Ustilagineæ. Among the latter are the interesting *Ustilago andropogonis* of Kellerman and Swingle, and the apparently related *Sorosporium ellisii* of Winter, both infesting the inflorescence of *Andropogon provincialis*. A dozen fine specimens of Slime Moulds (in boxes) closes this vnluable century. —CHARLES E. BESSEY.

Seymour and Earle's Economic Fungi.—During the month of January, the first foretaste of a new distribution of the fungi made its appearance. "The object of this series," the authors say in their announcements, "is chiefly to supply a set of authentic specimens to illustrate the diseases of useful and noxious plants, for the use of Agricultural Experiment Stations, and persons interested in the subject from a practical standpoint." The specimens before us (Nos. 1 to 50) indicate that the authors have done this work well and wisely. Six species affecting Vitaceæ, and twenty-eight upon Rosaceæ, are presented. Of the latter six species affect the Blackberry (*Rubus villosus*).

No station can afford to do without this set, especially when its moderate price of $3.00 per fascicle of fifty specimens is considered. We trust that the authors may meet with encouragement to warrant them in continuing their work.—CHAS. E. BESSEY.

The New Gray's Manual.—It is a significant thing that in bringing out a new edition of the familiar Manual of Botany of the Northern United States, by Asa Gray, the revisers found it necessary to extend its geographical limits westward to the 100th meridian, that is, to the middle of the Great Plains. "The rapid increase of population west of the Mississippi River and the growing need of a manual covering the flora of that section, have seemed a sufficient reason for the extension of the limits of the work westward." This action will relieve the teaching of elementary botany, in the west, of many of its embarrassments. Those who have not tried it, can have little conception of the difficulties encountered by college and high-school teachers in attempting to give to their pupils a knowledge of the local organic flora in the region lying between the Mississippi River and the Rocky Mountains.

By a hasty calculation it appears that the region covered by the Manual has been increased about 70 per cent. The species described have been increased by about 40 per cent.; however this is in part by the addition of the Hepaticæ (141 species), and a number of immigrants not included in the earlier addition. Probably the westward extension of the Manual has given it from 30 to 33 per cent. more species. The total number now described is 3298, of which 405 are said to be introduced.

It is interesting to note where this increase takes place. It appears that the Polypetalæ have gave gained 46 per cent. (289 species), the Gamopetalæ 36 per cent. (271 species), the Apetalæ 64 per cent. (121 species), the Monocotyledons 17 per cent. (115 species). In this increase certain orders stand out prominently; for example: the Leguminosæ are increased from 98 to 156, the Rosaceæ from 72 to 95, the Compositæ from 288 to 407, the Gramineæ from 168 to 250. The Gymnosperms are increased by one only (*Pinus ponderosa Douge, var., scopulorum* Engelm. in Nebraska), while through rigid revision the Cyperaceæ actually number two less than in the old edition.

In glancing through the book one meets many new plants which will have an unfamiliar look to the eastern local botanist. We found, for example, *Argemone platyceras, Cleome integrifolia, Viola nuttallii' Prunus demissa, Mentzelia ornata, Cucurbita fœtidissima, Adoxa moschatellina, Grindelia squarrosa, Aplopappus spinulosus, Eustoma russellianum, Solanum rostratum, Pentstemon cobæa, Amarantus blitoides, Elæagnus argentea, Andropogon hallii, Buchloë dactyloides, Munroa squarrosa*, etc., etc.

There is a marked spirit of conservatism dominating every part of the work. We look in vain for any recognition of the somewhat radical notions which have of late arisen in some quarters. The time-honored arrangement of orders, the time-honored genera, the time-honored rules as to capitalization, punctuation, and citation of authorities, are strictly adhered to. The Gymnosperms are still wedged in between monocotyledons and dicotyledons; Carya is Carya still, and not Hicoria; Nymphæa is Nymphæa still, and not Castalia; and even in so plain a matter as the spelling of Pirus, we have Pyrus, as in the older editions. All this, and much more like it, implies that for many years still the young botanists of America are to be made familiar with the older and quite conservative views of classification and arrangement. We had hoped for something different. Meanwhile we are glad to get the book, for it was much needed.—CHARLES E. BESSEY.

ZOOLOGY.

Zoological News.—General.—The Verhandlungen der Gesellschaft für Erdkunde (Berlin), contains an account of the biological results of the Plankton Expedition of the summer of 1889, by Prof. K. Brandt, and of the voyage itself, by Dr. Krummer. The trip seems to have been confined to the Atlantic, and returned to Kiel on November 7, after an absence of 115 days, and a run of 15,600 miles. The experience of the expedition was that the ocean, even in the tropics, was poorer in life than the North Sea and Baltic.

Protozoa.—The last report in Vol. XXXII. is by Ernst Haeckel, and concerns the curious group of organisms known as the Physemaria. These Haeckel pronounces to be sponges of affinities to the Keratosa, but modified by symbiosis with a commensal which is in most, if not in all cases, a hydro-polyp stock. Four families and eleven genera are described. In the Stannomidæ, examples of which were dredged at depths of from 2,425 to 2,925 fathoms, there is present a fibrillar spongin skeleton of thin, simple or branched spongin fibrillæ, not anastomizing nor reticulated, together with the usual symbiotic hydroids. Prof. Haeckel believes that these fibrils throw light upon the peculiar filaments of the Hircinidæ. They are monaxial keratose spicules. This report occupies ninety-two pages, and is illustrated by eight plates.

Cœlenterata.—The last volume of the Challenger Zoölogical Reports, Vols. XXXI. and XXXII., have lately been issued. The first of these contains the important report upon the Alcyonaria, by Messrs. Wright and Studer, and the comparatively short account of the pelagic fishes, by Dr. A. Gunther. Of the 189 species of Alcyonarians found by the expedition, 133 are here described as new. From the chapter upon geographical distribution, it appears that the West Indian Isles, the western shores of North America, and the Australian and Japanese seas, are the headquarters of this group. The report occupies 386 pages and is illustrated by 49 plates.

The first report in Vol. XXXII. is by G. Brook, and treats of the little known group of the Antipatharia. As most of the specimens of Antipathes preserved in museums are in a dry and shriveled condition, good diagnoses of the species are rare. Fortunately most of the Challenger examples had the polyps well preserved, and, therefore, a partial revision of the tribe has been attempted, and the classification put upon a correct natural basis. Nearly all the species are new, and are mostly from localities whence no forms were before known. Littoral forms are remarkably deficient. Besides the species found by the Challenger, other new forms already in the British Museum are described. The report contains the first detailed outlines of the structure of the group yet given. The structure of the genera is described, and the forms of the zooids, as well as the number and proportion of the mesenteries, are detailed. Four of the species occurred between 2,000 and 3,000 fathoms. The Antipatharia approach the Cerianthidæ more than the Hexactiniæ in the arrangement of the mesenteries, and in the relatively thin mesoglea, devoid of stellate connective tissue cells, the rudimentary musculature of the mesenteries, etc. This report has 222 pages, and 15 plates.

Echinodermata.—J. Georg (*Archiv für Naturgeschichte*, Sept., 1889), gives reasons for the belief that the echini excavate their holes in the rocks not by any chemical solvent, but by their teeth. As they enter young, the bottom of the hole is larger than the entrance, and thus the tenants are prisoners, dependent for food upon such forms of life as are brought by the currents, such as foraminifera, etc. Though the spines are not the prime agents in the excavating process, they aid the teeth by their rotary motion. It has been surmised by some that marine algæ, by their chemical action upon limestone, aid the urchins in the boring of their holes, but it cannot be found that algæ exert any such chemical influence, and urchins bore into sandstones, granite and lava as well as into limestones, so that there is no relation between algæ and urchin-holes. The principal object of the toothed urchins in thus excavating seems to be to find shelter from the violence of the waves. (See Fewkes, NATURALIST, Jan., 1890).

Mollusca : Annelida.—The Polyzoa collected in Japan by Dr. L. Döderlein are described in the *Archiv für Naturgeschichte*, of December, 1889, by Dr. A. Ortman, and the memoir is illustrated by four double plates.

Nos. 5 and 6 of the *Annals of Natural Sciences* (Zoöl., Vol. VII.), are occupied by M. Louis Roule's studies upon the development of the Annelida, and especially of *Enchytroedes marioni*, a new species of limicolous oligochoete. His results are somewhat startling, inasmuch as they induce him to place the mollusks and the annelids in the same group, called by him Trochozoaires. In both groups the cœlom is not a true enterocœle, since it is not derived from the archenteric diverticular, but is hollowed out, without direct relation with the archenteron, in the mass of cells that are produced by the initial mesoblastic segmentation. Moreover, both groups, as is sufficiently well-known, have similar larvæ, Trochospheres or Trochozoa. The chief difference is the polymerism of the one group and the monomerism of the other.

An immense squid, the long arms of which, although shrunk, measured 30 feet in length, and the body and short arms of which were 60 feet in circumference, was stranded in November last upon Achill Island, off the west coast of Mayo, Ireland. Some of the short arms measured four feet in circumference.

Arthropoda.—In the first and second numbers of the *Annals and Magazine of Natural History*, for 1889, M. E. L. Bouvier describes the nervous system of decapodous crustaceans, and the relations of that system to the circulatory system, giving particular attention to the Anomoura. The Carididæ have an abdominal chain of six pairs of ganglia. In the Palinuridæ these pairs are completely fused transversely, but in the Astacidæ are less so. In the Galatheidæ there are still the same number of abdominal ganglia, but they are more concentrated longitudinally, and less so transversely. In the Paguridæ the longitudinal concentration increases, while the transverse union is more remote than in the Galatheidæ. The Porcellanidæ, short though is their abdomen, have still five pairs of abdominal ganglia, while the Brachyura have the abdominal chain fused.

Dr. Walker and Dr. F. B. Mason enumerate nearly 100 species of insects in Iceland, about thirty of which are Coleoptera.

It is rather curious that not a single species of Lepidoptera has so far been discovered there. No Lepidoptera have as yet been seen upon Pitcairn's Island.

Ernst Lehrman (*Archiv für Naturgeschichte*, Sept., 1889), gives notes upon the anatomical structure of the Pentastomidæ. He treats of the body-covering, which is usually a chitinous skin, of the connective tissue, which is extraordinarily developed, of the musculature, of the nerve and sense organs, and also of those of digestion and sex.

Fishes.—It is not generally known that any of the Balistidæ have the power of producing sound. Prof. Moebius, however, has noted this peculiarity in *Balistes aculeatus*, and has recently described before the Berlin Physiological Society what he believes to be the apparatus producing it. During the drumming the skin between the clavicle and branchial arch vibrates, and the vibration seems to be caused by the motions of the post-claviculare, which forms a lever with a long and a short arm, the former of which is made to move by the action of the ventral muscles of the trunk. The short arm is thus made to move with noise on the rough inner surface of the clavicle. The swim-bladder, which lies very near, acts as a resonator.

There have lately been frequent reports of the presence of anchovies at Torquay and other southern coast fishing places, and this has been capped by the notice that they have also been found in Moray Frith.

Birds.—Many new species of birds from New Guinea and the Moluccas have been described by Hunstein Forbes and Woodford, during the last seven years, and thus the supplement to Salvadori's Accipitres, Psittaci, and Picariæ of these regions contains twelve new species of the first group, fourteen of the second, and nine of the third.

Mr. F. E.Beddard has, in a recent issue of the Proceedings of the Zoölogical Society, discoursed upon the structure of the Hornbills, especially that of the syrinx, and the muscular anatomy.

W. H. Hudson, in his Argentine Ornithology, gives an account of the manner in which *Polyborus tharus* singles out the white egret from among a crowd of other birds, apparently for no other reason than because of its shining white plumage, and he asks, how has it been possible for the two white species of South American heron to escape their enemies and continue to exist?

Mammals.—*Nature* (Nov. 7) states that about 1829 some individuals of the buffalo (*Bos bubalus*) were landed at Port Essington, and that at the present time the increase of these specimens has resulted in the existence of immense herds in certain parts of North Australia.

The columns of *Nature* have recently contained quite a controversy upon the discovery of the existence of true teeth in the jaw of the young Ornithorhynchus. This discovery is claimed by Mr. Poulton, and the structure of the teeth has been described by Mr. Oldfield Thomas. The reference to the teeth of both the young and the adult Duck-bill in the works of Sir Everard Home is asserted to have been solely to the horny plates which eventually take the place of the true teeth, and to the changes that take place in them.

The last volume issued by the venerable cetologist, P. J. Van Beneden, restricts the number of European Cetacea to twenty-six, of which seven are whalebone whales, and five ziphioids.

In the *Quarterly Journal of the Microscopical Society* A. W. Hubrecht gives the results of his studies upon the placentation of the hedgehog. The phenomena of placentation are more complex than in the ungulates, and lead up directly to those exhibited by the primates and man. But as the Insectivora are now pretty generally regarded as the most primitive of the monadelphous mammals, this takes away the importance of the division into Deciduata and Adeciduata. The Ungulata are certainly adeciduate, but among the Edentata some genera are deciduate and others adeciduate: the lemurs are also non-deciduate.

PSYCHOLOGY.

The American Society for Psychical Research—Is a thing of the past. It was disbanded as a separate organization when its fifth and last annual meeting was held in the lecture room of the Boston Society of Natural History, and it became a branch of the English society. Prof. William James presided at the meeting, which was attended by about 200 members and associate members and their friends. Secretary Hodgson read the records of the last meeting, the certificate of the auditors that the financial statement for the year ending in 1889 was correct, and the report of the treasurer for the year just closed. By the latter it appeared that the receipts were $3898, the expenses $3542, and the balance on hand $356. Mr. W. L. Parker and Dr. Morton Prince were appointed to audit this account.

Dr. E. G. Gardiner was then called upon by the president to give the views of the council of administration in regard to a proposition that the American society become a branch of the English organization. He said that the council found, some time ago, that the society was not receiving a sufficient amount of funds to properly carry on its work of psychical research. The members were asked if they would submit to an increase in their dues; but few of them agreed to this, and though a number of donations were received from friends, their sum was not large enough for the needs of the society. At this juncture the council communicated with the English society, which offered to form a branch in this country, of which any member or associate member of the American organization might become a member on the payment of annual dues amounting to $3. The English members are required to pay $5 per annum, but these in this country would have all the privileges of those in England, except that of voting, and would get copies of all the publications of the society, including the monthly journal and the annual proceedings. It was the desire of English society to retain the American secretary, and it had guaranteed his salary for one year, but it would have to receive financial aid from America to continue employing him after the expiration of that time. Three American vice-presidents—Prof. S. P. Langley of the Smithsonian Institute, Prof. William James of Cambridge, and Prof. H. P. Bowditch of the Harvard Medical School—have already been elected, and they would form an advisory board for this country.

Dr. Gardiner said there seemed to be no choice but to disband, for the society did not have the money to go on. It would cost less to maintain a branch of the English society than it would to support a separate organization. The English society thought it could carry on psychical work in this country, where the American society had failed, and he moved that the latter be abandoned and be made a branch of the English organization.

Mr. Samuel H. Scudder spoke in favor of the proposition, seconding Dr. Gardiner's motion, as did also Prof. James, who briefly reviewed the history of the society. He said he had little hope of its success from the start, for few joined it who had given special attention to psychical research, although many of the members occupied prominent positions in other branches of science. So the work had been done almost entirely by the secretary. There had been a formal organization, with but few workers to back it up, and the organization had been a hindrance, rather than a help, to investigators, who could accomplish more if they were responsible directly to the English society.

The question was then put to vote, and it was carried unanimously. Only nine votes were cast, however, as that was the number of active members, who alone are entitled to vote, present at the meeting. The secretary stated to a *Herald* man that there are 400 members of the society, fully three-quarters of whom will become members of the English society.

The meeting was continued as a session of the new organization, Prof. James remaining in the chair as vice-president of the English organization. He described his visit to the leaders of the English society and the psychical congress in Paris last summer. He came away, he said, with great respect for the work that is being done in Europe, and he was struck with the respect in which it is held by all classes of intelligent people there. He spoke of the international census of hallucinations now in progress in England, France, Germany, and America, which is under his charge in this country, and he dwelt, at length, on some of the wonderful investigations that have been made by M. Pierre Janet, of France, and others.

On the circulars calling the meeting it had been announced that Secretary Hodgson would read a paper by Mr. Frank Podmore, of the English Society for Psychical Research, on "Phantasms of the Dead," but he stated that Mr. Podmore's paper had not been received, and instead, he read statements of some of the recent cases which he collected. Among them were some truly weird and remarkable narratives of dreams and presentiments, and several cases were given where people had saved themselves from bodily harm by obeying unaccountable impulses.

ARCHÆOLOGY AND ETHNOLOGY.

Prehistoric Occupation in Cambodia.—Shell-heaps in Asia.—Polished Stone Implements in the National Museum. —The principal river of Cambodia is the Me-Kong. Its source is far up in the mountains of Thibet, where it has the name of Lam-Thsang-Kiang. It traverses the Chinese province of Yum-Nan, and those of Laos and Cambodia, and enters the China Sea in the French province of the latter name, in latitude 10 degrees north, longitude 106 degrees and 40 minutes east. Its average width through Cambodia is 3,500 to 4,000 feet. In its lower portion it divides itself many times and forms a network of navigable waters, and finally discharges itself through eight mouths.

The present capital of the province is Phnom-Penh, situated on the Me-Kong, about one hundred and seventy-five miles from its mouth. At the city of Phnom-Penh the river Me-Kong forks. It is the western fork with which this account deals. The eastern branch is the main river; the western branch is but a blind stream which, after the fashion of a bayou, is fed from the main river. Its length is one hundred and seventy-five miles, and it ends in an immense lake eighty or ninety miles in length called Ton-le-Sap.

Each year the Me-Kong river, by reason of the melting of the snows in the mountains of the central plateaux of Thibet, overflows and inundates the lower country which it traverses. The level of the lake Ton-le-Sap is about thirty-six feet lower than that of the Me-Kong river at Phnom-Penh where the bayou joins the river. The period of inundation is the months of July, August and September, and at their beginning the waters from the river fill the bayou, run northward through its length, and empty in and fill the lake. During the inundation the water in the lake attains a depth of thirty-five or forty feet, and, consequently, spreads over a vast extent of the country which before was uncovered. On the termination of the flood and the subsidence of the water in the river, the current in the bayou is reversed; it runs south, empties into the river, and so drains the lake. During the dry period, which lasts six months of the year, Ton-le-Sap, instead of being a great lake of water, is a plain of soft mud.

The action of the water in this river and lake is similar to that of the Nile and the lake Moeris in Egypt. It is easy, with the illustration of the Nile, to understand the operation, and also the quantity of alluvial soil which would be deposited each year in the lake Ton-le-Sap, likewise the numerous changes made in the shores of the lake during the ages this operation has been going on.

On the retreat of the waters, the shores of the lake and little islands in it become dry. The people from the neighboring highlands come down, occupy these spots, and there appear flourishing villages, which are to last, however, only six months of the year, when they will be submerged by the next year's inundation, the inhabitants being driven to the highlands for safety.

The geographic and hydrographic details being understood, we may now explain the prehistoric stations of the neighborhood. Not far distant from the border of this great lake there have been found numerous and vast Kjoekenmoeddings, or shell-heaps, many of which have been excavated by the natives to obtain the material for fabrication of lime. It was from these shell-heaps that Mr. Jammes obtained the stone implements which have lately come into the possession of the National Museum. He discovered eighteen of these shell-heap stations, and excavated some of them. They are covered by a stratum of alluvial soil, the deposit of the floods. The depths or thicknesses of the shell-heaps were from thirteen to twenty-nine feet. They were composed of three layers quite distinct from each other, and each bearing evidence of a different civilization and an occupation by a different set of men. They were as follows, commencing at the top:

The first stratum had the least thickness. In it were instruments of copper, though possibly some of bronze—hatchets, pins, bracelets, etc. There were pieces of stone finely worked. The pottery was of the most perfect form, and some of it was ornamented with the ordinary designs of the bronze age.

In the second stratum were objects in stone mixed with those of the bronze or copper, and this is considered to mark an epoch of transition between the bronze age and the stone age which formed the lower stratum.

This lower stratum was the deepest of the three, and here were found the implements and pottery which belonged to the age of polished stone.

These shell-heaps have required a long period of time. Some of them were distant more than fifty miles from the great lake, and it is supposed that at their epoch they were on the borders of the lake thus extended. In the lake of Ton-le-Sap are now found several species of the same shells and mollusks as those of the prehistoric stations, but the latter are thicker and heavier. It is certain from this and other discoveries that the period of the polished stone age is very ancient in Indo-China, possibly of higher antiquity than the same age in Europe, though there has, as yet, been no synchronism established between them. It is now more than 2,000 years since the Khmers, of whom the Cambodians pretend to be the descendants, constructed temples and palaces which were of sufficient dignity to have belonged to the antiquity of Egypt. These are all in ruins, yet the voyager can still see enough to show them in their gigantic and barbaric splendor. The temple of Ang-Kor-What, of which Mr. Jammes has made an attempt at restoration, is not less than 3,900 feet in the length of its principal façade, by one hundred and sixty or one hundred and seventy feet in height. It was built of cut stone and is ornamented everywhere with superb sculptures and bas-reliefs. To-day these imposing ruins are invaded by a tropical vegetation that has covered and suffocated them in its embrace. On the ruined and fallen towers, or in the earth about them, enormous trees now grow, and sometimes portions of the wall, windows or doors are sustained and supported by the roots of the great banian trees.

Anthropology demonstrates that the men of the epoch of polished stone were the ancestors of the constructors of the great temples in the Orient, though they were then in full possession of iron, silver and gold. How many centuries of this rude civilization was required to traverse the space between the polished stone age when these shell-heaps were made, and in which its objects and implements were lost or deposited, until the brilliant period of the temple of Ang-Kor-What?

The anthropological side of this subject has not yet been studied. We are in ignorance of the facts, and are without sufficient knowledge to be able to even approximate this great progression. Mr. Jammes found several skeletons in his excavations of these shell-heaps. He calls the people the race of Som-rong-sen, after the name of the principal shell-heap. The people of the race he remarked as being of large proportion, great height, and vigor. Some of the skeletons were, as he reports, more than two metres in height. What seemed to astonish him more than anything else was the thickness of the skull, which sometimes attained twelve millemetres in the occipital region.

The men of these shell-heaps buried their dead in their habitations. The care that they took in the position of the skeletons is a slight evidence of their belief in a future life. Near the bodies were frequently placed various implements of their industry. Pieces of pottery were found filled with the débris of food.

This civilization belongs to a prehistoric race, and corresponds with a mixture of the polished stone and bronze ages in western Europe.

The objects found were some of them similar; others only analogous. The polished stone hatchets, and similar implements, were the most numerous. They were not nearly so well made nor so complete as those from other countries. The material is usually a fine, hard, compact and siliceous schist, sometimes yellow or gray, other times black, frequently made of a pebble with remains of its original crust apparent. Some of them would indicate a new method of handling, for they have a straight stem or tang, as large square as the thickness of the hatchet, and which is cut down at the edges so as to make shoulders. The tool most plenteous is the adze. Its sharpening is all done from one side. Gouges are found, though not so common. They are made in the same way as were the adzes, except that the edge is polished. Objects of shell are frequent; bracelets, rings, and beads are made of this material. It also served for scrapers and cutting implements. Objects of bronze were not found, but those of copper were.

Mr. Jammes is Director of the Royal School of Cambodia at Phnom-Penh, and he displayed his collection at the International Congress of Anthropology and Prehistoric Archæology held at Paris last summer.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Geological Society.—At its late meeting in New York, December 26-28, the following papers were presented (Continued from the NATURALIST, February, 1890, page 212.):

ON THE TERTIARY DEPOSITS OF THE CAPE FEAR RIVER REGION. William B. Clark, Baltimore, Md.—The Eocene occupies small detached basins within the Cretaceous, while the Miocene extends widely over Eocene and Cretaceous alike.

Post-Cretaceous erosion left an irregular surface over which the older Tertiary deposits were scattered. Post-Eocene erosion approximately base-leveled this surface, leaving the early Tertiary sediments preserved in the deeper Post-Cretaceous depressions. Upon this base-leveled surface the Miocene strata were laid down.

An intermingling of numerous characteristic Cretaceous species with Eocene forms was observed at several places; likewise of *Exogyra costata* hiwt Miocene types.

CRETACEOUS PLANTS FROM MARTHA'S VINEYARD. C. D. White, Washington, D. C.—The topics treated in this paper are: Review of opinions respecting the age of the Vineyard series; plants found at various localities in that series; the Gay Head flora cretaceous; its distribution and affinities; mode of occurrence; eastward extension of the Middle Cretaceous; origin of amber in the Vineyard. Illustrated.

THE GEOLOGY OF THE CRAZY MOUNTAINS, MONTANA. J. E. Wolff, Cambridge, Mass.—This paper describes the structure of these mountains, which are composed of Cretaceous strata, horizontal or but gently inclined, cut by numerous narrow vertical dikes and large irregular masses, as well as great bulging intrusive sheets of laccolites, which have been tilted with the strata. Brief descriptions are given of the eruptive rocks and of the contact metamorphism produced by them.

THE CUBOIDES ZONE AND ITS FAUNA. A DISCUSSION OF METHODS OF CORRELATION. H. S. Williams, Ithaca, N. Y.—In this paper, after discussion of the principles of correlation, and after comparisons of fauna of this zone in Europe and Asia, as well as in America, the author comes to these conclusions:

That the fauna of the Tully limestone of New York is the representative of the fauna of the Cuboides zone of Europe homotaxially; that the relations of the two faunas may be best explained by the hypothesis that the fauna of the Tully limestone is not a direct sequent of the underlying Hamilton fauna alone, but in its characteristic species shows evidence of community with European faunas to be explained by migration.

A comparison of all the related faunas at present known leads to the conclusion that the Cuboides and Tully faunas are not only homotaxial but relatively contemporaneous, the margin of difference in the time of the existence of the two faunas probably not greater than the period of existence of the Cuboides fauna in its typical localities in Europe.

THE INTERNAL RELATIONS AND TAXONOMY OF THE ARCHÆAN OF CENTRAL CANADA. Andrew C. Lawson, Ottawa, Canada.—Archæan comprises two great systems, Lower (Laurentian), composed of plutonic igneous rocks; Upper, of indubitably normal surface rocks, variously altered. Lower, irruptive through Upper and of younger age, piercing the latter, holding detached fragments from its shattered margin, and inducing contact metamorphism. Conception of Archæan suggested by the facts: Its ideal simplicity; complications; combined effect of plutonic irruptions and crust-crumbling forces. Geognostical equivalents of Laurentian elsewhere found to be eruptive.

THE CRYSTALLINE SCHISTS OF THE BLACK HILLS OF DAKOTA. C. R. Van Hise, Madison, Wisconsin.—A review of the distribution of the slates, schists, and granites is given as mapped by Newton. Cross lamination, and the arrangement of pebbles in the conglomerates, show that the real thickness of the slates is independent of their apparent thickness as measured by cleavage. The largest area of crystalline schist is a belt surrounding the granite mass in the southern part of the pre-Cambrian area. It always strikes parallel to and dips away from the granite. The structure is then here laccolitic. The granite, by its contact and dynamic action, produced these crystalline schists. The evidences of fragmental origin in clastic rocks is generally retained when subject to pressure only, however great the pressure. The evidences of fragmental origin in clastic rocks is rapidly obliterated when they have been subject to dynamic action. Illustrations: The original detritus of the Black Hills mica-schist was feld sparand quartz. By a decomposition of the former, producing mica and quartz, and a breaking down of the larger particles of the latter by dynamic action, coarse, even granular, completely crystalline mica schists have been extensively produced. Different degrees of crystalline character are seen in the field, and various stages of the change are traced out in thin section. The paper then speaks of the age of the slates, schists, and granites.

SOME RESULTS OF ARCHEAN STUDIES. By Alexander Winchell, Ann Arbor, Mich.—This memoir is a condensed statement of observations made by the author in northern Minnesota and contiguous regions. With these are incorporated some records of other observers in the same field. Being simply a report of facts observed, the memoir is calculated to stimulate inquiry rather than provoke discussion. The field is thought to be one of such comparative simplicity of structure as to promise a much easier solution of the Archean problem than any of the complicated regions of New England and eastern Canada. Several systems of rocks are enumerated in succession, distinguished by structural relations, and lithological and mineralogical contrasts. These are, in descending order: V. The uncrystalline schists (Animike); IV. The sub-crystalline schists (Kewatin of Lawson); III. The crystalline schists (Vermilion of N. H. Winchell); II. The gneissoid rocks; I. The granitoid rocks (not fundamentally distinct from the gneissoid). The oldest four of these systems exhibit an unexpected stratigraphical conformity with each other, and a stratigraphical and mineralogical intergradation, which seems to unite them in closer historic continuity than could be admitted on the consideration of their enormous volumes, their disparity of age, and their widely contrasted lithological facies. The fifth system is shown to lie in wide structural discordance with the older ones, and to be in every respect impossible of identification with the IVth system, with which Irving confounded it under the designation "Huronian." The four oldest systems are geographically and structurally distributed over a number of oval or irregular areas, each revealing granitoid rocks in the centre, and gneissoid rocks and crystalline schists in successive concentric bands, with the subcrystalline schists filling the intervals between the crystalline schists of neighboring areas. The granitoid and gneissoid centres appear to have been protruded, and crowded mutually upon each other, until the intervening subcrystalline strata have been thrown into closely folded synclinal attitudes. These schists, consequently, are vertical in position, and the crystalline schists and gneisses succeed them in close parallelism. Toward the centre of each area, the gneisses, even while maintaining their verticality, sustain anticlinal relations to each other. But sometimes, in approaching the centre, a dip towards the periphery supervenes, and this diminishes to horizontality. The centre of the area is not always occupied by granitic rocks. In some cases, they are strictly gneissoid. The state of the facts may be easily comprehended by conceiving all the systems originally in a horizontal position, and conformably superposed in the order indicated—then an up-swelling in places, which, with shrinkage of the terrestrial crust, would crowd the higher beds into interareal synclinal olds as we find them.

Thus, if we had only the geology of the Northwest to settle, the Archean question would be simple. Older observations in more difficult regions have created questions of correlation which the canons of science require us to answer. But these and other questions of a speculative character are postponed to future occasions.

Origin of the Rock-Pressure of Natural Gas in the Trenton Limestone of Ohio and Indiana. Edward Orton, Columbus, Ohio. —In this paper the author defines the term rock-pressure: shows the decrease in rate westward: discusses theories of origin already offered: presents facts supporting the theory of hydrostatic origin: offers conclusions respecting duration of gas-supply in Ohio.

On Pot-Holes North of Lake Superior Unconnected with Existing Streams. Peter McKellar, Fort William, Ontario.—This paper deals with some large and remarkable "Kettles" or "pot-holes" some distance back from the Lake, and at a considerable elevation above the present level. They must have been produced by a very swift current of large volume, yet there is no existing stream near them. The direction of the torrent is examined. The well-marked high terraces of the north shore of Lake Superior are considered in this connection, also the lines of depression through the low watershed between Lake Superior and Hudson's Bay.

On the Pleistocene Flora of Canada. Sir William Dawson and D. P. Penhallow, Montreal, Canada.—The Pleistocene deposits of Canada were defined as consisting of three principal members.

First.—The Till or Lower Boulder Clay, containing local and traveled stones and boulders, often glaciated and resting on glaciated surfaces. In the more maritime regions, *e. g.*, the lower St. Lawrence, it contains marine shells of arctic species. Further inland, *e. g.*, in Western Ontario and the plains west of Red River, it is not known to hold marine remains.

Secondly.—Stratified clays and sandy clays which in the more maritime and lower regions are the "Lower and Upper Leda Clays," holding many maritime shells and drift plants, etc., indicating neighboring land. In the interior they hold more abundant vegetable remains and locally beds of peat, and also fresh-water shells. These beds have been known as "Interglaciæ."

Thirdly.—Sands, clays, and gravels, often stratified, sometimes containing traveled boulders throughout; in other cases having boulders below and above. These beds in the maritime region contain seashells; further inland they are unfossiliferous. They constitute a second or newer boulder formation, and their traveled boulders are often of large size, and found at greater elevations than that of the lower boulder clay.

Above these are alluvial deposits, lakes, terraces, gravels, and eskers-prairie-silt, peat deposits, etc., which may be regarded as modern, or post-glacial.

The plants referred to are contained principally in the second formal tion, but when, as sometimes happens, this is absent, drift vegetable fragments are found in the boulder clay.

The phenomena point to extensive changes of level and climate going on throughout the pleistocene, in which, while the high lands were occupied with snow and glaciers, and the submerged plains and valleys were filled with floating ice, there were throughout, and especially in the central period, oases occupied with vegetation, in the manner so well explained by Fielden as now occurring within the Arctic circle.

The plants procured had in part been described and figured in papers published by Sir W. Dawson in the Canadian *Naturalist.* They constitute a cold, temperate, or boreal flora, composed of species still living in the region of the Lawrence and its lakes, and northward. Professor Penhallow has kindly undertaken to review the material previously described, and to examine a number of specimens recently obtained, and presents a detailed list and notes of the forms described.

Boston Society of Natural History.—December 4, 1889, Dr. R. T. Jackson discussed certain points in the development of the Mollusca. Dr. J. Walter Fewkes described a remarkable instance of rock excavation by Sea-Urchins.

December 18, Dr. Frederick Tuckerman read a paper on the "Gustatory Organs of Mammals." Mr. S. H. Scudder made a few remarks on fossil plant-lice.

January 1, 1890, there was a discussion of "The Climatic Conditions of the Glacial Period."

February 5th, Prof. F. W. Putnam spoke on "Early Man in America," and brought forward some new evidence of the contemporaneity of man with the mastodon. Mr. S. H. Scudder made a few remarks on a small collection of beetles from the inter-glacial clays of Scarboro', Ontario.

February 19th, Mr. Samuel Garman read a paper on "Some Recent Discoveries in Caves." Prof. W. O. Crosby spoke on "A Large Granite Bowlder in Madison, New Hampshire," and on "The Occurrence of Decomposed Granite in Blandford, Massachusetts."

March 5th, Prof. W. O. Crosby called attention to an "Interesting Occurrence of Decomposed Granite in Blandford, Massachusetts." Dr. J. Walter Fewkes read a paper on "Some Rare Marine Animals from California."—J. Walter Fewkes, *Secretary.*

New York Academy of Sciences.—March 10, 1890, the following paper was read: "On Geographical Variations in the Horned Larks of North America," by Jonathan Dwight, Jr.—H. Carrington Bolton, *Secretary.*

Chicago Academy of Sciences.—March 11th, Maj. Gen. Geo. Crook, U. S. A., held a conversazione. Subject: "The Mode of Warfare, Life, and Character of the American Indians."—C. E. Webster, *Recorder.*

The Chicago Institute for Instruction in Letters, Morals and Religion.—A course of lectures on the testimony of science to evolution has been held in Rehearsal Hall, in the new Auditorium Building, as follows :

November 22, Prof. E. W. Claypole, D. Sc., F. G. S., Akron, Ohio, "The Development and Destiny of the Earth."

December 6, Prof. T. J. Burrill, Ph.D. (University of Illinois), "Lessons from Leaves, Flowers and Fruits."

December 20, Pres. David Starr Jordan (University of Indiana), "Evolution and the Distribution of Animals."

January 3, Prof. Alexander Winchell (University of Michigan), "The Paleontological Evidences of Evolution."

January 17, Prof. W. K. Brooks (Johns Hopkins University), "Embryology and Evolution."

February 7, Prof. Edward S. Morse (Director Peabody Academy of Science, Salem), "Variation and Inheritance as Factors of Natural Selection."

February 21, Prof. S. A. Forbes (University of Illinois), "Entomological Illustrations of Evolution."

March 7, Prof. E. D. Cope (University of Pennsylvania), "Causes and Agencies of Evolution."

March 13, Prof. John Fiske (Cambridge, Mass.), "The Doctrine of Evolution ; its scope and influence."

Proceedings of the Natural Science Association of Staten Island.—December 12, 1889. Meeting called to order at 8.20 o'clock. A paper on the Carabidæ of Staten Island, by Mr. Charles W. Leng, was read by the corresponding secretary.

The corresponding secretary read by title a paper by Mr. William T. Davis, upon the homestead graves of the island, which will be issued as a special number of the proceedings.

Mr. Joseph Thompson showed *Cecropia* cocoons which had been eaten by field mice.

Mr. Arthur Hollick showed specimens of wheat in which the grains had all sprouted while in the ear. The specimens were from stacks in a field on the Vanderbilt farm at New Dorp. The grain in all the stacks was in the same condition—due to the phenomenal wet season.

Adjourned at 9.45 o'clock.

February 13, 1890. Amongst the various communications read was one from a prominent resident of the island, offering to donate half an acre of land for the building. The secretary was not, however, authorized to make public the donor's name. Attention was also called to the many favorable notices of the enterprise in the local papers and elsewhere.

The old milestone, formerly standing at the junction of Signs Road and Richmond Turnpike, was on exhibition, having been secured by the association since the last meeting. This was supposed to be the last one remaining on the old post route between New York and Philadelphia, or at least upon that portion of it which crossed Staten Island. The stone is considerably the worse for wear, the upper part having been chipped off, possibly for momentos, thus destroying part of the inscription, which now reads:

Miles
to
N. YorkE

The figures denoting the distance were doubtless upon the part which was chipped away. This old and interesting relic of bygone times has been secured none too soon, and the association is to be congratulated upon having secured and placed it where it will be safe from further danger. In this connection Mr. Arthur Hollick stated that at some future meeting it was expected that a paper upon the subject would be presented, and then read the following brief abstract from Clute's History of Staten Island:

"After Governer Tompkins had laid out and opened the Richmond Turnpike stages ran regularly over the whole length of the new road, in connection with steamboats from New York, and constituted part of the route of travel between New York and Philadelphia. At the western terminus of the Turnpike stages were carried over the sound by means of large scows, and this ferry received the name of the 'New Blazing Star.'"

A mummified rat was shown, presented by Mr. Daniel Campbell. The animal had contrived to force its way into an angle between a beam and the cellar wall of a dwelling in New Brighton, and for some reason had been unable to extricate itself. The remains were thoroughly dessicated and excellently preserved.

Mr. E. M. Eadie presented a large piece of drift rock from Old Place, probably Oriskany sandstone, containing *Spirifer arrectus*.

Biological Society of Washington.—October 19, 1889, the following communications were read: Dr. C. Hart Merriam, "Description of a new Spermophile from the Painted Desert, Arizona;" Mr. Theo. Holm, "The Ancestors of *Liriodendron tulipifera;*" Mr. Theo. Gill, "On the Dactylopteroidea."

November 2, 1889, the following communications were read: Prof. C. V. Riley, "The Remarkable Increase of *Vedolia cardinalis* in California;" Mr. W. H. Dall, "Notes on the Genus *Gemma* Deshayes;" Dr. George Marx, "On a new Spider and its Influence on Classification;" Dr. C. Hart Merriam, "Remarks on the Spotted Skunks (Genus *Spilogale*) with Descriptions of New Forms."

November 30, 1889, the following communications were read: Dr. Theobald Smith, "Preliminary Observations on the Micro-organisms of Texas Fever;" Dr. D. E. Salmon, "General Remarks on Texas Fever, illustrated by Lantern Slides;" Mr. C. D. Walcott, "Description of a New Genus and Species of Inarticulate Brachiopod from the Trenton Limestone;" Dr. Frank Baker, "An Undescribed Muscle of the Infraclavicular Region in Man."

December 14, 1889, the following communications were read: Dr. C. Hart Merriam, "Results of a Biological Survey of the San Francisco Mountain Region in Arizona;" Mr. C. D. Walcott, "A New Genus and Species of Ostracod Crustacean from the Lower Cambrian;" Dr. A. F. A. King, "On the Flight of Young Birds."

December 28, 1889, the following communications were read: Dr. A. F. A. King, "On the Flight of Young Birds;" Mr. M. B. Waite, "On the Method by which the Seeds are Projected in *Pilea pumila;*" Dr. C. Hart Merriam, "A New Red-backed Moose (*Evotomys*) from Colorado;" Mr. Theodore Holm, "Generic Characters of *Gramineæ* and *Cyperaceæ,* taken from the Structure of the Leaves."

February 8, 1890, the following communications were read: Dr. Frank Baker, "An Undescribed Muscle from the Infraclavicular Region of Man;" Mr. C. D. Walcott, "A New Genus and Species of Ostracod Crustacean from the Lower Cambrian;" Dr. Cooper Curtice, "The Moultings of the Cattle Tick;" Prof. Lester F. Ward, "The Flowers that Bloom in the Winter Time."

March 8, 1890, the following communications were read: Mr. B. T. Galloway, "Notes on a Fungous Disease of the Apple;" Mr. C. L. Hopkins, "Animal Life Observed above Snow Line on Mt. Shasta," "Notes upon the Timber and Timber Line of Mt. Shasta;" Mr. W. H. Dall, "On Dynamic Influences in Evolution."—FREDERIC A. LUCAS, *Secretary*.

SCIENTIFIC NEWS.

A Review of the Charges Against the Paleontological Department of the U. S. Geological Survey, and of the Defence made by Prof. O. C. Marsh.

To the Editor of the NATURALIST:—"I am glad that the matter has at last come out. It will clear the atmosphere. The truth will be sifted out from the falsehood, and great good will be accomplished." This was the answer given by Prof. H. F. Osborn, of Princeton, to a *N. Y. Herald* correspondent, when asked for his opinion about the Cope-Marsh controversy. I fully agree with Prof. Osborn in these remarks.

I will now give a short review of the charges made against Professor Marsh, and of his defence, based on an experience of nearly six years, during which I was an assistant of Prof. Marsh, paid by the U. S. Geological Survey.

1. In the New York *Herald* of January 12th, Prof. E. D. Cope, of the University of Pennsylvania, stated, "The collections made by Prof. Marsh, as the vertebrate palæontologist of the Geological Survey, . . . are all stored at Yale College, with no assured record as to what belongs to the Government and what to the College."

To this Professor Marsh replied that "every specimen belonging to the government is kept by itself, and no mixing with the Yale Museum collections is possible." Prof. H. F. Osborn and Dr. O. Meyer have sustained this fully, and I am glad to say that great care is taken at the Yale Museum in this regard. But this is irrelevant to the question raised by Prof. Cope, for, of course, the labeling is entirely in the hands of Prof. Marsh, without any control from the Geological Survey. In this connection there is one thing that I can not quite understand; how it is that the splendid specimens of horned dinosaurs became the property of Prof. Marsh, and not of the government. Can Prof. Marsh pay his collectors this month out of his own pocket, and the following out of the pocket of the government?

2. The next statement made in the *Herald* is, that these collections "are locked away from the people, and no one is allowed to see them, not even visiting scientists." This Prof. Marsh admits is in part true.

He says, that "visiting scientists of good moral character are always welcome." Now I may mention, that a scientist of very "good moral character," well known in this country and in Europe, wanted to see the material of the Dinocerata shortly after the volume on this order had been published. When he arrived at New Haven he was told by Prof. Marsh that he was very sorry not to be able to show him the material, since it had been boxed up lately and was inaccessible. The fact is, that the whole material was spread on a large table in the room where the conversation took place. By the order of the professor the fossils had been covered up with cloth the day before.

3. The next charge of Prof. Cope is, that the greater part of Prof. Marsh's published work has been done by his assistants. This is denied by Prof. Marsh emphatically. As it is a very important question, I shall try to solve it as far as I am able to do. I can not speak of the authorship of the work on the Odontornithes from personal knowledge, but from all that I have heard at New Haven it is true that this memoir is mainly the work of the late O. Harger. Mr. G. B. Grinnell, in a letter written to Prof. Marsh and published in the *Herald*, stated that Prof. Marsh dictated to him a part of the description and all the conclusions of the work. This is all true, but the question remains, *From whom did Prof. Marsh receive that which he dictated* to Mr. Grinnell? I think it is now the proper place to speak a little more fully as to the way of using his assistants adopted by Prof. Marsh. The fact is that a great part of the descriptive and general part of most of Prof. Marsh's papers is the work of his assistants. Prof. Marsh asks them questions, the answers of which he either immediately puts down in black and white, or he makes out a list of questions to be worked out by his assistants, for instance: "What are the principal characters of the skull of the Sauropoda?" or, "What are the relations between the different groups of Dinosaurs?" and so on. The assistant, if not yet fully familiar with these questions, begins to work; he goes over the whole literature, a thing rarely done by the Professor, and studies the specimens in the collection. After this is done, the Professor receives the notes of the assistant, or he asks questions, writing down the answers he receives. In this way he accumulates a great quantity of notes, written in his own handwriting, or in that of the assistant. By comparing and using these notes it is easy for him to dictate a paper to any person who can write. This person, of course, when asked, can testify that the work was dictated by Prof. Marsh, without telling a falsehood.

Since I have been named in connection with the work of the Dinocerata, I may state here fully the nature of the assistance I rendered in its preparation. On two Sundays I spent a number of hours at

Prof. Marsh's house, to "go over his conclusions." Questions were asked and answered, new points were brought up by me and adopted, and when it came to the classification of Ungulata, I gave my opinion, which was mainly based on Prof. Cope's work, introducing small changes only. I gave the classification with Prof. Cope's names, as I informed him; but these were all changed by Prof. Marsh. There is no doubt Prof. Marsh had never studied Prof. Cope's papers on this subject, since he not only did not know the names of the orders, but he even asked how to spell them. That the descriptive part of the Dinocerata was mainly the work of Mr. O. Harger, I know. He made both descriptions and measurements of the different bones, which were used by Prof. Marsh when he wrote his text, or dictated it. It may be here a proper place to mention the language used by Prof. S. E. Smith, of Yale University, in an obituary of Mr. Harger, his best friend. "His best work and highest attainments were in the department of vertebrate palæontology. Remarkable logical powers, an unbiased mind, and years of accurate observation, had given him a truly wonderful knowledge of vertebrata osteology. Under his hand the broken and disarranged bones of an unknown carpus or tarsus seemed to fall into their proper places by magic. But his knowledge was not one of details alone; he had a truly philosophical grasp of the bearing of facts on evolution and classification, and *only the few who knew his attainments can appreciate how much palæontological science* would have been advanced *had he been able to publish his observations and conclusions.*" (Italics are mine.) I may mention here, that the statements of Dr. O. Meyer in regard to the Batrachia and Mammals from the Jurassic, and the oldest "bird" *Laopteryx*, are true.

Now let us consider some papers of Prof. Marsh which were doubtless written by himself. There is one on the Cretaceous Mammals. In this paper several times over three or four genera are made out of three or four teeth belonging to animals of one genus. Incisor, molar and premolar teeth of the upper and lower jaw are considered to belong to three or four different animals; each representing a new genus. The discovery of Cretaceous mammals in great numbers (only one species was known before, which was found by Dr. J. L. Wortman, Prof. Cope's former assistant) of course was a very interesting fact, and it is certainly this fact which induced Prof. Flower and Prof. Gaudry to write complimentary letters to Prof. Marsh. But the latter discovery is due entirely to Mr. J. B. Hatcher and Dr. C. E. Beecher. The description given by Prof. Marsh of these fragmentary, but highly interesting, fossils is simply ridiculous, and has been already criticised by Prof. Cope and Mr. Lydekker, of the British Museum. Among other cases of the kind, I may mention only two, of one of which Dr. O. Meyer has already written. In 1877 Prof. Marsh described a new mammal under the name of *Apatodon mirus*, from the Jurassic of the Rocky Mountains, with the following words: "One of the most interesting specimens hitherto found in the Rocky Mountain region, is a portion of a lower jaw with the last molar in place. This fossil is widely different from anything yet discribed, and its exact affinities are doubtful. The fragment pertained to an animal about as large as a Tapir, and the general appearance of the specimen at once suggests the mammalian type. The tooth most resembles, in form and superior surface of crown, that of a typical suilline. The structure of the tooth, however, is different, and the fangs are, in part at least, coössified with the jaw.

"This specimen was found near a locality where Dinosaur bones were abundant, and it is possible it may belong with that gronp. The jaw, however, is very unlike any corresponding jaw of a Dinosaur, so far as now known. The geological horizon is Lower Cretaceous or Jurassic."

This was certainly a most interesting discovery. A mammal as big as a Tapir, from a Jurassic or Cretaceous formation, from which only very small Marsupial-like mammals were known, a mammal with teeth like a typical suilline from such an old formation, a mammal with the teeth partially coossified with the jaws, is something startling new! I had the greatest curiosity to see this specimen, and fortunately my curiosity was gratified. The hog-jaw from the Cretaceous or Jurassic was a weathered piece of a Dinosaurian vertebra, from the neural spine, some parts of which looked something like a tooth of a hog. Prof. Marsh knew of this mistake long ago, but he has not found it necessary to correct it. Only in his list of genera printed for private use, this specimen appears as a genus of Dinosaurs.

Another example. In 1884 the palæontological world was aroused by the highly important discovery by Prof. Marsh of a Dinosaur which was said to have the metatarsals united, just as a bird. The metatarsus of this reptile, called *Ceratosaurus* by Prof. Marsh, was figured side by side with the corresponding bone of a penguin, and at the end of the paper the following sentence occurs: "All known adult birds, living and extinct, with possibly the single exception of archeopterx, have the tarsal bones firmly united, while all the Dinosauria, except Ceratosaurus have these bones separable. This exception in each case brings the two classes near together at this point, and their close affinity has now been clearly demonstrated." Now a word about this great discovery, which has been already reported in text-books and popular works. The specimen on which the conclusion was based is pathological. The animal when alive had a fracture of the lower part of the metatarsus, but it was happy enough to recover from this accident. The bones coössified, as it generally happens in such cases, at the place where they were broken, but not at any other place. From this pathological specimen Prof. Marsh trumpeted forth to the world one of his greatest discoveries. Prof. Marsh knows very well that this specimen is pathological, but he has never taken back his blunder, notwithstanding that I discussed this matter at different times with him.

4. Another accusation of Prof. Cope against Prof. Marsh is, that he has plagiarized the work of others. This is so well known among scientists that it is hardly necessary to go into this point. But I may give a few examples. Everybody knows that Prof. Huxley's lectures on the evolution of the horse were written long before Prof. Marsh began to work on the subject. That Kowalevsky published two extensive memoirs on the genealogy of the horse in the year before Marsh, is also a fact.

Prof. Marsh states that he never saw Kowalevsky's work before his own was completed and partly published. This may be, but it hardly agrees with the fact that one of Kowalevsky's papers was published in the greatest palæontological journal of to-day, in Prof. V. Zittel's *Palæontographica*, and the other one in the Memoirs of the St. Petersburg Academy. Prof. Marsh's invectives against Kowalevsky, the most able palæontologist of Europe, a man admired by Darwin and Huxley, who took his life in an attack of insanity, are outrageous. It shows that Prof. Marsh is not afraid of any means he can use to defend his reputation.

In the same way Prof. Marsh has tried to plagiarize an important discovery by Dr. T. W. Hulke, of London, a president of the Geological Society of this city. Dr. Hulke published in 1875, in the Proceedings of the Geol. Soc. of London, a paper, with figures, in which he expressed some entirely new ideas on the pelvis of birds and reptiles. Dr. Hulke sent a copy of this paper to Prof. Marsh, who, besides, receives regularly the *Geological Journal*. Three years later Prof. Marsh publishes exactly the same results as Dr. Hulke, and he is kind enough to state in a foot note, "After these figures were made, showing the position of the Dinosaurian pubis, which has caused so much discussion since Cuvier, I found that Dr. T. W. Hulke had already suggested the true solution of one difficulty (*Journal Geol. Soc. of Lond.*, Vol. XXXII., p. 334)." The year 1875 is wisely left off, and the statement that Dr. Hulke suggested the solution is not true, because he really solved the whole problem in the same manner as Prof. Marsh.

Only a short time ago I had opportunity to observe Prof. Marsh's passion to adorn himself with other's plumes. I have devoted considerable time to the study of the evolution of the skeleton of the ostrich. Among others, I made a discovery which was of especial importance, as it throws new light on the question of the relation between birds and Dinosaurs. I told Prof. Marsh about this discovery, and did not publish it. When Prof. Marsh wrote his paper on *Ornithomimus* he simply claimed the discovery as his own, not mentioning me at all. This I saw when he gave me the proof-sheets of the paper. It was after a discussion of nearly two hours that Prof. Marsh agreed to give me credit for it (in a place where it could be easily overlooked) in the explanation of the figures.

That Prof. Marsh ignores the work of others is a well known fact, which can be seen by everybody who takes the trouble to look over his papers; who will, with extremely rare exceptions, never find any paper cited. There is, it is true, a extensive bibliography appearing as an appendix to the Dinocerata, but this bibliography is not used in the text, and nobody can see from the text what has been done by others on this order.

5. Dr. O. Meyer has made the statement that specimens are restored in a very unscientific way under the direction of Prof. Marsh. This statement I sustain. Plaster of Paris has been used in restorations in a very extensive way, although latterly, I am glad to say, there has been a reduction of the extent of it. I have seen specimens restored with colored plaster, so that it was hard to tell where the bone began and the plaster ended. Such specimens are made nearly useless for exact study, and it will only be possible after the plaster has been removed, and this with great difficulty. Colored plaster has been used especially in restoring bones of Sauropoda, Stegosauridæ, and Dinocerata. The general effect is that nearly all the specimens of this group look complete. But this artificial embellishment of the specimens has also been transferred to the drawings. Some of the plates of the great volumes which wait for publication contain drawings of complete bones, but which, if examined, consist of a considerable part of plaster. That such plates are unscientific, I do not need to state. I must say, in justice to Prof. Marsh, that for the last five years this method has been stopped, and that now, with very few exceptions, the drawings are

made from the actual specimens, and that the missing parts are shaded in. A very great calamity is, that the specimens are often not drawn as they really appear in nature, but that they are drawn restored. These restorations are made according to the order of the Professor. If it now happens that the restoration should prove to be incorrect, the plate becomes worthless and has no scientific value.

Dr. O. Meyer has stated that Prof. Marsh has antedated his volume on the Dinocerata intentionally. This is also true; and everything that has been said by him about this point is correct. The review of this work was written by Prof. Marsh himself, and he asked the signatures of Mr. Harger and Dr. Williston for it without success, and had to accept instead the initials of the lady type-writer.

7. There is one insinuation made in the article of Dr. Meyer on which I have to say a few words. It refers, if I understand rightly, to the type specimen of *Triglyphus* which has disappeared from the Museum at Stuttgart. Dr. Meyer has asked Prof. Marsh to state how he came in to possession of a tooth from a "Jurassic" (Triassic) mammal from Germany, of which Prof. Marsh told Dr. Meyer. Prof. Marsh has not answered Dr. Meyer's article. In justice to Prof. Marsh, I state that the tooth in the possession of Prof. O. C. Marsh was purchased from a dealer of Stuttgart, in 1865, *and that it is not the type of Triglyphus which disappeared from the Stuttgart Museum.* All the positive statements of Dr. Meyer's article I consider to be true.

8. Prof. Cope thinks "that an investigation as to who has delivered Prof. Marsh's lectures in Yale College during past years will yield some interesting results." To this I have to say, that such an investigation is not necessary; *Prof. Marsh does not lecture at Yale at all.*

9. Prof. W. B. Scott, of Princeton, has published in the *Herald* of January 22d, a letter written by him to Prof. Marsh. What Prof. Scott has said there I fully sustain. He says: "I feel constrained to say that I disapprove of your work, your methods and your administration of the office which you hold. This disapproval does not rest on what I have heard from others, nor upon any personal considerations, but upon my own experience and my studies in the field to which both you and I are devoted. If called upon to testify in any investigation, this is the line to which, however reluctantly, I shall be compelled to adhere."

G. Baur, Ph.D.

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ON THE BRECCIATED CHARACTER OF THE ST. LOUIS LIMESTONE.

BY C. H. GORDON.

IN the absence of the Chester, the St. Louis beds constitute the uppermost division of the Subcarboniferous in Iowa. They consist generally of limestone above, yellowish-gray, more or less magnesian layers below, with a light gray friable sandstone between. The character of the limestone constituting the uppermost division is such as to merit more than a passing notice.

Throughout its area in Iowa, and its northern outcrop in Illinois, it has a peculiar brecciated or concretionary structure, not observed elsewhere. It is made up of a mass of angular limestone fragments, which have become more or less firmly recemented together. The stratification is very irregular, though in some places, where the brecciated character is absent, it is found even enough to furnish very excellent building stone. It is generally hard, and often cherty, and where it forms the floor to the coal measures, constitues a very excellent guide to those in search of this useful deposit. Its cherty character makes it very difficult to penetrate, and so when once reached it is readily recognized. In its typical locality—at and about St. Louis, where it was first studied by Dr. Shumard—it is described as a fine-grained, compact, subcrystalline limestone, often enclosing numerous cherty concretions, and the layers separated by thin green shale beds. It thus appears that the lithological character of these beds changes toward the south.

The question as to the cause of the peculiar brecciated character of the limestone in Iowa and adjacent parts of Illinois presents a pertinent field of inquiry. Worthen and Hall make frequent mention of this feature of the St. Louis limestone, and White goes so far as to say that "during the time of the deposition of this limestone there seems to have been some slight disturbance of the strata, apparently amounting only to local disarrangements of its own layers. This is principally shown in the upper division, and consists of the slipping, bending or slight distortion of all the strata, also by the breaking up of that limestone into angular fragments which have in many cases become recemented together by similar limestone material, forming the breccia above referred to. The most of the disturbance seems to have prevailed during the deposition of the upper division."[1] It would be exceedingly interesting to learn the nature of these local disturbances. Hall speaks of it as follows: It "consists generally of a breccia composed of fine, compact, ash-colored limestone in fragments of various sizes, having the interstices filled with a subcrystalline, yellowish, granular, calcareous material, which is sometimes quite pulverulent, and rarely very compact. The rock at Keokuk, and at points above this on the river, as well as at Mt. Pleasant and elsewhere, appears like the attenuated margin of a more important formation, presenting the usual fractures of the thinning out of a limestone, viz., a brecciated and concretionary structure. This presumption proves to be true, for as we trace the rock southward beyond the state, it presents other aspects, gradually losing its concretionary and brecciated character, and becoming a more important limestone formation."[2]

This explanation can hardly be considered adequate, for it would necessarily follow that the attenuated margins of all limestones should present the same characteristics; whereas they do not. That the brecciated character is a marginal attendant in

[1] Geological Survey of Iowa 1870, Vol. I., p. 218.

[2] Geological Survey Iowa, 1858, Vol. I., Part 1, p. 98.

this case cannot be gainsaid; but that the shore line is always thus attended cannot be sustained by facts. The stress laid upon this feature of the St. Louis limestone by Worthen, White, and even Hall himself, is of itself sufficient to necessitate an additional explanation of its cause.

Another important feature of this limestone not yet noted, and one of great significance, is its oölitic character. In the Iowa Reports this is not mentioned by White, though noted several times in the detailed observations by Prof. Worthen in Hall's Report of 1858, as also in the Illinois Reports.

"Above it becomes a regularly bedded light gray limestone, in strata from six to twenty inches in thickness, the upper layers having an oölitic structure."[3] In the vicinity of Keokuk, Iowa, the semi-oölitic character may also be observed, though not especially prominent.

In Illinois it was observed by Worthen at several localities: "Oölitic beds are quite characteristic of this division, and in Hardin county massive beds of oölitic limestone form the upper portion of it at several localities. . . . . . About three miles above Alton there are some oölitic and semi-oölitic beds in the lower part of the division, which are characterized by great numbers of small shells."[4]

In Indiana the oölitic structure is especially prominent, occurring in massive strata twenty to thirty or more feet in thickness in the counties of Owen, Monroe, Lawrence, Washington, Harrison, and Crawford.

The quarries in these counties supply a most excellent building stone, which is becoming quite celebrated for its durability, as well as the facility with which it may be dressed to any desired form.

It "has been formed from the crushed remains of marine shells, corals, etc. These have been pulverized to the condition of fine sand, their soluble impurities washed away, and their insoluble residue reunited into solid rock by a deposit of carbonate of lime as a cementing material. . . . . Its rich gray color, close

[3] At Croton, Ia. Hall's Report, 1858, p. 191.

[4] Illinois Report, Vol. I., p. 88.

and uniform texture, and facility of working, both by hand and machinery, make it extremely valuable for architectural purposes, and its assured strength and durability make it especially desirable for all permanent engineering works."[5]

Another notable feature of this limestone, especially in Iowa, is its irregularity as to thickness: frequently varying from ten to fifty feet within very short distances. At Keokuk the thickness is from ten to twenty feet; following up the Des Moines river, the course of which is nearly parallel with its original outcrop, its thickness increases until we reach Farmington, where it measures seventy-five feet. Between this place and Bentonsport, thirteen miles beyond, it decreases to four or six feet. This irregularity in thickness is accompanied by trough or basin-like depressions in the surface of the limestone, in which the coal measures were afterward deposited. A miniature basin of this kind occurs at Hillsborough, while at Farmington the coal occurs in a more extensive depression. At Hillsborough the basin is "oval in form, and does not exceed fifty paces in diameter in either direction. The coal dips rapidly from the edge to the centre, where it is about fifteen feet below the surface of the limestone, outcropping around the rim of the basin."[6] Fig. 1, Plate X., shows a cross-section of this basin:

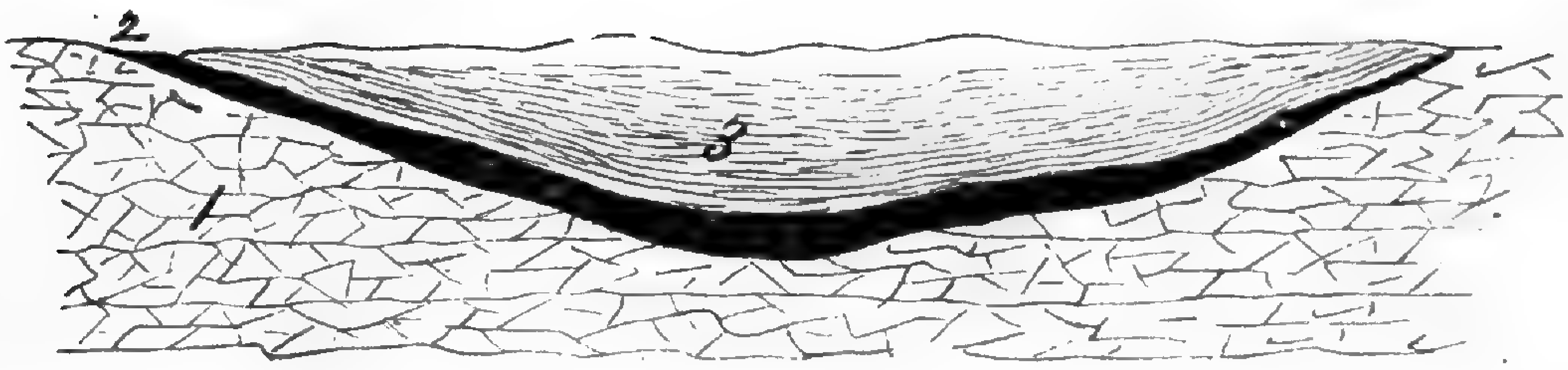
We have observed the same irregularity in the surface of this limestone at Keokuk, the thickness at one place being diminished by half in a distance of one hundred feet. The accompanying section across Point Keokuk from northeast to southwest (Fig. 2, Plate X.,) shows the observed position of these beds.

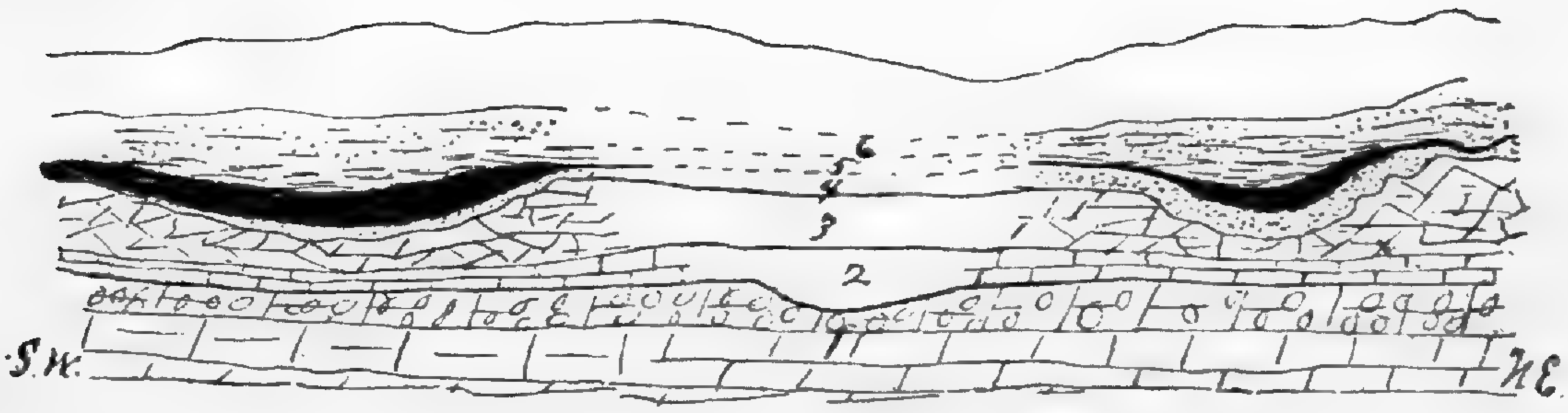
Toward the northeast the junction of the sandstone with the limestone may be observed, showing very conclusively the uneven surface of the limestone, and, a few inches above, a black coaly layer, here amounting to a mere parting, but which rapidly thickens to a layer ten or twelve inches in thickness, accompanied by a still greater thickness of slate. This basin is apparently a very small one. Within the limits of the city these rocks have been mostly removed by erosion. A similar basin occurs toward

[5] Indiana Report, 1881., p. 29, et seq.

[6] Hall's Iowa Report. Vol. I., Part I., p. 223.

PLATE X.





THE ST. LOUIS LIMESTONE.

the south, but we have not observed the underlying sandstone. Here the coal is found eighteen to twenty inches thick.

The facts above cited would seem to warrant certain conclusions as to the conditions under which the limestone was deposited. Its general character would seem to imply the existence of coral reefs fringing the shore throughout its northern extent. The accompanying map (Plate XI.) shows approximately the expanse of the Gulf during the St. Louis epoch.

The probable direction of the Gulf Stream is indicated by the arrows. The proof of the existence of marine currents and clear waters along the borders in Iowa, Illinois, Indiana, and southward, lies in the presence at these points of extemsive beds of limestone. It would seem improbable that any communication with the ocean existed to the north and east, for had such existed the Gulf Stream would, doubtless, have taken that direction, involving clear waters and limestone deposits; whereas, the arenaceous and argillaceous characters of the Lower Carboniferous of Ohio are marked. The northern extension of the Gulf Stream, bringing with it the warm waters of the Tropics, would materially affect the climate of this region, and in part explain the tropical conditions during the following epoch.

The causes operating to exclude corals from tropical coasts, as shown by Dana,[7] are: (1) cold extratropical ocean currents; (2) muddy, or alluvial shores, or the emptying of large rivers; (3) presence of volcanic action; (4) depth of water on precipitous shores. The first and third were manifestly absent. That the shores were not muddy is shown by the presence of the limestone as noted above.

The general dip of the strata here is toward the south and west. It is very slight, but increases along the Mississippi, after leaving the lower line; it changes, however, so as to bring the Lower Carboniferous again to the surface in the region of Quincy, Ill.

There is thus afforded just such a shelving shore as would comport with required conditions.

It is therefore not at all improbable that a line of reefs occupied

[7] Manual, p. 617.

this northern shore line, just as Florida is now fringed by its existing representative.

This conclusion is strengthened by the resemblance of the St. Louis limestone to coral rocks. Dana[8] describes coral rocks as: (1) fine-grained, compact, clinking limestone, with or without fossils; (2) a compact oölite; (3) a conglomerate, mostly of corals and shells; (4) a rock consisting of corals as they grew,—the interstices filled in with coral sand, shells, and fragments, sometimes very loosely. By the incessant trituration of the waves the original features of coral rocks are to a great degree lost, and the oölitic and brecciated characters are the most prominent remaining features.

From Le Conte[9] we learn that "in some places . . . . it (coral rock) is a coarse conglomerate or *breccia*, composed of fragments of all sizes cemented together; in other places it is made up entirely of rounded granules of coralline limestone (coral sand) cemented together, and forming a peculiar oölitic rock. But the larger portion of the reef ground is a fine, compact limestone, made up of comminuted coralline matter (coral mud) cemented together. This fine coral mud is carried by waves and tides into the lagoon and serves to raise its bottom; it is also carried by currents and distributed widely over the neighboring sea bottoms. . . . . In some places it (reef rock) contains imbedded remains of corals and shells, but in other parts it is entirely destitute of these remains."

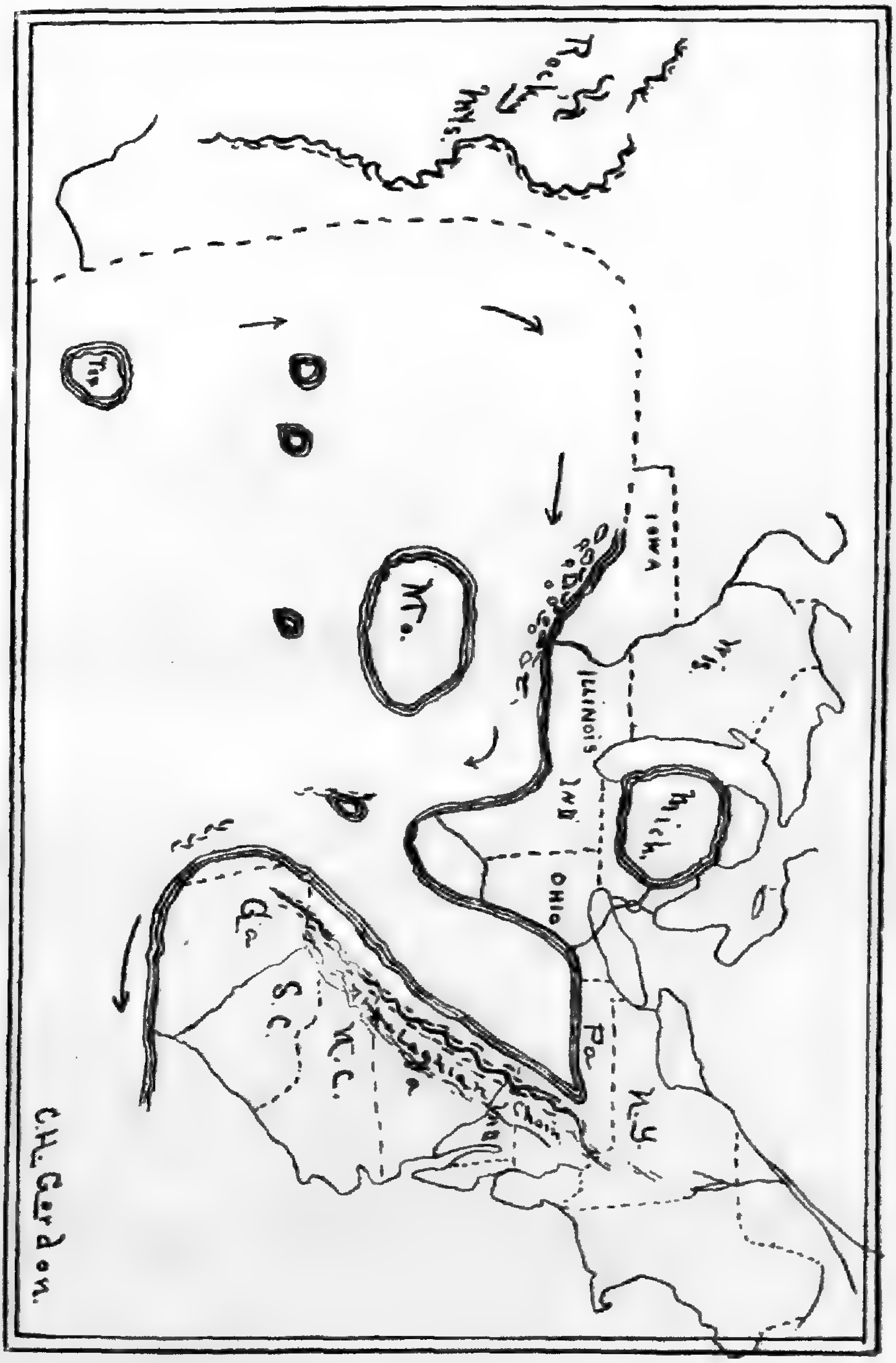
The corroborative evidences of a like origin for the St. Louis limestone may be briefly summarized as follows:

1. In its brecciated character and uneven stratification it closely resembles the brecciated portions of coral rock now forming. In general the fragments are composed of fine-grained bluish-gray limestone, resembling the clinking limestone of the coral seas. The only coral generally distributed through it is the massive *Lithostrotion canadense* Castelnau, the remains of which are abundant and conspicuous. The remains of this fossil occur at numerous localities in Iowa, Missouri, Illinois, Indiana,

[8] Manual, p. 620.

[9] Elements, p. 148.

PLATE XI.



The Carboniferous Ocean and Continent.

Kentucky, Tennessee, and Alabama. "This fossil is one of the most widely distributed corals of the Carboniferous limestones, and appears to hold the same geological position from Central Iowa to Alabama, everywhere marking the horizon of the St. Louis limestone."[10] In Iowa both the fossiliferous and unfossiliferons kinds of rock may be observed in the regions of the brecciated limestone. In some cases masses of the coral are found unbroken, but usually they are in a fragmental condition. In the vicinity of Keokuk we have observed places at which the limestone pieces are conspicuously fossiliferous, abounding in broken fragments of the above coral, as well as other fossils in a more or less comminuted condition. On the whole, however, the brecciated portions are comparatively unproductive of fossils. It is significant that n its extension northeastward into Ohio and Pennsylvania no remains of *L. canadense* are found, though Meek has shown this formation to be present in that region.

2. The character of the St. Louis towards the south corresponds with what might be expected in its more seaward portions It there becomes more evenly stratified and greatly more fossiliferous. The brecciated character is nearly lost, appears only at intervals, beginning and ending abruptly, and the intermediate portions showing more or less oblique laminations.

4. The uneven surface of the brecciated limestone would be a necessary sequence of the development of land seaward along a reef-bound coast.

On the retreat of the sea the lagoons and intermediate spaces were filled by shore-wash, accompanied by a luxuriant vegetation, and land progression outward, similar to that of Florida, as shown by Agassiz, in more recent times. Under this hypothesis the irregular pockets and basins of coal in the Lower Coal Measures are easily accounted for. They result from the accumulation within the lagoon of vegetation growing upon the banks or transported from without. That in these cases it did not in all cases grow in situ would appear from the fact that the coal rests almost immediately upon the limestone with no intervening layer to form a soil for its growth. In other localities the coal is under-

[10] Hall. Geology Iowa, Vol. I., Part II., p. 668.

laid by a stratum of soft, coarse sandstone. In this connection it might be objected that the above explanation would make the deposit of sandstone contemporaneous with the growth of some portions of the coral reef, in which case it should contain some internal proof of proximal relations. Such proof is not wanting. On the Iowa side of the Mississippi river, one-half mile above Keokuk, the brecciated limestone is overlaid by fifteen feet of this sandstone, which is somewhat harder than usual elsewhere, forming a projecting ledge. At this locality the writer has observed a mass of *Lithostrotion canadense* five or six inches in diameter imbedded in the lower portions of the sandstone, about two feet above the base. The presence of the coral here is accounted for on the supposition that at some not distant point a coral reef was growing at the time this sandstone was deposited. By the action of the waves this mass was broken from its bed and driven along the shallow bottom to find at last a resting-place in the mud and detritus brought in from the neighboring land. That the distance may not have been great may be inferred from the known fact that in coral regions the transition from a bottom of coral detritus to one of mud or earth is often very abrupt.[11]

From the above we submit the following brief

RECAPITULATION:

1. The Upper Division of the St. Louis Beds is a limestone which in its northern extension is decidedly brecciated and irregular in stratification and thickness. In the interior, with a few exceptions apparently due to littoral conditions, the rock is of a fine-grained, even texture, and regular stratification.

2. No adequate cause for this prominent feature of the limestone has thus far been advanced. While present in the attenuated margins of some limestones, it is not in all, and hence would imply the existence of other than littoral conditions alone.

3. Another significant feature accompanying the brecciated structure of this limestone is its oölitic character.

[11] Dana, Manual, p. 623.

4. In these and other features the limestone shows marked resemblances to that observed in coral regions.

5. The conditions for the growth of reef-building corals were apparently present at the time of the deposition of the St. Louis Beds. That the *Lithostrotion canadense* and *L. proliferum* were reef-building corals seems quite probable, though scarcely susceptible of proof.

6. The presence of coral reefs along the shore-line during the St. Louis epoch would seem to account for the various peculiarities of structure and arrangement observed in this limestone.

Keokuk, Ia., March, 1890.

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 157, Vol. XXIV., 1890.)

PORTUGAL CABBAGE. *Brassica oleracea costata* D.C.

THIS cabbage is easily recognizable through the great expansion of the midribs and veins of the leaf, in some cases forming quite half of the leaf, and the midrib losing its identity in the multitude of radiating branching veins. In some plants the petioles are winged clear to the base. Nearly all the names applied to this form indicate its distribution, at least in late years, from Portugal, from whence it reached English gardens about 1821,[1] and in American gardens, under the name of Portugal Cabbage, about 1850.[2] It should be remarked, however, that a *Choux a la grosse cote* was in French gardens in 1612,[3] and in three varieties in 1824.[4]

[1] Hort. Soc. Trans., 1821, 12.

[2] Buist. Fam. Kitch. Gar., 1851.

[3] Le Jard. Solit., 1612, 158.

[4] L'Hort. Franc., 1824.

This cabbage varies in a direction parallel to that of the common cabbage, or has forms which can be classed with the kales, and the heading cabbages of at least two types.

The peculiarity of the ribs or veins occasionally appears among the variables from the seed of the common cabbage, whence atavism as the result of a cross can be reasonably inferred. As to the origin of this form, our opinion, at the present stage of our studies, must be largely speculative, but we may reasonably believe that it originated from a different form or a different set of hybridizations than did the common cabbage.

The names in English are *braganza*, *portugal* or *sea-kale cabbage*,[5] *large-ribbed cabbage*,[6] *large-ribbed borecole*, *tranxuda*,[7] *couve tronchuda*; in France, *choux a grosses cotes*, *chou tronchuda*; in Spain, *col de pezon*, *col tronchuda*; in Portugal, *couve tronchuda*, *couve mantiega*, *couve penca*.[8]

The synonymy appears to be:

Choux a le grosse cote. Le Jard. Solit., 1612.
Chou blond a grosses cotes. Bosc. Dict., 1789, 4, 43.
Brassica oleracea aceppala costata. D.C. Syst., 2, 584.
B. oleracea costata. D.C. Mem., 1821, 12.
Chou a grosse cotes. Vilm., 1883.

POT MARIGOLD. *Calendula officinalis* L.

The flowers are used in some culinary preparations, and for this purpose it is yet grown in some gardens. It has not been used to any great extent in modern times, and even in 1783 Bryant,[9] while noting its common occurrence in gardens, says that the flowers were formerly in high esteem, being gathered and dried to use in soups and pottage. It was in American gardens in 1806. The plant was described in nearly all the early botanies, and is mentioned by Albertus Magnus in the 13th century.

[5] Vilmorin. The Veg. Gard., 1885, 128.
[6] Booth. Treas. of Bot.
[7] Burr. Field and Gard. Veg., 1863, 273.
[8] Vilmorin. Les Pl. Pot., 1883, 126.
[9] Bryant. Fl. Dict., 1783, 146.

Pot marigold is called, in France, *sonci des jardins;* in Germany, *ringelblume;*[10] in Holland, *goudbloem;* in Italy and Spain, *calendula;* in Russia, *nogotki;*[11] in Arabia, *zobejbe;* by the Greeks at Constantinople, *chamobuoreta;*[12] in Hindustani, *gul-i-mariyam, phirki, genda;* in Bengali, *genda phul;* in Burma, *htat-ta-ya;* at Lahore, *adsrioon;* in Japan, *kin-sen-kwa.*[13]

POTATO. *Solanum tuberosum* L.

The varieties of the potato are now innumerable, and while of several distinct types of form and color, are all supposed to have been derived from a common wild progenitor. It is interesting to observe, therefore, that varieties were under culture in South America even before the discovery. In a vocabulary of a now extinct tribe, the Chibcha, who once occupied the region about the present Bogota, ten different varieties are identified, one of which, "black inside," has not as yet appeared in modern culture.[14] At the present time Vilmorin[15] makes an extremely artificial classification, as follows: 1, the round yellow varieties; 2, the long yellow varieties; 3, the variegated long yellow varieties; 4, the round red varieties; 5, the flat pink or red varieties; 6, the smooth long red varieties; 7, the notched long red varieties; 8, the violet colored and variegated varieties. The yellow and red varieties are mentioned by Bauhin[16] in 1596, "fusci vel atrorubentis," or literally, the tawny and the purple. In 1726 Townsend[17] mentions the white and the red in England, as does Bryant[18] in 1783. In 1785, Varlo[19] describes nine sorts, the white round, the red round, the large Irish white smooth, the

[10] Vilmorin. Les Pl. Pot., 551.

[11] McIntosh. Book of the Gard., II., 240.

[12] Forskal. Fl. Æg. Arab., CXX., XXXIII.

[13] Pickering. Ch. Hist., 550.

[14] Gramatica Vocabulario . . de la Lingua Chibcha, for Don E. Urichoechea, quoted in Gard. Chron., Dec. 4, 1886, 720.

[15] Vilmorin. The Veg. Gard., 1885, 443.

[16] Bauhin. Phytopin., 1596, 301.

[17] Townsend. Seedsman, 1726, 23.

[18] Bryant. Fl. Diet., 1783, 15.

[19] Varlo. Husbandry, 1785, II., 97.

large round red, the culgee, the early-wife, the white kidney, the bull's-eye red. In further description he says the Jerusalem is long and full of eyes, the culgee is red on one side, the early-wife does not blossom, and are of a light-red, and the toadback is nearly akin to the large Irish, the skin almost black, and rough like a russetting; the kidney is oblong, white with a yellowish cast. In 1806 McMahon[20] describes but one kind for American gardens, but in 1828 Fessenden says there are many varieties, and in 1832 Bridgeman says the varieties are very numerous. In 1848 nearly one hundred sorts were exhibited at the Massachusetts Horticultural Society in Boston. Decaisne and Naudin give the number of varieties in France in 1815 as sixty; in 1855 as four hundred and ninety-three, in 1862 as five hundred and twenty-eight.

We have grown a number of wild varieties of the potato at the New York Agricultural Experiment Station, including the *Solanum maglia.* One sort, which has not as yet been identified by us with its specific name, corresponds to the notched class of Vilmorin. The *maglia* corresponds to the round and oblong flattened forms; the *Jamesii* to the round form. The colors of these wild potatoes are said by some growers to include the white, the red, and the variegated. In their habits of growth the *maglia* forms its tubers deep under the ground, the *Jamesii* very much scattered and extending a long distance from the plant.

The synonymy of our types can include those described by Vilmorin, as follows, but I have not attempted to make it complete.

I. *Round yellow.* Vilm., 1885.
Round as a ball. Ger., 1597, 781; 1633, 927.
Solanum tuberosum. Blackw. Herb., 1773, pl. 523, b.
White round. Varlo, Husb., 1785, II., 97.

II. *Long yellow.* Vilm., 1885.
Ovall or egge fashion. Ger., 1597, 781; 1633, 927.
Oblonga. Bauh. Prod., 1671, 90. Matth., 1598, 757, cum ic.
Papas peruanorum. Clus. Rar., 1601, 2, 79, cum ic.

[20] McMahon. Am. Gard. Cal., 1806.

III. *Variegated l ng yellow.* Vilm., 1885.

IV. *Round red.* Vilm., 1885.
Pugni magnitudine. Matth., 1598, 757.
Red round. Varlo, Husb., 1785, II., 97.

V. *Flat pink or red.* Vilm., 1885.

VI. *Smooth long red.* Vilm., 1885.
?*Solanum tuberosum.* Blackw. Herb., 1773, pl. 523, b.

VII. *Notched long red.* Vilm., 1885.
?*Membri virilis forma.* Bauh. Prod., 1671, 90.

VIII. *Violet colored and variegated.*
?*Atrorubens.* Bauh. Phytopin., 1596, 301.
Toadback. Varlo, Husb., 1785, II., 97.
Solanum tuberosum tuberibus nigricantibus. Blackw. Herb., t. 586.

The figures I have seen, which seem to me to be referrable to the *maglia* species, are:

Batata virginiana sive virginianorum pappus. Ger., 1597, 781.
Solanum tuberosum esculentum. Matth., op., 1598, 758; Bauh. Prod., 1671, 89.
Arachidna theophrasti forte, Papas peruanorum. Clus. Rar., 1601, 2, 79.
Papas americanus. Swertius, Florelig., 1612, t. 28, fig. 4.

The potatoes which are now grown in this country were derived from several sources, from England, and of late years from Bogota[21] in 1847, from Chili[22] in 1850, etc.

Potatoes were grown in Virginia in 1609,[23] and are also mentioned in 1648[24] and 1650.[25] In 1683 Worlidge[26] says potatoes are much used in Ireland and America, but their introduction into New England is said not to have been until 1719,[27] at Lon-

[21] Farmers' Library, 1847, 382.
[22] Trans. N.Y. Ag. Soc., 1850, 726; 1851, 367.
[23] A True Decl. of Va., 1610, 13.
[24] A Perf. Desc. of Va., 1649, 4.
[25] Virginia, by E. W., 1650, 48.
[26] Syst. Hort. By J. W. Gent., 1683, 187.
[27] Hort. Register, III., 214.

dondury, N. H., and at Salem, about 1762.[28] In 1779, however, potatoes were among the Indian foods destroyed by Gen. Sullivan[29] during his invasion into Western New York.

This plant has secured a wide distribution, and has been successfully cultivated throughout nearly the whole world. Its northern limits are in Norway, 71° 7′; in Russia, the Pinega River, 65°; Turukansk, 65°; Yakutsk, shores of the Okotsk Sea, Kamchatka, Kadjah Island, Sitka Island; Mackenzie River, 65°; Canada, Labrador, 58° 45′; Greenland.[30]

The modern names for the potato are: In France, *pomme de terre, parmentiere, tartauffe, tartufle*, etc.; in Germany, *kartoffle;* in Flanders and Holland, *aard appel;* in Denmark, *jordepeeren;* in Italy, *patata;* in Spain and Portugal, *patatas;* in Spanish America, *papa;*[31] in Norway, *potet;*[32] in India, *wvlaetee aloo;*[33] in Telinga, *alu-guddalu;* in Ceylon, *rata-innala;*[34] by the Malays, *ubi bungala;*[35] in China, at Pekin, *shan-yas-tou;* in southern China, *ho-lan-shu*.[36]

PUMPKIN. *Cucurbita* Sp.

See under squash.

PURSLANE. *Portulaca oleracea* L.

Common purslane is a weed of the garden, and has spread over nearly the whole world. Whether originally an American plant is in doubt, but certain it is that plants *called* purslane were seen by the early visitors to the American coast. The cultivated purslane differs from the wild in being erect, and Hooker found

[28] Felt's Annals of Salem, II., 146.

[29] Conover's Early Hist. of Geneva, 1880, 45.

[30] Bergman. *Nature*, Aug. 21, 1884, 392.

[31] Vilmorin. Les Pl. Pot., 478. For Germany, see Die Deutschen Volksnamen du Pflanzen. Pritzel and Jessen.

[32] Schubeler. Culturpf., 90.

[33] Speede. Ind. Handb. of Gard., 136.

[34] Birdwood. Veg. Prod. of Bomb., 174.

[35] Treas. of Bot., 1186.

[36] Bretschneider. On the Study, etc., 17.

in northwest India a variety with erect stalks.[37] The use of the purslane as a vegetable is noted in the Greek writers under the name *andrachne*, and by the Romans under this name and *portulaca*. In the 13th century Albertus Magnus[38] does not mention culture in gardens, and apparently refers to the wild form, "the stems extending over the soil." In 1536 Ruellius[39] describes the erect, green-leaved, cultivated form, as well as the wild procumbent form, and in this he is followed by many of the succeeding botanists. Three varieties are described,—the green, the golden, and the large-leaved golden. The golden varieties are not mentioned by Bauhin in his phytopinax, 1596, nor in his pinax, 1623, but are mentioned just as if a well-known variety in Le Jardinier Solitaire, 1612. The green variety is figured by nearly all the earlier botanists. The golden has the following synonymy:

Pourpier doré. Le Jard. Solit., 1612, 378; Tourn., 1719, 236; Vilm., 1883, 518.

Red or Golden. Quintyne, 1693, 199.

Portulaca sativa lutea sive aurea. Ray, 1688, 1039.

Golden purslane. Ray, 1688, 1039; Townsend, 1726, 19; Mawe, 1778; Burr, 1863, 392.

Purslane was formerly much more grown than at present; with Quintyne it was a vegetable for forcing. It is seldom seen in American gardens, but the spinage from the wild plant is occasionally served at table.

Purslane is called in France, *pourpier, porcelin, porcellane, porchailles;* in Germany, *portulak, kreusel;* in Flanders and Holland, *postelein, postelijn, porcelein;* in Denmark, *portulak;* in Italy, *porcellana;* in Spain, *verdolaga;* in Portugal, *beldroega;*[40] in Norway, *portulak;*[41] in Russia, *schrucha*.[42]

In Arabia, *brabra, chamile, doenneb el farras, ridjlet el farras;*[43]

[37] Hooker. Fl. Br.-Ind., I., 240, ex. D.C. Orig. Des. Pl. Cult., 70.

[38] Albertus Magnus. De Veg., Jessen ed., 1867, 548.

[39] Ruellius. De Nat. Stirp., 1536, 482.

[40] Vilmorin. Les Pl. Pot., 517.

[41] Schubeler. Culturpf., 109.

[42] Decandolle. Orig. Des Pl. Cult., 70.

[43] Forskal. Fl. Æg., Arab., CXII.

in Arabic, *rigleh* ;[44] in Bengali, *moonya, buroloonia* ;[45] in Burma, *myae-byet* ;[46] in Ceylon, *genda-kola* ;[45] in China, *ma chi hien* ; in Cochinchina, *rau sam* ;[47] at Constantinople, *glisrida* ;[43] in Egypt, *baglae, ridjle* ;[46] in India, *choolee, mooncha, moonea, khursa, khurfa* ;[48] in Japan, *bakin, uma biju, siberi fiju* ;[49] in Nubia, *segettemum* ;[44] in Persia, *turuek, kherefeh* ; in Sanscrit, *lonika, loonia* ; in Tamil, *caril-keeray, puropoo-keeray*.[45]

QUINOA. *Chenopodium quinoa*, Willd.

This plant was grown as a cereal plant in the table-lands of New Grenada, Peru, and Chili, at the time of the discovery of America, and De Vega[50] notes that both the Indians and the Spaniards use the foliage as a spinach, as well as the grain. In Chili a variety is named by Molina,[51] which yields a white grain, and this is the kind that is used as a vegetable in European gardens. A black-seeded variety, cultivated in gardens, is mentioned by Feuille[55] in Peru, preceding 1725. It was introduced in 1785,[52] but has not received very extended use. In 1853 seeds from France were distributed from the U. S. Patent Office.

The *white quinoa* is called in France, *anserine quinoa blanc, quinoa blanc* ; in Germany, *peruanischer reis-spinat, reis-gewachs* ;[53] in Peru, *quinua* by the Indians, *mujo* by the Spaniards ;[50] in Chili, the white sort, *dahue* ;[51] in Bolivia, *quinua*.[54]

RADISH. *Raphanus sativus* L.

In European culture the radish is grown for its roots, but in other countries it is grown as well for its leaves and seed. Thus

44 Delile. Fl. Æg. Ill.

45 Birdwood. Veg. Prod. of Bomb., 38, 161.

46 Pickering. Ch. Hist., 611.

47 Louriero. Fl. Cochinch., 293.

48 Speede. Ind. Handb. of Gard., 171.

49 Kaempfer. Amoen., 831.

50 G. de Vega. Royal Com. Hak. Soc., ed. II., 358.

51 Molina. Hist. of Chili, I., 91.

52 Heuze. Les Pl. Alim., II., 259.

53 Vilmorin. Les Pl. Pot., 1883, 10.

54 Gibbon. Amazon, 139.

55 Feuille. Peru, III., Ap. 16, t. X.

in Sikh, India, Edgeworth[56] says the radish is cultivated both as a vegetable made of the young buds, and for its oil. In Arabia, Forskal[57] says the foliage and not the root is eaten. The Arabs are very fond of the tops of radishes, says Bayard Taylor,[58] and eat them with as much relish as donkeys. Klunzinger[59] describes the radish of Upper Egypt as of a peculiar kind, of which as a rule the leaves only, and not the small sharp root, are eaten. In 1726, in England,[60] radishes were sown for cutting in the first leaf for small salads. The oil-bearing radish of China is grown extensively there for the seeds, from which an edible oil is expressed, and it has been introduced and successfully cultivated in Italy, whence it has reached France.[61] This esculent root has been known from a remote antiquity, and has furnished a number of forms which have remained distinct from time immemorial. If the figures given by Woenig[62] as of the radish in the XII. dynasty of Egypt be the radish, we may recognize the turnip-rooted and the long. A. P. Decandolle[63] in 1821 divided the radishes into two divisions, the one including the common European sorts, the other the large black or white winter sorts. As a matter of convenience we will treat the various forms as species, giving the history of each.

I. *Raphanus radicula* Pers.[64]

This is the round or turnip radish, the root swollen into a spherical form, or an oval tube rounding at the extremity to a filiform radicle. It has several shades of color, from white to red or purple. Its savor is usually milder than that of the other

[56] Edgeworth. Hooker's Jour. of Bot., II., 273.

[57] Forskal. Fl. Æg.-Arab., XCIII.

[58] Bayard Taylor. Central Africa, 105.

[59] Klunzinger. Upper Egypt, 142.

[60] Townsend. Seedsman, 1726, 17.

[61] Bon Jard., 1882, 699.

[62] Woenig. Die Pflanzen in Alt Ægypt, 1886, 217.

[63] Decandolle. Mem. upon the Brassicæ, 1821.

[64] Baillon. Hist. of Plants, III., 222.

sorts. It seems to be the *Boeotion* of Theophrastus,[65] who described this form as the least acid, and of a rotund figure, and with small leaves; the *Syriacan* of Columella[66] and of Pliny.[67] This sort does not appear to have received extensive distribution northward during the middle ages, as they find but little mention in the earlier botanies. In 1586 Lyte[68] says they are not very common in Brabant; but they are figured in two varieties by Gerarde. I am disposed to put here the *Raphanus vulgaris* of Tragus, 1552, which he describes as round, small, and common in Germany. Bontius[69] in 1658 mentions them in Java, and in 1837 Bojer[70] describes them as grown at the Mauritius. In 1842 Speede[71] gives an India name, *gol moolee*, for the red and white kinds.

Raphanus orbiculatus. Round radish. Ger., 1597, 184.
Scarlet French Turnip. Vilm., 1885, 485.
Small Early White Turnip. Vilm., 1885, 487.
Radicula sativa minor. Small garden radish. Ger., 1597, 183.
White olive-shaped. Vilm., 1885, 490.
Olive-shaped Scarlet. Vilm., 1885, 488.

Raphanus sativus Mill.[72]

The root of this class is long, nearly cylindrical, diminishing insensibly to a point at the extremity. It is now the common garden radish. It has a variety of colors from the white to the red, and is noteworthy from the transparency of the flesh. It may well be the *radicula* of Columella,[73] and the *Algidense* of Pliny,[74] which he describes as having a long and translucent root. It is

[65] Theophrastus, Lib. VII., c. 4.
[66] Columella, Lib. X., c. 114; Lib. XI., c. 3.
[67] Pliny, Lib. XIX., c. 26.
[68] Lyte. Dodoens, 1586, 687.
[69] Bontius. Ind. Orient., 1658, 12.
[70] Bojer. Hort. Maur., 1837, 16.
[71] Speede. Ind. Handb. of Gard., 1842, *147*.
[72] Baillon. Hist. of Pl., III., 222.
[73] Columella, Lib. IV., c. 8; Lib. XI., c. 2.
[74] Pliny, Lib. XIX., c. 26.

not described in England by Lyte nor by Gerarde; it is described as in the gardens of Aleppo in 1573–5.[75] In 1658 Bontius[69] calls them in Java *Dutch radish;* in 1837 Bojer[70] names them in the Mauritius, and in 1842 Speede[71] gives an Indian name, *lumbee moolee.*

Raphanus minor purpureus. Lob. Obs., 1576, 99; ic., 1591, I., 201.

Raphanus longus. Cam. Epit., 1586, 224.

Raphanus purpureus minor. Lobel., Lugd., 1587, 636.

Radicula sativa minor. Dod., 1616, 676.

Raphanus corynthia. Bodaeus, 1644, 769.

Long Scarlet. Vilm., 1885, 490.

Long White Vienna. Vilm., 1885, 492.

Raphanus albus longus.

The long white late and large radishes I do not recognize in the ancient writings, unless it be the reference by Pliny[74] to the size; some radishes, he says, are the size of a boy infant, and Dalechamp[76] says that such can be seen in his day in Thuringia and Erfordia. In Japan, so says Kizo Tamari,[77] a Japanese commissioner to the New Orleans Exposition of 1886, the radishes are mostly cylindrical, fusiform or club-shaped, from one-fourth of an inch to over a foot in diameter, from six inches to over a yard in length, and J. Morrow[78] says that at Lew Chew radishes often grow between two and three feet long, and more than twelve inches in circumference. In 1604 Acosta[79] writes that he had seen in the Indies "redish rootes as bigge as a man's arme, very tender and of good taste." These radishes are probably mentioned by Albertus Magnus[80] in the 13th century, who says that the *radix* are very large roots of a pyramidal figure, with a somewhat sharp savor, but not that of *raphanus;* they are planted in

[75] Gronovius. Orient., 81.

[76] Hist. Gen., Lugd., 1587, 634.

[77] Am. Hort., Sept., 1886, 9.

[78] Morrow. Perry's Japan, II., 16.

[79] Acosta. Hist. of the Ind., 1604, 261.

[80] Albertus Magnus. De Veg., Jessen Ed., 1867, 556, 645.

gardens. They seem to have been the principal kind in northern Europe a few centuries later, and are said by Lyte[81] in 1586 to be the common radish of England. In 1790 Loureiro[82] describes them as cultivated in China and Cochin China, and they seem to be the form described by Kaempfer[83] in Japan, in 1712. The radishes figured by the early botanists enable us to connect very closely with modern varieties.

(*a*.)
Raphanus longus. Trag., 1552, 732.
Raphanus. Matth., 1558, 241; 1570, 332.
Raphanus sive radix. Pin., 1561, 145.
Raphanus magnus. Lob. Obs., 1576, 99; ic., 1591, I., 201.
Raphanus alba. Cam. Epit., 1586, 223.
Raphanus sativus Matthiol. Lugd., 1587, 635.
Raphanus sive radicula sativa. Dod., 1616, 676.
White Strasbourg. Vilm., 1885, 494
(*b*.)
Raphanus II. Matth., 1570, 332; 1598, 349.
Raphanus secundus Matthiol. Lugd., 1587, 635.
Laon long gray Winter. Vilm., 1885, 496.
(*c*.)
Raphanus. Matth., 1558, 241; 1570, 332.
Raphanus sive radix. Pin., 1561, 145.
Raphanus sativus matthiolus. Lugd., 1587, 635.
Radice. Cast. Dur., 1617, 383.
White Spanish Winter. Vilm., 1885, 497.
(*d*.)
Raphanus sativus. Garden Radish. Ger., 1597, 183.
Large White Russian. Vilm., 1885, 497.

Raphanus niger vulgaris A. P. DC.

This radish does not seem to have been mentioned by the ancients. In 1586 Lyte says, The radish with a black root has

[81] Lyte. Dodoens, 1586, 687.
[82] Loureiro. Fl. Cochin Ch.; 1790, 396.
[83] Kaempfer. Amoen., 1712, 822.

of late years been brought into England, and now beginnith to be common.

Raphanus nigra. Cam. epit., 1586, 223.
Raphanus sive radicula sativa nigra. Dod., 1616, 676.
Raffano longo. Cast. Dur., 1617, ap.
Long-rooted Black Spanish. Bryant, 1783, 40.
Long Black Spanish Winter. Vilm., 1885, 496.

Raphanus niger rotundus A. P. DC.

This is a turnip-rooted or round form of a black radish, usually included among winter sorts.

Raphanus pyriformis. Ger., 1597, 184.
Raphanus I. Matth., 1598, 349.
Large Purple Winter. Vilm., 1885, 495.

There is another form of black radish figured in the early botanies, of quite a distinct appearance. It answers suggestively to the description by Vilmorin of the Radis de Mahon, a long red radish, exceedingly distinct, growing in part above ground, and peculiar to some districts in southern France and to the Balearic isles. I connect it with diffidence with the following:

Raphanus niger. Lob. ic., 1591, I., 202.
Radice selvatica. Cast. Dur., 1617, 384.
Raphanus niger. Bod., 1644, 770.
Radis de Mahon. Vilm., 1885, 499.

Theophrastus mentions the Corinthian sort as having full foliage, and the root, unlike other radishes, growing partly out of the earth, but the Long Normandy answers to this description as well as the Mahon.

The radish was known to Turner[84] in England in 1536 under the name of *radyce.* It was noted in Mexico in the sixteenth century by Peter Martyr,[85] by Benzoni[86] in Hayti in 1565, and was under cultivation in Massachusetts about 1629.[87]

[84] Turner. Libellus, 1537.
[85] Peter Martyr. Eden's Hist. of Trav., 1577.
[86] Benzoni. Hist. of the New World. Smyth Trans., 1857.
[86] Wood. New Eng. Prosp., 1st Ed., II.
[87] Vilmorin. Les Pl. Pot., 518.

The radish is called in France, *radis, petite rave, rave* ;ni Germany, *radies* ; in Flanders and Holland, *radijs* ; in Denmark, *haveroeddike* ; in Italy, *ravanello, radice* ; in Spain, *rabanito* ; in Portugal, *rabao, rabanite* ;[87] in Norway, *reddik* ;[88] in Greece, *rapania*.[89]

In Arabic, *figl*,[90] *fioyl, bokel* ; in Bengal, *moola* ;[91] in Burma, *mung-la* ;[89] in Ceylon, *rabu* ;[91] in Egypt, *fidjel* ;[89] in Hindustani, *moola, muli* ;[91] in India, *moolee* ;[92] in Japan, *daikon* ; in Malay, *lobak* ; in Sanscrit, *mooluka* ; in Tamil, *moolinghie* ; in Telinga, *mullangi*.[91]

Raphanus caudatus L.

This radish has pods often a foot or more in length, and these find use as a vegetable. It became known to Linnæus in 1764 ;[93] it reached England from Java about 1816,[94] and was described by Burr [95] as an American kitchen plant in 1863. According to Firminger [96] the plant has but lately come into cultivation in India, and there bears pods often three feet in length. These pods make excellent pickles.

It was at first called in England *tree radish from Java*,[94] in India, *rat-tailed radish*,[96] the name it now holds in the United States ; by Burr,[95] in 1863, *Madras radish*.

There are a number of radishes now known whose type requires further study before presentation. Such are the Chinese winter radishes, whose roots are swollen more at the base than at the summit, the oil-bearing radish, etc. The first of these is in general cultivation in Japan.

[88] Schubeler. Culturpf., 107.

[89] Pickering. Ch. Hist., 473.

[90] Delile. Fl. Æg. Ill.

[91] Birdwood. Veg. Prod. of Bomb., 138.

[92] Speede. Ind. Handb. of Gard., 147.

[93] Miller's Dict., 1807.

[94] Gard. Chron., 1866, 779.

[95] Burr. Field and Gard. Veg., 384.

[96] Firminger. Gard. in Ind., 140.

RAMPION. *Campanula rapunculus* L.

The roots and leaves of Rampion are eaten in salads. It is recorded as in gardens by Pena and Lobel[98] in 1570, and is figured by Tragus[97] in 1552, Lobel[99] in 1576, as well as by other writers of this period as an improved root. In 1726 Townsend[100] says it is but in few gardens in England, and Bryant[101] in 1783 says it is much cultivated in France, but in England is now little regarded. It is recorded in American gardens in 1806, 1819, 1821, etc. As late as 1877 an English writer says rampion is a desirable addition to winter salads.[102]

Rampion is called in France, *raiponce, baton de Jacob, cheveux d'eveque, petite raiponce de careme, pied-de-sauterelle, rampon, rave sauvage;* in Germany, *rapunzel;* in Flanders and Holland, *rapunsel;* in Italy, *raperonzolo, raponzolo;* in Spain, *reponche, raponchigo;* in Portugal, *rapunculo.*[103]

RED CABBAGE. *Brassica oleracea (capitata) rubra* L.

The first certain mention I find of this cabbage is in 1570, in Pena & Lobel's Adversaria,[104] and figures are given by Gerarde, 1597,[105] Matthiolus, 1598,[106] Dodonaeus, 1616,[107] and J. Bauhin, 1651.[108] These figures are all of the spherical headed type. In 1636,[109] Ray notices the variability in the colors upon which a number of our seedsmen's varieties are founded. The oblong or the pointed headed types which now occur, I cannot trace.

97 Tragus. De Stirp., 1552, 725.
98 Pena and Lobel. Adv., 1570, 130.
99 Lobel. Obs., 1576, 178.
100 Townsend, 1726, 23.
101 Bryant. Fl. Diet, 1783, 27.
102 E. Hobday. Cottage Gard., 1877, 113.
103 Vilmorin. Les Pl. Pot., 537.
104 Pena and Lobel. Adv., 1570, 91.
105 Gerarde. Herbal., 1597, 246.
106 Matthiolus. Ed. of 1598, 367.
107 Dodonæus Pemgt., 1616, p. 621.
108 J. Bauhin. Hist., 1651, II., 831.
109 Ray. Hist. 1686, 795.

The solidity of the head and the perfectness of the form in this class of cabbage indicate long culture and a remote origin. In England they have never attained much standing for general use,[110] and as in this country are principally grown for pickling.

The *Red Cabbage* is called in France, *chou pommerouge;* in Germany, *rote kopfkohl;* in Italy, *cavalo rosso;* in Dutch, *rood kool;* in Spain, *berza colorado;* [111] in India, *lal kobee.*[112]

The synonymy seems to be as follows:

I.

Brassica convoluta and arcte occlusa rubro colore. Adv., 1570, 91.

B. Lacuturria. Lyte's Dod., 1586, 637.

B. Capitata rubra. Bauh. Phytopin., 1596, 176; Pin., 1623, III.; Ger. Herb., 1597, 246; J. Bauh., Hist., 1651, II., 831; Ray, Hist., 1686, 621.

B. rubra capitata. Dod. Pempt., 1616, 621.

Chou pomme rouge. Tourn., Inst., 1719, 219.

Red cabbage, spherical headed forms.

II.

Dark red early pointed headed. Vilm., Alb. de Cliches, 1885.

New Garfield Pickeler. Tillinghast Cat., 1884.

RHUBARB. *Rheum* sp.

The rhubarb as a vegetable is in more repute in American and English gardens than in France, and is now widely distributed and much grown in American gardens. It is, however, of recent introduction; the first of its kind being only known about 1608, and the first reference I find to its growth as a vegetable in England being in 1778, although its culture probably dates somewhat earlier. It appeared in American gardens before 1806, but in 1821 Cobbett says he had never seen it in America. In 1822,

[110] J. W. Gent. Syst. Hort., 1683, 203. Townsend. Seedsman, 1726, 27, etc.

[111] McIntosh. Book of the Gard., II., 116.

[112] Speede. Ind. Handb. of Gard., 114.

J. Lowell, in the Massachusetts Agricultural Repository, says that thirty years ago we were strangers to the rhubarb, which has now become an article of extensive culture. R. Manning, Secretary of the Massachusetts Horticultural Society, says that in 1844 it was acquiring that popularity which now renders it indispensable. In 1863 Burr describes ten varieties for American gardens. I am not sufficiently acquainted with this genus to refer our cultivated sorts to their proper species, but I cannot agree with Vilmorin in referring them all to one species, *Rheum hybridum*. I present the species, in order of introduction, to which our cultivated rhubarbs have been referred by authors.

Rheum rhaponticum L.

A native of Southern Siberia and the region of the Volga, it was introduced to Europe about 1608, and cultivated at Padua by Prosper Alpinus, and seeds from this source were planted by Parkinson in England about 1640 or before.[113] There is no reference, however, to its use as a vegetable by Alpinus[114] in 1627, nor by Ray[115] in 1686, although the latter refers to the acid stalks being more grateful than that of garden sorrel. In 1778, however, Mawe[116] says its young stalks in spring, being cut and peeled, are used for tarts. In 1806 M'Mahon[117] mentions it in American gardens, and says the footstalks are very frequently used, and much esteemed for tarts and pies. In 1733 Bryant[118] describes the footstalks as two feet long, and thicker than a man's finger at the base.

Rheum undulatum L.

To this species have been referred garden varieties with a red stalk. It is said to be a native of China, and introduced to Europe in 1734. It is mentioned in American seed catalogues of

[113] Pharmacographia, 1879, 500.

[114] Alpinus. De Exot., 1627, 188.

[115] Ray. Hist., 1686, 170.

[116] Mawe. Gard., 1778.

[117] M'Mahon. Am. Gard. Cal., 1806, 205.

[118] Bryant. Fl. Diet., 1783, 67.

1828. Decaisne and Naudin[119] say it is grown in gardens, but is not as esteemed as is the Victoria rhubarb. In 1840[120] *Buck's* and *Elford* rhubarb are referred to as originating from this species. In 1882, a variety called *Tartreum*[121] announced in France as new, and highly praised, is referred here.

Rheum palmatum L.

Its habitat ascribed to China neighboring to Tartary, it first reached Europe in 1763[122] or 1758.[120] The footstalks are much smaller than those of other kinds, hence it is not in general cultivation.[120] It is yet rare in France, although this species is superior in quality, as it is quite tender.[123]

Rheum compactum L.

A native of Tartary and China, it became first known in Europe in 1758. In the Bon Jardinier of 1882 it is said to be the species principally grown in France as a vegetable, but Vilmorin[124] refers his varieties to *Rheum hybridum*, but these it is to be remarked are English.

Rheum hybridum L.

This is the species to which our largest and finest varieties are usually referred. It is of uncertain origin. It is first noticed in England in 1773 or 1774,[125] but it did not come into use as a culinary plant until about 1827. In 1829 a footstalk was noted as sixteen inches long.[126] The Victoria rhubarb of our gardens is referred to this species. In 1877 a stalk was exhibited at

[119] Decaisne & Naudin. Man., IV., 190.

[120] Vegetable Substances, 1840, 205.

[121] Bon. Jard., 1882, 565.

[122] Noisette. Man., 1826, 297.

[123] Bon Jard., 1882, 706.

[124] Vilmorin. Les. Pl. Pot., 1883, 538.

[125] Miller's Dict., 1807.

[126] Rhind. Veg. King., 1857, 309.

Boston which weighed 2 lbs. 2½ ozs., and in 1882, twelve stalks which weighed forty pounds.[127]

Rheum ribes L.

This plant is considered by Linnaeus[128] to be the *Ribes arebum* of Rauwolf, who traveled in the Orient in 1573-5, and who found it in the region of the Lebanon,[129] and its habitat is also given as Eastern Persia. Decaisne and Naudin[130] refer to it as grown in gardens in France, but not as esteemed as the *R. hybridum*, while the Bon Jardinier of 1882 says it is reported the best as an esculent, and is greatly praised.

Rheum australe, Don.

This species, which is the *R. emodi*, Wal., is said by Loudon[131] to have an excellent flavor, somewhat resembling that of apples, and excellent for a late crop, and the Bon Jardinier of 1882 says the petioles are longer and more esteemed than those of other species. On the contrary Burr[132] in 1863 says the leaf stalks, although attaining an immense size, are unfit for use on account of their purgative properties, but the plant is sometimes cultivated for its leaves, often a yard in diameter, which are useful for covering baskets containing vegetables or fruit.

The wild rhubarb about Cabul is blanched for use as a vegetable, and under the name of *rewash* is brought to the market. Gravel is piled about the sprout as it breaks from the earth, and by continuing the process the plant is forced to grow to the height of 18 or 20 inches. Another process is to cover the sprout with an earthen jar, and the sprout then curls itself spirally within the jar, and becomes quite white, crisp and free from fibre. It is eaten in its raw state with either salt or sugar, and makes a favorite preserve[133].

127 Mass. Hort. Soc. Trans., 1887, III., 1882, 244.

128 Linnaeus Sp., 2d ed., 532.

129 Gronovius. Orient., 49.

130 Decaisne & Naudin. Man., IV., 190.

131 Loudon. Hort., 1860, 688.

132 Burr. Field and Gard. Veg., 1863, 631.

133 Harlan. U. S. Pat. Off. Rept., 1861, 528.

Rhubarb is called in France, *hubarbe ;* in Germany, *rhabarber ;* in Flanders and Holland, *rabarber ;* in Denmark, *rhabarber ;* in Italy, *rabarbaro, robarbaro ;* in Spain and Portugal, *ruibarbo*[134].

ROCAMBOLE. *Allium sorodoprasum* L.

The culture of Rocambole is limited in this country, but in southern Europe the Genoese bring vast quantities to Provence under the name of *ail rouge*[135]. It is not of ancient culture, as it cannot be recognized in the plants of the ancient Greek and Roman authors, and finds no mention of garden cultivation by the early botanists. It is the Scorodoprasum II. of Clusius[136], 1601, the Allii genus, ophioscorodon dictum quibusdam, of J. Bauhin[137], 1651, but no indications of culture in either case. Ray[138], in 1688, does not refer to its cultivation in England. In 1726 however, Townsend[139] says it is "mightily in request"; in 1783 Bryant[140] classes it with edibles. In France, however, it was grown by Quintyne[141] in 1690. It is enumerated for American gardens in 1806[142]. No varieties are mentioned.

Rocambole is called in France, *ail rocambole*, *ail rouge*, *ail d'Espane*, *eschalote d'Espagne*, *rocambole ;* in Germany, *roccambol;* in Denmark *rokambol ;* in Italy *aglio d'Indi ;* In Portugal, *alho de Hespana.*[143] It 1698 in England it was called *Spanish-Garlick*, and in 1826 *rockambole.*

[134] Vilmorin. Les. Pl. Pot., 538.

[135] Bon Jard. 1882, 414.

[136] Clusius. Hist., 1601, 190.

[137] J. Bauhin. 1651, II., 559.

[138] Ray. Hist., 1688, II., 1120.

[139] Townsend. Seedsman, 1726, 25.

[140] Bryant. Fl. Diet, 1788, 23.

[141] Quintyne. Comp. Gard., 1704, 223.

[142] McMahon. Am. Gard. Cal., 1806, 190.

[143] Vilmorin. Les. Pl. Pot., 3.

THE KNEES OF THE *TAXODIUM DISTICHUM.*

BY ROBERT H. LAMBORN.

IN a "Preliminary Notice of Some of the Results of the United States Geological Survey Examination of Swamp Land," by Prof. N. S. Shaler, of Cambridge, Mass. (*Science*, March 8, '89), it is stated as the result of observations begun in 1874, while engaged on the Kentucky State Survey, and continued and recorded in various publications by the author, official and otherwise, extending up to date, that the occurrence of knees on the *Taxodium distichum* is explained "through a need of an aëration of the sap which is denied the roots that are under water." He also ascribed the enlarged base of the tree to the same need of aeration of the sap, and discards as disproven the hypothesis that such enlarged or buttressed base is useful to the tree as securing greater resistance to storms.

In the Memoir (by the same author) of the Museum of Comparative Anatomy (Harvard College, 1887), the theory of aeration is still more distinctly enunciated. "The failure of knees to develop when they grow on high ground; the development of the knees when the roots are in permanent water; the rise of the knees above permanent water level, and to a height varying with that level, and, finally, the destruction of the trees whenever the level of permanent water rises above the tops of the knees,—these facts incontestably show that there is some necessary connection between them and the function of the roots, when the latter are permanently submerged." "It seems likely, therefore, that some process connected with the exposure of the sap to the air takes place in these protuberances." Following these official publications, a communication was presented to the Academy of Natural Sciences, of Philadelphia (pp. 67 to 69, Proceedings, April, 1889), by Prof. Wilson, of the University of Penna., in which the result of certain observations made by him in Florida in 1885-6 are given. He records a careful series of experiments made by digging up young trees, by cultivating the plant from the seed, and by observing exposed root systems. He finds that "if the tree requires, from inundation or other causes, more aerating surface than can be readily or rapidly produced by young and growing roots, then either the whole upper surface of the root in question may become more active and rapid in its growth, or the places of growth may be limited to certain definite points"—so knees are produced. He continues: "I do not propose at this time to discuss the function of these knees, further than to say that their *location* and *occurrence* indicate beyond a doubt that they are for purposes of aerating the plant."

In the monthly publication of the Pennsylvania Forestry Association (*Forest Leaves*, December, 1889), in a careful article on the Taxodium, Prof. Wilson, referring to Prof. Shaler's work, again adverts to the knees, and says: "From recent experiments made by the writer at the department of Biology, it has been demonstrated that the knees are organs produced by the roots for the purpose of taking in a greater supply of oxygen than could otherwise be had from the surrounding water.

This theory which finds in the knees and swollen boles of the cypress the sole function of conveying something advantageous from the atmosphere to the sap of the tree during periods of submergence, seems to have been entertained as early as 1847, when Dr. Dickinson and Andrew Brown read before the Association of American Geologists, in Boston, a study of "The Cypress timber of Mississippi and Louisiana." In this interesting illustrated article of eight pages in *Silliman's Journal* for January, 1848, they say, "The cone-shaped, leafless protuberances, sometimes ten feet high, growing from the interlacing roots in a dense forest, resemble in all but their color the crowded stalagmites in some enormous cavern. By means of these protuberances the roots, though totally submerged, have a communication with the atmosphere. We suggest," they say, "that this function is fulfilled by the knees." When this communication is cut off by the annual overflow rising above the tops of the knees, the swollen base carries the similar structure of the roots up the bole of the tree to an elevation sufficient to reach the atmospheric air.

Until recently this aerating theory seems to have met with no opposition, and it bid fair to become the generally accepted explanation for these strange vegetable growths, which travelers in our Southern states so often observe and mention.

A paper in *Garden and Forest,* the result of careful studies in Florida, which we now reproduce, will be found interesting because it explains the same phenomena upon an entirely different assumption. It is as follows:

From time to time, during and since my first visit to our southern tier of states in 1876, I have examined, sketched and photographed the roots of the Deciduous Cypress—the *Taxodium distichum* of Richard. I was attracted to the tree because of the singular beauty of its forms and foliage, and by the unusual boldness with which it raises its great, gray, smooth column, sometimes over a hundred feet perpendicularly, above and upon what an engineer would pronounce a most dangerous foundation—loose submerged sand, the saturated morass or the soft alluvium of low river margins.[1] But notwithstanding this seeming insecurity, I have never found a healthy cypress that had fallen before the fierce hurricanes that sweep through the southern forest-lands.[2]

The surprising and characteristic temerity of the tree is accompanied by another striking peculiarity—it almost invariably, in soft soils, throws upward from the upper surface of its roots conspicuous protuberances that are known as "Cypress knees."

These seemingly abnormal growths have attracted much attention, and for more than half a century have furnished an enigma to the so-

[1] It is a pleasure to follow Bartram in his enthusiastic burst of admiration for this tree as he writes of it in east Florida 116 years ago: "This Cypress is in the first order of North American trees. Its majestic stature is surprising. On approaching it we are struck with a kind of awe at beholding the stateliness of its trunk, lifting its cumbrous top toward the skies and casting a wide shade on the ground as a dark intervening cloud, which from time to time excludes the rays of the sun. The delicacy of its color and the texture of its leaves exceed everything in vegetation. . . . Prodigious buttresses branch from the trunk on every side, each of which terminates underground in a very large, strong, serpentine root, which strikes off and branches every way just under the surface of the earth, and from these roots grow woody cones, called Cypress knees, four, five and six feet high, and from six to eighteen inches and two feet in diameter at the base.

[2] Elliot ("Bot. of S. C. and Ga.," 1824, p. 643) says: "This Cypress resists the violence of our autumnal gales better than any other of our forest trees." By my friend, Dr. J. S. Newberry, whose extended geological labors have led him to examine many widely separated Cypress-bearing regions in the Mississippi Valley and elsewhere, I am assured that he remembers no instance of the overthrow by the wind of a living *T. distichum.*

lution of which scientific travelers have addressed themselves. Michaux made a careful study of the Cypresses, and in his "Sylva," published in 1819, says: "The roots are charged with protuberances eighteen to twenty-four inches high.[3] These protuberances are always hollow, and smooth on the surface, and are covered with a reddish bark, like the roots, which they resemble in softness of wood. They exhibit no sign of vegetation, and I have never succeeded in obtaining shoots by wounding the surface and covering it with earth. They are peculiar to the Cypress, and begin to appear when it is twenty to twenty-five feet high." Michaux adds, with the frankness natural to a scientific mind, "No cause can be assigned for their existence." Hoopes says in his "Book of Evergreens" (1868): "No apparent function for which the knees are adapted has been ascertained." And Veitch, who seems to have studied the protuberances in England, gives in his "Manual" (1881, p. 216) a picture of a tree growing at Ilesworth, surrounded by scores of knees, and says: "They are peculiar to this Cypress, and no cause has been assigned for their existence." That the question continued in this unilluminated condition until recently was shown in 1882, when I had the privilege of visiting, in company with the highest botanical authorities,—Dr. Gray, Thomas Meehan, John H. Redfield, John Ball, Professor Carruthers and others,—the classic collection of trees planted by William Bartram on the borders of the Schuylkill. There we examined a fine Cypress and the knees it had produced. Dr. Gray then told me that the use to the tree of the knees was unknown. I remarked that they might be a means of raising a point on the root above surrounding water to the end that a leaf-bearing shoot could readily sprout therefrom. To this suggestion he made the same statement made by Michaux and above recorded. Unaware that the subject had been so thoroughly investigated, I have since that period examined hundreds of living "knees" in southern swamps, and found upon them no trace of bud, leaf or sprout, except where some seed may have lodged in a decayed or depressed portion of the surface and there taken root.

In 1887 I had the good fortune to find a number of Cypress trees under such unusual conditions that their aforetime subterranean anatomy could be studied without obstruction, and I reached a conclusion respecting the use to the tree of the protuberances which I have retained in my note-book, awaiting an opportunity to make some further illus-

[3] I have ridden among them in central Florida, in temporarily dry upland basins, where they arose to my breast as I sat upon the saddle, and were not less than seven feet in height above the root.

PLATE XII.

trative sketches before placing it before botanists. Some recent publications on the subject by widely and favorably known authors have, however, ascribed to the Cypress-knees the sole function of aërating the sap of the parent tree, and this idea bids fair to become embedded in botanical literature. Therefore this communication comes to you earlier than I had purposed sending it.

Stretches of the shore of Lake Monroe, in central Florida, are closely set with large Cypress-trees. They grow in various kinds of bottom, —clay, mud and sand. Those of which I shall here speak stood in sand so loose that when the level of the water was lowered the waves readily washed it away and carried it into the depths of the lake. Some four vertical feet of the root-system were thus finely exposed. After several days spent in examining a score or more large trees that had been thus denuded I became convinced that the most important function of the Cypress knee is to stiffen and strengthen the root, in order that a great tree may anchor itself safely in a yielding material.

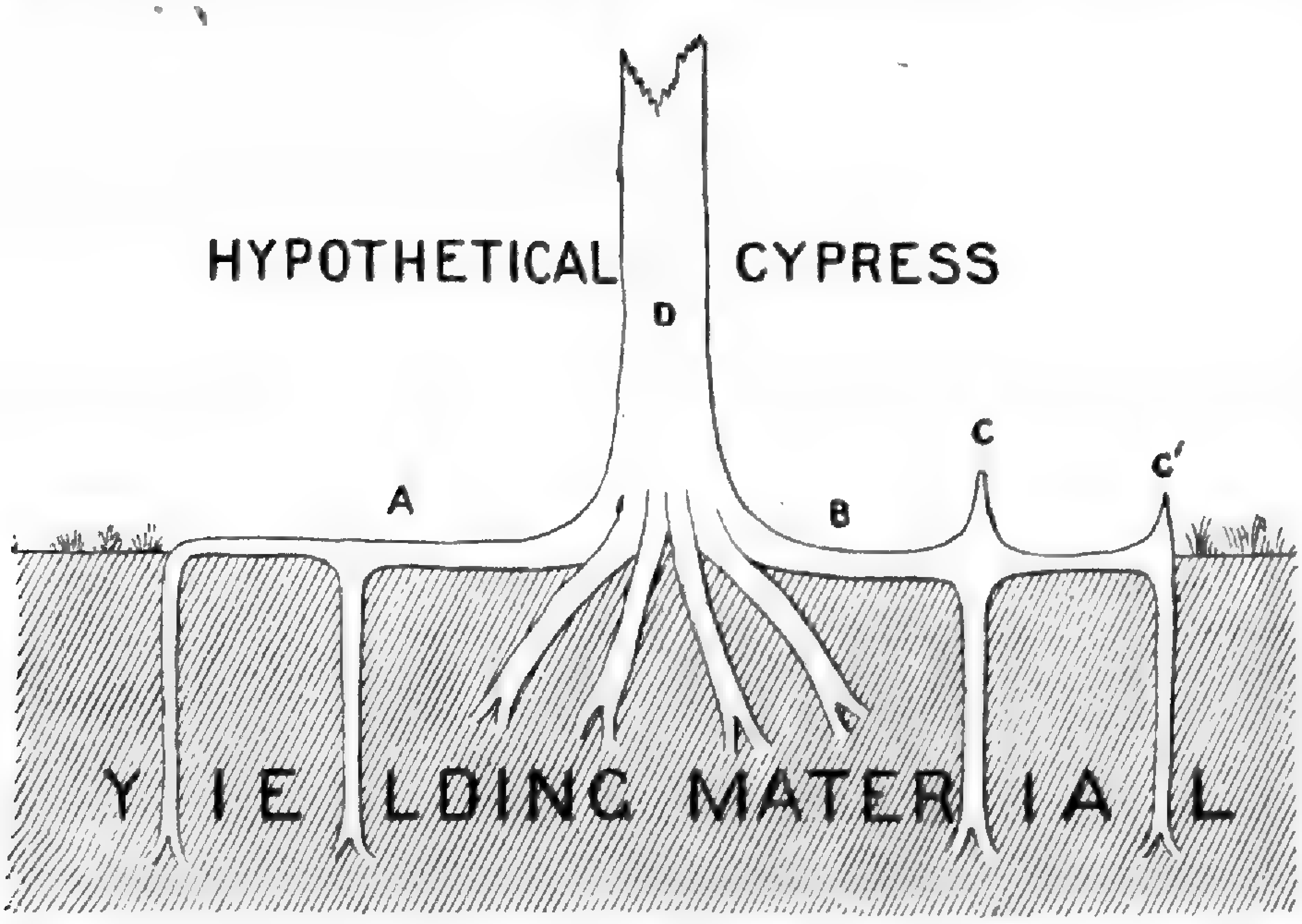
The word "anchor" is indeed an apt one here, for the living root, curved to its work and firmly grasping the sandy bottom, suggests vividly the best bower-anchor that a man-of-war may throw into similar loose sands, when threatened by the very atmospheric forces that the Taxodium has been fitting itself to resist since Tertiary times.[4]

Truly a most admirable and economical arrangement to stiffen and strengthen the connection between the shank of the anchor and its fluke is this knee, and usually in the living anchor the fluke branches or broadens as it descends, so that its effectiveness is greatly increased, like the sailor's anchor of many flukes, or the "mushroom anchor" that he may have learned to depend upon where the bottom is softest.

The accompanying picture (see page 20) is from a photograph that I made in 1887 of the lower portion of a tree that rises some seventy feet above the shore line of Lake Monroe. The original surface of the sand was near the level of the higher roots. The picture shows the manner in which this peculiar species throws out horizontal roots from its conical (usually hollow) buttressed base. At different distances from this conical base these horizontal roots project strong branches more or less perpendicularly into the earth. When such perpendicular "flukes" branch from the main horizontal "shank," it will be seen,

[4] My friend Thomas Meehan informs me [December 17th, 1889] that he has "observed a case where the interior hollow makes an annual layer of bark equally with the exterior," and he is of the opinion that "it is by the decay of the outer layer of this inside course of bark after several years that the knob becomes hollow." If this habit is general it is an admirable means of forming and of preserving undecayed, at the smallest cost to the tree, a living elastic strengthener at the forking of the roots.

there is formed a large knob, which is the "knee" under discussion. This knee, when fully developed, is generally hollow, comparatively soft, gnarled, and very difficult to rupture, so that it has the quality of a spring that becomes more rigid as it is extended or compressed out of its normal shape. When in a hurricane the great tree rocks back and forth on its base, and with its immense leverage pulls upon this odd-shaped wooden anchor, instead of straightening out in the soft material, as an ordinary root might, thus allowing the tree to lean over and add its weight to the destructive force of the storm, it grips the sand as the bower-anchor would do, and resists every motion. The elasticity at the point of junction allows one after another of the perpendicular flukes attached to the same shank to come into effective action, so that



From "Garden and Forest." Copyright, 1890, by the "Garden and Forest Pub. Co."

before being drawn from the sand or ruptured the combined flukes present an enormous resistance.

The above drawing I have made for the purpose of simplifying the discussion. It shows a hypothetical Cypress with two roots of the same length and diameter—one with knees, the other without them. The superior strength of the stiffened root would seem sufficiently evident; but, with the view of obtaining the judgment of a mind thoroughly trained in questions of this nature, I submitted the drawing to my friend, Charles Macdonald, late Director of the American Society of Civil Engineers, whose eye has been accustomed to estimating the value of strains in structures by an active experience of twenty-five years, and who has just finished the largest drawbridge in America, at New London. Mr. Macdonald agreed with me that the root B, which is trussed with the knees C and C′, would very largely exceed in capacity for holding the tree firmly in yielding material the root A, which is similar but destitute of knees. This greatly increased security against destruction by storms is, I think, a sufficient advantage to account for the existence and maintenance of an organ that draws so slightly upon the vitality of the plant.

It is proper to record here another observation that may explain the existence of the elevated, narrow point which the knee sometimes develops, and which rises higher than the curved growth that would be necessary to secure the maximum resistance to compression and extension. The home of the Cypress is in broad, level river-margins subject to periodic overflow, where hundreds of square miles become covered with a shallow bed of slowly moving water, or in basin-like depressions, sometimes of vast extent, where from time to time water rises above the level of the horizontal roots. Then these stake-like protuberances, rising into and through the current formed by the drainage or by the winds, catch and hold around the roots of the parent trees many thousand pounds of "plant food" in the form of reeds and grass, or small twigs among which dead leaves become entangled. The tree that exclusively possesses this source of nutrition is at an advantage over all others in the neighborhood, and the higher these attenuated "drift-catchers" rise in the stream, the more drift will they arrest, for the highest stratum of water is richest in float. The theory that some distinguished writers have suggested that the knee is a factor in the aëration of the sap, and that the tree's death is prevented by such aëration taking place in the upper portion of the knee during periods of high water, would seem to need careful experimental confirmation. Where nature forms an organ whose purpose is to preserve the life of the individual, she takes special care to adapt such organ to the function it is depended upon to perform. In this case the rough, dry bark of the knee offers a most imperfect means of access for the oxygen or other gases of the atmosphere to the interior vessels of the plant, and instead of presenting broad surfaces of permeable membrane, formed for transmitting elastic fluids, at its upper extremity the protuberance becomes more narrow and presents less surface as it rises, so that when during periods of high water the life of the tree is most jeopardized, the life-saving organ attains its minimum capacity. In the presence of this manifest want of adaptation it also seems important for the acceptance of the aërating theory that some one should experimentally show that the aërating organ of the Cypress really aërates to an extent sufficient to make it of material advantage to the plant.[5]

It was long ago observed that no knees are developed when the tree grows in upland upon a firm bottom, in which ordinary simple roots can obtain in the ordinary way the hold necessary to resist overturning forces, and where there is no stratum of water to transport food. So conservative is nature, that she reverts to an original or adopts a simpler form of root even in a single generation if the need for the more complicated arrangement ceases to exist.

Finally, I may perhaps be permitted to add an observation regarding the roots of other trees that trench upon the same soils affected by the Cypress and often take advantage of the anchors it sets so boldly in treacherous bottoms. These trees project their cable-like, flexible roots in every direction horizontally, interlacing continually until a fabric is woven on the surface of the soft earth like the tangled web of a gigantic basket. Out of this close wicker-work, firmly attached to it, and dependent for their support upon its integrity, rise the tree trunks. Thus slowly, and by a community of growth and action, a structure is formed that supplies for each tree a means of resisting the storms. Such communities of trees, provided with ordinary roots, advance against and overcome enemies where singly they would perish in the conflict. The cyclone, the loose sand, the morass—these are the enemies they contend with, as it were, in unbroken phalanx, shoulder to shoulder, their shields locked, their spears bristling against the foe; but the graceful plumed Cypress, the knight-errant of the sylvan host, bearing with him his trusty anchor—the emblem of Hope—goes forth alone and defiant, afar from his fellows, scorning the methods of his vassals, and planting himself boldly amid a waste of waters, where no other tree dare venture, stands, age after age, erect, isolated, but ever ready to do battle with the elements. Twenty centuries of driving rain and snow and fierce hurricane beat upon his towering form, and yet he stands there, the stern, gray and solitary sentinel of the morass, clinging to the quaking earth with the grasp of Hercules, to whom men were building temples when his wardenship began.

[5] The "Chemical Theory" of the Cypress knee seems to be but a revival of the elaborate hypothesis of Dickinson and Brown, published in their memoir on *T. distichum* in the *American Journal of Science and Arts*, in January, 1848. These industrious observers discard the "Mechanical Theory" entirely, and consider both the spongy knees, and, strangely enough, even the spreading base of the tree, as organs of communication with the air, forgetful that the successful and most celebrated lighthouse in the world—the Eddystone—was avowedly modeled after a similar spreading tree-base for the purpose of withstanding the storm shocks of the English Channel. By means of a curious drawing they show how the swollen portions of the base rise "to the top of the highest water level, which must, in some instances, attain an elevation of at least twenty-five feet;" thus continuing the functions and the structure of the knees, "up the body of the tree to the atmosphere."

FROM BRUTE TO MAN.

BY CHARLES MORRIS.

THAT man as an animal is an offspring of the lower life kingdom, none who are familiar with the facts of science now think of denying. Despite the indignant protest against this idea when promulgated by Darwin less than thirty years ago, it is now generally accepted by all those who have fully considered the evidence, and who therefore are alone competent to decide upon it. But that man as a thinking being has descended from the lower animals is a very different matter, and is by no means proved. Regarding the origin of man's intellect, there is much difference of opinion, even among scientists, and such a radical evolutionist as Alfred Russel Wallace finds here a yawning gap in the line of descent, and believes that the intellect of man is a direct gift from the realm of spirits. His explanation, it is true, is more difficult than the difficulty itself. It cannot justly be called a hypothesis, for a hypothesis should have some facts to give it warrant, and this has none. That man's mind cannot be explained on the principle of natural selection alone we may, with Wallace, admit. But it certainly would have been better had he on his part more fully considered the possibilities of use and effort, and other natural agencies, before dragging in the angels to bridge the chasm.

That man's intellect at its lowest level is not different in kind from the brute intellect at its highest level Romanes has satisfactorily shown. His evidence, indeed, is superabundant. Controversy on this subject is too apt to be based on the difference between the intellect of the brute and that of enlightened man. Yet the mental gap between the latter and the lowest savage is quite as great as that between the savage and the brute. From the intellect of the animal to that of enlightened man the distance is enormous, yet throughout its whole extent, with a single exception, can be traced intermediate steps of mental development

This exception is the interval between the anthropoid ape and the primitive savage. This is the only gap that remains open in the kingdom of the mind,—the one important lost chapter from the story of mental evolution. It is acknowledged by every well-informed scientist that man's body came up from below. Its links of association with the lower animals are too many and too significant to admit of any other theory. Supernaturalism, therefore, has taken its last stand upon man's mind, and claims that here at least the line of descent is a broken one, and that the gap could not have been filled without a direct interposition from the realm of spirit.

This view of the case is not likely to be accepted as final. Science has bridged with facts so many chasms in the kingdom of nature, that it will scarcely be ready to admit, certainly not till the case has been more thoroughly investigated, that here is a chasm which cannot be bridged, and must be leaped. And yet the known facts that bear upon the question are stubborn things to explain on the evolution theory. If, for instance, we examine the existing conditions of ape and savage intellect no evidence of any active evolution can be discovered. However the anthropoid apes gained their mental acuteness, there is nothing to show that it is increasing. The same may be said of the lowest savages. They are mentally stagnant. The indications are that their intellectual progress for thousands of years in the past has been almost nothing. Yet if man is the descendant of an anthropoid ape there must have been an extraordinary degree of mental development between the one state and the other to produce the great increase in size of brain and activity of intellect. Under the present conditions of imperceptible progress, the whole tertiary period of geology, and perhaps much of the secondary period, would be needed to fill the gap. Yet no such extensive interval can be admitted, and if we seek to deduce man's mind from the ape mind we must be able to show that influences existed calculated to produce a much more rapid mental evolution than now can be perceived in either ape or savage.

Man has changed but little physically since he became man, and perhaps changed little during the period in which he was becoming man. Could we behold the species of ape which, in the opinion of evolutionists, was his ancestor, we should probably be able to discover no important differences in form. The change has been in the brain, not in the body. The transforming influences acted upon the organ of the mind, not upon the organs of physical life. The brain has yielded to these forces, not by varying in form, but by increasing in size, and by a special expansion of that portion of it devoted to intellectual activity. This great increase in the size of the brain, with the accompanying remarkable unfoldment of the mental powers, certainly indicated the action of very vigorous and long-continued transforming influences; which, if we may judge from the mental stagnation of the present ape and savage, no longer exist.

It is true that the mental organism may be far more plastic than the body, and that no time relations between the development of the intellect and of the physical structure can be drawn. Transformation, under influences of equal potency, may possibly be produced more rapidly in the one case than in the other. An extraordinary development has taken place in the human intellect within a few thousands or tens of thousands of years, yielding the difference that now exists between the cultivated European and the debased savage, and which perhaps equals that between the latter and the ape. If, therefore, it can be shown that influences were at work upon original man as powerful as those that have produced civilization, we shall have done something towards showing how the ape brain may, in a comparatively limited period, have become the brain of man.

The leading causes of the development of civilized man are not at all difficult to discover. Undoubtedly the most potent among them was the influence of warfare, the struggle between man and man on the one hand, and between man and the conditions of soil and climate in the colder latitudes on the other hand. More recently competition in commerce and industry has taken the place of the warlike struggle for existence, and the contest for wealth and position is continuing the effect which the contest for life produced. Hostility between man and nature, and between man and man, has for ages been invigorating the human intellect, replacing the dull of brain and slow of thought by the quick-witted, energetic, and intelligent, and we may safely look upon this as the most active agent in the unfoldment of civilization.

Was the development from ape to human intellect due to a similar conflict? In the tropics, the home of the savage, war between man and nature scarcely exists, and war between man and man is in its primitive stage. Yet here, as elsewhere, it has much to do with such mental unfoldment as exists. Mastery in warfare is due to superior mental resources, which are gradually gained through the exigencies of conflict, and are shown in greater shrewdnesss or cunning, superior ability in leadership, and the invention of more destructive weapons. War acts vigorously on men's minds, peace acts sluggishly; and the whole story of mankind tells us that intellectual evolution has been due in great part to the destruction in war of the mentally weaker, the preservation of the more energetic and able, and the effect of conflict in producing intellectual activity. But no organized warfare or alert conflict with nature can be perceived in the lowest existing savages. This powerful agent of intellectual development is certainly not at present exerting much influence upon them; they accept the world as they find it, without question or revolt, and their thoughts and habits are as unchangeable as the laws of the Medes and Persians.

But that this stagnancy has always prevailed may well be doubted. The position of the savage is to-day very different from what it was ten or twenty thousand years ago. Then he was dominant upon the earth, the undisputed lord of the kingdom of life. Now new lords of life have come, who are pressing in upon him on every side, preventing his expansion, hampering his activities, and gradually crowding him off the earth. What powers of development primitive man may have possessed can hardly, therefore, be determined from a study of the existing savage, and to gain any solution of the problem we must consider the position of primitive man.

As we have said, the lower savages and the anthropoid apes are at present alike mentally stagnant, while the mental interval between them is very great. But primitive man differed from the lower animals in one important particular. He was lord and master of the animal kingdom, the dominant being in the world of life. He had no rival in this lordship. None of the herbivora, and none of the carnivora, in any full sense, have ever possessed a similar mastery. The large carnivora are dominant only over the weaker herbivora. So far as we know, the only animal which, except in self-defence, will assail the large carnivora, is the gorilla. This powerful ape is the only creature, except man, of which the lion seems afraid. It does not attack it, however, from any desire for mastery, but simply to drive away a dangerous neighbor.

Man stands alone in his relation to the lower animals He is lord of them all. Savages everywhere are aggressive against, and are feared and avoided by, the largest and strongest beasts of their region. This hostility does not come from the wish to drive away an enemy. It is the desire for food or the instinct of control that moves the savage hunter. He feels, and prides himself on, his lordship. Man does not fight defensively, like the gorilla, but offensively, and whatever be his position in relation to his fellow-man, he admits no equal in the world below him.

This lordship was not gained without a struggle, and that a severe and protracted one. The animal kingdom did not submit supinely to man's mastery. The war must have been long and bitter, however fixed and settled the relations now seem. Rest has followed victory. The animal world is now submissive to man, or in dread of his strength and resources, and the strain upon his mental powers has ceased. But there is certainly reason to believe that men's intellectual progress was due to warlike struggles alike in the primitive and in the historic epoch, the former being a conflict with animals, the latter with man.

We cannot describe at length this primitive hostility. It will suffice to say that it must have been attended with a somewhat rapid mental progress, probably greatly in excess of that which we now perceive in apes and lower man. For the battle was fought with the mind, not with the body. That is to say, man did not depend on hereditary instincts and his natural weapons of claws and teeth for victory, but brought his mental resources into play. Cunning, caution, boldness where necessary, close observation, variation in modes of attack and defence to suit varying circumstances, are hostile methods of purely mental origin. They are not peculiar to man; many of the lower animals employ them, though none to such an extent as man. But the use of other than the natural weapons is nearly peculiar to man. Some of the monkeys occasionally and imperfectly employ missiles, but man alone has become aware of their great utility, and employs them constantly and skilfully. By the use of artificial implements of warfare his powers were enormously increased, and the steps of progress in his subordination of the lower animals were doubtless marked out by his invention of more and more efficient weapons.

We take it for granted that the animal world did not submit without a struggle, and a protracted one. Step by step, through many centuries of conflict, were the larger animals subdued. It was man's mind, not his body, that subdued them. Physically they were his equals or superiors. His superiority lay in his mental resources, and his victory was due solely to his mental superiority. The effect of the conflict, therefore, bore principally upon his mind, and its organ, the brain, very little upon the body; and when we consider the extent of the achievement we cannot be surprised at the result. Such an advantage, if gained by any of the lower animals through variation of physical structure alone, could not but have produced radical and extraordinary changes in size, strength, and utility of natural weapons. In man the influences of variation were exerted upon the brain alone, and the decided increase in size and activity of this organ does not seem too great for the magnitude of the result. The conflict ended, man settled down to quiet consciousness of victory, but with a much larger brain, and greatly superior mental powers than at the beginning of the struggle. This brain and the higher mentality it indicated enabled him to hold the position he had gained, but there was no special further strain upon his powers, and he simply held his own until a new era of war, now between man and man, or between man and cold and stubborn nature, called again upon the resources of the mind, and a new era of intellectual evolution began. It is quite possible, as we have said, that the strain in the former case was equal to that in the latter.

Not every animal is adapted by nature to such an evolution. Nearly every animal would be prevented from it by physical disadvantages. Even the anthropoid apes lack certain essential conditions of structure and habits, though favored by the formation of their hands, and their power of grasping and using weapons. But of all animals, the species from which man descended seems to have been the best adapted, and far the most likely, to become the ancestor of a thinking being. For the mental evolution of man was due not only to his struggle for mastery, but also to special advantages which he possessed in the physical structure and the social relations of his ape ancestor. Let us consider the former of these. We know that the ape family are fruit-eaters, and that trees are their natural habitat. But the larger apes manifest an inclination to descend to the earth, probably from their weight rendering a continual life in trees none too agreeable. The largest of them, the gorilla, dwells almost normally on the ground, and it is quite probable that this was the case with man's ancestor. On the ground apes have to make certain changes in their method of locomotion. In the trees they move in a quadrupedal or in a semi-bipedal attitude, by crawling along the limbs, or by walking along the lower and clasping higher limbs with their hands. On the ground either a quadrupedal, a bipedal, or an intermediate motion must be assumed. The baboons, whose fore and hind limbs are nearly equal in length, have become quadrupeds. The three principal species of anthropoid apes, in each of which the fore limbs are of considerable length, have adopted an intermediate mode of motion, swinging their bodies between their hands. The gibbon alone walks in an erect attitude, its very long arms enabling it to use its hands in walking without bending its body. All these animals are essentially quadrupeds, inasmuch as they use all four limbs in locomotion. The gibbon alone is somewhat inclined to walk as a biped, but not when moving swiftly.

Man is structurally different from all these. His arms are shorter as compared with his legs than in any of the existing large apes. It would be impossible for him to walk in the swinging manner of these apes, or by aiding himself with his hands like the gibbon. Quadrupedal motion on hands and feet would be almost equally difficult for him. If his ancestor was like him in this respect, as was undoubtedly the case, then on descending to the ground it must have been forced to walk on its feet alone, from the much greater difficulty, if not the impossibility, of the other modes of motion.

If man's ancestor, however, became a biped through this necessity, it at once assumed a position of remarkable advantage, becoming the only species among the higher animals that did not have to use all four of its limbs in locomotion. His arms and hands were freed for other purposes, and the grasping powers of the hands added immensely to the advantages which this gave. In fact, there can be no question that man owes his supremacy in the animal world to the possession of two limbs which were free from duty as walking organs and could be used fully for attack and defence, and to the grasping power of his hands, which rendered easy and natural the employment of weapons. To this must be added the mental development which all known anthropoid apes possess. These marked advantages at once changed his relation to the lower world of animals. Flight was no longer necessary to safety. He was able to meet much larger animals on equal ground. He was already, like all the apes, mentally acute, observing, and capable of foreseeing and providing for contingencies. As his power of walking erect became easy and natural, and the adaptation of his arms and hands to the use of weapons grew more definite, his standing in the animal kingdom essentially changed; fear and flight ended, so far as animal foes were concerned, retreat ceased, attack began, his mental acumen was called into active play, and the great battle for mastery of which we have spoken came fully into play.

Still another essential element in this development was the social habit of man's ancestor. If we may judge from the conditions of existing savages, the man-ape was a more social animal than any of the existing anthropoids. The orang and the gorilla are not sociable to any important extent. The chimpanzee is somewhat more so. The indications are that man's ancestor was social in a higher sense than any of these, and employed the principle of mutual aid in a greater degree. It is scarcely necessary to speak of the advantage this would give in the struggle with animals. This advantage is patent. But there is one important result of close social relations of the utmost importance in this connection,—that of education. All social animals educate one another, either with or without design. Anything of importance learned by one member of the group is quickly imparted to all members, and the more rapidly the better their methods of communication and the more complete their system of mutual aid. The lower monkeys teach their young, and indicate to one another anything of importance. There is no doubt that any new and useful weapon or method of assault or defence devised by any member of such a group would become quickly and permanently the property of all the members, and would constitute an important aid in mental development. A long succession of such ideas or inventions, gained by single bright members of evolving mankind, and taught to the others, must have played a highly useful part in the progress from apehood to manhood.

Socialism has been an important requisite of mental evolution throughout the animal kingdom. The highly social ants and bees have raised themselves mentally far beyond all the other insects. The social beavers show a remarkable mental ability as compared with the other rodents. It is, indeed, the communal rather than the simply social animals that have made these great steps of mental progress, those whose labor is devoted solely to the good of the community, and who work in concert for the advantage of each and all. To what extent man was communal in his developing stage it is impossible to say, but the general communism of barbarism may well have been an outgrowth of a primitive condition. There is reason to believe that the individualism which now prevails is of late origin, and was not a characteristic of original man.

One further agency was necessary to man's development—that he should become carnivorous. The apes are fruit-eaters, and lack the native fierceness and the aggressive disposition of the flesh-eating animals. Doubtless man's ancestor was a fruit-eater, but new habits of life probably accustomed him to a mixed fruit and flesh diet at an early period, and the quest of animals for food must have led him to wider excursions and more active enterprise than in the case of any of his frugivorous kindred. Here was an agency calculated to bring him into new scenes and novel relations to nature, and thus greatly to increase the strain upon his faculties and the consequent activity of his mind.

If man came from the ape, it seems certainly very probable that these were the channels of his coming, these the adaptations, the methods, and the exigencies through which a frugivorous ape became an omnivorous man, with a brain like that of the ape in form but greatly developed in size, and faculties like those of the ape in quality, but immensely developed in width and height. From being the equal of the animals he became lord of the animals, their peer perhaps in body, their monarch in mind.[1]

[1] The views presented in this paper are not offered as original. The argument from the social habits of man has been advanced by myself in a previous paper in the NATURALIST, while as for the general subject of the influence of intelligence on human advancement, it has been dealt with by Prof. E. D. Cope in papers entitled "The Method of Creation of Organic Types," "The Hypothesis of Evolution," "The Review of the Modern Doctrine of Evolution," and others, which may be found in his work entitled "Origin of the Fittest." The influence of Use and Effort, as agents in Evolution, has been dealt with by various American writers. The doctrine of Selection through the Struggle for Existence, in fact, covers all that has been said above, and the only novelty claimed is the particular application of this doctrine to the struggle of man for dominion over the world of brutes, and the influence of this struggle on the growth of the brain and the development of intelligence. This view, so far as the writer knows, has not been advanced before.

RECORD OF AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

IT is the intention to catalogue here in systematic order all papers relating to the Zoology of North America, beginning with the year 1889. To the title and reference will be added such notes upon the contents of the papers as will make the record more valuable to the student. An asterisk indicates that the paper has not been seen by the recorder. Authors are requested to send copies of their papers to J. S. Kingsley, Lincoln, Nebraska.

GENERAL.

WILSON, H. V.—On the Breeding Seasons of Marine Animals in the Bahamas. J. H. U. Circ., VIII., p. 38.—Sponges, Gorgonids, Corals, Annelids. Chiton, *Aplysia*, *Anolis*, *Gonodactylus*.

WILSON, H. V.—Report as Bruce Fellow of the Johns Hopkins University. J. H. U. Circ., VIII., p. 40, 1889.—Account of work at Bahamas, including notice of sense organs in Hoplophora.

HERRICK, F. H.—Days and Nights by the Sea. AM. NAT., XXIII., p. 406. 1889.

STEARNS, R. E. C.—Instances of the Effects of Musical Sounds on Animals. AM. NAT., XXIV., p. 22. 1890.

HEILPRIN, ANGELO.—The Bermuda Islands: A Contribution to the Physical History and Zoology of the Somers Archipelago, [Etc.] Philadelphia, 1889.—Reprints from the Proceedings of the Academy of Natural Sciences of Philadelphia.

PACKARD, A. S.—Cave Fauna of North America; with Remarks on the anatomy of the brain and origin of the blind species. Memoirs Nation. Acad. Sci., Vol. IV., p. 1. 1889.—Vide Infra.

PROTOZOA.

LEIDY, JOSEPH.—On several Gregarines and a singular mode of conjugation of one of them. Proc. Phila. Acad., 1889, p. 9.—Describes *Gregarina philica* from *Nyctobates pennsylvanicus*, *G. actinotus* from *Scolopocryptops sexspinosus*, *G. megacephela* from *Cermatia forceps, G. microcephala* from *Hoplocephla bicornis.* The paper is reproduced in *Journal de Micrographie,* Nov., 1889.

RYDER, J. A.—The Polar Differentiation of *Volvox* and the Specialization of possible Sense Organs. AM. NAT., XXIII., p. 218, 1889. (See Proc. Phila. Acad., 1889, p. 138.)

KELLICOTT, D. S.—Intestinal Parasitic Infusoria of Frogs. *Microscope,* IX., p. 46, 1889.—Presence of *Nyctotherus cordiformis.*

S———, H. M.—A Note on *Difflugia urceolata. Microscope,* IX., p. 307. 1889.—Difflugia leaving its shell.

LATHAM, V. DA L.—Short Notes in Practical Biology.—Amoeba. *Am. Mo. Micros. Jour.,* X., p. 151.—Laboratory work; nothing new.

HARGITT, C. W.—Methods of Mounting Infusoria. *Am. Mo. Micros. Jour.,* X., p. 183. 1889.—Kill by corrosive sublimate or Lang's fluid, dehydrate by alcohol, and mount in balsam.

SPONGES.

LEIDY, JOSEPH.—The boring sponge Cliona. Proc. Acad. N. S. Philadelphia, 1889, p. 70.—Describes supposed new species, *C. phallica,* from Florida, and gives resumé of known facts.

CŒLENTERATA.

MCMURRICH, J. PLAYFAIR.—A contribution to the Actinology of the Bermudas. Proc. Phila. Acad., 1889, p. 102, Pls. VI., VII. —Anatomical Notes on *Aiptasia* sp., *Condylactis passiflora, Oulactis fasicculata* (nov.), *Diplactis* (nov.) *bermudensis* (nov.), *Zoanthus flosmaris, Mammillifera tuberculata, Corticifera ocillata, C. glaveola,* and *Gemmaria rusei.*

MCMURRICH, J. PLAYFAIR.—The Actinaria of the Bahama Islands, W. I. *Jour. Morph.,* III., p. 1 (see AM. NAT., XXIV., p. 80). An elaborate paper upon the structure of *Aiptasia annulata, A. tagetes, Condylactis passiflora, Bunodes tæniatus, Aulactinia stelloides* (nov.), *Lebrunea néglecta, Discosoma anemone, Rhoductis sancti-thomæ, Heteranthus floridus, Phymanthus crucifer, Oulactis flosculifera, Zoanthus sociatus, Gemmaria isolata* (nov.), and *Corticifera flava.*

McMurrich, J. Playfair.—List of Actinaria found at New Providence, Bahama Islands. J. H. U. Circ., VIII., p. 30, 1889.

McMurrich, J. Playfair.—On the occurrence of an Edwardsia stage in the free-swimming embryo of a Hexactinian. J. H. U. Circ., VIII., p. 31, 1889.

Wilson, H. V.—On the Occasional Presence of a Mouth and Anus in the Actinozoa. J. H. U. Circ., VIII., p. 37.—Closure of Mouth of *Cereactis bahamensis* in the middle.

Morgan, T. H.—Notice of Dr. H. V. Wilson's paper on the Development of *Manicina areolata.* J. H. U. Circ., VIII., p. 39, 1889.

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ARACHNIDA.

IVES, J. E.—*Linguatula diesingii* from the Sooty Mangubey. Proc. Phila. Acad., 1889, p. 31.

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rum n, *Bryiobia?* (or *Penthalæus?*) *meyerensis* n, *Laelaps?* (or *Holostaspis?*) *wyandottensis* n, *L.* (= *Iphis?*) *cavernicola* n, *Gamasus* (or *Hypoaspis*) *troglodytes* n, *G. stygius* n, *Damæus* (=*Delba*) *bulbipedata* n, *Oribata alata* n, *Uropoda lucifugus* n, *Sejus? sanborni n, Obisium cavicola, Chthonius packardi, C. cæcus, Phalangodes robusta, Ph. flavescens, Ph. armata, Ph. spinifera, Phlegmacera cavicolens, Nemastoma troglodytes, N. inops,* and reprints Emerton's descriptions of cave Araneina (Am. Nat., IX., p. 278, 1875.)

MYRIAPODA.

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EDITORIAL.

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

THE increase in the number of original investigators in science during the last few years in the United States, is a gratifying indication of intellectual progress. Progress in science and philosophy means increase in positive knowledge. This means light for the mind, as well as comfort and health for the body, both now and in time to come To know whence we come and whither we tend, is to be prepared for the future as well as for the present. The age demands knowledge, and provision is being gradually made in this country for the producers of it. The time is not far distant, we suspect, when the confusion between the producers and the distributors of knowledge, which is so prevalent, will disappear. Millions are expended for the dissemination of knowledge through the medium of schools and libraries, while small sums only can be obtained for the production of new truth. The increase in the number of producers in science is educating the public mind, and one great need, that of institutions of original research, will be supplied. Professors in universities and colleges who are competent in this work can now only pursue it in leisure moments, and these are often few.

New institutions might be endowed with this object in view, since few of the old ones supply the organization necessary for the successful execution of such work. These might be appropriately associated with universities in the proper localities for purposes of mutual advantage. The increase in the original investigators holds forth a promise of the organization on a true basis of academies of science in our States. Those in existence having commenced by electing as members everybody who can pay the necessary fees, have mostly lost their scientific character, and have sunk into inaction. Little can be done with them, since those into whose hands they have fallen are generally unwilling to adopt the necessary changes. But the times will soon be auspicious for the organization of new bodies, whose membership will be an order of merit, and a recognition of work done.

—WITH this number of the AMERICAN NATURALIST we begin the publication of a serial catalogue of all current articles relating to the fauna of North America. Beginning with the year 1889, we intend as far as possible to place in classified order the titles of all articles which appear in American or European journals relating to the animals of North America and the West Indies. This list will be continued in succeeding numbers, taking up the different groups in ascending order, and then, when the series is complete, returning to the lowest forms again. For 1889 the list will be but little more than a bare catalogue, but beginning with 1890 each title will be followed by such hints at its contents as will make the bibliography more valuable to students.

—THE Marine Biological Laboratory has issued its annual report, in which it makes an exceedingly good showing. The laboratory was crowded last summer, and doubtless will be in the coming session. The trustees appeal for $7,000, enumerating as their chief needs an addition to the building, an increase in the library, and a steam launch. It is to be hoped that the funds will be forthcoming, but it is hardly fair that Boston should furnish them all. Last year both Philadelphia and Chicago furnished more students than Boston. Any subscriptions will be thankfully received by the Secretary, Miss A. D. Philipps, 12 Marlboro street, Boston, Mass.

—THE House of Representatives has passed the bill appropriating about $200,000 for a zoological garden and park within the limits of the City of Washington. The location on Rock Creek is a good one, and under the direction of Mr. W. T. Hornaday, it should be a success. Zoological gardens mean the preservation of such animals as will breed in them from extinction, as well as the instruction of the public. When a good price can be had for living wild animals, people living where they abound will have an interest in preserving them in a wild state. We understand that Professor Frank Baker will be prosector, and will have charge of the department of comparative anatomy in the United States National Museum.

General Notes.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The granite bosses of Morbihan, France, have suffered on their peripheries certain modifications which are ascribed by Barrois[2] to the rate of cooling. These modifications are endomorphous contact effects, but are in no way dependent upon the nature of the surrounding rocks. Two cases are recognized, according as the boundary lines of the bosses correspond with the strike of the enclosing strata or are perpendicular to it. In the first case, the granite, which is a muscovite-biotite rock, possesses on its periphery a zone of granite porphyry, with its phenocrysts arranged in fluidal lines. In the second case, the exterior modification is a fine-grained panidiomorphic aplite. Since the aplite and the porphyry both contain their constituents in idiomorphic grains, the author concludes that the crystallization of the magma yielding these and the granite has gone on progressively, the porphyritic rocks representing an intermediate stage in the formation of a granite from a magma. Schistose granites (gneisses) on the peripheries of these same bosses are aplites and porphyries that have been crushed by mechanical forces and then recemented by the deposition of secondary quartz. Since the gneisses are found only on the south sides of the bosses, the pressure to whose existence they are due is supposed to have come from that direction. ——Mr. Iddings[3] has continued[4] his study of the cause of different structures in rocks produced from the same magma, and has published some of the results of his investigations on the igneous rocks of the Yellowstone Park. This study is concerned principally with the chemical relation of different rocks produced by the cooling of a single molten magma under different conditions. Electric Peak is a neck of diorite cut by numerous dykes of porphyrite. Separated from this by a great fault is Sepulchre Mountain, made up in large part of surface flows of the magma that was extruded through the orifice at Electric Peak. This magma under the conditions surrounding flows formed

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Soc. Geol. du Nord., XV., 1887–8. p. 1.

[3] Bull. Philos. Soc. of Wash., XI., p. 191.

[4] AMERICAN NATURALIST, Dec., 1885, p. 1216, and Aug., 1889, p. 718.

pyroxene and hornblende andesites. The chemical composition of the group of plutonic rocks (represented at Electric Peak) and of the effusive group (at Sepulchre Mountain) is shown to be the same. The structure of their members and their mineral composition, however, are different, and these are shown by the author to be due to the different conditions under which the two groups solidified. The different mineralogical compositions of the various rocks belonging to the same group are likewise shown to be functions of the slight differences which occur in their geological environment. This affects the rate at which the heat escapes from the magma, and also the pressure which is experienced during its crystallization. These in turn affect the efficacy of the mineralizing agents held absorbed by the magma before its solidification. The mineralizing agents in turn show their effect upon the magma in the nature of the minerals separated from it.——Renard[5] announces that the rocks of St. Thomas, in the Antilles, are diorites, containing phenocrysts of hornblende, and diabases. The former contain oligoclase, and the latter bytodnite or anorthite. They are both much altered. The feldspar of the diorites has in most cases changed into epidote and quartz; that of the diabases into epidote, chlorite and calcite.——The same author[6] describes the rocks of the island of Teneriffe as scoriaceous basalts, containing olivine and augite of the first consolidation. The very light color of the latter mineral and its well-marked polysynthetic twinning lamellæ cause it to resemble plagioclase. The lack of plagioclase places the rock in the group of the limburgites. The rocks from the crater of the Cañadas are also basalts, whose olivines are filled with muscovitic inclusions. Large crystals of andesine present in it have an undulous extinction. Augite andesites and trachytes containing sodalite, augite and sanidine with an undulous extinction are also described.——An interesting suite of analyses of some lower Silurian felsites from the southeast of Ireland enables Hatch[7] to divide these rocks into potash, soda, and potash-soda felsites. The first group comprises felsites with few or no phenocrysts, while the second and third groups contain many porphyritic crystals of a striated feldspar in a cryptocrystalline aggregate of orthoclase and quartz. The phenocrysts may be albite or anorthoclase, while the feldspar of the ground-mass is orthoclase. The

[5] Proc. Verb. Soc. Belg. d. Geol., II., 1888, p. 212.

[6] Bull. Soc. Belg. d. Geol. Memoires, XII., 1888, p. 67.

[7] *Geol. Magazine*, Dec., 1889, p. 545.

composition of the three groups may be represented by the following analyses:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	Loss	Sp. Gr.
(1)	70.8	15.1	1.0	.6	.2	1.1	9.1		1.6	2.606
(2)	71.2	16.8	.8	1.5	.8	.9	2.1	4.7	1.5	2.606
(3)	70.6	15.3	.7	1.7	.8	.8	6.1	2.7	.9	2.645

——Wethered[8] has examined the Jurassic pisolite of Cheltenham, England, and has discovered to his surprise that its structure is not concretionary, but that it is of organic origin. The spherules show a nucleus, surrounded by numerous concentric layers of innumerable minute tubuli, produced by an organism similar to *Girvanella*.——The Kentish Rag, from near Maidstone, Eng., contains a large proportion of calcium sulphide, as shown by an analysis made by Mr. Sanford:[9]

SiO_2	$Fe_2O_3.Al_2O$	P_2O_5	CaO	MgO	Alk.	CO_2	SO_3	CaS	Aq
72.051	2.15	.055	12.523	.054	.122	9.984	.647	1.334	.995

——Some of the peculiarities of the numerous dykes cutting the slates and granite in the neighborhood of Kennebunkport, Maine, are mentioned by Mr. Kemp.[10] The rocks forming the dykes are granites, diabases, camptonites, and diabase porphyrites.

New Minerals. — *Redingtonite, knoxvillite, metastibuite* and *nopalite.*—At the hundred and fifty foot level of the Redington Mine, in the Knoxville District, California, is a hydrous chromium sulphate, supposed to be the result of the action of solfataric gases upon chromic iron. The mineral occurs as a finely fibrous mass of a pale purple color, that becomes colorless in the thin section. The fibres are doubly refractive, and have an extinction varying between 13° and 38°. When heated, the mineral turns green without losing all of its water, and then agrees in most of its properties with *copiapite*. The green sulphate consists of rhombic tables with angles of 78° and 120°. They have good cleavages parallel to the base, the prismatic faces and the macropinacoid. The absorption is greatest when the short diagonal of the crystals corresponds with the principal plane of the nicol. The axes of elasticity lie in the oP face—the one parallel to the brachy-axis being the greater. Mr. Becker[11] calls the purple mineral *redingtonite* and the green one

[8] *Geol. Magazine*, May, 1889, p. 197.

[9] Ib. Feb., 1889, p. 73.

[10] *Amer. Geologist*, Mar., 1890, p. 129.

[11] G. F. Becker: Geology of the Quicksilver Deposits of the Pacific Slope. Monographs XIII. Washington, 1888, p. 343.

knoxvillite. A brick-red sulphide of antimony from the filling of a vein in a sinter deposit in the Steamboat Springs District, near the Comstock Lode, Nevada, is named ***metastibnite*** by the same author. *Napalite*[12] is a dark reddish-brown substance of the consistency of shoemaker's wax occurring at the Phœnix Quicksilver Mine, Pope Valley, California. Its hardness is 2, and specific gravity 1.02. It is brittle. It fuses at 42°–46°, and boils at 300°. When first taken from the ground it is green by reflected light, and garnet by transmitted light. Upon exposure it loses its green fluorescence. The composition of the mineral is supposed to be near C_3H_4. ——*Nesquehonite*[13] is an alteration product of *lansfordite*, the new magnesium compound described by Genth[14] a few months ago. The latter mineral, upon exposure, rapidly changes over into prismatic, orthorhombic crystals, usually arranged in radiating groups. Their axial ratio is $a:b:c = .645 : 1 : .4568$. oP is the plane of the optical axes. The brachy-axis is the acute bisectrix, which is negative. The optical angle $2V_{na} = 53° 5'$. Hardness = 2.5, and Sp. Gr. = 1.83. The composition of the substance corresponds to $MgCO_3 + 3H_2O$ [$CO_2 = 30.22$; $MgO = 29.22$, $H_2O = 40.32$]. Artificial nesquehonite has been prepared by allowing aqueous solutions of magnesium carbonate containing carbon dioxide to stand undisturbed for some time. The crystals thus obtained present the same features as the natural product. Measurements of the indices of refraction on one of these crystals gave: $\alpha = 1.495$, $\beta = 1.501$, $\gamma = 1.526$. Perfect pseudomorphs of nesquehonite after lansfordite (incrustations and stalactites) were found at the locality from which the latter mineral has been described—Lansford, Schuylkill Co., Pa.——*Natrophilite* is a new member of the triphylite group lately described by Messrs. Brush and Dana[15] from Branchville, Connecticut. The mineral is usually found in masses with a good cleavage, although occasionally grains with an indistinct crystal form are detected. It resembles very closely the lithiophilite ($LiMnPO_4$) discovered by the same authors some time ago, in both its morphological and optical aspects. Its color, however, is a deep wine, resembling the tint of Brazilian topaz. Its most characteristic features are its very brilliant lustre and its easy alteration into a a pale yellow, silky, fibrous substance that covers all its surfaces and

[12] Becker: Ib., p. 372.

[13] Genth and Penfield: *Amer. Jour. Sci.*, Feb., 1890, p. 121.

[14] AMERICAN NATURALIST, April, 1889, p. 261.

[15] *Amer. Jour. Sci.*, March, 1890, p. 205.

penetrates its mass. The composition of natrophilite, as determined by Mr. H. L. Wells, is:

P_2O_5	MnO	FeO	Na_2O	Li_2O	H_2O	Loss
41.03	38.19	3.06	16.79	.19	.43	.81,

essentially $NaMnPO_4$. The new mineral is regarded as but another one of the very interesting substances produced by the alteration of *spodumene* and *lithiophilite*. The *triphylite* group as now known consists of triphylite ($LiFePO_4$), lithiophilite ($LiMmPO_4$), and natrophilite ($NaMnPO_4$), besides many intermediate compounds.——*Rosenbuschite*, *nordenskjoldite*, and *melanocerite* have been described by Brögger[16] from the syenite dykes in the vicinity of the Langesundsfiord, in Southern Norway. The first mineral is found in radial groups composed of monoclinic fibres with cleavages parallel to oP, $\infty P\bar{\infty}$ and $2P\bar{\infty}$. The axial ratio is $a : b : c = 1.1687 : 1 : .9775$. $\beta = 101°$ 47′. The acute bisectrix is *b*. The obtuse bisectrix is inclined 36° to *c* in the acute angle β. Double refraction strong. The mineral is easily fusible, and is decomposed with strong hydrochloric acid. It is light orange gray in color, and is weakly pleochroic with $C > B > A$. Its specific gravity is 3.31 and hardness 5–6. In morphological properties and in composition it is apparently a zirconium *pectolite*.

SiO_2	ZrO_2	TiO_2	Ti_2O_3	Fe_2O_3	La_2O_3.	$(DiCE)_2O_3$	MnO	CaO	Na_2O	Loss
31.53	18.69	6.07	1.31	1.15		2.38	1.85	25.38	10.15	.20

——*Nordenskjoldite* is a calcium-tin-borate with the composition [Ca Sn $(BO_3)_2$]:

SnO_2	ZrO_2	CaO	B_2O_3	Loss
53.75	.90	20.45	23.18	1.72

It crystallizes rhombohedrally with $a : c = 1 : .8221$, and is tabular in habit. It is sulphur yellow in color, is transparent, optically negative and strongly doubly refractive. Its hardness is 5½–6 and Sp. Gr. 4.2. *Melanocerite* is also rhombohedral with $a : c = 1 : 1.2554$. It occurs in tabular crystals of a deep brown or black color. Their double refraction is negative, hardness 5–6, and specific gravity 4.129. Chemically the mineral is a complicated compound of the rare earths with silica, tantalum, boron, and fluorine.——*Cohenite* is described by Weinschenck[17] from the meteoric iron of Magura, Hungary. When dissolved in hydrochloric acid the meteor leaves a residue in which little prismatic tin white crystals are discovered. These turn brown when

[16] Geol. För. i. Stockholm Förh., IX., 1887, p. 247. Ref. *Neues Jahrb. f. Min., etc.*, 1889, II., p. 432.

[17] Ann. K. K. Naturh. Hofmus., Wien., IV., 1889, p. 94.

exposed to the air. They are highly magnetic, are brittle, have a hardness of 5.5–6, and a specific gravity of 6.977. When analyzed they yield Fe = 90.19; Ni = 3.08; Co = .61; C = 6.70; P = .08; and traces of Cu and Sn—a composition corresponding to the carbide of iron and nickel $(55Fe.\ 2NiCo)_3C$.——In addition to the organic compound napalite, referred to above, two others have lately been described; one by Blake[18] from the Uintah Mountains in Wahsatch County, Utah, to which he has given the name *wurtzilite*, and the other by Morrison[16] from the old red sandstone at Craig Well, near Dingwall. The latter is a mineral tar, associated with *albertite*. It is called *elaterite*. Its composition as found by Macadam is C = 81.186; H = 13.372; O., etc., = .4453; N = .127; S. = .862. *Wurtzilite* is a firm, black, solid substance resembling jet. It is found in large, pure, amorphous masses a little heavier than water, and elastic in thin flakes. In thin pieces it is garnet red. Its hardness is 2–3, and specific gravity 1.03. It does not fuse in boiling water, but melts readily in the flame of a candle, when it burns with little smoke. It does not dissolve easily in any of the usual reagents.——Two new minerals to which names have not yet been given by their discoverers have been described respectively by Sjögren[20] and Ussing[21]. Sjögren's mineral occurs in vitreous, transparent, light green tables, associated with *synadelphite*, at the mine Ostra, in Nordmark, Sweden. The tables possess an easy cleavage and a pearly lustre. They are biaxial, with the plane of their optical axes nearly normal to the cleavage plane. The axial angle is small. Before the blowpipe the mineral blackens and fuses with difficulty. In the air it oxidizes and becomes dirty gray or brown. A qualitative examination shows the presence of As, Mn, Zn, and Fe. Ussing's compound is found imbedded in microcline, and associated with aegerine and lithium mica. It forms, small, thick rhombohedral crystals, with $a : c = 1 : 2.1422$. The principal forms present are oR, $\frac{1}{8}$R, $\frac{1}{4}$R, R, ∞R,—2R,—$\frac{1}{2}$ R and ∞P2. The faces are sometimes brilliant, and at others dull. The crystals are yellowish-brown and translucent. They are optically uniaxial and positive. Their specific gravity is 2.07, and hardness 5. In form, they resemble *eudyalite*. Their locality is Kangerdluarsuk, Greenland.

[18] *Eng. and Min. Jour.*, December 21, 1889.

[19] *Min. Mag.*, March, 1889, p. 133.

[20] Ofversigt af Kongl. Vetenskaps-Ak. Förh., Stockholm, 1888, p. 561. Ref. *Neues Jahrb. f. Min., etc.*, 1890, I., p. 24.

[21] Geol. Fören. Förh., X., p. 190, Stockholm. Ref. *Neues. Jahrb. f. Min., etc.*, 1890, I. p. 25.

Miscellaneous.—Perlitic structure, according to Mr. Chapman,[22] may be produced in Canada balsam by heating this substance until it is thick enough to become brittle when cold, and then pouring it upon a roughened glass plate and suddenly immersing in cold water.——Harker[23] ascribes the eyes of pyrite in slate to the displacement of the matrix around pyrite crystals through pressure. Because of its hardness the pyrite resists the pressure. The slate yielding to it breaks away from the crystal along a plane perpendicular to the line of force, and leaves little hollows on both sides of it. The hollows are afterwards filled with quartz. The eyes consist of pyrite, forming a center, imbedded in a lenticular mass of quartz or some other secretionary mineral.——In a book of about two hundred and seventy pages Mr. Merrill[24] publishes a catalogue of the building stones in the collection of the National Museum, and gives a very clear and succinct account of the methods employed in quarrying and finishing the various rocks used in construction.——A very valuable account of the mineral resources of Michigan is given by Mr. Lawton[25] in his annual report as Commissioner of Mineral Statistics of Michigan.——Dick[26] describes a new form of binocular microscope for use in petrographical investigations, made according to his own design. The most important new feature of the instrument is the connection of the two nicols, which may be made to revolve together or separately, at the will of the manipulator.

BOTANY.

Three Suggestions on Botanical Terminology.—So far as I can find there are at least two very marked and interesting phenomena in the physiology of plants which have as yet received no appropriate names by which they may be always recognized and under which they may be discussed. These are—first, the peculiar irritability of twining plants, in view of which, together with their negative geotropism and their asymmetrical nutations, the spiral habit of growth is maintained. From the most recent researches it appears probable that Von Mohl was correct in his early conjecture that some such specific irritability existed in twining plants, and it is proper that this specific irritability

[22] *Geol. Mag.*, Feb., 1890, p. 79.
[23] Ib., Sep., 1889, p. 397.
[24] Rep. Smiths. Institution, 1885–6, Pt. II.
[25] Mines and Mineral Statistics. Lansing, 1889.
[26] *Min. Mag.*, March, 1889, p. 160.

should have its name, and that English writers on the subject should be freed from the necessity of expressing themselves upon it in paraphrases. Unless some better term has been devised or some little-used term should have priority, it is proposed to term the motion of twining plants—so far as that motion is the result of the specific irritability—*dromotropism*, and we can then speak of such twining shoots as dromotropic.

Again, certain very well-known but as yet very poorly understood movements take place during fertilization and conjugation, by means of which antherozoids are directed to the waiting oösphere,—perhaps passing down the long neck of an archegonium; by which pollen tubes reach the oösphere in the embryo-sac of phanerogamous plants, and in view of which it is possible for the conjugating, motile or resting, sexual cells of zygophytic plants to come in contact with each other through an intervening space of air or water or soil. In the case of the higher cryptogamous plants, where clear differentiation of male and female organs and cells exists, the directive impulse seems to originate in the oösphere itself. Possibly the movement of the antherozoids towards the oösphere—a movement of such great biological importance—should be explained by attributing, as has been done, to the oösphere the power of excreting some chemical compounds which, while of the nature of waste products or excreta, nevertheless exert a stimulative and directive effect upon antherozoids in the near vicinity. So far as I can learn careful experiments to indicate just how far the oösphere can exert this stimulative influence have not yet been made. It would be of the greatest importance to discover through how many millimetres of water, for example, a polypodium antherozoid would find its way to the proper archegonium, but in the present state of the knowledge upon this topic, we cannot speak very accurately. Should the conjecture of a chemical stimulus be the correct one, the whole series of phenomena connected with conjugation and fertilization, to which passing allusion has been made, would possibly be most analogous to the hydrotropic curvatures of roots and shoots in view of which growth takes place from a region less saturated with moisture to one more saturated, or *vice versa*. For evidently if any aromatic excretum is given off from a sexual cell it would be in greater quantity the nearer one came to the originating cell.

Movements, then, of antherozoids and pollen-tubes, since they are clearly irritable movements, might appropriately be termed *gonotropic*, and the movements of the water cells themselves towards the female might be termed *gonotropism*. If it were deemed necessary to distinguish between the movements of free, locomotive antherozoöids such as those of Marchautia or Aspidium and the curvature of pollen tubes, the name gonotropism could be appropriately reserved for the latter class of movements, while the former might have the name of *gonotaxis*, analogous to phobotaxis—seen in swimming green zoöspores and in chlorophyll bodies of unequal axes. The movements of antherozoöids then might be termed *gonotactic*.

In the case of phanerogams, however, the stimuli which direct the pollen tube do not seem to originate in the oösphere alone, but are apparently sent forth by the *synergidæ* or "co-workers" as well. That the pollen tube should pass between the synergidæ and thus penetrate to the oösphere lying directly behind them, whatever the position of the ovule itself, could scarcely take place unless some stimulus should be sent from the synergidæ. This peculiar habit of the pollen tube, most instructively shown in anatropous or campylotropous ovules, might be explained as due to a repellent influence or stimulus sent from the *synergidæ*, in view of which the pollen tube, growing in the line of least resistance, necessarily must pass between them,—as, for example, to use a rather violent simile, the sailors of ancient days steered between Scylla and Charybdis, avoiding each as far as possible. This irritability of the pollen tube, in view of which it avoids the synergidæ, can scarcely be explained by supposing that stimuli originate in the oösphere alone, for, if this were true, the uniform course of the pollen tube between the synergidæ would not become clear. Neither can it be explained by supposing the synergidæ and oösphere capable of equal gonotropic stimulation, for then the further growth of the pollen tube after reaching a point midway between the three cells at the top of the embryo-sac would become a matter of chance. Apparently then we must consider the synergidæ as cells capable of sending stimuli, probably chemical in nature, either similar to the gonotropic stimuli of the oösphere, but much feebler, or of a nature precisely the reverse of the oösphere stimuli. Concerning the point here suggested there is yet no experimental evidence sufficiently strong to allow more than conjecture. If, however, the conjecture of a specific gonotropic irritability, different in different species of plants, be accepted, the possibility of hybridization depends upon two preliminary coördinations; first, the tissues of the receiving stigma, style and ovary must be such that nutrition and growth of the stranger-pollen is possible; second, gonotropic stimulation of the stranger-pollen must intervene to direct the course of its growth. This makes no account of the act of fertilization itself, but refers merely to externals, if one might name them so. Evidently the highly specialized requirements of pollen-tubes in the matter of nutrition are properly supplemented by highly specialized specific gonotropic irritabilities. The first is exactly paralleled by the specific nutrition requirements of the various parasitic fungi, which select each their own particular host-plant or animal, but the second is *sui generis*.

When, however, the cells of zygophytic plants find their way to each other, as for example, the zoösphores of Pandosina, or the conjugating cells of Piplocephalus, there is scarcely a localisation of gonotropic irritability in one cell, and of gonotropic stimulation in the other. In such plants we are below the stage of specialization, and the whole act of conjugation is so unlike that of higher plants that a different name might properly enough be given to the peculiar directive influence which each conjugating cell has upon the other. They might truly be considered equally gonotropic and equally capable of stimulation; but for the sake of differentiating between the bisexual movements and the unisexual, it might be well to term the movement shown by either of two similar conjugating gametes gamotropism. That gonotropic irritability is a specialized type, an outgrowth from *gamotrophic*, goes without saying. Both are probably connected with the excretion of certain as yet unclassified chemical compounds, and the progression of the higher from the lower, with accompanying specializations, would open a field of research exceedingly interesting although exceedingly difficult.

Carefully conducted and systematic experiments are needed along two lines, suggested in this brief note upon so fertile a subject: 1st, Experiments to indicate the distance to which specific gonotropic stimuli can be propagated through the surrounding medium; 2d, Experiments to show, by cross-pollenations, the relation between gonotropic irritability and appropriate nutrition upon the growth and direction of pollen-tubes.—CONWAY MACMILLAN, *Univ. of Minn.*

The So-Called Uredospores of Gymnosporangium.—Mr. H. M. Richards has carefully re-investigated the so-called uredospores of *Gymnosporangium clavariæforme*, and finds that Kienitz-Gerloff's conclusions are erroneous. In a recent number of the *Botanical Gazette* Mr. Richards publishes the results of a series of germinations of both forms of spores, viz., the fusiform (teleutospores) and the clavate (the so-called uredospores), and shows that, however much they may differ in form, they certainly present no constant difference in their mode of germination. Under favorable conditions both give rise to the characteristic promycelium bearing sporidia. Under less favorable conditions variations may arise, *e. g.*, great elongation of the promycelium when grown in an excess of water, or its great shortening when the moisture was insufficient. In the latter case the short promycelial cells readily fall apart, and under favorable conditions grow into hyphæ. Spores of the latter kind Kienitz-Gerloff considered to be uredospores, but Mr. Richards shows conclusively that their peculiar germination is due to special conditions, and that they are therefore to be still regarded as teleutospores.

Hackel's Revision of the Andropogoneæ.—The sixth volume of the "Monographiæ Phanerogamarum" of the De Candolles is a notable work of over seven hundred pages, entirely devoted to a monograph of a single tribe of the great order of the Gramineæ. When one observes that in this book there are descriptions of 420 species, the vastness of the undertaking of the noted author is made evident. At the present rate it will require from five to seven thousand pages in all, or from six to eight or nine additional volumes like the present one.

Hackel divides the tribe Andropogoneæ into five sub-tribes, to which he assigns the thirty genera which he recognizes. The scheme of classification may be made out from the following synopsis:

ANDROPOGONEÆ. Kth. ampl.

Sub-tribe I. Dimerieæ Hack.

Genus 1. *Dimeria* R. Br. Japan, Malay Archipelago, Australia. 12 sp.

Sub-tribe II. Sacchareæ Benth. & Hook.

Genus 2. *Imperata* Cyril. Tropical and Sub-tropical. 5 sp.
" 3. *Miscanthus* Anderss. Asia. 7 sp.
" 4. *Saccharum* Linn. Tropical and Sub-tropical. 12 sp.
" 5. *Erianthus* Michx. Tropical and Temperate. 18 sp.
" 6. *Pollinia* Trin. Tropical Eastern Hemisphere. 29 sp.
" 7. *Spodiopogon* Trin. Eastern Hemisphere. 5 sp.
" 8. *Polytrias* Hack. Java. 1 sp.
" 9. *Pogonatherum* Beauv. Eastern Hemisphere. 2 sp.

Sub-tribe III. Ischæmeæ Hack.

Genus 10. *Apluda* Linn. Tropical Eastern Hemisphere. 1 sp.
" 11. *Ischæmum* Linn. Tropical Eastern Hemisphere. 42 sp.
" 12. *Lophopogon* Hack. India and Australia. 2 sp.
" 13. *Apocopis* Nees. Asia. 2 sp.
" 14. *Eremochloa* Büse. Tropical Asia. 8 sp.
" 15. *Thelepogon* Roth. India and Africa. 1 sp.

Sub-tribe IV. Rottbœllieæ Benth.

Genus 16. *Vossia* Wall. India and Africa.
" 17. *Urelytrum* Hack. Africa. 2 sp.
" 18. *Rhytachne* Desv. Tropical Africa. 4 sp.
" 19. *Rottbœllia* Linn fil. Both Hemispheres. 1 sp.
" 20. *Manisuris* Sw. Both Hemispheres. 1 sp.
" 21. *Opheurus* Gærtn. Eastern Hemisphere. 4 sp.
" 22. *Ratzeburgia* Kunth. Burmah. 1 sp.

Sub-tribe V. Euandropogoneæ Benth.

Genus 23. *Trachypogon* Nees. America, Africa, and Madagascar. 1 sp.
" 24. *Elionurus* Humb. Tropical and Sub-tropical. 15 sp.
" 25. *Arthraxon* Beauv. Eastern Hemisphere. 8 sp.
" 26. *Andropogon* Linn. Both Hemispheres. 193 sp.
" 27. *Cleistachne* Beuth. Tropical Africa. 1 sp.
" 28. *Themeda* Forsk. Eastern Hemisphere. 8 sp.
" 29. *Iseilema* Anderss. India and Australia. 5 sp.
" 30. *Germainia* Bal. & Poit. India and China. 1 sp.

Some of the species are wonderfully complex; for example, ***Andropogon sorghum*** Brot., which contains two sub-species, ***halepensis*** and ***sativus***; the former with five varieties and seven sub-varieties; while the latter has thirty-seven varieties and twelve sub-varieties.

CHARLES E. BESSEY.

Sachs' History of Botany.[1]—The many readers of the NATURALIST who are familiar with the German edition of Sachs' History of Botany, which appeared in 1875, will be glad to see the work in an English dress. It will at once become much better known to botanical students, for with all our German teaching in the colleges, it is still a fact that books in the English language are read and consulted much more freely by students than when in German. The translation has been so well done in this case that American students may safely take it up in place of the original, expecially as the author has in this made some minor changes.

The work is divided into three "books," the first of which is devoted to the "History of Morphology and Classification," the second

[1] History of Botany (1530–1860), by Julius von Sachs, Professor of Botany in the University of Würtzburg. Authorized translation by Henry E. F. Garnsey, M.A., Fellow, of Magdalen College, Oxford. Revised by Isaac Bayley Balfour, M.A., M.D., F.R.S., Professor of Botany in the University, and Keeper of the Royal Botanic Garden, Edinburg. Oxford: at the Clarendon Press. 1890. Crown 8vo, pp. xvi., 568.

to the "History of Vegetable Anatomy," and the third to the "History of Vegetable Physiology." In treating these topics, the author says in his preface to the English edition: "I purposed to present to the reader a picture of the way in which the first beginnings of scientific study of the vegetable world in the sixteenth century made their appearance in alliance with the culture prevailing at the time, and how gradually, by the intellectual efforts of gifted men, who at first did not even bear the name of botanists, an ever-deepening insight was obtained into the relationship of all plants, one to another, into their outer form and inner organization, and into the vital phenomena or physiological processes dependent on these conditions."

In this preface several sentences attract the attention of the reader. For example: "I would desire that whoever reads what I have written on Charles Darwin in the present work should consider that it contains a large infusion of youthful enthusiasm, still remaining from the year 1859, when the 'Origin of Species' delivered us from the unlucky dogma of constancy. Darwin's later writings have not inspired me with like feeling. So has it been with regard to Nägeli."—CHARLES E. BESSEY.

Photographs of Dr. Parry.—I feel certain that I am obliging many botanists by stating that good photographs of the late Dr. C. C. Parry, the well-known botanist, may be obtained of Jarvis White & Co., of Davenport, Iowa, for twenty-five cents each. Wishing to place such a photograph in my gallery of botanists, I made inquiries, with the result given.—CHARLES E. BESSEY.

ZOOLOGY.

A New Actinian.—Dr. H. V. Wilson describes (Studies J. H. Univ., IV., No. 6) a new Actinian from the Bahamas, under the name *Hoplophoria coralligens*. It belongs in the family Antheadæ, and is noticeable from the fact that only six pairs of mesenteries reach the œsophagus, and in the position of four marginal sacs, which are highly developed stinging organs. In regard to Hertwig's suggestion that possibly the Madreporarian corals are a heterogeneous assortment of hexactinian polyps, which have independently acquired a skeleton. Dr. Wilson drops the hint that the study of the mesenterial filaments affords a negative argument. "Porous and aporous corals alike have simple filaments, but actinian have trifid filaments."

Entozoa of Marine Fishes.—Professor Edwin Linton has published a first paper on these forms, which, though included in the Fish Commission Report for 1886, did not appear until 1889. Professor Linton has spent several summers at Wood's Holl collecting the internal parasites of fishes. In the present paper he confines himself to the Cestods and Acanthocephala. Seventeen species in all are enumerated, of which ten are regarded as new, while three new genera are made in the paper. The general distribution of these parasites is summarized thus by Mr. Linton: Cestoid entozoa in the adult or strobile condition were found in great numbers in the alimentary tracts of all the Selachians examined. Encysted forms of the Cestoidea are for the most part confined to the Teleostei, and are found in greatest abundance in the sub-mucous coat of the stomach and intestine, although not infrequently met with in the peritoneum, liver, spleen, ovaries, etc.

A Two-Tailed Earth-Worm.—Some time ago one of my students brought in a specimen of a two-tailed earth-worm. While the literature of the subject is not at present accessible to me, I am under the impression that no such abnormal form has been reported from the United States, although several have been found in other parts of the world. When the animal was alive it seemed really two-tailed, the parts appearing of equal importance, but in the alcoholic specimen one division appears like a lateral branch, and is quite markedly constricted where it joins the body of the worm. Branches of the intestine and ventral nerve cord pass to both divisions, and there are two functional ani. The alcoholic specimen is 34 mm. long, the "tails" being about 12 mm. long.—C. Dwight Marsh, *Ripon College.*

Compound Eyes of Arthropods.—Mr. S. Watase has presented (Studies, Biol. Lab., Johns Hopkins, IV., No. 6) an extremely ingenious view of the morphology of the compound arthropod eye. The compound eye is formed by the vegetative repetition of the visual unit or *ommatidium.* In Serolis each ommatidium constists of two *corneagen* cells, which secrete on their outer (free) surface the chitinous cornea. Beneath these come two other cells (*vitrellæ=retinophoræ*), which secrete on the surfaces toward the axis of the ommatidium the chitinous *crystalline* cone, which, according to Watase, is purely dioptric, and has no connection with the optic nerve fibres. Beneath the vitrellæ are the *retinulæ,* cells which have their deeper ends in communication with the optic nerve, while their surfaces toward the axis of the ommatidium secrete a chitinous rod or *rhabdomere.* This structure is therefore to be regarded as a pit of ectoderm the cells of which, like all ectoderm cells, are capable of secreting chitin, and the pit is filled by this secretion. To this scheme can all compound eyes of Crustacea be reduced; with, of course, the addition of pigment cells, etc. In the compound eye of Limulus we have a very ancestral condition. The ectodermal pit remains open, and there is no distinction between cornea and crystalline cone, while the rhabdomeres exist as extremely delicate chitinous rods. "According to this view the compound eyes of Arthropods, either in the sessile or in the stalked forms, are nothing more than a collection of ectodermic pits, whose outer open ends face toward the sources of light, and whose inner ends are connected with the central nervous system by the optic nerve fibres. The cells forming the walls of the pit arrange themselves into three strata, in most cases accompanied by three regional functional differentiations. Grenacher's classification of the compound eyes of insects into 'acone,' 'pseudocone,' and 'eucone' types refers to the condition of the cells and their products in the middle stratum—the vitrellæ. Morphologically, then, the compound eye of an Arthropod is strictly single-layered, although, as is evident, the present conception is entirely different from the monostichous theory maintained by some recent writers." Mr. Watase further describes the development of the compound eye of Limulus, and inserts as an appendix some observations on the eyes of starfishes, which, as he shows, can be reduced to the type described among the Arthropods—a pit of ectoderm, the cells of which secrete a cuticle upon their free ends.

Tortoises Sold in the Markets of Philadelphia.—The taste for "stewed terrapin" and "snapper soup" has become so general in Philadelphia, that the United States are now ransacked for the means of supplying it. Within a few years the species sold were the "terrapin," *Malacoclemmys palustris;* the "red-belly," *Chelopus insculptus;* the "slider," *Chrysemys rugosa;* and the "snapper," *Chelydra serpentina.* Now large invoices of turtles are sent from Mobile, New Orleans, and St. Louis, which include the following species: *Chrysemys bellii, C. elegans, C. concinna,* and *C. troostii; Malacoclemmys geographica,* and *M. leseurii;* total, exclusive of sea turtles, ten species. All are abundant in the market except the *C. bellii.*—E. D. Cope.

Zoological News.—Vermes.—Beddard (Proc. Zoöl. Socy., London, 1889) catalogues the Oligochætes of New Zealand, enumerating fourteen species. His conclusions of the relationships of the fauna to that of Australia are: The Olighcoætous fauna of New Zealand differs markedly from that of Australia, in which the characteristsc genera, represented by numerous species, are Megascolides, Perichæta, and Cryptodrilus. The characteristic New Zealand form is evidently Acanthodrilus, while Perichæta is represented by but few species.

Arthropods.—Benham thinks that the structures found in a New Zealand earth-worm (*Acanthodrilus multiparvus*) throw light upon the possible origin of the Malpighian tubules in the Arthropoda. In this worm minute cæcal diverticula arise from the (? hind) gut, but a little farther forward similar tubules become continuous with undoubted nephridia. These are certainly comparable to the anal nephridia of the Gephyrea, and in order to convert them into Malpighian tubules is to limit their number and arrange them in regular order, their inner ends being closed.

Fishes.—Jordan & Fisher describe as new (Proc. Acad. Nat. Sci. Philadelphia, 1889) *Orthopristis lethopristis* from the Galapagos Islands.

Meek and Bollman describe (*l. c.*) two specimens of *Elegatis bipinnulatus* Bennett, taken off Long Island, N. Y., the first occurrence of the species in the waters of the United States.

Willard Morrison (*l. c.*) reviews the American species of Priacanthidæ. He regards the family as an offshoot of the Serranidæ, and recognizes two genera—*Priacanthus* with the species *catafula, crentatus* and *bonariensis*, and *Pseudopriacanthus* with a single species, *altus*.

Ph. Kirsch and Morton Fordice (*l. c.*) review the American Sturgeons. The species recognized are *Scaphirhynchus platyrhynchus* and *Acipenser sturio, medirostris, rubicundus, brevirostrum* and *transmontanus*.

Ph. Kirsch (*l. c.*) recognizes the following species of Uranoscopidæ in Europe and America: *Kathetostoma averruncus, Uranoscopus scaber, Astroscopus anoplos, Upsilonophorus Y-græcum, U. guttatus.*

Birds.—Beddard (*Ibis*, Jan., 1890) describes the alimentary canal of the Martineta Tinamou (*Calodromas elegans.*) The cæca differ from those of all other Crypturi, being furnished with numerous small diverticula, giving the inner surface an appearance not unlike the ventriculum of a ruminant's stomach.

Witmer Stone shows (Proc. Acad. Nat. Sci. Philadelphia, 1889,) that Sharpe has mistaken Verreaux's *Pratincola salax*, and that it is identical with *P. sybilla* Linne. *P. axillaris* Shelly may be a variety of the same.

Mammals.—Ryder (Proc. Am. Philos. Soc., XXVI., 1889) seeks the phylogeny of the mammalian sweat gland in the epidermal glands of the Batrachia. C. Hart Merriam (*North American Fauna*, No. 1; pubished by the U. S. Department of Agriculture) presents a revision of the North American pocket mice. With abundant material, he has recognized eighteen species, but has united the two genera Perognathus and Cricetodipus. Many changes in synonymy are noticeable. In a second paper (l. c., No. 2) the same author describes fourteen new species of mammals from North America, arranged in the genera Onychomys, Arctomys, Lagomys, Spermophilus, Tamias, Nyctionomus, and Phenacomys (nov.).

Beddard (Proc. Zoöl. Soc., London, 1889) describes the visceral anatomy and brains of the American tapir. He concludes that the American species is distinguished from the Indian by the absence of well marked valvulæ conniventes, the presence of a moderator band in the heart, the shape of the glans penis, and a more elongate cæcum sacculated by four bands. The cerebral convolutions are simpler in Tapirus than in other living Perissodactyles.

Dr. R. W. Shufeldt describes (Proc. Acad. Nat. Sci., Philadelphia, 1889) the skull in an embryonic specimen of the California wood-rat, *Neotoma fuscipes*.

Dr. Frank C. Baker describes (l. c.) the habits of the recently discovered round-tailed muskrat, *Neofiber alleni* True.

EMBRYOLOGY.

The Placentation of the Hedge-hog (*Erinaceus europaeus*), **and the Phylogeny of the Placenta.**[1]—Prof. A. A. W. Hubrecht has placed embryological students under great obligations to him for this admirable work upon the development of the hedge-hog. There is room, however, for very wide difference of opinion as to the significance of the facts recorded. While no one will probably be disposed

[1] *Quar. Jour. Mic. Sci.*, XXX., Pt. 3, 1889, pp. 283-404. Plates XV.-XXVII.

to question the primitive position in many features, especially so far as adult characters are concerned, of the hedge-hog and its insectivorous allies, the assumption that its placentation is primitive is a very different matter. While no one can help but admire the wonderful fidelity and care with which the facts of placental development are recorded, since the plates for histological details are simply unrivalled, the conclusion that the placentation of the hedge-hog is primitive is far from warranted.

So far from Prof. Hubrecht's assumption as to the primitive nature of this type's placenta being borne out by his facts, it is distinctly and emphatically negatived by them. In the first place, a "reflexa" such as is described by him is found in comparatively few forms. Moreover, such a development of the uterine mucosa is distinct evidence in favor of the conclusion that the placenta in forms having such a "reflexa" is specialized. In some rodents, man, possibly Tamandua, also Erinaceus, Talpidæ, Rhynchocyon, in all of which it is pretty certain that the whole complex series of primary differentiations of the blastocyst or blastodermic vesicle are completed without the accompaniment of an excessively rapid growth in its size, such as occurs in the rabbit and opossum, where also there is either no reflexa formed, or traces only of such an organ are developed later. In the first-named forms there has occurred an adaptive abbreviation of the early processes of development, which have not supervened in the last two, or in the rabbit and opossum.

The peculiar mode of development of the hypoblast in the hedge-hog is again specialized and widely different from what it is in most rodents.

In the same way the site of the placenta and the germinal area are different from those of other types, and therefore specialized. In the first place, the embryo itself is formed at a point in the blastodermic vesicle which is exactly opposite its homologue in the rabbit, mouse, and rat, and probably even man, Bradypus, and Tamandua, as well as many carnivora. In these last-named it is formed in a dorsal position in the uterine lumen or just beneath the insertion of the mesometrium. In Erinaceus the embryo is formed at a point on the surface of the blastocyst diametrically opposite to the point of insertion of the mesometrium. The embryo in the first-named series therefore has its dorsal aspect coincident at first with that of the parent; in the hedge-hog that aspect coincides with the ventral aspect of the parent. The site of the attachment of the placenta is similarly reversed. In the majority of forms the position of the placenta is immediately beneath the insertion of the mesometrium. In Erinaceus the placenta fœtalis is affixed to the side of the lumen of the uterus diametrically opposite to the insertion of the mesometrium. The conclusion is therefore forced upon us that *there is no exact homology between the maternal portion of the placenta in the hedge-hog and that of the same part in the large majority of other mammalian types.* The name "trophoblast" which Hubrecht proposes for the "outer layer" of the blastocyst is exceedingly apt and convenient, while his elaborate studies as to the role it plays in the formation of the placenta, as well as its growth and fate, constitute a most valuable contribution to the embryology of the higher vertebrates. Nevertheless, one cannot help regretting that the obvious and clear homology of this layer with the serous envelope, subzonal membrane,—*Deckschicht* as this layer has been variously called,—has not been more strongly emphasized. Of such a homology there cannot be the slightest doubt; the only difficulty in making it out is due to the excessive concentration or abbreviation of the early stages of development already referred to. The modification of their early stages and their abbreviation in mammalia are also clearly adaptive and directly so under the influence of trophic stimuli, which differ very widely in character in the different mammalian orders. These differences are apparently due to the effects of what may, for want of a better phrase, be called the reciprocal trophic stimuli exerted reciprocally upon each other by the blastocyst and uterine walls in the different types during the initial stages of development. The variations in the differentiation and arrangement of the mucosa and its vessels in the different forms must have had something to do with the genesis of such different methods of differentiation of the primary stages of mammalian development. The expectation of ever unravelling thef causes of such differences through a study of the early development of the fœtus alone will be fruitless. The processes are in the clearest possible manner directly adaptive in certain very definite ways, which purely morphological study is utterly and forever incapable of explaining, and is no less irrational and absurd than to attribute such modification to the "action" of natural selection.—JOHN A. RYDER.

PHYSIOLOGY.

Electrical Phenomena in Human Skin.—Tarchanoff[1] makes some interesting discoveries regarding the electrical phenomena in the human skin, accompanying the stimulation of sense-organs and different forms of psychic activity. He connects different parts of the skin with the galvanometer, *e. g.*, palm and back of hand or of foot, palm of hand and outer surface of forearm, latter and axilla, etc. Slight tickling of the body surface produces a considerable movement of the galvanometer mirror, following a latent period of from one to three seconds, and continuing sometimes for several minutes after the stimulus has ceased. Other stimuli cause similar electric currents, such as heat, cold, pain, electric shocks, sounds, such as speaking and hand-clapping, sniffing of ammonia and acetic acid vapor, sugar and other sapid substances placed upon the tongue, light thrown into the eyes as when the eyelids are merely opened to ordinary light. The author goes further and finds that merely imagining these sensations, without any stimulus of the sense-organs whatever, is sufficient to produce analogous galvanic disturbances; for example, if the individual fancies himself to be enduring intense heat, a strong cutaneous current appears. Mental processes, such as the multiplication or division of numbers, are accompanied by currents varying in intensity according to the complexity of the process; thus, arithmetical problems, the answers to which may be taken direct from the multiplication table, call forth almost no electric change. Expectation of stimuli or of questions to be answered causes irregular movements of the galvanometer mirror. Voluntary movements cause changes of an intensity proportional to the amount of movement. Fatigued individuals show little or no galvanic effects.

In all of these cases the portion of the skin richer in sweat glands becomes negative to the other portion. The author hence regards the current as a secretion current. The results go to confirm the idea that nearly every kind of nerve activity, from the simplest to the most complex, is accompanied in man by increased activity of the sweat glands, and to strengthen Hermann's view that the current exhibited in the contracted human hand is a secretion current, not a negative variation of a preexisting muscle current. In explanation of the fact of increased sweat secretion accompanying nerve activity, the author casually suggests that, inasmuch as the latter causes an increase of

[1] Pflüger's *Archiv*, Vol. XLVI., p. 46.

temperature and an accumulation of waste products, the perspiratory activity is useful as a regulator by cooling the body and eliminating the wastes.

Electrical Phenomena in Beating Heart.—Dr. Waller has investigated [2] more fully the electromotive changes in the contracting mammalian heart. The exposed and spontaneously beating heart of the cat was studied *in situ* by means of the capillary electronometer. The electrical variation of the ventricle resulting from a single beat was found to be diphasic, indicating negativity of apex followed by negativity of base. This confirms the author's former discovery by mechanical methods that the contraction of the apex precedes that of the base, which is the reverse of what takes place in the frog. Some preliminary experiments were tried on animals to determine whether the electrical variations accompanying the heart beat could be detected on the surface of the body. These were successful, and led to a study of the electrical variations of the heart in man.

It was found that leading off from points of the surface of the body remote from the heart in the intact animal or in man gave the same diphasic variation accompanying the ventricular contraction, the auricular contraction giving no electrical indication. The most favorable positions for the electrodes are on either side of a line running at right angles to the long axis of the heart. Such a "line of zero potential" in the normal human being, with heart tilted to the left, extends from the left shoulder to the right side; in the quadruped, with heart toward neither side, it is transverse to the body axis. Leading off from any point anterior to this line is equivalent to leading off from the base of the ventricles; leading off from a point posterior to this line is equivalent to leading off from the apex. Thus, in man electrodes placed on the right hand, and either the right or the left foot or left hand, gave a good variation; not so the left hand, and either the right or left foot. Favorable combinations are the mouth and the left hand, the right foot, or the left foot; an unfavorable one, the mouth and the right hand. In the cat a favorable combination is either anterior extremity with either posterior extremity, but not the two anterior extremities with each other. The electrical variation precedes the mechanical movement of the heart, and is always diphasic, indicating, as in the exposed heart, negativity of apex followed by negativity of base. It would seem, then, that in the human heart, and mammalian hearts generally, unlike the amphibian, the contrac-

[2] Philosophical Transactions, Vol. 180 (1889), B., p. 169. Cf. also Vol. 178 (1887), B., p. 215.

tion by which the ventricle empties itself begins at the apex and closes at the base.

Relations of Nerve Fibres and Ganglion Cells.—Langley and Dickinson[3] have discovered a method that promises to yield important results in the investigation of this question. In studying the effect of nicotin on the cervical sympathetic nerve they learned that after a dose of the drug stimulation of the sympathetic fibres below the superior cervical ganglion does not produce dilation of the pupil or constriction of the vessels of the ear, while stimulation above the ganglion produces both changes as usual. By applying nicotin to nerve and ganglion at different times they conclude that the poison paralyzes the ganglion nerve cells. This suggests a method of isolating the nerve fibres joining the ganglion cells from those passing through without such junction. Regarding the superior cervical ganglion, the authors conclude that the dilator fibres for the pupil, the vaso-constrictor fibres for the ear (probably also for the head generally), and the secretory fibres for the glands end in the ganglion cells. Regarding the relations of the vagus and splanchnic nerves to the ganglia of the solar plexus, it would appear that the stomachic inhibitory fibres of the splanchnic end in the cells of the cœliac ganglion, the intestinal inhibitory fibres of the splanchnic in the cells of the superior mesenteric ganglion, while the motor fibres of the vagus do not join the cells of the solar plexus; vaso-constrictor and vaso-dilator fibres of the splanchnic end in cells of the solar and renal plexuses. Other peripheral ganglia have been studied with results. The nicotin appears to affect the nerve fibres very slightly, but this effect is not to be compared in intensity with that on the nerve cells. Numerous interesting questions are suggested by the research, viz., among others, whether by nicotin centers may be isolated, and tracks followed in the brain and spinal cord.

Physiological Prize.—A member of the Physiological Society has offered two hundred and fifty dollars for the best research or researches bearing on the subject stated below, viz: "The regeneration of severed spinal nerves in mammals, including man, with special reference (1) to the reunion and return of function in such severed nerves, without degeneration of the distal portion; (2) to the possibility of union, with return of function, between the central portion of any one spinal nerve and the distal portion of any other (*e. g.*, the central portion of the ulnar with the distal portion of the median)."

[3] Proceedings of Royal Society, No. 284, p. 423.

Conclusions are to be supported, so far as possible, by histological as well as physiological evidence. The competition is limited to residents of North America, and the prize will be awarded for original work done between January 1, 1890, and October 1, 1891. Communications concerning the prize should be addressed to Professor H. Newell Martin, Johns Hopkins University, Baltimore, Md.

PSYCHOLOGY.

The Effect of Whistling on Seals.—While reading of "Instances of the Effects of Musical Sounds on Animals," by Mr. Stearns, in which I have been much interested, it recalled to my mind apparently similar effects produced upon seals, which I often noticed during a prolonged stay in Hudson's Strait. Here the Eskimo might often be seen lying at full length at the edge of an ice-floe, and, although no seals could be seen, they persistently whistled in a low note similar to that often used in calling tame pigeons, or, if words can express my meaning, like a plaintive phe-ew, few-few, the first note being prolonged at least three seconds. If there were any seals within hearing distance they were invariably attracted to the spot, and it was amusing to see them lifting themselves as high as possible out of the water, and slowly shaking their heads, as though highly delighted with the music.

Here they would remain for some time, until one perhaps more venturesome than the rest, would come within striking distance of the Eskimo, who, starting to his feet with gun or harpoon, would often change the seal's tune of joy to one of sorrow, the others making off as fast as possible.

The whistling had to be continuous, and was more effective if performed by another Eskimo a short distance back from the one lying motionless at the edge af the ice.

I may add that the experiment was often tried by myself with the same result.—F. F. Payne, *Toronto, March 26, 1890.*

ARCHEOLOGY AND ETHNOLOGY.

Fort Ancient, Ohio.—(By Warren K. Moorehead. Cincinnati, O., Robert Clarke & Co.)—This volume of Mr. Moorehead's is a valuable contribution to antiquarian literature. It is confined to the description of this fortification alone.

Fort Ancient is located in central Warren County, Ohio, some forty-two miles northeast of Cincinnati, on the P. C. and St. L. R. R. It lies upon a plateau 269 feet above the Little Miami River, which it overlooks and which flows at its base. The walls forming the enclosure follow the brink of deep ravines. The embankments are mostly of earth, although in places there are great quantities of stone. These rocks comprise flat slabs of limestone and some few pieces of sandstone, A deep ravine, having a slope of thirty-five to thirty-eight degrees. follows the earthwork for nearly a mile and a half on the western and southern sides. The embankment is built directly upon the edge of the ravine, so that the earth used in its construction has rolled down upon the outside. Thus the earth artificially placed can be distinctly traced forty feet from the summit of the earthwork. At the same place the inside measurement of the wall is twelve to fifteen feet.

The accompanying map of the structure will indicate the peculiar features.

In its topographical work, its illustrations, its intelligent description of the excavations, the volume is deserving of large praise.

Mr. Moorehead, with his party, spent the entire summer of 1889 at Fort Ancient, preparing material for the book.

We may differ from Mr. Moorehead in some of his conclusions, yet we cannot but admire the thoroughness with which the structure has been examined, and the completeness of the survey. In this regard it is worthy the imitation of more pretentious parties.

The work is more laudable because Mr. Moorehead was not assisted by any institution or person, but bore the expense of the investigations himself.

The first few chapters of the book deal with the outline of the structure, measurements, etc. Those following describe the stone graves and mounds explored, while the remaining chapters give quotations from some twenty prominent antiquarians upon Fort Ancient, and express the author's conclusions.

The distances of various points of interest have been ascertained with care; the length of the embankments in the Old and New Forts is 18,712 feet. The length of the crescent in the New Fort is 269 feet; length of the parallel walls, 2760 feet; the distance in a straight line between the extreme part of the New Fort to that of the Old is 4993 feet. The average height of embankment is twelve and one half feet. In the highest places (where the walls cross the eastern side of the plateau) it reaches an altitude of twenty-two feet, while in one locality, where scarcely any protection on account of precipitous ravines is necessary, it is but three and one-half feet high.

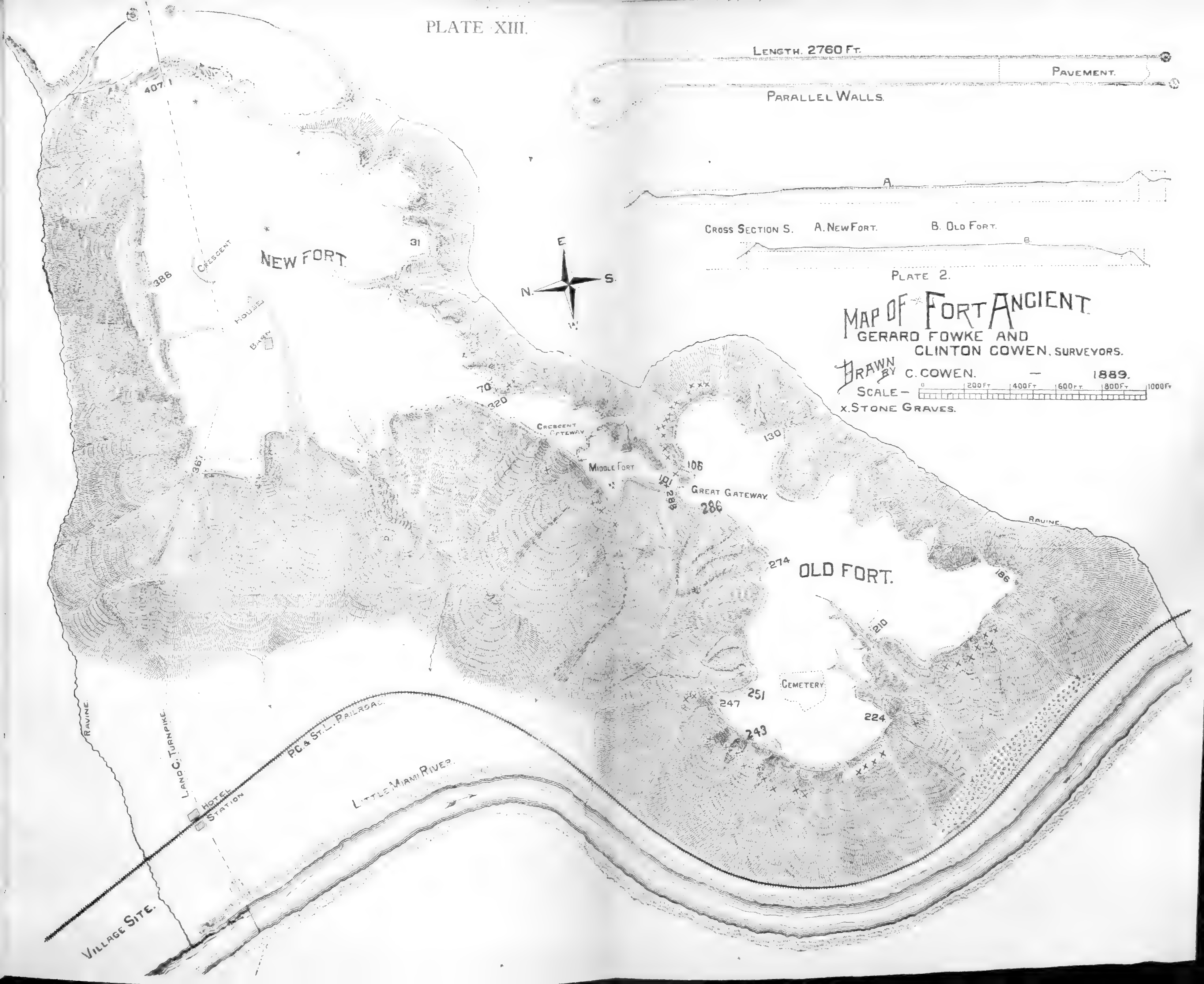
Two classes of burials were discovered; the one being made in stone graves, while the other was a simple interment under a small heap of stones. The former order of burial resembles the stone graves of Tennessee. A village site and cemetery similar to that of Madisonville, Ohio, was revealed by excavations in the valley adjacent to the Miami River. Out of this valley were taken a quantity of refuse such as would accumulate from an aboriginal village. The deposits were found at three levels, the deepest being five feet below the surface. As the pottery of the lower deposit was different from that discovered above, Mr. Moorehead is of the opinion that various tribes occupied this region.

The general conclusions drawn are interesting. He is led to conclude from his examination of the place that the fortification was erected by one people as a defence against a hostile tribe or nation. He thinks that the neighboring Indians living within a radius of one hundred miles were allied and held in common this structure, that a number were constantly detailed to keep it in repair, and that in case of an invasion they congregated here for safety.

Mr. Moorehead gives the following definition of Fort Ancient: "Fort Ancient is a defensive earthwork, used at times as a refuge by some large tribe of Indians; and at intervals there was a large village situated within the walls."

In the excavations upwards of two hundred skeletons were exhumed, an aboriginal stone pavement 130 by 500 feet discovered, etc. Altogether the work is commendable, and we would feel inclined to criticise but slightly. A ground plan of the fort is given, which is reproduced in the accompanying Plate XIII.—Thomas Wilson, Smithsonian Institution.

March 15th, 1890.



Length. 2760 Ft.
Pavement.
Parallel Walls.
A.
Cross Section S. A. New Fort. B. Old Fort.
B
Plate 2.
Map of Fort Ancient
Gerard Fowke and
Clinton Cowen, Surveyors.
Drawn by C. Cowen. — 1889.
Scale — 0 200 Ft 400 Ft 600 Ft 800 Ft 1000 Ft
x. Stone Graves.
E
N.
S.
W.
New Fort
Crescent
House
Barn
407
386
361
31
70
320
Crescent Gateway
Middle Fort
106
101
289
Great Gateway
286
130
Ravine
Old Fort.
274
186
210
Cemetery
251
247
243
224
Ravine
L and C. Turnpike.
Hotel
Station
P.C. & St. L. Railroad
Little Miami River
Village Site.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Papers Read Before the Anthropological Society of Washington During the Year 1889.—"The Shinto Faith," by Mr. Romyn Hitchcock. "Anthropology at the Paris Exposition," by Profs. O. T. Mason and Thomas Wilson. "Some Omaha Religious Practices," by Rev. J. Owen Dorsey. "Ancient Chipped-stone Workshops on Piney Branch, D. C." by Mr. W. H. Holmes. "The Cherokee Ball Play," by Mr. James Mooney. "Remarks on American Archæology," by Major J. W. Powell. "Attempts to Promote Prosperity by Limiting Production," by Mr. Wm. A. Croffut. "Human Footprints in Dakota" (Illustrated), by Mr. Henry I. Reynolds. "Vesper Hours of the Stone Age," by Capt. John G. Bourke, U.S.A. "The Archæology of North America," by Major J. W. Powell. "Ojibwa Ball Play," by Dr. W. J. Hoffman. "Prometheus (The Fire-maker), by Mr. Walter Hough. "Gentes of the Navajos," by Dr. Washington Matthews, U.S.A. "Gentes of the Apaches," by Capt. John G. Bourke, U.S.A. "Olecranon Foramen," by Dr. D. S. Lamb. "Tibet," by Mr. W. W. Rockhill. "The Origin of Llao Nous, a Legend of the Shasta," by Mr. Mark B. Kerr. "Christophe Plantin, the Antwerp Publisher of the XVIth Century," by Mr. G. R. Stetson. "The Societe d'Anthropologie of Paris," by Mr. Thomas Wilson. "The Omahas as Mound Builders," by Mr. H. I. Reynolds.

Biological Society of Washington.—March 22d.—The following communications were read: "Change in the Color of Human Hair, Change in the Color of Plumage in Birds, and in the Fur of Mammals," with specimens, by Dr. D. W. Prentiss. "The Color of Fishes," by Mr. G. Brown Goode. "The Colors of Insects," by Prof. C. V. Riley.—FREDERIC A. LUCAS, *Secretary*.

Natural Science Association of Staten Island.—March 13, 1890.—Mr. L. P. Gratacap exhibited specimens of quartz geodes and limonite concretions from the iron mines near Four Corners, loaned for the occasion by the superintendent of the mines, Mr. Amos Smith. Following is an abstract of Mr. Gratacap's remarks:

The specimens form but a small proportion of those which Mr. Smith has collected, and although they embrace but two, or at most three, mineralogical species, they are interesting from their real beauty, and for the speculations they suggest as to their origin. The species are quartz, limonite, and Göthite. The latter occurs as a delicate closely appressed velvety surface, bronzed yellow in color, and consisting of a film of minute needles. It may be referred to the variety of Göthite known as "sammet blende," and is strikingly beautiful when its color and texture appears in a direct light. The limonite is shown in siliceous concretions, sometimes in concentric shells, and in other instances enclosing ferruginous pebbles, between which an infiltrating seam of iron cement has thrown interior partitions. The quartz groups are large and handsome, and occur as geodes or small rounded mounds of slightly divergent, faintly amethystine crystals. They are characteristically alike in having the individuals composed of groups of interfering pyramids, amidst which the central crystal, most fully developed, rises, and at a distance seems to blend the jutting faces of the subordinate rhombohedrons with its own, and form a single stout termination. This peculiarity gives a slightly drusy appearance to the entire surface. The elements of as many as twenty-four pyramids are seen in some of the groups. These quartz groups have all doubtless formed the central crystallizations of geode-like siliceous balls or conduits. They have been found by Mr. Smith at the lower levels of the surface diggings, near the underlying serpentine ledges. The ores in which they occur are highly siliceous limonites, which were deposited, in all probability, by the oxidation of iron salts carried upward by thermal waters flowing through the crevices of the serpentine mass, and fed to some extent by surface waters carrying dissolved iron oxides, a process made familiar by the papers of Drs. Hunt and Julien. This view is supported also by Dr. Britton (Geol. Richmond Co. Ann., N. Y. Acad. Sci., Vol. II., p. 177).

Now the experiments of Schafhäutl, Senarmont, and Daubrée, in making artificial quartz, have shown that gelatinous silica and glassy silicates are attacked and dissolved by highly heated waters, either alone or assisted by hydrochloric or carbonic acid, and that such solutions deposit hexagonal pyramids of quartz. These interesting quartz groups in the iron beds point conclusively to the exudation, from the serpentine rocks below, of warm springs, at whose mouths, upon cooling and removal of pressure, the quartz pyramids have been formed. Their amethystine hue is attributable to manganese, which is a prevailing ingredient of the iron ore of this region.

As to the source of the silica, it is a possible hypothesis that it has been supplied in a soluble form from the slow change involved in the decomposition of hornblende masses, and the formation of serpentine. In such a change there would certainly be a discharge of silica or silicates, and they would naturally enter into solution in subterranean waters, which were themselves active agents in bringing about the very decomposition from which these products result.

Finally, the interrupted crystallization, to which we have especially alluded, suggests that there has been rapid cooling and *motion*, such as would occur at the orifice, and along or around the mouths of springs; unlike those magnificent results in Arkansas, where brilliant, sharply-cut, and long crystals, would seem to indicate a slow growth of the quartz prisms in a dense solution.

Mr. Arthur Hollick showed specimens of *Anemone hepatica* L., the common Liverwort, collected in full bloom at Prince's Bay on February 16th. This is the earliest recorded date at which it has been found in blossom on Staten Island, and is another evidence of the phenomenally mild winter. Following are the earliest recorded dates at which this flower was found in blossom in previous years:

1871	March 25th	1880	not recorded
1872	April 11th	1881	April 10th
1873	April 10th	1882	April 1st
1874	March 21st	1883	April 8th
1875	April 10th	1884	April 20th
1876	April 1st	1885	April 25th
1877	March 24th	1886	April 11th
1878	March 10th	1887	April 17th
1879	March 29th	1888	April 15th
		1889	April 14th

In nearly every instance the plants were examined carefully about a week or two previous to the dates above recorded, hence they could not have been in blossom many days earlier. As the location of plants makes a great difference in the time of flowering all these observations were made at the same or similarly situated localities, namely, sheltered banks with a southern exposure, either near the Crystal Water Co.'s reservoir, the Black Horse Ravine, or the pond near Prince's Bay. The plants in the latter locality are slightly in advance of the others and a week or more ahead of the average.

The following objects were shown: A cannon ball, presumably a relic of revolutionary times, presented by Mr. S. N. Havens, who had dug it up while excavating in the woods not far from the new Smith Infirmary building. A stone axe and arrow-head, presented by Mr. M. T. Merrill, which had been dredged from the bottom of the Kills near Linoleumville. The articles were encrusted with barnacles and Bryozoöns.

SCIENTIFIC NEWS.

5. Notes on the Paleontological Laboratory of the United States Geological Survey under Professor Marsh.

If there is any truth left under the sun then judgment must fall on the scientist who walks the halls of the Yale Museum armed with a wet sponge. Why a wet sponge? you say. Perhaps it was to wipe the dust from some noble fossil? Far from it! but rather to wash the purity of a truth out of the blackness of a falsehood. A kind of organized touchstone that distinguishes the little gold from the bulk of dross, which when deftly swept across the surface of a restored fossil, discloses the real and the unreal. For plaster of paris is porous, and absorbs more readily than the denser fossil any moisture from the sponge. So the blackened sepulchres yield up their grewsome skeletons. Veritable sepulchres they necessarily seem to those who have seen these fossils "black-washed" from centrum to spine, from shaft to extremities, reducing the whole to a uniformity of color that wiped out absolutely every vestige of the truthful white plaster, leaving mankind in doubt as to what is real, what conjectural. This is illegitimate restoration in the eyes of the whole world, and these old bones, restored to deceive rather than to instruct, must sooner or later stand as monuments of reproach to the man who has so far deceived the world and himself that he can only study them with a wet sponge.

To those scientists in foreign lands, especially Germany, who have marveled at the exceptional beauty and perfect preservation of Prof. Marsh's specimens, let it be said that although you cannot apply the sponge test to his faultless, fractureless plates, you can to the specimens from which they were drawn. But to see any man year after year calling for a wet sponge to assist him in determining whether a suture or a fracture were real or imitations wrought cunningly in the plaster by skilled labor, is to believe him worthy of the unqualified distrust of science, wherever that word is spoken. One feels this the more keenly when he knows that all his assistants to a man have repeatedly advised with him, and cried out against this abuse, warning him of the criticism inevitably resulting from such a stubbornly unscientific and misleading course. His assistants are asked, not how nearly they can approximate the truth, but instead, "How closely can you imitate the color and texture in that missing part?" which being translated is, How cunningly can you deceive? "That part looks too smooth; can't you work in a crack or two to give it a natural look?" "Just run a suture along here, and scrape that process there to make it look like the roughnesses for cartilaginous or ligamentous attachment."

At first the plaster worked badly, for many of the bones were black, and to get that color in white plaster it was necessary to add such quantities of lamp-black (with alcohol to make it mix with the water) that the restored parts were soft and crumbled away. To overcome this, glue water was added, which gave hardness, but like all glue was treacherous, drying, cracking, scaling off and pulling away from its moorings, thus exposing too clearly just where the fossil left off and the fraud began. It was not until he had learned how to combine plaster, bone-black, and gum acacia, that a mixture capable of unlimited possibilities was adopted. Were it possible, I would say, Verify these words,—but you can't. Stand straight before these restored specimens, in the full and truthful light of day, and you can't distinguish between the rusty, frost-cracked, weather-beaten, moss and lichen effects, craftily wrought in the plaster, and the conditions wrought by time on the specimens themselves. But if critical study can reveal—without the helpful sponge—the restored parts in some bones, it can't in others, some of which were prepared by myself, at his direction, in my earlier days on the Survey, and are so craftly modeled and colored that I cannot myself distinguish at arm's length the real fossil from the plaster. Of course the deceits and falsities of the specimens thus tampered with were naturally enough transmitted to the drawings, and the old deceits and falsehoods were enacted anew—compromising that pre-eminently reliable Journal. Yes, still a third time, in the costly plates of the government monographs, thence to be copied and repeated in other ways, how often who will say?—for a falsehood is proliferous and self-propagating. If the deceptions thus practised were confined to the specimens themselves, and not transmitted to paper and then distributed throughout the world, it would not seem so serious an evil. As it is, the Geological Survey must necessarily suffer reproach either now or in the future.

Geologists abroad who cannot acquaint themselves personally with the facts, may find in the above an explanation of the striking absence in Professor Marsh's plates of those conventional bars, light shading, and simple outlines which fair-minded scientists universally use to honestly indicate missing parts. In very marked contrast to his course is that of foreign geologists, and our own paleontologists. Their plates show things as they actually are, and are not daubed with plaster to enlarge, distort, or conceal anything at the caprice of the author. (Figs. 1, 2.) Another phase of this extensive restoration business is worthy of notice, and is thoroughly culpable. Professor Marsh gave tacit and oft-repeated directions " not to do a stroke on a Government fossil that was not absolutely necessary." " I am not doing missionary work for the Government," " They can do the fancy work at the National Museum; we will only work them out just enough to see what they are, and they can do the rest there." But bear in mind that all this time he was doing home missionary work on his own private collections, and at Government expense too; restoring, and embellishing, and mounting them on plaster bases and other supports ready for exhibition. " Life was too short " to give a Government specimen more than a lick and a promise, but quite long enough to devote months and years of Government time and money in beautifying his own private collections, and that too when they had all been drawn, and lithographed, and all the measurements had been

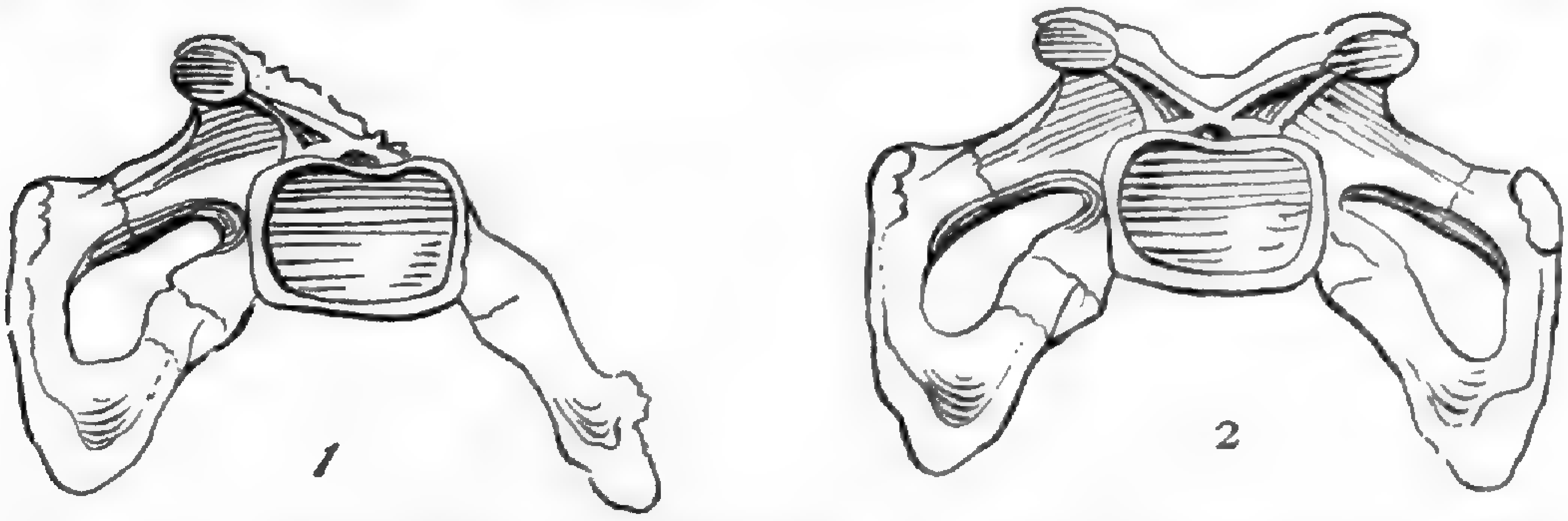


FIG. 1.—Cervical vertebra of "*Apatosaurus*" *laticollis* as it appeared when drawn. Take notice, it hadn't been plastered up when the drawing was made.)

FIG. 2.—The same as it appears now in geologies, scientific papers, and elsewhere, after it was doctored up. (Notice the slight differences on the two sides, a thing that heightens the realistic effect of the missing parts.)

taken, and the necessary notes made, so that not a single excuse remained for squandering the Government appropriation in garnishing and adorning his own particular specimens for impressive display in his own particular museum. This abuse of public trust led us to frequent and spirited disagreements and our relations became exceedingly strained, and still more so when I refused to add to the crime of misappropriating Government time that of deceiving in the restorations. For he not only wished to have the deceptive plaster used in the restorations, but insisted on having the bones so modeled as to exactly correspond with the lithographic plates already drawn, and that too after being repeatedly informed that to secure this similarity would necessitate distorting and even breaking the fossils.

Once when I frankly gave him my opinion of this wholesale misuse of the Government men and money for his own personal benefit, he declared that the power vested in him as Paleontologist was such that it enabled him to apply his appropriation in collecting recent Birds or Mammals in South America, or in hiring musicians for his entertainment while at work, if need be. On another occasion when I rose in opposition to this same wrong his reply was so strikingly characteristic that it seems worth while to reproduce it from my note-book, to whose unerring memory I entrusted all such matters. * * * "On one occasion when I complained to him frankly that it seemed wrong to employ so many of his force on private work, and that too much of that sort of thing was done by him daily, and cited as one of several instances the time when so many were engaged for more than a year in making a restoration in papier-mache of his (so-called) *Dinoceras*, he said, "Now I simply say this to you, I *have a contract direct with the Government for the restoration of Dinoceras.* What do you say to that?" There was nothing for a gentleman to say to so straightforward a statement, but I could scarcely believe my senses a moment later, when he explained that he had asked me as a favor to help him out,—that the time required for the completion of these restorations had been so gravely miscalculated that it had taken twice as long as they had judged to finish them, and he was sick and tired of the whole matter. "Besides it had cost tremendously, and, *every cent comes out of my own pocket.*" Then I suggested that heads of departments with "contracts direct with the Government" didn't pay for things out of their own pockets. He declared several times that I didn't understand. "You see it is this way; I am going to make the restorations, and the Government assures me it will pass a bill to pay for them, so you see it is all right." The strikingly characteristic part of it is that he really hadn't a contract when he said he had. When the investigating committees shall have inquired into the exact price the Government has paid for one paper model of Dinoceras (and a frail one at that) some interesting figures will surely come to light. His zeal to out-rival all others in the startling size of his fossils has led him to send out casts of heroic stature, and you natives and foreigners who have the great saurian femur ("*Atlantosaurus*" *immanis*) "exceeding eight feet in height," may saw off a two-foot back-log from the same, and then it will stand as high as it does in the Yale Museum to-day. And you authors of manuals of Geology, written in all sincerity for the honest and reliable instruction of the youthful mind, may lop off the same amount of plaster from your clean text. Neither was the huge Saurian one hundred feet long, nor was its great thigh bone over eight feet in length. It should be further stated for your information that the author of this greatest of femora allowed this mistake to remain uncorrected in the proof of Dana's Manual of Geology, which was submitted to him, after he and all around him could not help knowing it was false. [Figs. 3, 4.] And you students in universities and colleges throughout the world may turn to page 433 of Dana's Manual of Geology (third edition) or to page 462 of LeConte's Elements of Geology, or to page 779 of Geikie's Elements of Geology (not to mention other authors, for who can follow a deception through all its infinite ramifications!) and may draw your merciless pen through "more than eight feet high" and write "more than six."

4.

3.

FIG. 3.—Femur of "*Atlantosaurus*" *immanis* as it stands in the Peabody Museum to-day (more than six feet high).

FIG. 4.—Cast of femur of "*Atlantosaurus*" *immanis* (more than eight feet high), sent out to the museums of the world.

In ordinary cases the world would relegate this to the category of mistakes, but when the fragments refuse absolutely to go together, and when a skilled foreign modeler tries for days to reconcile fact with fiction, and tells his employer so, and when he "must match the pieces" by building them up with modeler's clay, then it is that the mistake looks so deliberate that the world withdraws its mantle of charity.

Plaster in bulk is cheap we know, but, when misused, will cost a man his reputation. When Professor Marsh made his notorious "*Bison*" *alticornis* blunder,—describing, for a second time at least, a reptile as a mammal,—the horns as they came in from the collector were not satisfactory,—from a bison standpoint,—and were straightway broken apart, straightened up, and given the "proper sweep."

All the ugly chinks were filled with the ever-ready mixture, and the helpless old "*Bison*" *alticornis* came out of it all with a nobility of front creditable to the king of bisons himself, but with his personal appearance so touched up withal that he couldn't tell himself whether he was a bull bison from the Tertiary, or an outraged reptile from the Mesozoic. Nor could anyone for that matter. But when future generations shall have chiseled away the plaster from the cavities, foramina, and sutures, its real identity may be re-established (Figs. 5 and 6).

FIG. 5.—The horns of "*Bison*" *alticornis* Marsh, as nearly as they appeared when received as is possible in their present condition. Colored plaster, once applied to a specimen, cuts off much that is worth knowing.

FIG. 6.—The same as they appear in the illustration, with no hint of the colored plaster. See *American Journal of Science*, Vol. XXXIV., October, 1887.)

But in the mean time illustrations of the "Bison" horns go out to the world (see *American Journal of Science*, Vol. XXXIV., October, 1887), but without the slightest intimation of the plaster hiatus there. Now that it turns out a horned reptile, and not a bison at all, he neither represents the live animal, nor the specimen as it came from the quarry.

Fortunately, a plaster of Paris deception, once set, is just the hard and lasting, and perfectly tangible sort of falshood that Science, without reserve lays rough hands on. And the day has at last come, we hope, when specimens from the plaster of Paris formation will no longer be accepted by science as fossils, and the "Plasterosauri,[1]" and "Plasterotheria" will be things of the past.

In his great antedated volume on the Dinocerata, the figures of his so-called *Dinoceras* and *Tinoceras* are plump with plaster. Why, in these plates of the Dinocerata many of the skulls and bones show not a trace of their construction! How strongly contrasted with this are the methods of all other American and foreign geologists, both as regards the specimens themselves, and the illustrations of them. These true paleontologists figure what they have, and do not figure what they have not (Figs. 7 and 8).

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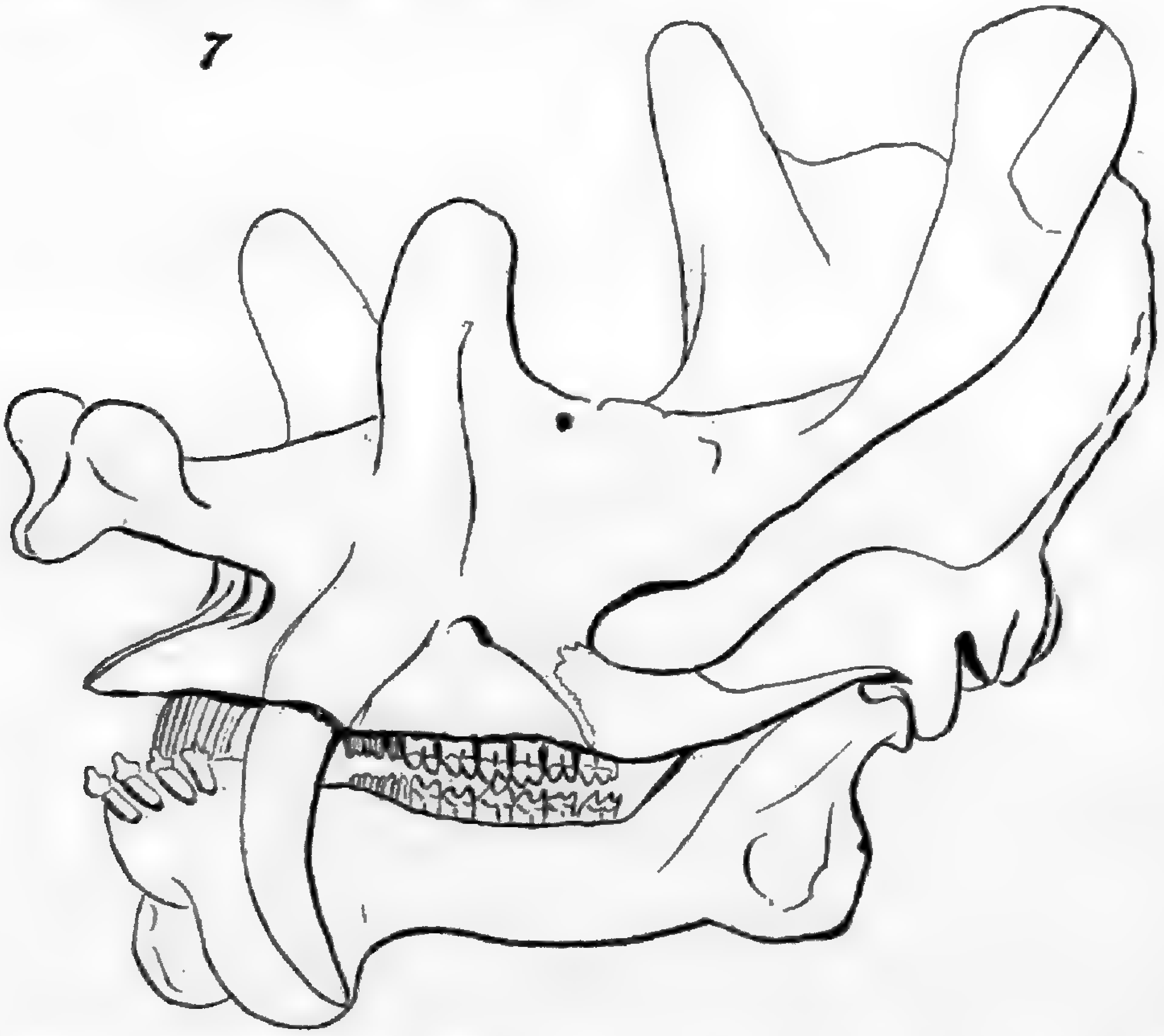

FIGS. 7 and 8.—Skulls of the Dinocerata, introduced to illustrate differences of treatment by different authors. FIG. 7.—Skull of *Loxolophodon ingens* Marsh, illustrating fairly the whole work on the Dinocerata. It will be noticed that the figure is free from anything suggestive of the blemishes covered up with colored plaster.

Speaking of *Dinoceras* and *Tinoceras* brings to mind that interesting time when his review of the Dinocerata, admittedly prepared by

[1] Plasterosauri not original. A name facetiously applied (to the great merriment of the force) by a Yale professor, to whom Professor Marsh was showing his various *Sauri*.

himself, was signed by the initials of his type writer amanuensis, after it had been rejected by two of his assistants; facts that were generally known and commented on by his assistants at the time. But where are the bones of *Tinoceras?* I have not seen them myself, save a skull, and one or two foot bones, and possibly a pelvis, and assistants best informed on this group declare that but few existed at all Yet the superb plate shows not a missing bone save a few caudals. Every vertebra, every rib, all the limb bones to the smallest bones of the feet, are perfect. Such a complete specimen was never known. There is a hole in the saucepan somewhere. Then too, it is my distinct and positive recollection that when preparing the restoration of

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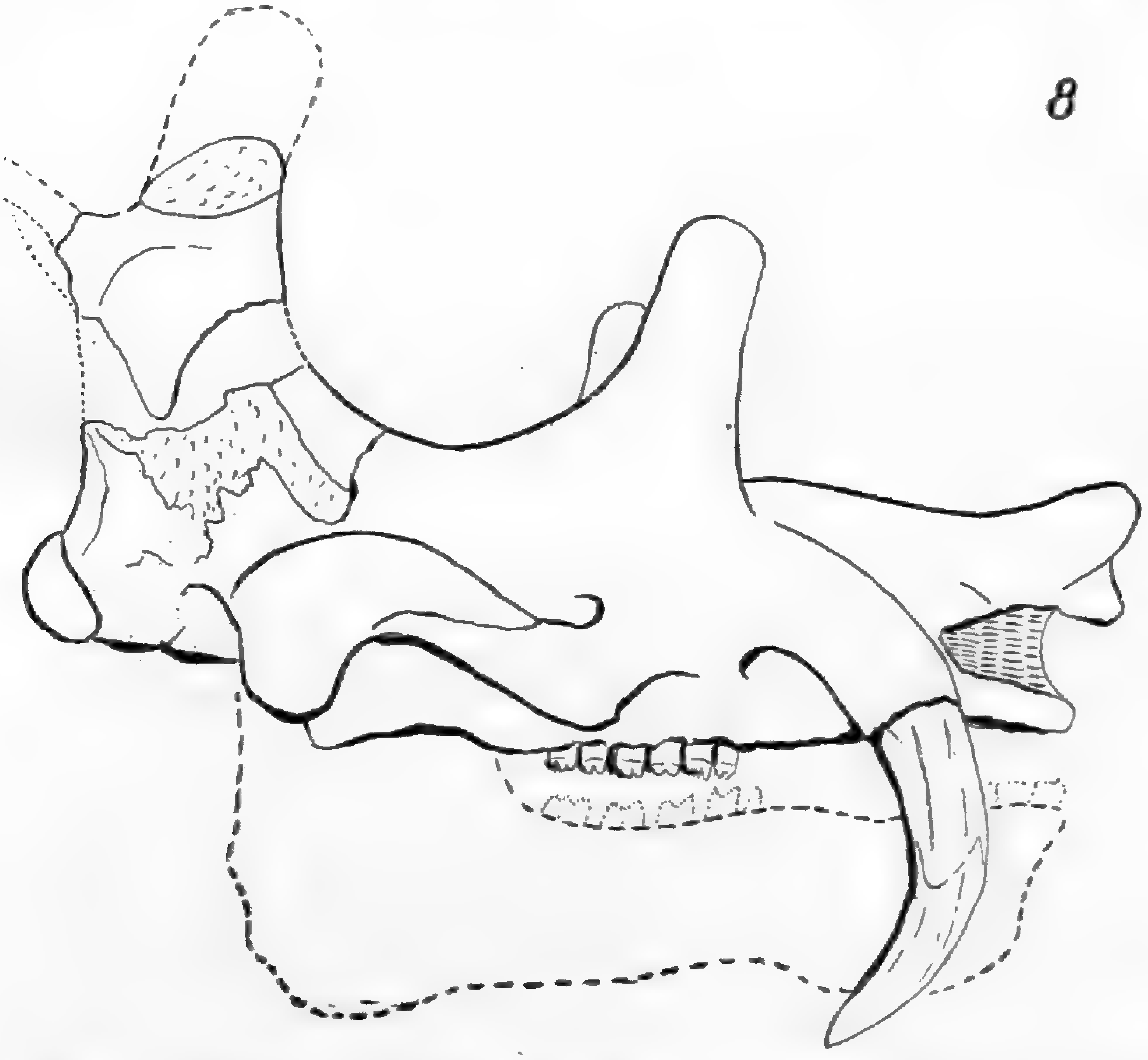

FIG. 8.—*Loxolophodon cornutus* Cope, from Cope's plate in the Tertiary Vertebrata.

Tinoceras he gave directions that the drawings of *Dinoceras* be enlarged one-fifth, and have a three-quarter view instead of side view, so that it wouldn't look too much like *Dinoceras*. These facts were rather freely criticised at the time, leading us often to mirthful considerations of the unusual elasticity of conscience which a Government paleontologist must have to stick the head of one individual on the enlarged carcass of another, and to found thereon a new genus and species for publication in an official monograph. Out of all this is evolved a paleontology so untrammeled by scientific conventionalities that it is free and spotless from those ugly cross-bars, light shading, and simple outlines indicative of missing parts, and quite as free from acknowledgment of priority, and recognition of the works and discoveries of others. But high art paleontology, not content with the omission of tell-tale bars and outlines, goes, with its long acquired momentum, still farther, and produces plates with such ingenious similarities and differences that the very elect are deceived by the realistic effects shown in the missing parts. These are flanked with text fraught with such subtleties and ambiguities that highly-plastered up impressions are easily conveyed.[2]

In substantiation of the frequent charges that Professor Marsh preempts land to shut out other geologists, I am ready to add my weight of testimony. More than that, he himself tells of putting hindrances in the way of younger geologists, for when one of his workmen said one day that "Professor Osborn had published a paper with a restoration of Brontotherium," he came to my room greatly agitated, declaring that Professor Agassiz had simply played him false, having promised that Professor Osborn should not see the collections at Harvard at all, and then he not only let him see them, but also describe them. When a former assistant secured a desirable position, Professor Marsh vowed if he had only "known it sooner the man would never have gotten that place." Not only does he avoid helping his assistants to better positions in geological fields, but he often hinders them by trampling on their good names when gone. We assistants watched the evolution of a falsehood from his lips, from the day when he said, "that man has resigned" to the month when he said, "I had to let him go; he was a bad lot," until still later he "dismissed him because he was unreliable and light-fingered." Thus it happens that some judicious assistants on resigning have shown commendable forethought in requiring of him papers, showing that they were not dismissed, as protections for their character against evil words and insinuations. Then by his ever-recurring, never-ending expressions of hatred and distrust, Professor Marsh methodically tries to fill to saturation the minds of his young assistants with prejudice against his contemporary in paleontology (Professor Cope). These are but allusions to his

[2] When one writes that "the diplosphene has long been known," the uninitiated might never suspect that the word had been coined for the occasion, to overthrow a name "hyposphene," proposed by a contemporary for a new osteological point.

hindrances put in the way of others in his attempts to monopolize paleontology in the East and West.

Can the people see the Government specimens? No, they cannot! and in all justice to the present management, possibly there is no reason, as he claims, why they should. After Professor Silliman and Professor Cope "went through" his collection, as Professor Marsh charges, we were directed not to admit even Professor Silliman or any of the Yale faculty, much less a stranger,—a demand so unjust that I for one refused, once for all, absolutely, to do anything of the sort. Newspaper men were particularly guarded against, even the editors of the college papers. Professor Benjamin Silliman was not only a member of the Yale Faculty, but was also one of the trustees of the Yale Museum, and I am one of the "two witnesses" who saw Professor Cope, at the invitation of Professor Silliman, "commit his depredations" on Professor Marsh's "private specimens," by walking through his open rooms. Professor Silliman and Professor Cope spent but a few minutes in each room. I saw them come and go. Professor Cope scarcely looked at the specimens, and didn't touch or uncover one, as I will testify under oath, Professor Marsh notwithstanding. So the scandalous half column devoted to the "depredations" and "outrages," and other designedly damaging statements, has only the most visionary foundation on fact. That his connection with politics should lead him to stoop from the high plane of a scientist to that of a scheming demagogue is a disgrace worthy of publicity. It is just such traits of character as this that have cost him the friendly support of all his assistants. A certain faithlessness runs through all his doings, so it is not to be marvelled at that it crops out in cuts and text. One important assistant, on private pay, not independent at the time (drawing a small salary, not half his just deserts), was asked as a favor to be listed on the Government pay-roll, to which he readily agreed as a matter of accommodation, only to find, the next quarter, that his salary had been cut down two hundred dollars. These facts, and many that are necessarily suppressed for the nonce, in consideration of the present members of his force, coupled with his insincerity in scientific work, will help to explain why the *personnel* of his force undergoes such constant and rapid change. High-spirited young men, college graduates, cannot and will not tolerate such associations and environments.

In the matter of drawings, Professor Marsh sacrifices veracity and honor to secure high art in his illustrations, and the Government pays the bill. Not only does he assiduously avoid combining figures on the plates, but he makes all drawings on a large scale, necessitating many double and quadruple folded plates.

He even goes to an extreme that is simply culpable, and makes some drawings natural size. To be specific, one such plate, representing a full-length drawing of an enormous caudal vertebra of "*Brontosaurus*" *excelsus*, is not far from three feet wide by four feet long, nearly equaling sixteen plates of ordinary size. Any lithographer can tell you about what the Government doles out for luxurious display of this sort. One plate would have given a very liberal space indeed for the figure of this unimportant caudal. The idea that to be scientific drawings must be full length! Let us rejoice that Professor Marsh is not called upon to write up, at the expense of the people, the natural history of the whale. But the cost of gorgeous plates is a mere bagatelle to the public treasury compared with the waste resulting from his natural indolence and mismanagement. Just think of leaving a large force of men without superintendence; no one to direct or advise! As a matter of practical business experience such a method is simply disastrous, and right here we may look for a rational explanation of the fact that Professor Marsh accomplishes but little, although his force is large and competent. He actually compels the men to hunt for work, instead of so appointing it as to secure their best efforts, and in general manages with such culpable deliberation that Government contracts for monographs lapse unnecessarily,[3] and in twenty-five years two monographs only appear to show for the talent and appropriations expended! But Ease finding itself outwitted by Industry, ingeniously catches up with all rivals by an antedate,[4] and we record one more quibble in the growth of a monograph.

On consulting my books I find myself writing indignantly about this matter as much as four years ago, and mentioning his spending every moment on trivial details which concerned the workmen only, instead of inspiring greater effort, or urging on the work as a whole. Or, as Mr. Harger has often told me, to illustrate Professor Marsh's eye for the small things, "I have seen him sign his approval to a plate having the name spelled wrong, and even the bone upside down, without seeing either mistake, but a comma with a broken tail had been carefully marked." (The entire edition of two plates was printed with the bones wrong end up.) Countless petty things

[3] As the author remembers it, each of three contracts for monographs have lapsed, been renewed, and lapsed a second time.

[4] The reference is, of course, to the Dinocerata, antedated to keep pace with the Tertiary Vertebrata, published in 1885, but before the Dinocerata.

detained him from the museum, such as buying Jersey cows, orchids, etc. A calving cow has detained him till dark—that, too, at a time when he was to leave the next day to be gone a fortnight. With even moderate industry his Sauropoda contract could not have lapsed, nor could his Stegosauridæ and Brontotheridæ contracts have shared a like fate. In all justice, however, to Professor Marsh, it should be stated that the best interests of the Survey demand that he should have the utmost freedom in going, coming, or absenting himself outright from the laboratory. But this does not excuse him for leaving his force without some one to systematize, plan, and direct the work effectively. Then his inefficient business methods as regards the salaries of his assistants lead to endless friction and general dissatisfaction. Not only does he dole out the pay quarterly,—not monthly, as the Government does,—but often, even then, postpones the pay-day from two or three days to as much as three weeks, and then at the end of this time makes matters still more annoying by all sorts of petty quibbles, and what we called "Marsh's tricks." On one occasion, during my earlier experiences on the Survey, he handed me the vouchers and a receipt in full, all of which were duly signed. He in turn signed a check for payment in part (deducting some fifty dollars), which he handed over, explaining in all candor that "the balance would be made good at the end of the year." "It's a way they have on the Survey." But as it was a way I didn't have, and "though his word was as good as his bond," another check was forthcoming. Forgetting this failure, the same untrue and unfair game was tried again later with like results.

His unpardonable neglect of proper superintendence costs the Government far more than all his sumptuous high art works on paper and in plaster. The only time when Prof. Marsh does show signs of real industry is when he rushes precipitately into the description of a "new genus." Utterly disregarding the advice of his ablest assistants, and neglecting those thorough investigations which might check his growing list of useless generic names, he describes his specimen on the first impulse, and his list is swelled by one more name. A sacrum comes in "consisting of only three vertebræ" (the other two knocked off): he sees in it a "totally different genus," and though it is contrary to all probability and to the advice of his assistants, he industriously founds a new genus and species on it. (See *American Journal Science*, Vol. XVII., January, 1879; also text-books of geology.) Should the Geological Survey by any chance be crippled by the recent overhauling of Prof. Marsh's methods, it would be a national loss, but it is certain that the present paleontologist deserves such a reprimand that he will be forced to adopt methods recognized as legitimate by scientists. Whether such men as Prof. E. D. Cope, Prof. Persifor Frazer, Dr. T. Sterry Hunt, Dr. F. M. Endlich, and others, are moved by envy, malice or hate in agitating this geological controversy, matters little—that is precisely the cheap kind of retort the world expects; yet the fact remains that Prof. Marsh's assistants and others are marshalled against him also. No man engaged in scientific pursuits, however flanked by wealth and influence, can possibly hope for the support of high-minded, honorable men, if his course is such as to lay him plainly open to charges of trickery, plagiarism, illegitimate methods, disregard of the works of others, the rights of priority, and incompetence in general. Although the present paleontologist may, by the very weight of his official position and influence, avoid the scrutiny of an investigating committee, which in common justice he should not escape, he cannot but be weighed in the balance by scientists and found wanting.—Erwin H. Barbour, Ph.D.

Iowa College, March 15, 1890.

Die Spinnen Amerikas.—The death of the German araneologist, Count Keyserling, made a large breach in the little circle of working araneologists. It was known that he had left a large amount of manuscript for the concluding parts of his work, "Die Spinnen Amerikas," and this, it was feared, would be lost to science. But the publishers, with praiseworthy enterprise, have resolved to complete Keyserling's work as far as possible after the original plan. They failed, however, to find any one in Europe who would edit the finished manuscripts and complete the fourth volume, which treats of the Epeiridæ. In this emergency they solicited the aid of Dr. George Marx, of Washington, D. C., who has at last consented to undertake the task. Being a thorough German scholar and a well-furnished araneologist, Dr. Marx is admirably equipped for this duty. A large part of Count Keyserling's manuscript, which was in a good degree of forwardness, has already been edited, and will soon be ready to transmit to Germany. Dr. Marx will then edit the notes upon the Orbitelariæ, and add descriptions of the species which Keyserling had not reached at the time of his death. He will thus contribute about one-third of the matter in what will constitute Volume IV. of "Die Spinnen Amerikas."—Henry C. McCook.

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THE HOMOLOGIES OF THE FINS OF FISHES.

BY E. D. COPE.

I. THE RELATION OF FINS TO LEGS.

ALTHOUGH it is well established that the paired fins of fishes are, as a whole, homologous with the limbs of the higher vertebrates, and although many naturalists have given their views upon the homologies of the respective parts, the subject is yet involved in considerable doubt; and, as stated by Prof. Huxley in 1871, the basal and radial supports of the fins themselves can only be identified in the most general way with the limb-bones or cartilages of other vertebrata.

The doctrine that the vertebrate limbs are modified ribs was advocated, to a varying extent and with modifications, by Maclise[1] (1832) and Oken[2] (1843); while Owen[3] (1848) regarded them as diverging appendages attached to ribs, with a shoulder-girdle of axial origin. Professor Goodsir[4] (1857) considered the limbs as homologous with the epipleural spines of fishes, and external to the proper visceral wall of the body. Professor Humphrey[5] (1871) concluded that the vertical fins were of bifold origin, since

[1] Todd's Encyclopædia, Vol. IV., p. 70. Fig. 490.

[2] Lehrbuch der Natur-Philosophie, p. 330.

[3] Archetype and Homologies of the Vertebrate Skeleton.

[4] *Edinburgh New Philosophical Journal*, Vol. V., 1857, p. 178.

[5] *Cambridge Journal of Anat. and Physiol.*, Vol. V. (Second Series, Vol IV.), p. 58, Plate II.

the dorsal and ventral mid-lines of the body are formed by the junction of the bifold *laminæ dorsales* and *ventrales*. He considered that the pectorals and ventrals were certain portions of the lower azygos fins, prevented from uniting by the interposed body-cavity. Maclise had previously regarded the distal portions of the limbs as corresponding with the azygos fins. In

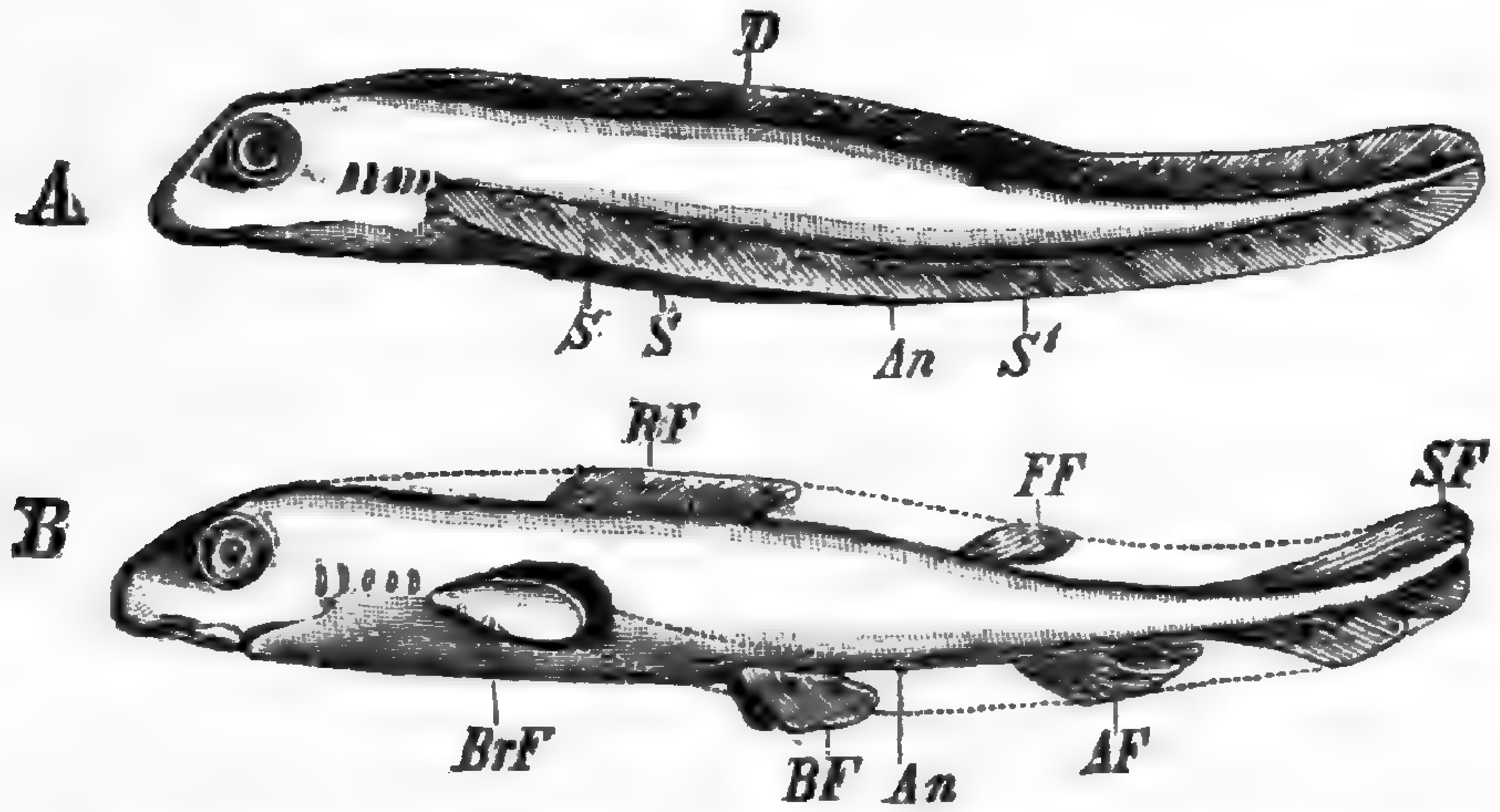


FIG. 1.—Diagrammatic representation of primitive and derivative types of lateral and median fins. *A*, primative condition, fins continuous; *B*, derivative condition, fins distinct and specialized; *D*, dorsal fins; *Br F*, pectoral; *B F*, ventral: *A F*, anal; *S F*, caudal; *R F*, dorsal; *F F*, second dorsal fin; from Wiedersheim.

1876 Balfour[6] described the development of the limbs of Elasmobranchs as "special developments of a continuous ridge on each side, precisely like the ridges of epiblast which form the rudiments of the unpaired fins," and concludes from this "that the limbs are remnants of continuous lateral fins." The primitive folds persist in the vertical and caudal fins, while the paired fins represent portions of such folds (Fig. 1).

As regards their intimate structure, those of the Elasmobranchs and Polypterus occupy in some sort a middle term between those of the Teleostomata and those of the Dipnoi. In order, therefore, to trace out the homologies between the segments of the paired fins of the Teleostomata and those of the limbs of the Reptilia, the parts must be traced in lineal order through the following classes or sub-classes: Reptilia, Batrachia, Dipnoi, Elasmobranchii, Teleostomata. (Figs. 2, 3.) Naturalists dis-

[6] Ibid., Vol. XI., Part I., p. 132.

agree in the interpretation of the homologies of these parts, but if the view enunciated by Balfour of the origin and development of the paired limbs is the correct one, it is possible that a homology can be traced along the downward scale of limb-development from the Batrachia on the one hand, and the Teleostomata on the other, to the ancestral type of the Ichthyotomi of the Carboniferous, the oldest limb type known.

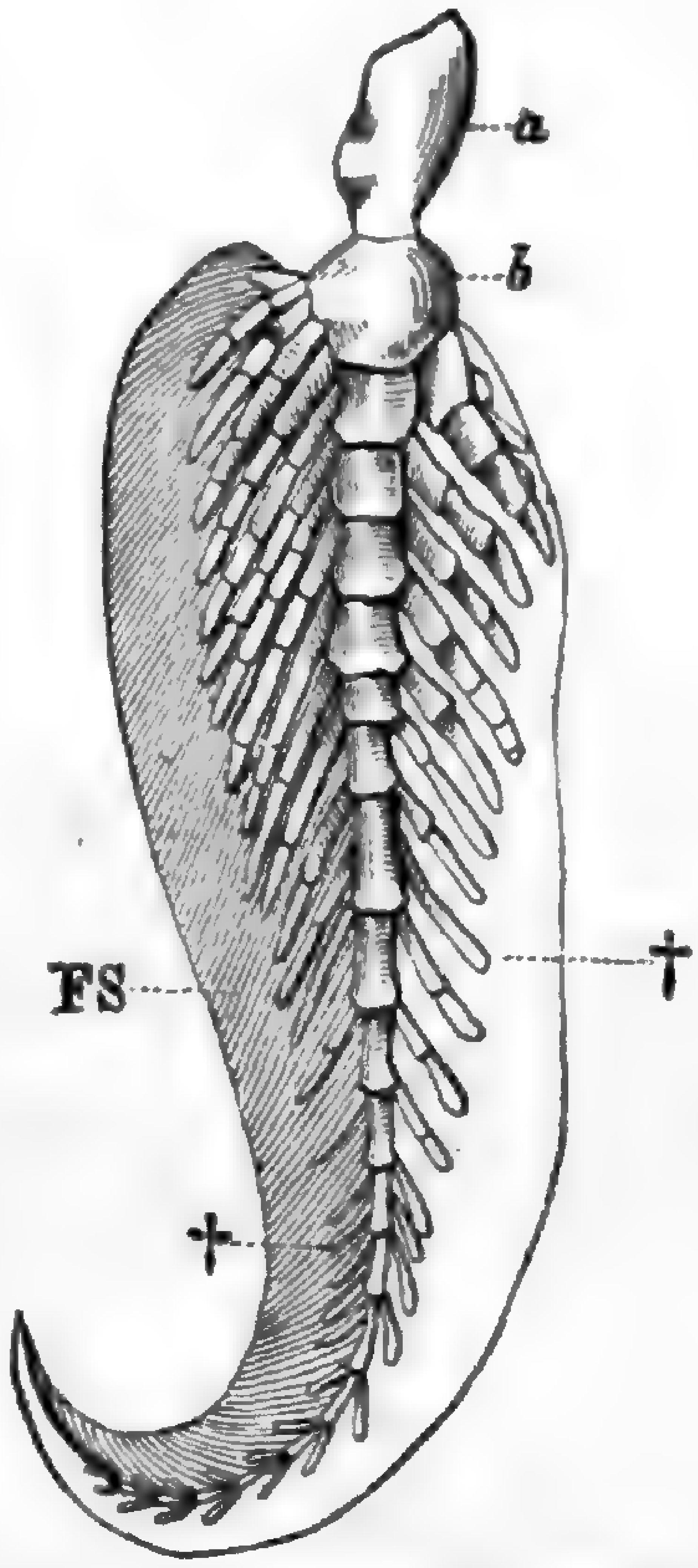


FIG. 2.—*Neoceratodus forsterii*, pectoral, fins, unibasal type; *a b*, axial elements; †, radials; *F S*, fin-rays; from Wiedersheim.

Dr. Gill[7] traces out the relationship of the members of the shoulder-girdle in the Dipnoi with those of the Batrachia as follows: The proximal element of the anterior limb of the Dipnoan is the homologue of the humerus. In the Urodela the humerus is articulated chiefly with the coracoid; therefore, the element of the Dipnoan shoulder-girdle with which the humerus is articulated is the coracoid, unless evidence to the contrary can be produced. The scapula in the Batrachia is entirely or almost excluded from the glenoid foramen, therefore the corresponding element in the Dipnoi must be the scapula. The element of the Dipnoan shoulder-girdle continuous downwards from the scapula, and to which the coracoid is closely applied, is named by Gill the ectocoracoid. Each half of the shouldergirdle is surmounted by an element which is named the supraclavicle by Gegenbaur, the suprascapula by Gunther, the scapula by Owen; and this is in turn connected with the skull by another element, the posttemporal of Parker and Gill, who justly observe that there is an *à priori* improbability against the homology with the scapula of any part having a ligamentary connection with the humerus-bearing element.

[7] Arrangement of the Families of Fishes, Nov., 1872. Smithsonian Misc. Col., Vol. XI.

As far as his argument applies to the Dipnoan pectoral Gill, may be safely followed, except in his view of the element abutting upon the occiput, which he regards as having intimate relations with the skull, and probably originating from it. In tracing back the homologies of the parts of the Dipnoan to those of the teleostome shoulder-girdle, Dr. Gill is less cogent, and the nomenclature adopted by Gegenbaur[8] appears preferable. The latter author figures the right half of the shoulder-girdle and the thoracic fin of a teleostome fish (Gadus). Here there is no humerus

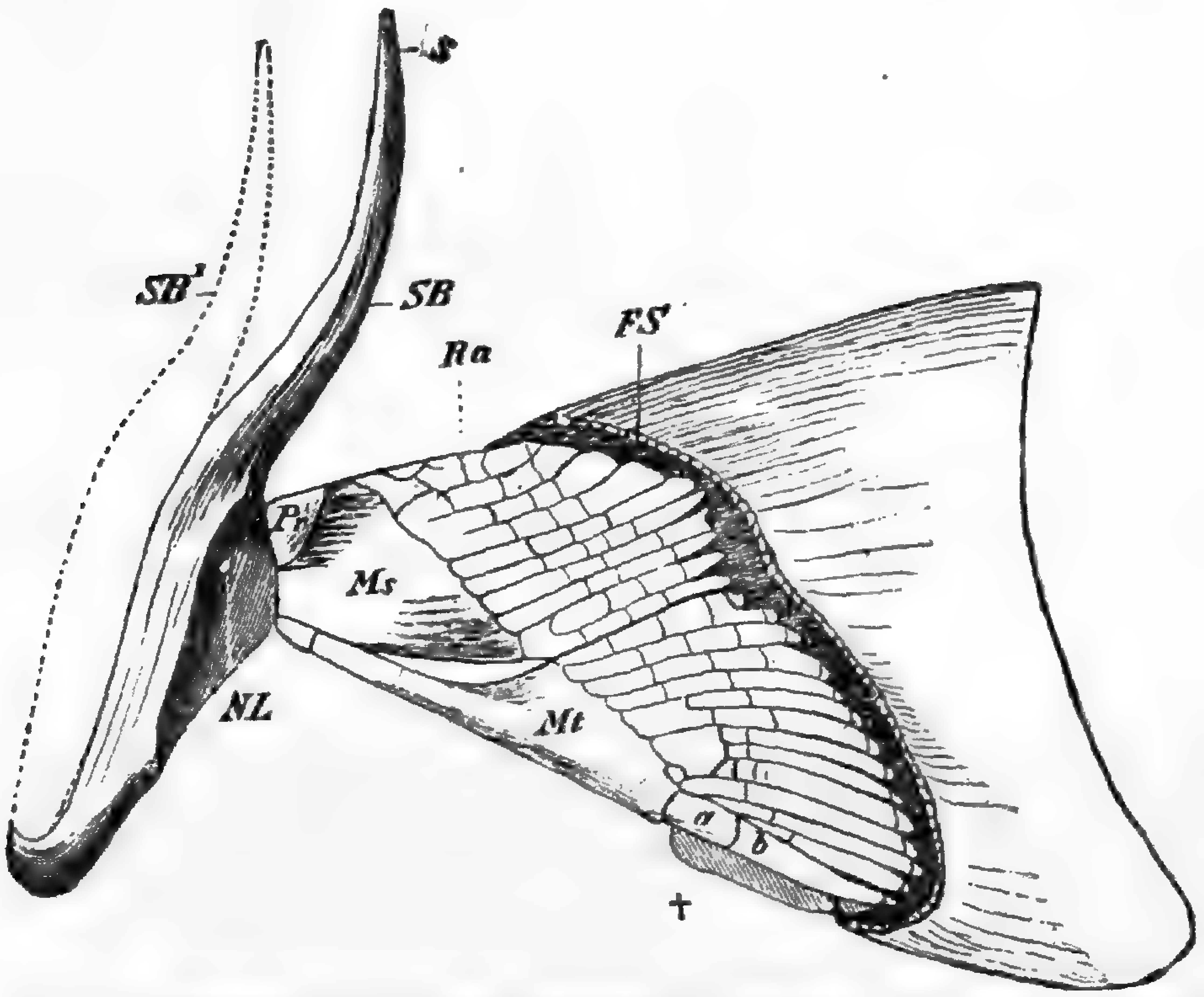


FIG. 3.—*Heptanchus griseus*, left pectoral fin, pluribasal type. *SB*, scapular arch; *NL*, foramen; *Pr*, propterygium; *Ms*, mesopterygium; *Mt*, metapterygium; *a b*, exis of metapterygium; *Ra*, basilars; *FS*, fin-rays; from Wiedersheim.

recognizable as such, but that the so-called "carpals" or basilars of the fin are regarded as representing it, is evident from the fact that the bone to which they are attached is styled the coracoid, and that which abuts against it the scapula. The element corresponding to the "proscapula" of Gill, and formed, according to him, of the united scapula and ectocoracoid, is by Gegenbaur called the clavicle, which is attached to the supraclavicle

[8] Elements of Comparative Anatomy, Second Edition, p. 475, 1877.

above. The bone connected with the skull is, as has been said before, named the posttemporal by Parker. The clavicle of Gegenbaur is the coracoid of Owen,[9] while his scapula is Owen's ulna, and his coracoid the radius. As Gill remarks, Owen first sought to determine an ulna and radius, and then identified the other bones from their relations to it. (Figs. 3 and 4.)

But, even though the terms used by Gegenbaur be adopted as representing most nearly the correspondences between the parts of the shoulder-girdle of the Dipnoi and Stapedifera on the one hand, and those of the Teleostomata, Crossopterygia, Podopterygia, and Elasmobranchs on the other, an exact homology is not yet positively assured. Hence Gill has subsequently termed Gegenbaur's scapula hypercoracoid, and his coracoid the hyopocoracoid.

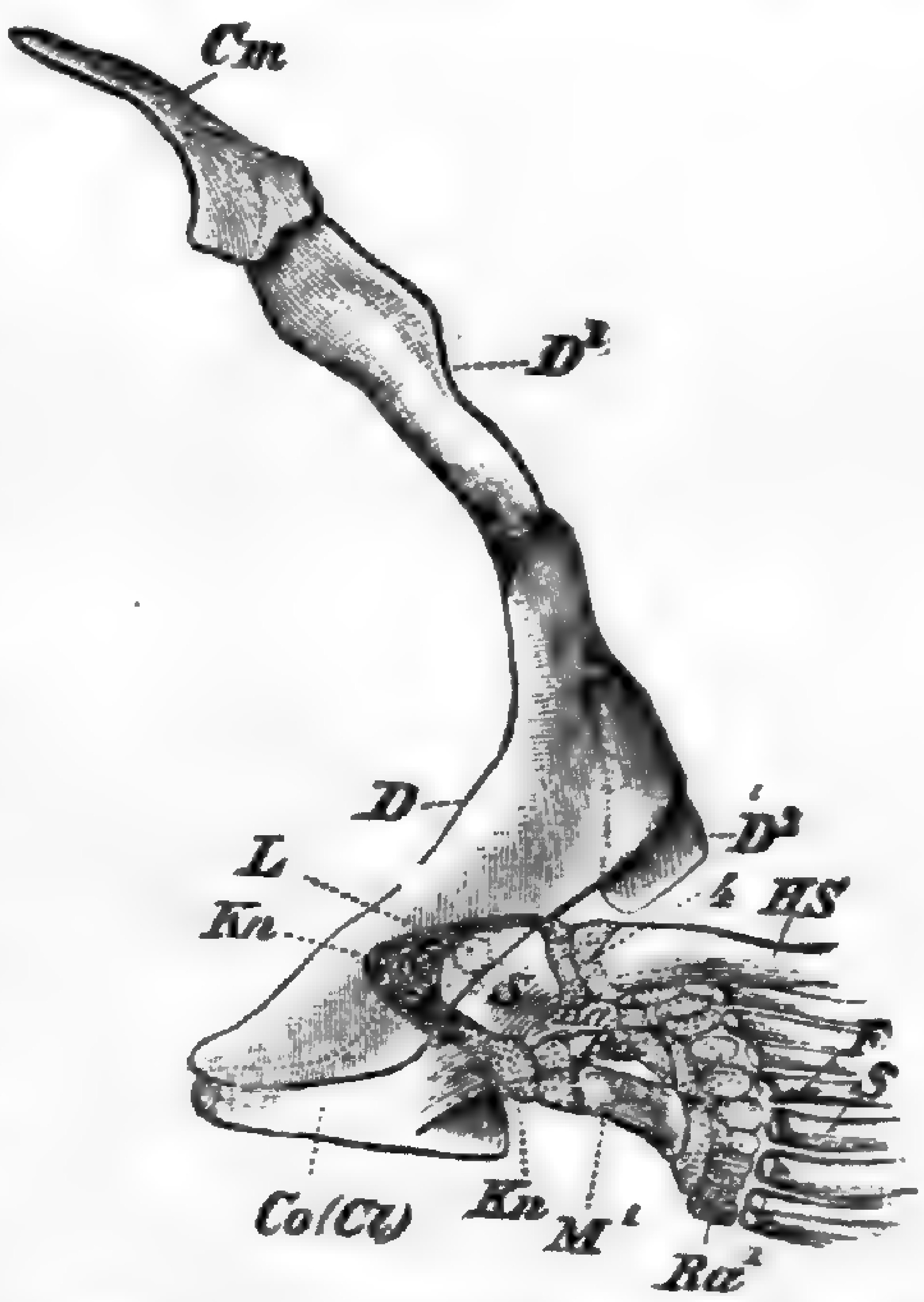


FIG 4.—*Salmo fario*, left shoulder-girdle; *Cm*, posttemporal; D^1, epiclavicle; *D*, clavicle; D^2, postclavicle; *S*, scapula; *Co(Cl)*, coracoid; *Ra*, basilars; *L*, scapular foramen; *HS*, *FS*, fin-rays.

In the ventral fins the process of concrescence is carried to a considerable extent in Polypterus and the Chrondrostei, and farther still in Amia, Lepidosteus and the Teleostomata, which agree in the possession of a single large elongated element proximal to the basilars in each ventral. To this base are attached four long basilar rays in Polypterus, nine in *Accipenser brevirostrum*, and three minute ossicles in the Teleostomata. The elongated supporting bone is styled by Thacher a pubis, and Wiedersheim has recently shown that it is a part of the pelvis, and, being preacetabular, is the homologue of the pubis.[10] The conclusion that can be arrived at from a study of both the pectoral and ventral fins is that the limbs of all air-breathing mammals or Stapedifera (possessed of a stapes) form a group

[9] Comp. Anat. and Physiol. of Vertebrates, Vol. I., p. 106.

[10] *Anatomischer Anzeiger*, 1889, IV.

more nearly related to each other than any of them are to any other vertebrate groups; and that the archipterygian form is to be found in the unibasal pectoral and ventral fins of the Ichthyotomi, the unibasal Crossopterygia, and the Dipnoi. (Plate XIV.)

These are substantially the conclusions arrived at by Mr. Thacher,[11] who names the group composed of the Dipnoi and higher vertebrates the Choanata, from their possession of "choanæ," or posterior nares opening behind the lips. But the Ichthyotomi and the unibasal Crossopterygia were not known to him.

According to Gegenbaur,[13] the archipterygium, or primitive form of limb from which all the limbs of the Gnathostomes, or vertebrates with lower jaws, have been developed, is to be found in its parent form in the limb of Ceratodus, which consists of an elongated, tapering, many-jointed rod, bearing upon each side a series of rays. In a previous paper,[14] the fin of Protopterus, bearing on the outer side only a series of rays, had been taken as the type. In the second edition of his "Grundriss," Gegenbaur adheres to the idea enunciated in his later article,[15] and identifies the metapterygium of Acanthias and other Elasmobranchs, plus one only out of the many rays, with the main stem of the fin of Ceratodus; while the propterygium, mesopterygium, and all the

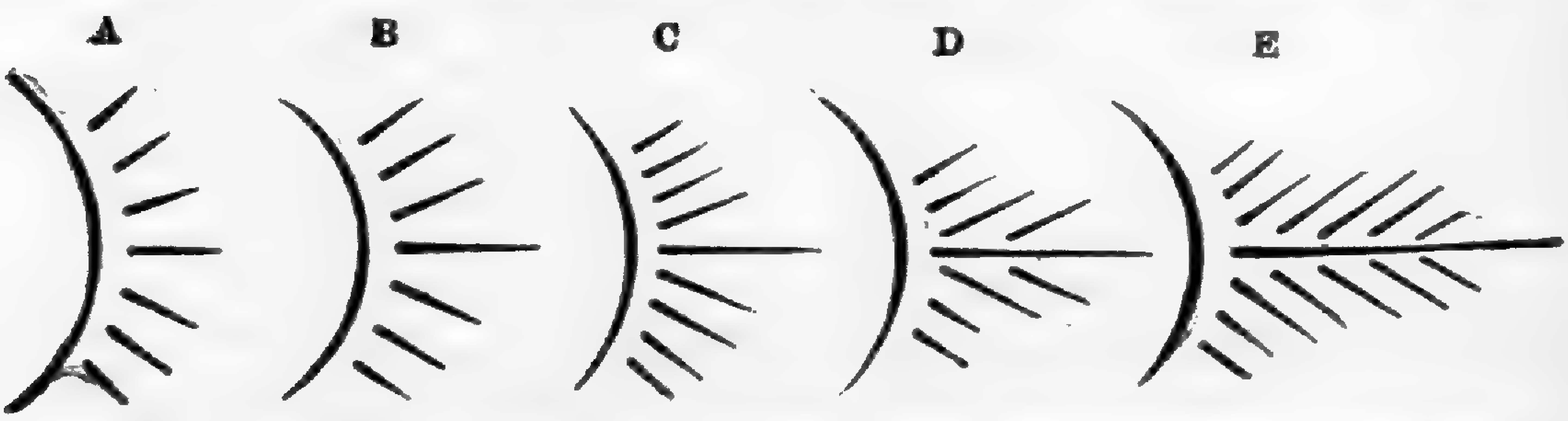


FIG. 5.—Archipterygium *E*, and transitional stages to actinopterygium *A*, according to Gegenbaur; from Wiedersheim.

other rays of the Elasmobranch fin are regarded as developments from the lateral rays of a Ceratodus-like fin. By a further slipping off of the rays from the main- or stem-row, Gegenbaur derives the many-rayed fins of the Teleostomata from those of the Elasmobranchii, which he has previously asserted to be derived

[11] Ventral Fins of Ganoids. Trans. Conn. Acad., IV., 1877, p. 242.

[13] Anatomy of Vertebrated Animals, p. 36.

[14] *Jena. Zeitschrift*, Bd. VII., Hft. 2, pp. 131-141.

[15] Ibid., Bd. V., Hft., 4.

from those of the Dipnoi. Huxley,[16] in 1876, concurred in this view of the archipterygium, but regarded the main stem as passing through the fifth finger instead of through the thumb, an arrangement which Gegenbaur has adopted in his second edition. (Fig. 4.)

As has been shown, the view propounded by Mr. Thacher in 1877,[17] and also independently worked out by Prof. Balfour, namely, that the paired fins of all vertebrates are formed from a continuous lateral fold, corresponding to the median fold from which the vertical fins of fishes are derived, is that which is supported by the greater weight of evidence, and is now most generally adopted. It is strongly supported by the extinct genus of Acanthodean fishes, Climatius, in which a series of spines extends on each side of the abdomen from the pectoral to the ventral fins. And these spines are said to be similar to those which support the anterior border of these fins. The evidence of paleontology is, however, equally in favor of the unibasal paired fin (archipterygium) as the ancestral form, as it characterized the oldest Elasmobranchii (Ichthyotomi) and Crossopterygia, while the pluribasal type is of later age in both divisions of fishes. But it may have been derived from a continuous fin, as suggested by Climatius.

If this view be followed, the Dipnoan paired fins must be regarded as a derivative from the paired fins of the Ichthyotomi, which must still be looked upon as the form from which the limbs of the Stapedifera or air-breathing vertebrates have been derived. Baur believes that the latter have been constructed from a simple axis like that of Lepidosiren by a process of budding, and not by rearrangement of the branches of a fin of the Ceratodus type. The Teleostomata, although specialized in many ways, stand on one side of the upward line that leads to the reptiles, birds, and mammals, and their paired fins retain much of the primitive character.

2. THE RELATIONS OF FINS TO EACH OTHER.

The paired limbs of the higher vertebrates appear, at first sight, exceedingly unlike the fins of fishes, yet it has long been

[16] Proc. Zoöl. Soc. Lon., 1876, Pt. 1, on *Ceratodus forsterii.*

[17] Proc. Conn. Acad., Vol. II., p. 281.

believed by naturalists that the pectoral and ventral fins of the latter are the homologues respectively of the fore and hind limbs of the former. But between the paired fins of fishes and the median or vertical fins there are also resemblances which warrant a suspicion of their origin from similar primitive structures, nsomuch that it is now believed by many that the median fins are derivatives from a primitive continuous vertical fold, while the paired fins are the specialized remainders of primitively continuous lateral folds.

Cope, writing in 1870,[18] remarks upon the analogy that exists, on the one hand, between the succession in the type of the pectoral fin, commencing with the simple axis of the Dipnoi, and passing to the axis with lateral appendages or radii, seen in Selache, and, on the other hand, the succession by which the median fins of Polypterus pass from rays with a jointed, forked extremity continuous with the base (in the caudal part of the series) to the structure that obtains in the dorsal pinnules, which consist of a strong spinous ray from the posterior face of which a number of soft rays project. He also regarded the segments which support the dorsal and anal rays in ancient fishes and Elasmobranchs as homologous with those which support the rays of the pectoral and ventral fins, and calls them all basilars, and, in a later essay, [19] baseosts. He showed that the baseosts experience the same reduction with time in all the fins, being obliterated in the dorsal, anal, and ventral fins in nearly all modern Teleostomata, and being reduced to four or fewer in the pectoral fin in most of the same.

A most carefully worked out contribution to this portion of the developmental history of vertebrate appendages is that of J. K. Thacher,[20] who converts the analogy noticed by Cope into a homodynamism, and regards the Dipnoan paired fins, not as maintained by Gegenbaur,[21] as the primitive form or archiptery-

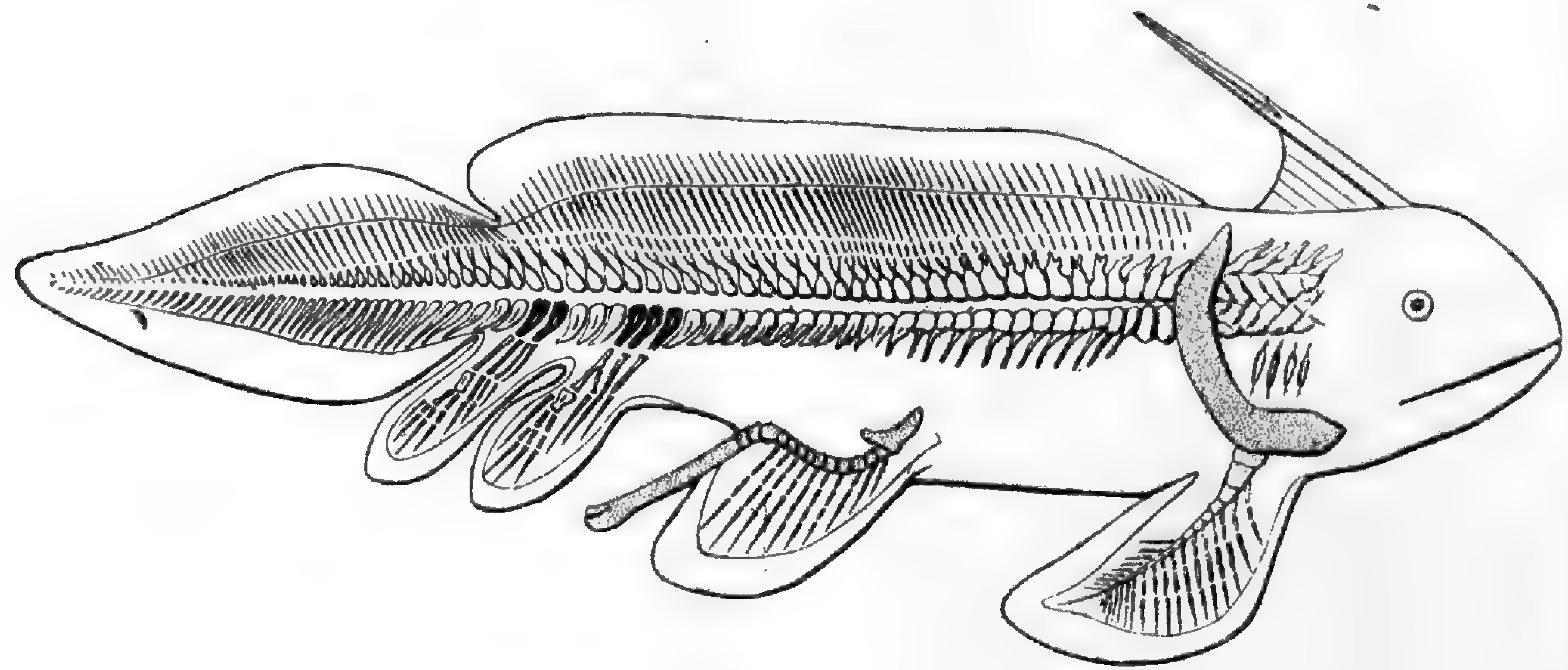
[18] Contribution to the Ichthyology of the Lesser Antilles. Amer. Philos. Society, XIV., 446-483, 1870.

[19] AMERICAN NATURALIST, 1887, p. 1016.

[20] Median and Paired Fins. Trans. Conn. Acad., Vol. III., 1877.

[21] *Jena. Zeitschrift*, Bd. V., Hft. 4. Gegenbaur über den Gliedmaassen der Wirbelthiere im Allgemeinen und der Hintergleidmaassen der Selachier in besonders. May, 1870.

PLATE XIV.



XENACANTHUS DECHENI.

gium, but as a derivative from the primitive series of parallel rays of the lateral folds.

The conclusions of this writer respecting the median fins are as follows: The primordial median fin-rays are derived from a series of parallel chondroid rods, which grow up in the median fold totally independent of the cartilaginous arches above and below the notochord. The earliest representatives of these parts, as the quadrate markings at the base of the median fin in Branchiostoma, and the fin-rays of Myxine and Petromyzon, are much more numerous than the vertebræ opposite them. Therefore, neither are median fin-rays derived from neural spines, nor neural spines from primordial fin-rays, but neural spines are formed by the dorsad prolongation and union of the neurapophyses of the vertebræ.

This statement, which is supported by the structure, not only of the lower fishes mentioned above, but that of the Elasmobranchs, which have from 2 to 3.5 fin-rays to one vertebra, and that of Acipenser, is in opposition to the earlier opinion of Gegenbaur,[22] who asserts that the primordial fin-rays, in their simplest form, are mere prolongations of the neural spines.

The primitive fishes have been shown by Cope to sustain the view of Gegenbaur. The invariable equality of number between the vertebræ and the actinophores (see section 3, below) in Dipnoi is supposed by Thacher to be the result of the entire loss of the primordial median fin-rays, the long and segmented supports of the median fold in Lepidosiren, Ceratodus, etc., being simply elongated neural spines. This view is not sustained by paleontology.

Carrying his argument onwards to the lateral or paired fins, Mr. Thacher shows that the ventral and dorsal fins of *Mustelus canis*, agree in every respect save the separateness of the basal elements in the latter, and their coalescence in the former, and argues that this certain amount of similarity warrants us in inferring an earlier state when the similarity was greater. The similarity between the structure of the anal and ventral fins of Acipenser is evident from an inspection of the figures. The theory put forward by Thacher, is, therefore, as follows: As the dorsal and anal fins

[22] Grundriss der Vergleichenden Anatomie, 1873, p. 488.

were specializations of the median folds of Branchiostoma, so the paired fins were specializations of the two lateral folds which are the homologues of the Wolffian ridges, in embryos of higher forms. Rods formed in both median and lateral folds. In the latter, these became at least twice segmented, the orad ones were prolonged inwards, more or less concresence took place, and the cartilages spreading, met below in the middle line, and later, extending dorsad, completed the limb girdle. Gegenbaur, in the later edition of his "Grundriss," has modified his views respecting the nature of the primordial fin-rays, since he says:[23] "Supporting organs, formed from the integument, are connected with the parts thus formed by the vertebral column (superior and inferior arches), and they are continued into the caudal fin. In the Selachii the fin-rays are formed by the so-called horny filaments, and in the Ganoidei and Teleostei by ossifications."

The same eminent anatomist, who has aided so greatly in establishing the relationship between the various parts of the simple paired fins of the Dipnoi, and those of the air-breathing vertebrates (Stapedifera, Thacher), refuses to concede the homodynamism of the median and paired fins, but adheres in the later edition of the "Grundriss" to the theory propounded by him in 1872,[24] namely: their derivation from the branchial arches, by the articulation of the simple lateral rays set upon those arches to the central ray, which gradually assumes increased length, and becomes an axis. In this way a fin like that of Ceratodus might be produced.

The views of Mr. Thacher are, however, supported by the independent but later observations of Balfour,[25] who found that in the embryo dogfish the lateral fins have precisely the same mode of origin as the dorsal median fin, arising "as special developments of a continuous ridge on each side, precisely like the ridges of epiblast which form the rudiments of the unpaired fins."

[23] Elements of Comparative Anatomy, by Carl Gegenbaur, 1877. (Translated by F. Jeffrey Bell, B.A., 1878), p. 431.

[24] Untersuchungen zur Vorgleichenden Anat. der Wirb., Hft. III., Kopfskelet der Selachier, p. 181, Note, 1872.

[25] Balfour. Development of Elasmobranch Fishes, 1878.

A later contribution to this branch of the subject is contained in a paper entitled "Notes on the Fins of Elasmobranchs, with considerations on the Nature and Homologues of Vertebrate Limbs," by St. George Mivart, published in the Transactions of the Zoölogical Society of London, February, 1879. After noting and discussing the opinions of Oken, Carus, Cuvier, Owen, Gegenbaur, Balfour, Parker, and others, upon this and other questions relating to the history of vertebrate appendages, the author states his conviction "that the nature of the paired and azygos limbs is fundamentally the same." This conviction was formed through finding various degrees of coalescence between the cartilaginous rays supporting the dorsal fins, and various degrees of connection or continuity between such fin-supports and the axial skeleton. *Scyllium canicula*, *Ginglymostoma cirratum*, and still more *Notidanus cinereus*, are examples of this. In the latter, the rays are supported by one continuous basal cartilage. Pristis and Pristiophorus show continuity between the dorsal fin-cartilages and the skeleton, and this may aid in the support of the saw-like rostrum. In Notidanus, Chiloscyllium, and Raia, there is much resemblance between the skeleton of the ventral and dorsal, in Notidanus, between the ventral and anal, while the ventrals of Polyodon are simple parallel rays like the simplest form of the dorsal skeleton. If the ventrals are thus admitted to be of the same nature with the vertical fins, the pectorals must also be of the same nature.

Prof. Mivart endorses the idea of Mr. Thacher with regard to the origin of the limb-girdles, viz.: that they are lateral ingrowths from the skeleton of the paired fins. The objection to this conclusion that has been drawn from the attachment of the pectorals by a shoulder-girdle instead of by direct longitudinal adhesion are met by the considerations that such adhesion would impede the flexure of the body in swimming, that the pectorals are too low to abut directly on the vertebral column, and that such connection is prevented by the intermediation of the body-cavity. The entire theory is thus summarized by Mivart:

1. Two continuous lateral longitudinal folds were developed similar to a dorsal and a ventral fold.

2. Separate, narrow, solid supports, with their long axes di-

rected outwards, were developed to a varying extent along the lines of these folds.

3. The longitudinal folds were interrupted variously, leaving two prominences on each of the lateral folds.

4. The anterior prominences (or limbs) increased more than the posterior.

5. The bases of the cartilaginous supports coalesced according to the needs of the various isolated parts or fins.

6. Occasionally the dorsal radials coalesced, and sought centripetal adhesion to the axis.

7. More constantly the hinder laterals coalesced, and finally prolonged themselves inwards by mesiad growths till such a pelvic structure as is found in Squatina was developed.

8. The pectoral rays also coalesced proximally, and, in search of a support, shot dorsad and ventrad to avoid the visceral cavity. They thus attained the axis above and came together below.

9. The lateral fins, as they were used for support, became elongated and segmented, till probably the propterygium, but possibly the mesopterygium, became the axis of the digit-bearing limb.

10. Pre-existing cartilages were enlarged, or new ones were developed, at the distal ends of the paired limbs, till the cheiropterygium (leg) was developed.

11. The pelvic limb acquired a solid connection with the spine from the need of a firm support on land.

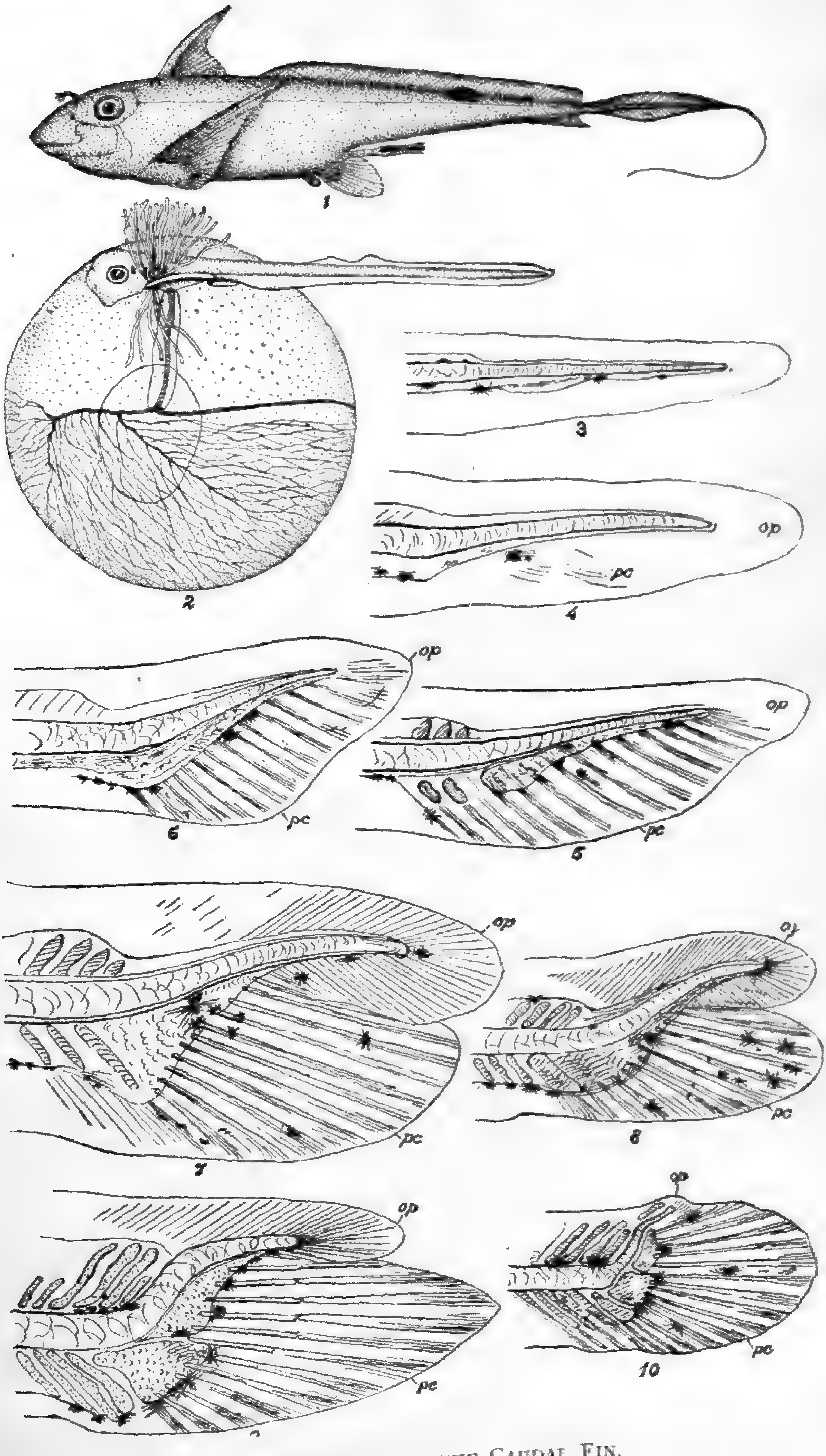
12. The pelvic limb became elongated.

These changes all came about from external causes acting on the plastic animal organism, and the limitation of the paired limbs to four was determined solely by locomotive convenience.

Prof. Mivart gives Mr. Thacher the credit of the first promulgation of the ideas he has adopted, but does not follow the latter in his conclusion that median fin-rays are never derived from neural spines, nor neural spines from fin-rays, as he considers this point to be unsettled, and only capable of proof by the study of their development.

The discovery of the structure of the pectoral and ventral fins in the Ichthyotomi by Sauvage and Döderlein, has substantiated

PLATE XV.



DEVELOPMENT OF THE CAUDAL FIN.

the view of Huxley that the fins of Ceratodus represent the archipterygium or primitive paired fin, as distinguished from a primitive lateral continuous fin, which the theory of Balfour leads us to anticipate may be yet discovered, and which is partly realized in the extinct genus Climatius. And whatever homology may be traced between the paired and median fins, it is evident that the axis of the former has undergone changes which the latter have not experienced. This consists in the sliding proximad of some of the lateral branches of the axis, so that there came to be two, three, or more axial pieces attached to the point of support or scapula. The primitive type is termed by Huxley unibasal, and the later type pluribasal. In the Elasmobranchii the paired fins are unibasal in the Ichthyotomi, and pluribasal in the Selachii. In the Holocephali all are pluribasal. In the Dipnoi the known forms are unibasal. In the Crossopterygia the majority are unibasal, but the order of Cladistia (Polypteridæ) are pluribasal, having two or three (as they are counted) axial bones articulating with the scapula. In other Teleostomata the paired fins are pluribasal, and have mostly lost the axial elements, the basilars only remaining (Fig. 4).

In any case the connection of the paired fins has not been traced to the vertebral axis, as is the case with the median fins, the scapular and pelvic arches being their support in the earliest stages and oldest types known. This has been completely established by the recent researches of Wiedersheim,[26] as far as embryology alone can do it.

As the case at present stands, whatever of proof morphology or embryology furnishes, is in favor of the similar origin and homology of the vertical and paired appendages, but that their relations with the skeletal axis are not identical.

3. ON THE NATURE OF THE SUPPORTS OF THE MEDIAN FINS.

In my memoir on the Fishes of the Lesser Antilles of 1870,[27] as already remarked, I have called attention to the systematic significance of the connection of the fin radii with the vertebral

[26] *Anatomischer Anzeiger*, 1889, No. 4.
[27] Transactions of the American Philosophical Society, p. 450.

column through the intermediation of the supporting elements in certain cases. In a review of Zittel's Paleontology of Fishes, published in 1887,[28] I applied the facts of this part of the struc-

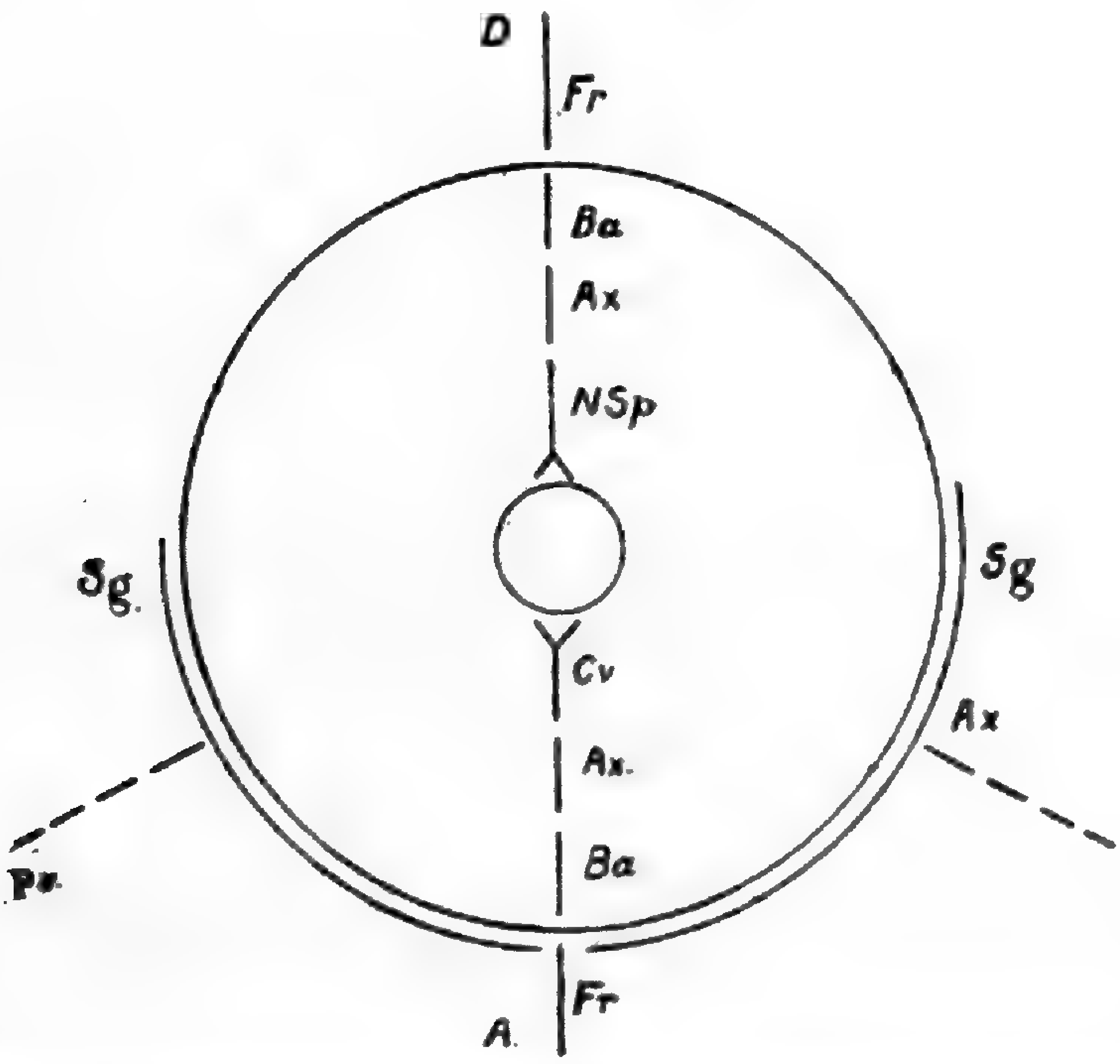


FIG. 6—Diagram representing the elementary constitution of the fins; *D*, dorsal fin; *A*, anal fin; *Pv*, pectoral and ventral fins; *NSp*, neural spine; *Ax*, axonost; *Ba*, baseost; *Fr*, fin-ray; *Cv*, chevron bone; *Sg*, shoulder girdle.

ture to the question of taxonomy and phylogeny more fully, establishing the subclass Rhipidopterygia, and several orders, on the varying characters of the median fin supports. Some additions were made to this system in a "Synopsis of the Families of the Vertebrata," published in 1890.[29] The basis of this analysis is the hypothesis above cited, that the fins represent longitudinal folds of the integument, within which have been developed rods which form a framework connecting the free edges of the folds with the vertebral column. These rods may have been primitively undivided neural spines, but in the oldest forms known to us two segments exist distad to the neural spine. These I have termed the axial and basal elements, or the axonost and the baseost; the latter supporting the fin-rays when they exist. Fin-

[28] AMERICAN NATURALIST, 1887, p. 1016.
[29] AMERICAN NATURALIST, 1889, October, published March, 1890.

rays, however, have developed as a result of specialization of less important and more delicate hair-like bodies, described by previous authors, which traverse the fin from base to border within, and which Prof. Ryder has called actinotrichia, and which he says originate in the mesoderm.

I have determined that continuity of neural spine, axonost and baseost is characteristic of all primitive fishes; while these are again to be distinguished into types which preserve the primitive actinotrichia, and those in which fin-rays are developed. In the latter case the fin-rays are always continuous with the baseosts or axonosts. (Fig. 7.) It has been long known that in modern fishes the axonosts have severed their connections with the neural spines, and do not correspond with them in number or position. The axonosts are then termed interneural and interhæmal bones. It is also a character of modern fishes (most Teleostomata) that the basilar bones are rudimental or wanting. The gradations between the primitive and modern types of fins represent the evolution of the class of fishes, and I have endeavored to express this view in the system which I have proposed, as above cited. (AM. NAT., October, 1889.)

The various stages or types of dorsal and anal fin structure may be defined as follows; and it seems necessary to give them names, to avoid the circumlocution requisite to express the characters in any other way. The diagrams appended explain the types referred to. They are applicable to the dorsal fin, and, inverted, to the anal fin. Each separate series in its totality is called by Ryder the actinophore. Its kinds are the following:

I. Actinotrichia present.

Neural spine, axonost and baseost continuous; *Entotetramerous.*

II. Fin-rays present.

All the elements present and continuous; *Ectetramerous.*

All the elements present, the axonosts not articulated with the neural spines; *Ectrimerous.*

Like the last, but the baseosts rudimental or wanting; *Ecdimerous.*

Axonosts not connected with the neural spines, reduced to one or two for each fin; *Rhipidopterygian.*

As I have already pointed out, there are two types of the Rhipidopterygian fin, the Rhipidistious where baseosts are present (teste, Traquair), and the Actinistious (Fig. 8) where they are wanting. These divisions, corresponding to orders, do not require renaming.

No fishes are known with the actinophore dislocated from the neural spines, and retaining actinotrichia. Should such be discovered, they will appropriately receive names similar to those given to the series with fin-rays, with the prefix ento, as entotrimerous, entodimerous, etc. For obvious reasons the discovery of an entotrimerous fish is more probable than that of an entodimerous one.

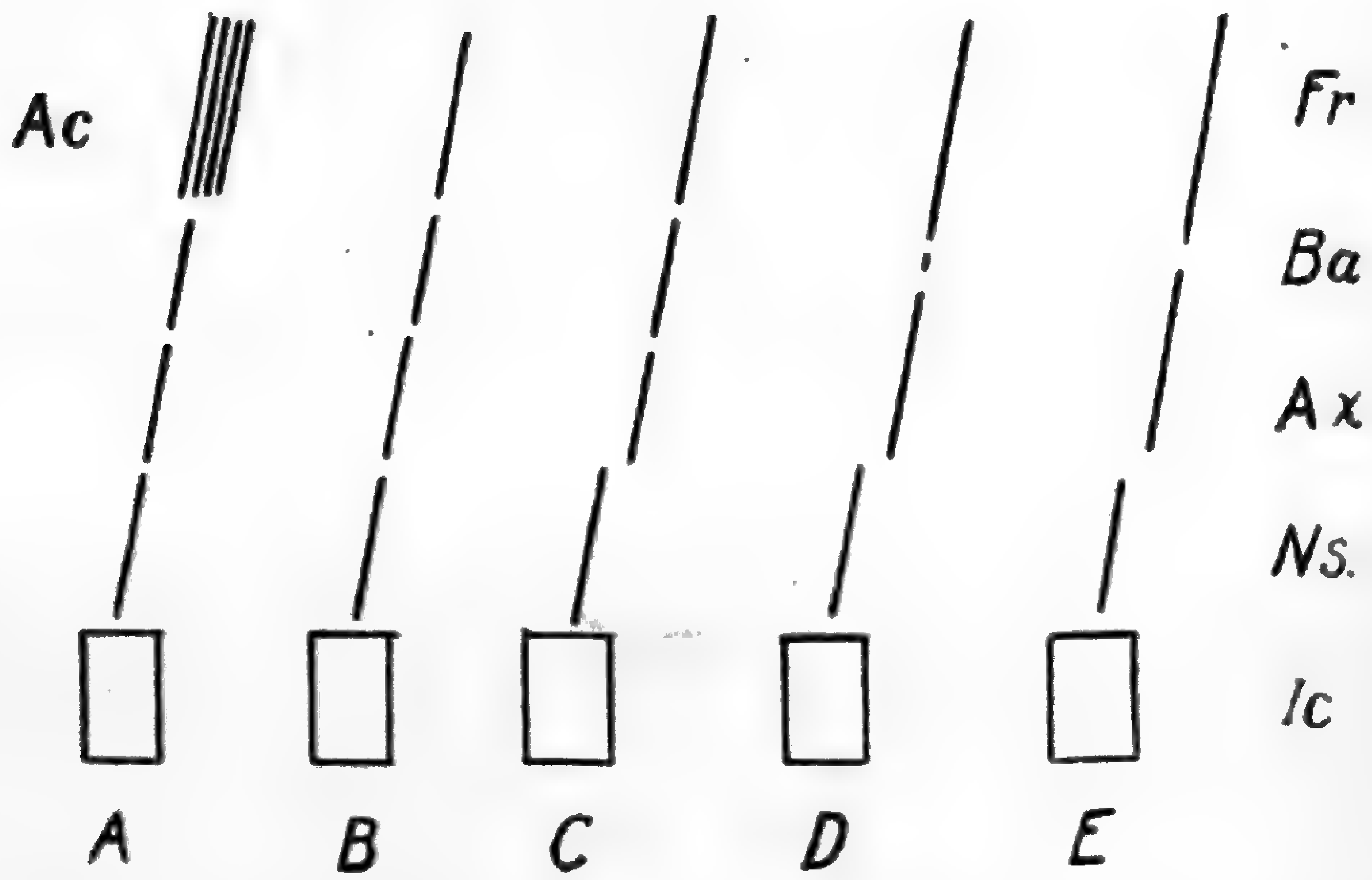


FIG. 7.—Diagrams of actinophores; *A*, entotetramerous; *B*, ectetramerous; *C*, ectrimerous; *D* and *E*, ecdimerous; *Ac*, actinotrichlia; *Fr*, fin-rays; *Ba*, basiost; *Ax*, axonost; *Ic*, intercentrum.

As regards the origin of the actinophores, Gegenbaur suggests that they were derived by segmentation from neural spines, while Thacher believes that they originated independently of the latter. Thacher bases his views on the structure found to exist in Selachii, which he supposes to represent the most primitive condition. The Selachii must, however, be regarded as, in many respects, degenerate, and Xenacanthus is probably more primitive. It is proba-

PLATE XVI.

Diphycercal and Heterocercal Caudal Fins.

ble however that Thacher's opinion is correct, but not for the reasons which he gives. I have oberved in a memoir On the Mechanical Origin of the Hind Parts of the Mammalia,[30] that "the mechanical cause of the origin of neurals pines may be traced to the strains upon the vertebral axis caused by a primary dorsal fold, or fin."[30] On this view the actinophores and the neural spines were simultaneously developed in lines of strain which naturally extend to the point of resistance nearest to the moving fin-fold, viz.: the apex of the neurapophysis. The development of the segments neural spine, axonost, and baseost was then simultaneous, and the one segment was not derived from the other. Thus the views of both Gegenbaur and Thacher are partially justified.

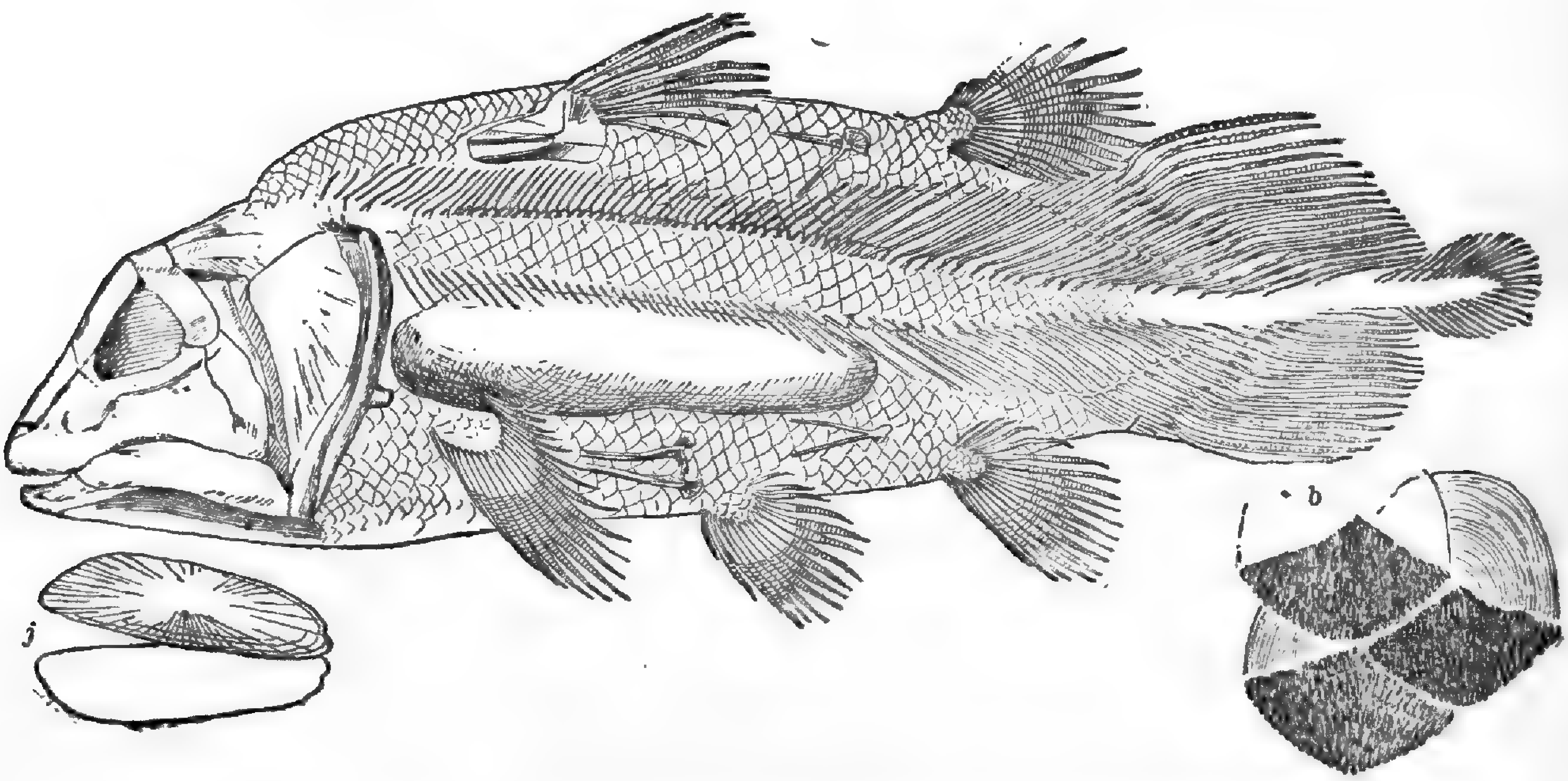


FIG. 8.—*Undina penicillata*, one-third natural size, showing rhipidopterygian and actinistious types of fins; *j*, jugular plates; *b*, scales of *Undina acutidens*; from Zittel.

The development of the appendicular skeleton is now shown to have proceeded from without inwards, and thus the homologies of the parts of the actinophores of all the fins must be interpreted from the same point of view, *i. e.*, from without inwards.

[30] *American Journal of Morphology*, 1889, p. 210.

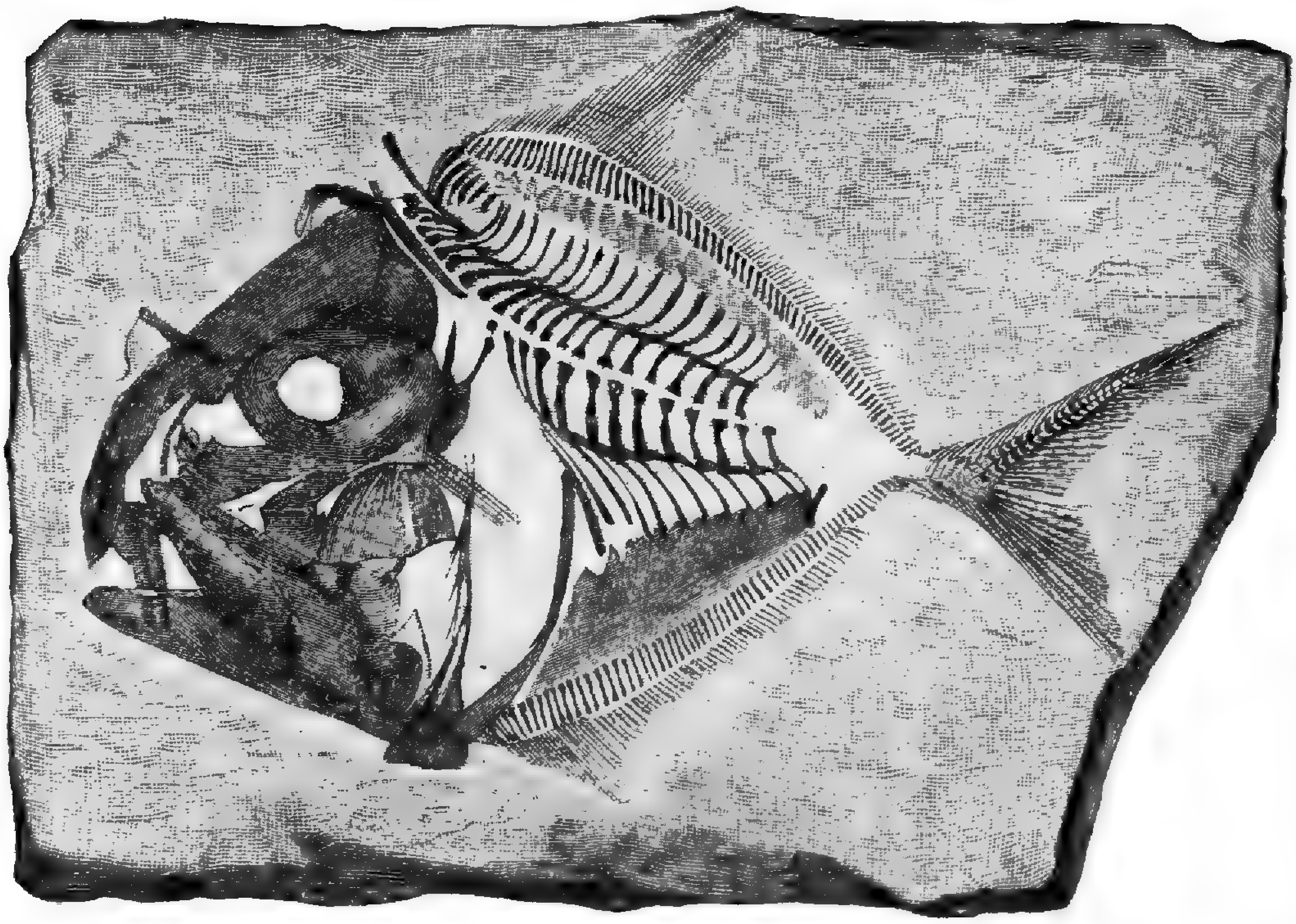


FIG. 9.—*Dorypterus althausii*, $\frac{1}{1}$, representing the order Docopteri, an actinopterygian fish from the Trias, with well developed baseosts of the median fins, and axonosts apparently continuous with the neural spines; from *Zittel*.

4. ON THE CAUDAL FIN AND ITS SUPPORTS.

Professor Louis Agassiz first called attention to the diversities in the structures of the caudal fins of fishes, and their relation to the general history of the class. He showed that the tails of modern fishes are constructed on two different patterns, which he called the homocercal and the heterocercal. In the former, the radial portion of the fin is in two unequal lobes, the superior being the more produced distally, and the inferior occupying a position on its inferior aspect, and having a much less degree of posterior prolongation. In the latter, the inferior lobe is of equal length and posterior prolongation with the superior. He showed that the homocercal type is characteristic of all Paleozoic and most of the Mesozoic fishes known to him, while the heterocercal type predominates in the Cenozoic and existing fishes. He also showed by a study of the embryology of the trout and other forms, that in their earlier stages the heterocercal fishes are homocercal. These results he regarded as important, and, in fact, they constituted the first intelligent application of the structural characters of fishes' fins to their systematic arrangement, which was made.

Subsequently the paleontologist McCoy,[31] observed that in some extinct fishes the vertebral column did not enter the superior part of the caudal fin, but continued directly to its middle base, and terminated without modification, the rods supporting the fin radiating equally and symmetrically above and below to the extremity. This type of fin he called diphycercal.

Later, Huxley[32] studied the development of the caudal fin in the salmon, and showed that although the caudal fin proper is heterocercal, some of the terminal vertebræ enter the base of the superior lobe, thus having a partially heterocercal structure.

Cope, in 1871,[33] reviewed the structure of the caudal fins of recent and extinct fishes. He stated that the diphycercal type (which he termed isocercal in ignorance of McCoy's paper) is the primitive condition of this region, preceding the homocercal in embryonic history. He showed that it persists in various modern fishes, as in the Lepidosiren and Polypterus, and among Telestomata, in the eel-like types, in the Gymnarchidæ, and in the Anacanthini, and in the last-named supporting a heterocercal caudal fin. He also showed that in various living isospondylous fishes besides the salmon, a partially homocercal condition persists, notably in the Notopteridæ.

A valuable contribution to this subject is that of E. T. Newton,[34] who has worked out some of the developmental stages of the sprat, and brings together the works of several earlier writers upon the subject. No notice is taken in this pamphlet of the writings of Cope, Wilder, and other American naturalists who have at various times observed or reasoned out the steps by which the primitive vertical fold becomes a highly differentiated caudal fin.

[31] *Annals Magaz. Nat. Hist.*, 1848, p. 304.

[32] *Quarterly Journal Microscop. Science*, 1859, p. 33.

[33] Transactions of the American Philosophical Society, XIV., 1870, pp. 452, 453.

[34] On Fishes' Tails, by E. T. Newton, F.G.S. Ext. from the *Journal of the Quechett Microscopical Club*, July, 1882.

Ryder has given a very full account of the embryology of fishes' fins, which has especial reference to the caudal region.[35] He distinguishes six stages in the development of the caudal fin as follows:

1. Archicercy; no caudal fin-folds. 2. Lophocercy; caudal fin folds, with or without actinotrichia. 3. Diphycercy; 4, Heterocercy; and 5, Homocercy, as above defined. 6. Gephyrocercy, in which the terminal vertebræ are aborted, so that a hiatus is created between the neural and hæmal elements, or actinophores, at the extremity of the axis. This structure occurs in Echiodon (Pl. XVIII., Fig. 3,) Mola, etc. In this case the epaxial and hypaxial tegumentary folds are continuous round the extremity of the vertebral axis, and develop fin-rays which appear later than those of the dorsal and anal fins. This is supposed to be a condition of degeneracy.

The subject is treated histologically and embryologically by Ryder, who reviews the work of various authors who have viewed it from the same standpoint, especially Vogt, Kölliker, Dohrn, and Lotz.

The latest contribution to the subject is one by Baur, who shows that the rods (axonosts) which connect the rays of the anal fin with the inferior side of the caudal vertebræ, in Lepidosteus, are chevron bones.[36] This agrees with the determination by Cope[37] that the vertebral bodies of fishes are intercentra, and not centra.

From the researches already cited it is now well understood that in the caudal fin as in other fins, the primitive actinotrichia have become specialized into fin-rays, and that these approximate more nearly to the number of their osseous supports than do the actinotrichia. They are rarely so reduced in number, however, as to correspond exactly to the hypural bones.

The actinophores of the caudal fin may or may not have been primitively divided like those of the other median fins into

[35] Annual Report of the U. S. Commissioner of Fishes and Fisheries, 1886, pp. 981-1086.

[36] *Amer. Journal of Morphology*, 1889, p. 463. Dr. Baur inadvertently calls the axonosts "actinosts."

[37] Transac. Amer. Philosoph. Society, 1886, p. 243.

PLATE XVII.

HOMOCERCAL CAUDAL FINS.

(chevron) axonost and baseost. Such appears to have been the case with the Dipnoi, but whether it is strictly the case in the primitive Xenacanthus remains to be ascertained. The axonost and baseost are lost from the modern types of diphycercal tails, as Anguilla (Ryder, Pl. IV., Fig. 4) and Gadus.

The change from diphycercy to heterocercy is seen in the upward curvature of the extremity of the vertebral column, and the development of a portion of the inferior fin (anal) into a posteriorly projecting angle. This is the state of affairs in the Elasmobranchii, Chondrostei, and various extinct Teleostomata.

The change from heterocercy to homocercy is seen in the increased recurvature of the column, and the successive abortion of its extremity. This is accompanied by the increase in antero-posterior diameter of the hypural bones, especially distally, since they develop to occupy the space gained by the recurvature. The neural spines corresponding to them become correspondingly reduced. Such modified elements have been called (provisionally) hypural bones. All stages of development of these bones may be formed in the Teleostomata. Thus in the lower forms (most Malacopterygia) they remain distinct from each other. In many of the Acanthopterygia—e. g., Cottus, (Pl. XVIII., Fig. 1,) and Pharyngognathi, they are fused together, forming a continuous fan-shaped body, which supports the fin-rays directly.

The different types of hypural bones are well illustrated in the accompanying plates from Ryder.

Explanation of the Plates.

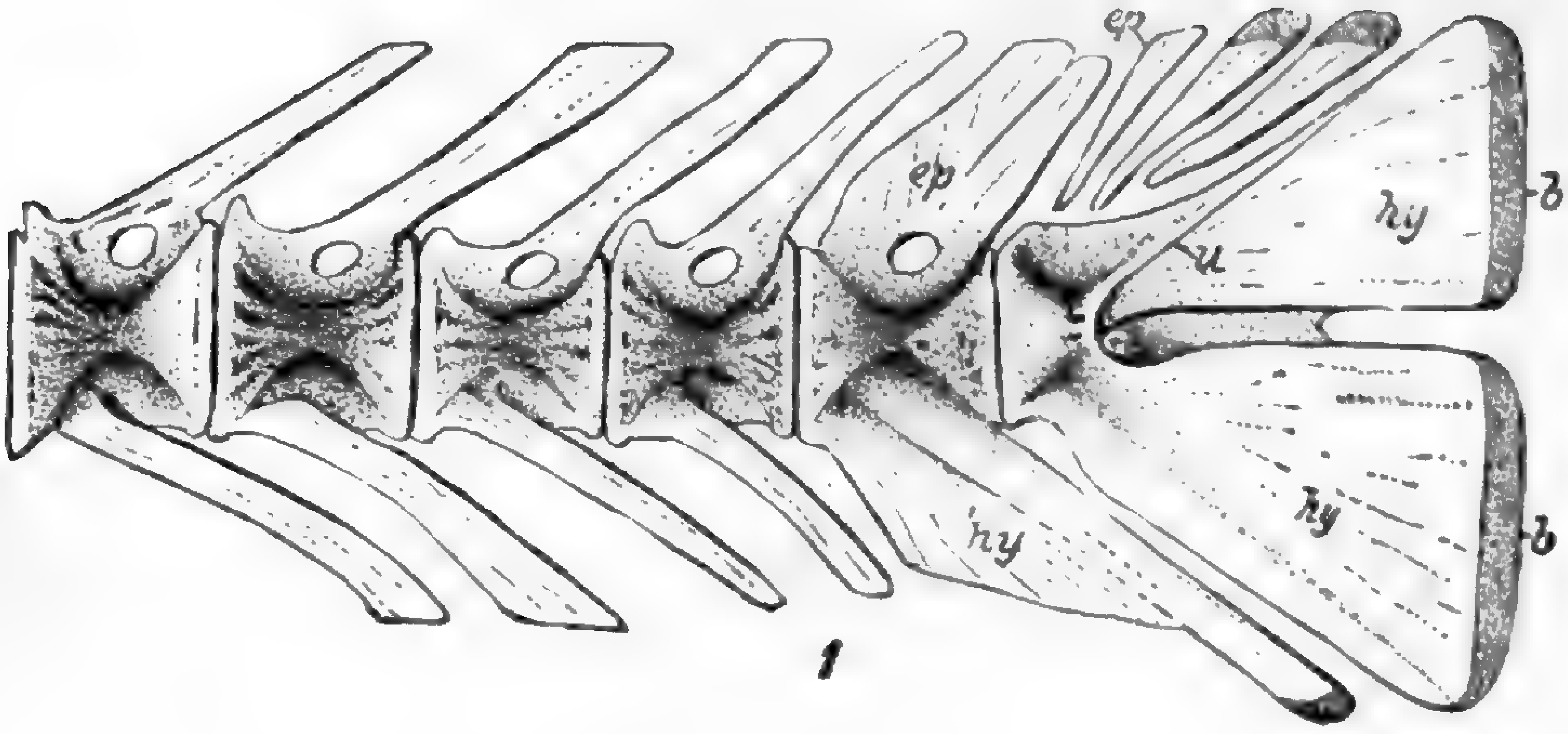
For the Plates XV. to XVIII., which are taken from those illustrating Professor J. A. Ryder's memoir on "The Origin of Heterocercy," I am indebted to the Hon. Marshall MacDonald, U. S. Commissioner of Fish and Fisheries.

Plate XIV.—Restoration of *Xenacanthus decheni*, an Ichthyotomous Elasmobranch from the Coal Measures of Alsace, much reduced. From Brongniart and Sauvage.

Plate XV.—Fig. 1, *Chimæra monstrosa* L. ♂. Fig. reduced from Agassiz's Poissons Fossiles, showing opisthural filament. Fig. 2, Side view of embryo ray in the lophocercal stage, natural size, from a specimen taken near Wood's Holl, Mass. Fig. 3, Lophocercal tail of young flounder 6 mm. long. Fig. 4, Lophocercal tail of young flounder a little older than the preceding, beginning to show a slight upbending of the notochord, and the first trace of the permanent caudal lobe (*pc*) and opisthural lobe (*op*). Fig. 5, Caudal lobe of a somewhat older flounder, showing indentation and definition of permanent fin-rays. Fig. 6, Specimen with tip of notochord still more reflexed than in the preceding; permanent caudal and opisthural lobes somewhat more distinct. Fig. 7, Permanent (*pc*) and opisthural lobes (*op*) now form a sharp angle where they join; distinction between permanent and embryonic rays well marked. Fig. 8, Permanent caudal as long as opisthural lobe (*op*). Fig. 9, Cartilaginous supports of fin-rays are now strongly developed; the end of the chorda has begun to degenerate and approximate the position which it will occupy permanently as the urostyle. Fig. 10, The caudal has become more rounded, the opisthure (*op*) is almost wholly absorbed, and the notochord has suffered atrophy somewhat, and now presents a still closer approximation to the form of the urostyle of the adult. Figs. 3–10 inclusive after A. Agassiz.

PLATE XVI.—Fig. 1, Caudal skeleton of Coccosteus after Pander; *ep* and *hy*, epural and hypural elements, all of which do not bear rays, but as in Pterichthys, extended out only so far as the scaly covering of the tail; *d*, dorsal; *a*, anal fins. Fig. 2, *Polypterus bichir*, caudal skeleton, from Agassiz's Poissons Fossiles, modified from Kölliker; *ep*, styliform ray-bearing and nodular non-ray-bearing interspinous epural elements; *ep*, neural spines; *hy*, hypural ray-bearing elements. Fig. 3, Lepidosteus, caudal skeleton from Kölliker, adult; showing urochord more prolonged and attenuated than in the preceding. Fig. 4, Platysomus restored, after Agassiz's Poissons Fossiles; *ep* and *hy* epural and hypural pieces; *u*, urochordal end of skeletal axis, which was mainly notochordal. Fig. 5. Lepidosteus, tail of young specimen 11 cm. long, from Balfour and Parker; *cd*, permanent caudal; *ff*, eradiate fin fold of opisthure; *op*, opisthure; *my my*, its myotomes. Fig. 6, Lepidosteus, young, 21 mm. long, side view; dissected and magnified so as to show its structure at this stage; *ep* and *hy*, epural and hypural cartilaginous rudiments of the neural and hæmal arches; *ch*, chorda; *cb*, its opisthural portion, which afterwards becomes partially aborted and included in the upper part of the tail; *cd*, tip of fold, which becomes the permanent caudal; *op*, opisthural lobe of the larval tail; *ff*, lophocercal fin-fold, which contains horn-fibres throughout its extent, *hf*. After Balfour and Parker. Fig. 7, Magnified view of the caudal skeleton of a young Cyprinodont, Gambusia, ⅓ of an inch long, and which was removed from the ovarian follicle in which it developed; *ch*, chorda dorsalis; *ep* and *hy*, epural and hypural cartilages; *ms*, medulla spinalis; *r r r*, rays. Fig. 8, *Centrina salviani*, caudal skeleton of adult; *ep* and *hv*, as before; *va*, ver-

PLATE XVIII.



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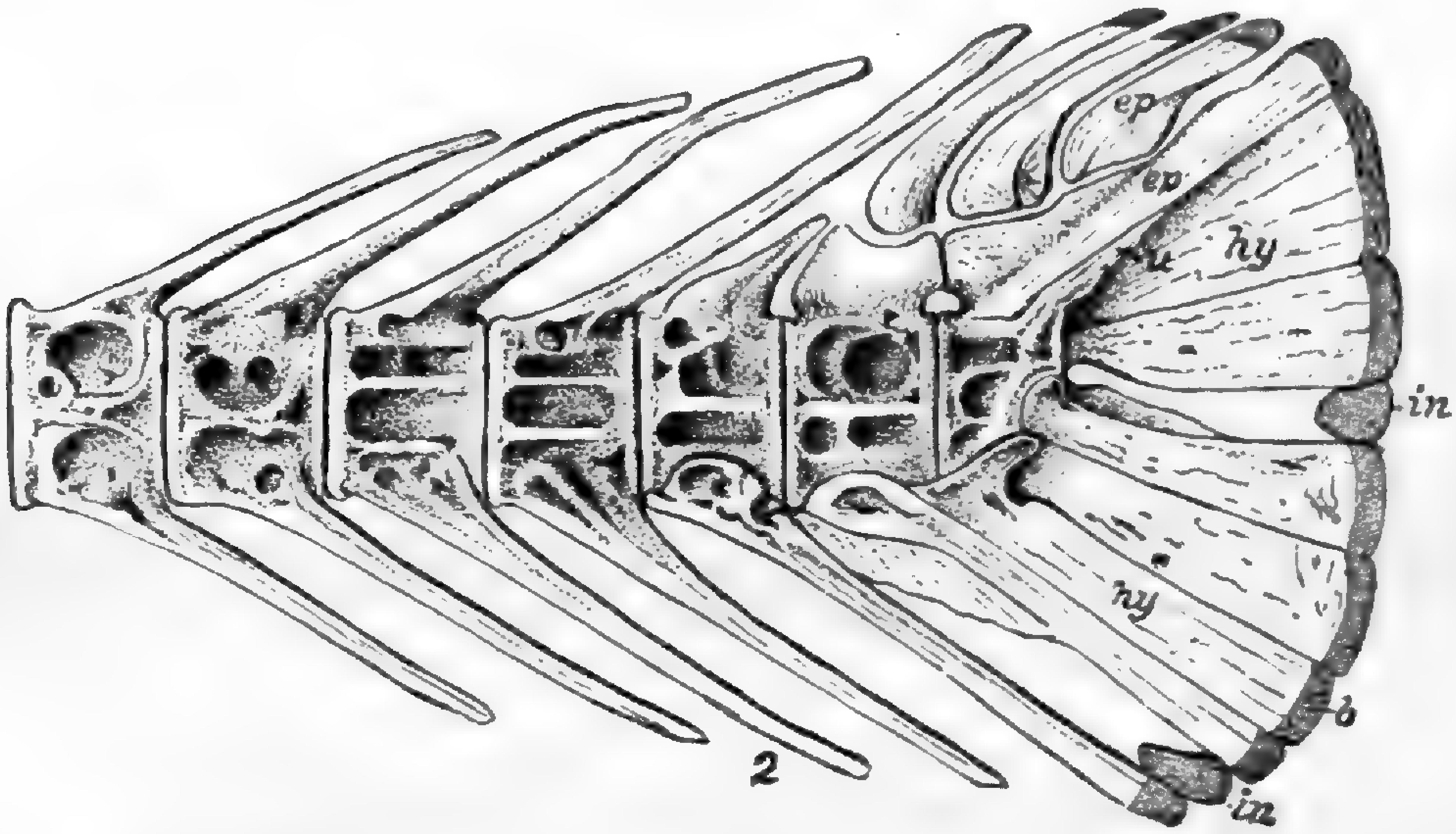

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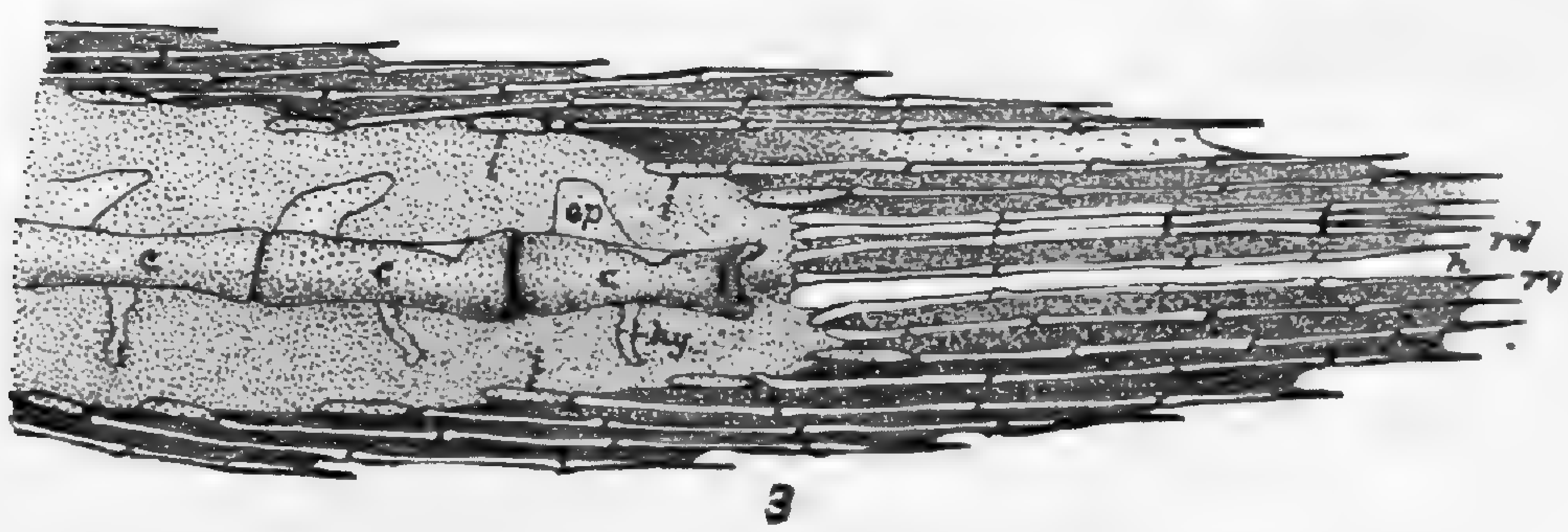

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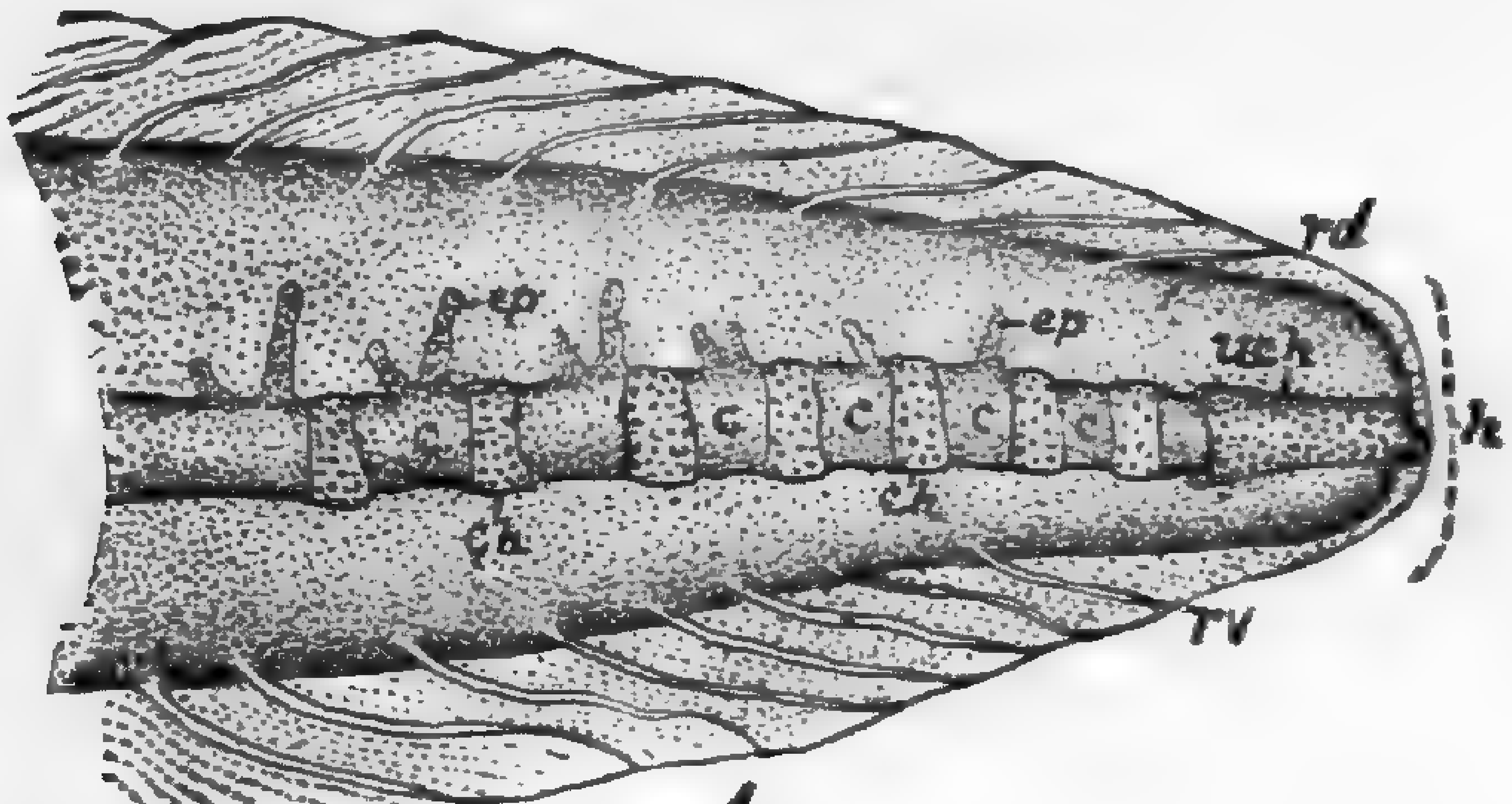

4

HOMOCERCAL AND GEPHYROCERCAL FINS.

tebral axis ; *ff ff*, its dorsal and ventral membranous lobes, which include numerous horny and partly osseous supporting fibres. From Günther.

PLATE XVII.—Fig. 1, *Salmo fario*, adult, caudal skeleton ; *b* and *bi*, basilar cartilages ; *ep*, epural, and *hy*, hypural elements ; *m*, lateral membrane bone, which has had an epural cartilaginous element as its nucleus ; *in*, intercalary cartilage ; *u*, urostyle ; *op*, opisthure. After Lotz. Fig 2, *Salmo salar*, adult, caudal skeleton ; lettering as in Fig. 1. From Lotz. Fig. 3, *Barbus fluviatilis*, adult, caudal skeleton ; lettering as before. From Lotz.

PLATE XVIII.—Fig. 1, *Cottus gobio*, adult, caudal skeleton ; lettering as in Plate XVI. From Lotz. Fig. 2, *Perca fluviatilis*, adult, caudal skeleton ; lettering as before. From Lotz. Fig. 3, *Echiodon dentatus*, adult, gephyrocercal caudal extremity ; *c*, centra ; *ep* and *hy*, hypural processes ; *b*, basilar cartilages : *i*, interspinous cartilages ; *h*, hiatus between dorsal rays (*rd*) and postanal rays (*rv*) ; x 17. From Emery. Fig. 4, *Fierasfer acus*, gephyrocercal caudal extremity ; *ep*, epural processes ; *c c c*, centra not in contact ; *ch ch ch*, membranous or cartilaginous central intervals ; *uch*, exserted end of chorda, or urochord ; *h*, hiatus between last dorsal rays (*rd*) and last postanal rays (*rv*) ; x 55. From Emery.

A ZOÖLOGICAL RECONNOISSANCE IN GRAND MANAN.

BY J. WALTER FEWKES.

ON the side towards Eastport, Grand Manan presents a series of lofty cliffs rising abruptly out of the sea, so precipitously that it would be almost impossible to climb from the shore to their summits. Only in a few places is this rampart broken through, leaving sheltered coves where boats can find anchorage. Ordinarily the lofty cliffs rise abruptly from the sea, and the few stretches of beach crowded in between the foot of the cliff and the water are exceptional, and limited in extent. Deep into this lofty buttress of rock there extends at one point on this side of the island a deep fiord, known as Dark Harbor, so-called because in former times its heights were covered with sombre trees. The sides of these hills have been denuded by forest fires of their ancient woody covering. This fiord, however, is a harbor only in name, and while it may have been formerly a bay, there now stretches across its entrance a low beach formed of cobblestones, effectually shutting out its deeper waters from the sea outside. It still has communication with the Bay of Fundy by means of a small artificial channel through which the waters rise and fall twice every day, the still lagoon feeling the influence of the giant tides, for which this region is remarkable. Around the base of the lofty cliffs sweep the strong and swift currents which the great tides create. Sometimes this moving water is irresistible, carrying everything along with it as it sets back and forth under the brow of the high land which forms the dike or backbone of the island.

Under these lofty cliffs the fisherman spreads his net or casts his lines, and the Passamaquoddy Indian still as of old hunts the porpoise from his frail canoe, and on the scanty beaches at the base of the cliffs he tries out the oil. His picturesque but not overclean huts, perched on the side hills, and a few houses at Dark Harbor, are the only habitations of man on this side of the island, save the isolated light-house and the home of the light-keeper.

But there is another shore of Grand Manan which is very different from that we have mentioned. The coast on this side is less rugged and more inviting as a landing-place, and on this shore there are many harbors protected by out-lying islands, in which fishing craft ride at anchor. Here the land slopes more gradually to the water's edge, and the coast is indented by frequent bays and coves.[1] Through the channels which separate the islands from the shore line currents similar to those on the other side of the island make their way with great power, and the ebb-tides cause the water to retreat so far that the coves are often left bare by the retreating water. But here the coast is more hospitable, and more like the adjacent shores of New England.

[1] Among many geological evidences of erosion on this shore, not the least interesting are the examples of "pot-holes," or "giant's kettles," found between Seal Cove and Grand Harbor, not far from the main road. The well-marked prismatic and columnar structure of the dike which forms the lofty cliff is well shown at Southern Head, near the light-house.

Upon this shore most of the homes of the inhabitants of Grand Manan are situated, for here are clustered the small villages of fishermen's houses, scattered in hamlets here and there at intervals from one end to the other of the island. Along this shore wharves are frequent, and several small villages lie nestled near the water's edge, on well protected bays.

At a point about midway from one end of the island to the other there is a group of houses called Woodward's Cove. The main road from North Head, where the steamer lands, to the opposite extremity of the island, skirts the shore, leaving only the landing places, upon which are situated a few houses for smoking herring, between it and the water. The place is a picturesque one, and interesting in many ways, but perhaps more especially to me, since around it cluster pleasant recollections of a summer's vacation passed on Grand Manan, in the study of the rich marine life of the island.

Just opposite Woodward's Cove lies an island called Nantucket. Why so named, or whether the story of its southern namesake is here repeated, I have never been able to discover. It is but one of the numerous islands which rise here and there from the shallow platform between the main island and the deep water of the Bay of Fundy.

My first visit to Nantucket was during a thick fog. Alighting with baggage from the carriage which carries passengers and mail from one end of the island to the other, I found myself in Woodward's Cove in the midst of a thick fog. So dense was the fog, in fact, that I was obliged to trust the statement of the boatman that Nantucket existed at all. No land was visible as we pushed off from the shore and headed our boat in a direction in which the island was known to lie, and we had to trust our boatman, and patiently wait until we reached the other side of the channel before we were at all sure of its existence. The certainty with which the fishermen of Grand Manan can find their way in the thickest fog is marvelous. Thoroughly trained in navigation in these waters, every incident, every sound, guides their course when sight fails; the direction of the wind the set of the tide, the ripple of the water on the rocks or beach, the gun from the distant Gannet Rock, all contribute to a keen sense of direction by which these men find their way to their fishing grounds and back in a thick fog, when one not skilled in this knowledge would lose his way, or, bewildered, would lay his course to the distant shore of Nova Scotia, or the broad open entrance to the Bay of Fundy.

Nantucket is known far and wide among naturalists as the home of Mr. Simeon Cheney. This gentleman was well called by Professor Baird a "natural naturalist." He is an acute observer of nature, a good collector, a tireless worker, and one whose interest in natural history age but increases, and whose energy in his old age many younger naturalists have good cause to remember. It was my purpose to spend a few weeks with him on Nantucket studying the sea animals of this interesting locality.[2] My visit was not unrewarded, and I have good reason to congratulate myself that the choice of this island was made. I was accompanied and aided in my work by an enthusiastic student of natural history, Mr. J. G. Owens, of Bridgeton, New Jersey.

On coasts where the tides are high, and other conditions favorable, the collecting of the marine life which is characteristic of the shore, is, as a rule, very profitable. Similar conditions to those which are found at Nantucket exist along the coast of the English Channel, and in Brittany on the coast of France. The same tidal characteristics are found about Eastport, and at other places in Maine. Grand Manan offers many advantages for the study of marine animals, while the outlying islands, reefs, and ledges left bare by the retreating tide present unparalleled resources for collecting the varied life of the north-eastern coast. As time goes by and as naturalists turn their steps more and more frequently to the shores to investigate the marine life, these islands will be more and more visited, and it is to be hoped that they will acquire an ever-increasing reputation for the many advantages which they possess for the study of these animals in

[2] I can recommend Nantucket as better than any place on the coast of New England for "show collecting."

their native haunts.[3] If it may be permitted me to speak with enthusiasm I may say that marine zoölogists have hardly begun to appreciate the wealth of life round about this island, which lies comparatively speaking at our very doors, and simply awaits an investigation.

The opportunities for work at Grand Manan with the dip-net in the study of free-swimming animals are also very great. The student of these forms of life is particularly recommended to visit the so-called "Ripplings" or tide eddies, several miles from the shore, near the line where the platform of the islands sinks to the deeper sounding of the Bay of Fundy. These eddies are favorite feeding places of many marine animals, from the whale to the minute Medusæ and Crustacea, and at a proper time of the tide afford most profitable collecting places. The distance from the shore and the difficulty of access is the only drawback, but if possible they should be visited by every naturalist who is interested in the study of marine life in its natural habitat. A world for investigation here awaits the attention of the naturalist.

Of those who have visited Grand Manan, and left valuable publications adding greatly to our knowledge of the marine life of the place, prominent among all should be mentioned the name of Dr. William Stimpson. Many others have worked here, but as the group of animals which it was my purpose to study had been more particularly considered by him I mention his name with especial indebtedness. I went to Grand Manan to study the lower Invertebrata, and my studies of this group found in this locality were greatly aided by his previous studies. It does not detract from my appreciation of the value of the works of others that I have singled out his work as of greater use to me, and his paper is recommended as one of many valuable companions for those who would visit this island for a purpose similar to my own.

My object in spending a vacation on Nantucket was to study the Cœlenterata and Echinodermata, more especially the changes

[3] Grand Manan had last summer a tri-weekly communication with Eastport by the mail steamer *Flushing*. Eastport can be reached from Boston by the steamers of the International Line, also called the St. John's steamers. The trip to Eastport by rail from Boston to Calais, and then by steamer down the St. Croix river, gives the visitor much scenic beauty.

in form which certain members of these groups pass through in their development. There are certainly many remarkable genera of these animals found nearer home, of the young of which little is known, but I aspired to trace the changes in the external form of the body of the young of those of which we know next to nothing, since many of these animals are more numerous at Grand Manan than elsewhere on our coast. The study of the Echinoderms, and the desire to trace the development of certain genera, are subjects which have interested me for several years, and these studies can be pursued with great advantage on the shore of Grand Manan. No locality on the coast is more prolific in Echinoderm life than this, and here occur animals the problems connected with which rank among the more interesting of those presented to the consideration of the morphologist.

Looking, for instance, from the embryological standpoint, we have of starfish the genus Hippasterias, of the young of which nothing is known. Pteraster, also found in these waters, carries its young in pouches on the back or aboral side of the body. It presents interesting problems of the nature and significance of direct development. Among these animals, with the exception of a pair of figures of a single stage of the young, nothing is known of the embryology of this marvelous genus. Then there is Ctenodiscus, whose young have a strange projection on the middle of the dorsal region of the body, reminding one of the stem of a Crinoid. Of the young of Solaster and Crossaster we know nothing. Moreover, the affinities of the latter with Brisinga, which has likenesses itself to the Ophiurans, are such that a study of its young promises interesting morphological results.

Although many points which I hoped to investigate I was unable to make out, my visit was not wholly without valuable results.

My search for the Comatula described by Stimpson from Grand Manan was without success. Familiar with the places which this animal loves on other coasts, I looked in similar localities along the shore, among the laminarians on the Fucus, everywhere, but always with disappointment. I gave it up at last, and concluded that the specimen which he found was a straggler from some congenial home. Not that I hoped to discover anything new in relation to the development of the young of this animal, for the changes which it passes through are well known, but it would have been a pleasure to be the second person to detect here this rare animal, if its home is really in the waters of Grand Manan. That pleasure would have been enhanced by the fact that since the time when this little creature was found by Stimpson in these waters genera and species of this animal have been described, and it would have been a satisfaction to know whether or not his specimen belongs to some species twice made known, for until this animal is once more found and compared either with types or with descriptions we must remain in doubt what it is or to what species it is allied.

We also searched in vain for the "basket-fish," *Gorgonocephalus agassizii.* Fresh from dredging excursions in the channel between Eastport and Campobello, where, as under the brow of the "Friar," many of these Echinoderms are brought up in the dredge, it was a surprise that this interesting creature was not found in our work. Distant trips to remote dredging grounds failed to reward us. A trip to the side of the island under the lofty cliffs near the Indian encampment, where it is said to exist in numbers, was without result. But always, like a phantasmagoria, the stories of the fishermen led us on. There is no doubt that the "basket-fish" is to be found there, but where it occurs we were not fortunate enough to discover. An account of the metamorphosis which it passes through between the egg and adult would be a substantial contribution to our knowledge of Echinoderm development.

But the rewards which came to us in collecting Ophiurans more than made up for our want of success in regard to Comatula and Gorgonocephalus. Nowhere have I seen a richer harvest of the genera Ophiopholis, Amphiura, Ophioglypha, and Ophiacantha. A favorite collecting place for the first of these is on the shore opposite Mr. Cheney's house. On the point left bare by the retreating tide hardly a single stone could be raised without disturbing an Ophiuran hidden under its cover. These animals have a variety of colors, with markings of many patterns, but all belong to the same species, *Ophiopholis aculeata*. In the channel off the Weirs between High Duck Island and Nantucket we dredged bushels of these animals so crowded together that the dredge bay was simply gorged with them. A motley crowd they were, too, as we emptied the dredge in the bottom of the boat. My friend and fellow-student, to whom this was the first introduction to these animals, was beside himself with joy, but subsequent repetition of these hauls renders even the most enthusiastic less anxious to secure specimens, and we came to wish that something else from the sea bottom might have a chance.

Amphiura squamata was not found as abundant as *O. aculeata*. We picked them up among the small stones, sometimes in the coralline zone, but never as abundant as the Ophiopholis. The characteristic Ophiocoma and Ophiacantha were dredged more sparingly, but they may be said to occur in numbers off High Duck Island and Nantucket. We never collected these genera on the shore between tides in places where Ophiopholis and Amphiura love so much to dwell.

All of the many genera of starfishes which live in the waters of Grand Manan were found in our several dredging excursions.

Among the most interesting of the Asteroidea are the beautiful species of Hippasterias, two of which were dredged off Long Island in comparatively shallow water. Crossaster was taken in the channel between Long Island and High Duck, while Solaster was found at various points near low water mark. The latter was often taken with the boat hook, and in collecting could sometimes be readily seen from the boat when the water was quiet.

Innumerable specimens of three species of Asterias, some of which are of giant size, occur in the passage ways between the islands, and were readily found and preserved.[4] Crebrella, which is very common at Grand Manan, is found in all conditions of

[4] Our method of successful preservation of these Echinoderms was to place them first in fresh water until the rays were extended and the body inflated, then, plunging them into boiling hot water, they were allowed to remain there for from three to five minutes. They were then baked in an oven or over the stove, never, however, allowing them to become over-heated. It was best to cut out the hepatic cœca of the genus Hippasterias by an incision in the angle of the arm before baking, otherwise the body of the starfish is blackened by the exuding matter from this organ.

growth. A colony composed of fifty or more, each resembling a bright red spot on the rock, was taken by my friend Mr. Owens. The young of Crebrella when the arms begin to push out from a pentagonal disk do not differ from those of Asterias, but as the arms develop it was found that there was no prominent row of dorsals, and that the plates were irregularly scattered over the back.

The number of individuals of the Echinoidea at Grand Manan is very great, but the variety is small. Echinarachnius and Strongylocentrotus are the most common. The former were often found in such abundance as to clog our dredge, and on the points of land at low tide we gathered many on the shore. White specimens of Strongylocentrotus were found which resemble in every respect the green colored. The boring habits of this genera I have already mentioned in a former number of the NATURALIST.

The gaint among the Holothurians, *Pentacta frondosa*, is very common at Grand Manan, where it is known as the "sea pudding." Cuvieria is rare, but its bright red body may often be detected as the animal clings by its suckers to the rocks at the line of low tide. This Holothurian is sometimes called the "sea orange" or "sea lemon." The very young Cuvieria were found clinging to the rocks by two terminal suckers, in which are embedded scales composed of an open calcareous lattice-work. Scales or perforated plates are also found in the tentacles, which are but little branched. In the younger stages the color of Cuvieria reminds one of a young Actinian.

The summer of 1889 at Grand Manan was exceptional in the variety of animals from southern waters which were collected. Among these were *Physalia arethusa*, and the well-known Anatifer which is often so common in Narragansett Bay. A floating half cocoanut, covered with the ordinary "Goose Barnacle," was picked in the bay near Gannet Rock. The long voyage which this fragment had taken in the waters of the Gulf Stream need not surprise one; but the fact that it was found in the cold waters of the Bay of Fundy is an unusual one. All the hydroids mentioned by Stimpson, with the exception of Grammaria, were collected by us. In place of this problematical genus a beautiful

Antennularia, which closely resembles Grammaria, which has never been found in the Bay of Fundy, was taken on several excursions. Halecium, a hydroid not described by Stimpson, but not unknown from Grand Manan, is one of the most common of the hydroids observed, while Eudendrium, Tubularia, Corymorpha, Clava, Campanularia, and various genera of Plumularidæ and Sertularidæ are very abundant. There is no subject which would yield better results in the study of our marine animals than that of the hydroids of the waters about Grand Manan. Very little research on these animals from the Bay of Fundy has yet been carried on.

A genus allied to Myriothela also occurs at Grand Manan. The genus called Acaulis was discovered at Grand Manan, and described by Stimpson, who failed, however, to recognize its affinities with Myriothela. The true relation of the genus Acaulis has been for many years[5] problematical with me, and I have been led to regard it as the broken head of a Tubularian, following the opinion of several well-known naturalists in this identification. A study of the living specimens of Myriothela, and an examination of the unpublished figures of the Eastport representative, made over ten years ago by Professor Hyatt, and loaned to me for study, leads me to place Acaulis in the neighborhood of Myriothela, retaining Stimpson's name for it until a new examination can be made to determine its true systematic position. Stimpson's description is quoted below verbatim, in order that what is at present known of this animal may preface a few conclusions of my own, drawn from an examination of Prof. Hyatt's drawings.

Fig. 2. — Acaulis. (A. Hyatt, del).

Stimpson's account of Acaulis ["Invertebrata of Grand Manan"] is as follows:

[5] My examination of specimens of Myriothela found at Roscoff, France, convinced me that Acaulis is a close ally of this interesting genus. On several visits to Eastport and Grand Manan I have repeatedly looked for both Myriothela and Acaulis, but have never been able to find either.

"ACAULIS, St. n. g.

A. primarius, St. n. s., Fig. 4. The remarkable polyp for which this name is proposed, which is probably the largest hydroid known,[6] was observed at Grand Manan in two successive stages of development. It was first taken early in August, when it was of a sub-cylindrical form, tapering suddenly to a point at each extremity. At the upper extremity was the mouth, very small, a little below which the tentacula commenced, scattered at first, but gradually increasing in number, and somewhat in size. These tentacula were minute, very short, equaling in length about one-sixth the thickness of the body, with large globular tips. They occupied about two thirds of the body; on the remainder below, their places were supplied by the medusa buds, which were crowded, and much larger than the tentacula although as yet but little developed. The inferior extremity of the body terminated in a short, pointed, fleshy spike, free from appendages, from which exuded a tenacious mucus, by which it adhered to the subaqueous surfaces to which it might be applied. Around the base of this spike, and immediately under the buds, were regularly arranged eight long gracefully-curved cirriform processes, each equaling in length about half that of the body. These appeared from their motions to be in this—the first stage of the animal's existence—the locomotive organs.

"At a subsequent time I met with several of these animals which presented a different appearance. The tentacula were larger, especially in the region of the mouth, at the now blunt extremity of the body; and the medusa buds were in an advanced state of development, soon to become free-swimming individuals. The inferior appendages had disappeared, and the body was firmly attached by a broad base, and bore much resemblance to one of the ordinary Corynidæ deprived of its stalk. In strong contractions it assumed a shape approaching an hour-glass. The length of the animal in this latter stage was half an inch, the breadth two-tenths. In the earlier stage the dimensions were one-half these.

[6] The giants added to the Hydroidea of the deep sea by the explorations of late years were unknown when this was written by Stimpson.

"It was dredged in the laminarian, from 5 to 15 feet, attached to various Rhodosperms, as Ptilota, Chondrus and Rhodymenia. Circumstances did not permit me to ascertain the medusoid form of this polyp, although I have my conjecture."

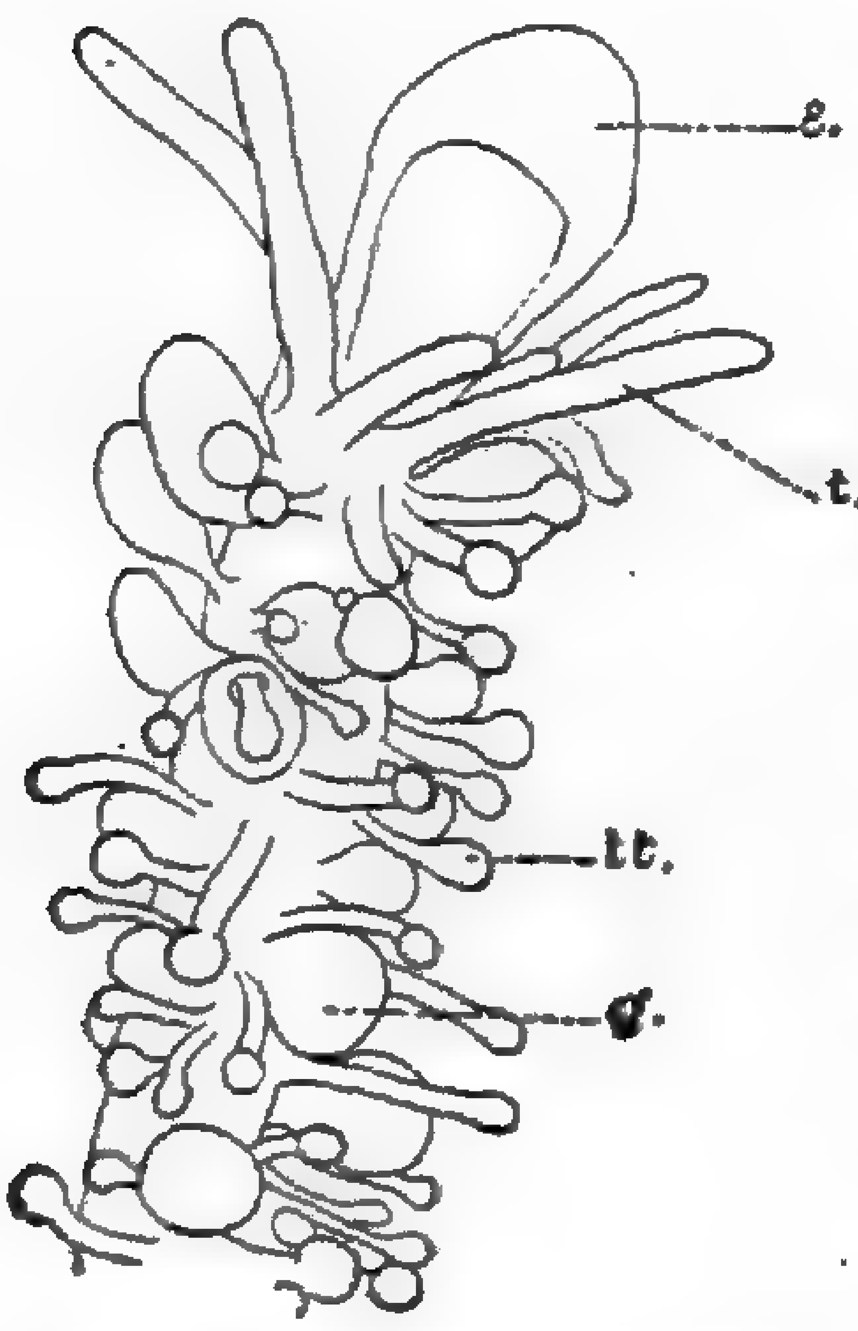

FIG. 3.—View of anterior end of Acaulis, showing temporary tentacles *tt* (A. Hyatt, del.)

Prof. Hyatt's sketches[7] represent two stages of development in the life history of this remarkable hydroid. One of these [Fig. 3] is evidently of a younger and less developed animal, possessing temporary tentacles which have a likeness to those figured by Allman in the immature Myriothela. We know from Allman that as the Myriothela grows older, the tentacles, which in this genus are known to belong to larval life, disappear, and are lost in the adult. These are represented in our figure [Fig. 3] on the axis, about one-third the length of the young Acaulis, while the remainder of the body bears simply suckers, which cover the surface of this region of its body. In the second figure [Figs. 1 and 2], which represents a larger individual, and one which is therefore probably more mature, two regions can be readily distinguished in the body, which we may call an anterior and a posterior body-region. The animal is represented as attached to a shell by suckers at the anterior end,—the broken parts of these organs are represented by dotted lines, as these appendages have been ruptured. In Prof. Hyatt's notes, brown matter is mentioned as being found at the place of adhesion of these suckers to the foreign body.

For a short portion of the body adjoining the terminal tentacles its surface is thrown into folds or ridges (*f*), which are possibly due to mural contraction. From this region there arise botryoidal bodies, which are supposed to be gonophores (*g*) or homologous structures, each of which has, according to the notes, a dark purple interior and a granular whitish exterior wall. The remainder

[7] Stimpson's figures of Acaulis are the only ones yet published of this highly exceptional hydroid.

of the body narrows gradually to its so-called posterior end, throughout which it is covered with closely crowded, wen-like structures of a light pink color. The interior of this region of the body is dark purple, and there is, according to the notes, a terminal orifice (*a*).

It will be noticed in reviewing Stimpson's account, and comparing his figures with those here published, that he also describes two successive stages of development which correspond closely with those which I have figured. The "tentacula" in the anterior region of one of those given are larger at the blunt extremity of the body, while the gonophores are in an advanced stage of development. In this stage of growth, organs which are called the "inferior appendages" by Stimpson had disappeared. The stage last mentioned is supposed to be the adult, or at all events to be older than the other form which he figures. By comparing it with the adult of Myriothela, as figured by Hincks and Allman, this conclusion seems to be tenable.

If now we turn to the two similar stages shown in the figures, which we here have given, it will be found that the older (Fig. 1), differs from the younger in the same way that the "adult" in those by Stimpson differs from what he considers the young. Possibly the most important difference in each case between the two stages is the loss, in the adult, of the temporary tentacles found in the young.

There have been several opinions expressed as to the relationships of the Acaulis. It has been called a free-swimming hydroid, and associated with the supposed free hydroid of Nemopsis,[8] mentioned by McCrady. It has also been likened to a head of a Tubularian ruptured from a hydroid stem. The true affinities have been conjectured by several naturalists, but so little has been made known of the anatomy of Acaulis that it has been difficult to compare it with other hydroids.

Hincks,[9] in discussing the relationship of Acaulis and Myriothela, says "Mr. Alder has suggested the probability of a close affinity between Myriothela and the Acaulis of Stimpson, and

8 The young of Nemopsis has been shown to have a fixed hydroid.

9 A History of British Hydroids, pp. 76, 77.

would place it in the family of the Tubularidæ. To this view I am unable to assent, although it has received a certain measure of support from Prof. Allman. The Acaulis is furnished at first with a verticil of filiform tentacles near the base of the polypite (though

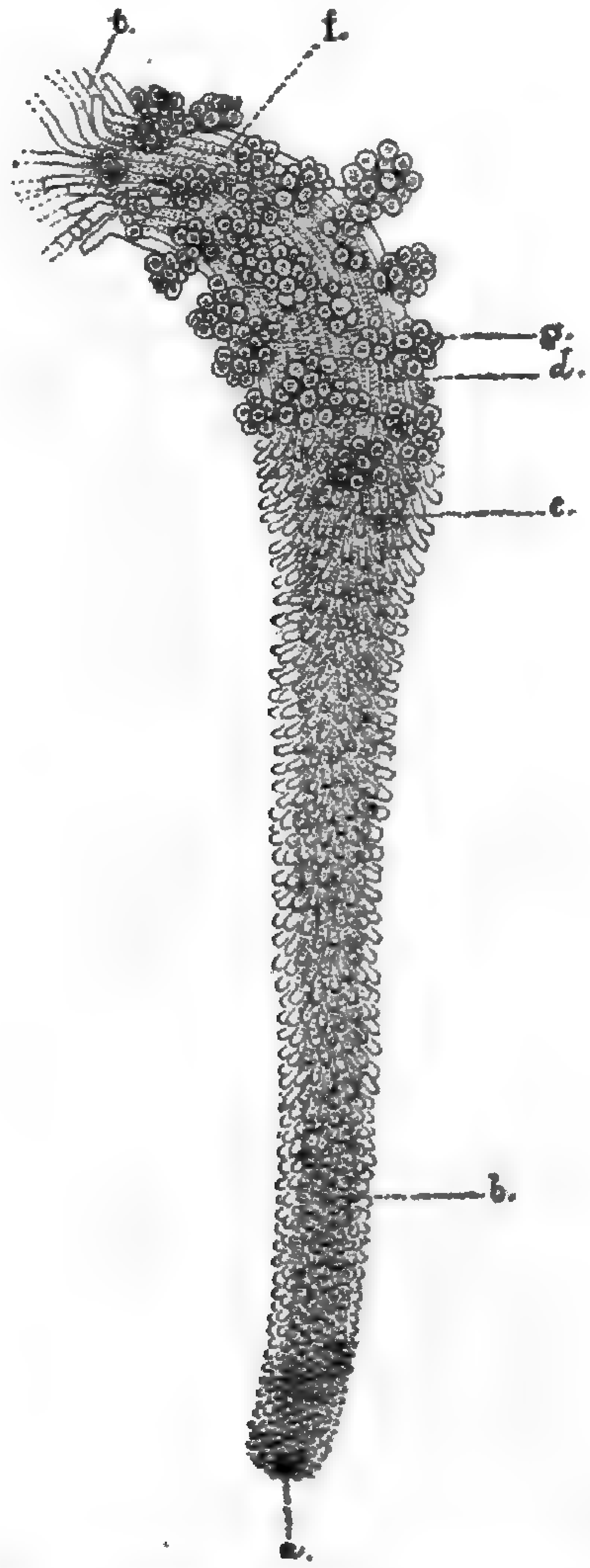

FIG. 1.—Adult Acaulis. *a*, terminal opening of the body—the interior of this body is "dark reddish purple"; *b*, central, purple-colored body wall; *c*, small papillæ—these, as well as the external body wall, are light pink; *d*, ridges or folds in the external walls of the body, of a "white color"; *e*, terminal continuation (unattached) of the body of the young Acaulis. *g*, gonophores—the interior of these clusters is dark purple; the exterior, white granular; *t*, permanent tentacles—"suctorial tentacles"; *tt*, temporary tentacles.

they are said to disappear subsequently), and between these and the upper capitate tentacles the reproductive buds are developed on the body. But Myriothela, so far as we know, is destitute of basal tentacles at all stages of its existence, and the gonophores, instead of being borne on simple or branched pedicles, as in the Tubularidæ, are produced on distinct coryniform zooids—small, rudimentary polypites, which are homologous with the so-called gonoblastidia of Hydractinia or Dicoryne. It is, as I have said before, a cluster of polypites nearly related to Coryne; but its marked peculiarities would seem to entitle it to stand as the type of a special family."

The author would here offer the following generalization to which he has been led by the consideration of two facts exhibited in the characters of the animal above described. First, the basal cirri of the first stage are homologous to the lower or exterior tentacula of Tubularia. Secondly, these cirri, or tentacula, are lost [10] with the growth of the animal, and do not appear in the second stage. Hence we should consider the Tubularidæ, in which they are persistent, as lower in the scale. It might add some weight to this conclusion to call attention to the fact that the medusæ of Tubularia assume the form of Actinulæ, in which we have a remote resemblance to the young Acaulis.

It may be deduced, also, from the above account that the species just described, having basal tentacula, is more embryonic than Coryne and its allies, in which they never appear, so that it is correctly classed between that genus and Tubularia; and if, as is possible, the single circle of tentacula in the Sertularidæ is homologous with the basal tentacula of Acaulis and Tubularia, it would follow that that family should stand lower in an ascending scale of classification. The disappearance of the verticil of filiform tentacles in Acaulis is certainly not an objection to considering this genus as allied to Myriothela, especially since the account which Allman gives of the embryology of Myriothela, published subsequently to Hincks's "History of British Hydroids," shows that Myriothela has these or similar tentacles.[11]

10 In regard to Hincks' dissent from Prof. Allman's opinion in regard to the affinities of Myriothela, and the grounds of his objection, it is only necessary to refer to Allman's Embryology of Myriothela, which to my mind effectually answers all objections as far as the supposed want of "basal tentacles at all stages of existence" goes. I believe, however, with Hincks, that Myriothela has such marked peculiarities that they "seem to entitle it to stand as a type for a special family."

11 Probably absorbed, not deciduous.

It seems possible to take another view of the homology of the temporary or embryonic tentacles in the former stage of Acaulis than that suggested above. In the first place, we may regard them as the same as the temporary tentacles of the young Myriothela. They are in point of fact not unlike similar appendages in Actinula, with which they may be readily homologized. Somewhat similar temporary appendages appear in the young Glossocodon on the side of the bell, as have been described by others, and as I have figured in my paper on the Tortugas Acalephæ. If we regard the Actinula as represented by the young Glossocodon it seems possible that the temporary appendages in both may be homologous. It seems to me probable that there is a close likeness between the young Myriothela, as represented by Allman, and an Actinula in the smaller of the two kinds of specimens which are here figured.

It is on account of the embryonic likeness of Myriothela that in my plates of the Hydrozoa in the Embryological Monographs (Memoirs Museum Comp. Zoology, Vol. IX., No. 3.) I placed Myriothela in close proximity with Hydra among the lowest forms of these animals. Still, in certain features, Myriothela has a high organization which is shared also by Acaulis. It would be interesting and valuable from a morphological standpoint to know more of the ultimate form of the body and appendages of Acaulis, and some of the early stages in growth which lie between the ovum and the young with temporary tentacles.

RECORD OF AMERICAN ZOÖLOGY.

BY J. S. KINGSLEY.

(*Continued from Vol. XXIV., p. 357.*)

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EROSIVE AGENTS IN THE ARID REGIONS.

BY RALPH S. TARR.

AMONG the mountains in the western part of the United States the agents of erosion are not unlike those of the moister sections of the east. Rain, snow, ice and frost are the chief factors in the sculpturing of these mountain masses.

On the plateau the conditions are different. Snow and ice are rarely seen; frost seldom appears, owing to the extreme dryness of the atmosphere, and rain falls under peculiar conditions. In all climates the action of animals and plants, of sun and air, are important factors in the wearing away of land masses; but in few places are the effects of these agents so important as in the western plateau region. Most if not all the agents of erosion which I shall describe have been noticed and mentioned by the various writers on the geology of the arid regions; but their importance seems so great that it may be well to group them and call especial attention to them.

Of the physical agents, as in all sections of the world, except the most arid, rain is the chief. For fully nine months in the year little or no rain falls upon the truly arid belt. When, during these months, rain falls at all, it comes simply as light showers or brief drizzling rain, producing almost no geological effect. It is absorbed by the soil, and is rarely in sufficient quantity to freshen the parched vegetation.

During the three summer months the region is liable to excessive local rains, often called "cloud-bursts." Several inches frequently fall in an hour during such a shower. Two-thirds of the annual precipitation falls in a few such rains. The geological effect of so much water suddenly poured upon the ground is intense. The whole soil is completely wetted for a depth of several feet, and even in this dry region torrents flow tumultously to the streams. The arid plateaux are chiefly regions of young drainage, on which there are large tracts without drainage arteries.

When a cloud-burst falls upon such a place deep ravines or "arroy s" are suddenly formed by the rush of the waters. Sometimes an "arroyá" fifteen feet deep is cut out in the soil for a distance of a mile. The destructive effects of such a cloud-burst are great, particularly when it breaks upon high ground and flows upon a plain. In July, 1886, I witnessed the effects of such a torrent in the Rio Grande Valley, in New Mexico. The cloud-burst broke upon the low Donna Anna mountains, but no rain fell outside of their limits. The mountains were capped by a dark thunder cloud, while in the valley at Donna Anna, about six miles distant, the sky was cloudless. In a short time a wall of muddy water a foot high spread over the flood plain of the Rio Grande near Donna Anna, and this was followed by similar waves for a half-hour. At Donna Anna, which is situated on a bluff bounded on the south by an "arroyá," a body of water completely filling the arroyá was seen to pass by for about a half-hour, then the body of water gradually diminished to a trickling stream, and in less than an hour no water was flowing. The depth of water must have been twenty feet at this point. It cut under the cliff on which Donna Anna is built, and scaled off a large piece, leaving a house on the edge of a precipitous wall. The stream carried vast quantities of bushes, roots and clay, and, I am told, some animals. On the flood plain several acres of vineyard were completely covered with silt and grıvel, one or two small orchards were partially buried, and an adobe house about ten feet high was buried to within two feet of the top. Several thousand tons of earth must have been removed during this torrent. Such floods are not uncommon in these arid regions, and their intense erosive activity may be seen by this illustration.

Next in importance to rain is the direct effect of the air as an erosive agent. In many places in the arid territories extensive sand dunes are proofs of this æolian action; but these are merely grand illustrations of a common phenomenon. During all months of the year dust is being blown about either in clouds or in creeping waves along the surface of the ground. In the valley of the lower Rio Grande, in New Mexico, often for several days in succession strong winds blow clouds of dust along the mesa, and these are often so dense that the Oregon Mountains, ordinarily plainly visible, are completely obscured from view. On the upper Rio Grande, at Embudo, in March, 1889, clouds of dust not uncommonly swept up the cañon, obscuring the high canyon walls from view, although they were only a mile distant. In February of the same year I encountered a dust storm in the pass among the White Mountains, near Fort Stanton, New Mexico, which lasted for several hours. The wind was blowing at a velocity of sixty miles an hour, and not only sand but small bits of gravel were blown with such force as to produce a painful blow on the face. The road could not be seen for a distance of twenty feet. Fine particles of dust penetrated to the works of my watch and caused it to stop.

Another common phenomenon of aerial erosion is the formation of small whirlwinds, to be seen on all sides on the plateau during the summer time. These sometimes gather force enough to carry away small bushes. The creeping action of blowing sand I have often had forcibly illustrated, when during a windy night the sand has blown upon my blankets, and formed a thin coating of sand.

The direct effect of change in temperature must be an important geological agent. On the plains the temperature of the sand is often 115° during mid-day, while in the early morning it may be as low as 60°. During the winter a black bulb thermometer registered 105° at one o'clock, while the minimum temperature at night was 27°. Such an excessive thermometric range must aid greatly in breaking up the rocks, especially the black basalts so common in the west.

Organic aids to erosion are also important. Plants serve very slightly in breaking up the soil. They grow with extreme slowness and great difficulty. They are important more in a conservative than a destructive way. The vegetation is thin and scanty, and hence does not act as a protective covering to the extent that plants of a moister climate do. The conservative effect is well shown, however, in the case of the mesquite, which catches and holds down the blowing sand, and as a result often causes to be built around it a bank of sand many feet high, often fifteen or twenty feet. The mesquite, and indeed almost all arid land-plants, have great root extension, by far the greater part of the plant being beneath ground, and the disintergrating offect of this peculiarity must be considered.

Among animals there are at least three types which are doing much work of erosion. Formerly the bison, and now their successors,—cattle,—have done an appreciable geological work. In the formation of trails and the general tramping of the ground they have aided in protecting the soil against the action of wind and water. Recently in southern New Mexico, on the Pecos, I have had my attention forcibly called to the importance of cattle in this direction. Several small streams had their course considerably lengthened by the puddling of the stream-bed by cattle.

Ants are very abundant on the plateau, and they are continually at work tunnelling the soil and bringing fresh earth to the surface. On the upper Rio Grand, near Embudo, there is a clayey gravel containing many small garnets. The ant-hills in the vicinity are composed chiefly of garnets. The clay is apparently washed out, and the coarser particles have remained. Ant-hills are frequently washed away during a rain, but they are quickly rebuilt. A peculiar ant, the "agricultural ant," so called, is common in the south-west. These creatures have a clear space around their homes, thus exposing the bare ground to the action of the elements.

The work done by prairie dogs, while in individual cases apparently insignificant, must amount to a grand sum total. Over large tracts their burrows open to the air at intervals averaging not more than twenty-five feet apart. I have no means of telling how far they extend into the ground, but from the appearance of their mounds I should judge it to be only a few feet. This mound rarely exceeds a height of two feet, and generally less. Being in the form of a truncated cone, with a very gradual slope; they are sometimes three feet in diameter. Their burrow is seldom more than six inches wide, so that its extreme length cannot be many feet. That the creatures are constantly at work is proved by the great number of new holes in every "dog town," and also by the number of holes in old roads passing through sections inhabited by the prairie dog. Deserted burrows can always be told by the destruction of the mound, and widening of the hole under the influence of subaerial denudation. The towns are generally built on gentle sloping hills, where there is some drainage, consequently the fresh clay and earth brought to the surface is gradually drifted away. Not only is the work of erosion aided by the bringing up of material to the surface, but also by the opening of tunnels, by which water is allowed free underground passage. With a mound around the hole this inflowing of water is reduced to a minimum; but when the hole is abandoned, and the mound destroyed, water freely enters, and in such cases I have frequently noticed small runlets leading to the hole.

Thus it will be seen that the great agent of erosion, water, is of particular importance in the arid regions on account of its intensified action during brief periods; that the direct effect of aerial currents is a powerful factor in the erosion of these plateaux; that the sun's heat must also play an important part; that plants are only slightly conservative and slightly destructive; and that animals, by tramping down the soil or by burrowing and tunneling into the earth, are important aids in the great work of subaerial denudation by which the plateaux of the west are being gradually eaten away.

EDITORIAL.

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

THE U. S. National Academy of Sciences is entertaining a proposition to divide its membership into classes. These are ten in number in the plan, as follows: Mathematics, Physics, Astronomy, Geodesy and Mechanics, Chemistry, Geology, Botany, Zoölogy, Anthropology, and Political Economy and Statistics.

A classification of the sciences which shall be consistent with their nature and relations is of course difficult, and the above arrangement may be criticised, especially on the part of biologists. It is, however, reasonable that physiology, embryology and paleontology should be relegated to botany and zoology respectively. But psychology cannot be properly so referred, and its omission is a defect in the plan which it is important to remedy.

We believe that such a division into classes will be useful in directing attention to possible deficiency or excess in the representation of the various branches of science. But it must be borne in mind on the other hand that no equality of representation will be possible, and the departments, if adopted, will be filled as nearly as possible in accordance with the number of deserving candidates which can be found.

In order to secure a more equal and just representation, another plan of division was proposed some years ago which was not adopted. Four classes were recommended, viz.: Psychology, Physics, Natural History and Applied Science. It was proposed to give to the first and last-named classes fifteen members each, and to the second and third, which would correspond with the old sections A and B of the American Association for the Advancement of Science, thirty-five members each. This may be a better scheme than the one now before the Academy.

The new plan proposes that any of the classes may be called together and hold meetings to consider questions relating to their departments. This is a proposition to be considered with care. Occasions requiring such separate action will be rare, and perhaps had better be deferred until meetings of the entire Academy can be had. It is doubtful whether such a plan would be productive of advantage to the Academy. We hope also that the division into classes will not be made a pretext for increasing the membership to above one hundred persons.

—THE last meeting of the Committee of Arrangements for the reception of the International Congress of Geologists was held in Washington, D. C., April 18th. The American Committee had, on the occasion of their last Congress (in London), presented the invitation of a number of Philadelphia organizations and officials to the Congress to hold its next session in Philadelphia, which invitation was accepted by the Bureau of Direction on behalf of the Congress. Some uncertainty remained as to the best time of holding the Congress, owing to the fact that the Jubilee of the University of Pennsylvania and the International Exposition at Chicago had both been postponed from the original dates, and it was thought to be important that the Congress should coincide with one or the other of these events. The committee, however, voted that the meeting of Congress should be held in 1891, thus allowing but little time for preparations. This premature action might have been harmless, however, but for the subsequent action by which it was voted to ask the Bureau to transfer the place of meeting from Philadelphia to Washington. The time required to get the consent of the Bureau, whose members live in many countries and at remote distances, will be so great as to prevent the proper preparation for the Congress, owing to the lack of time. This conclusion was reached principally by the votes of active or past employees of the U. S. Geological Survey on motions made by the Director of the Survey (Major J. W. Powell), who constituted a majority of the Committee; one member of the Survey, Capt. C. E. Dutton, not voting. The adoption of the motions of Major Powell is equivalent to the destruction of the international character of the Congress. The object of the Director in bringing about this result may be well imagined. That he should have the support of the International Congress of Geologists is no doubt a very desirable consummation for the Director of the

Survey, since he has not hitherto experienced any especial recognition from that body. And that he shall have such recognition from a body controlled by himself, is a foregone conclusion. There are, however, many American geologists who think that this International Congress should not be used to advance the political aspirations of Major Powell. We are of this number, and we therefore hope that the Bureau of Europe will not accede to the request of the majority of the Committee, but will adhere to their original decision that the Congress be held in Philadelphia, where it will have a truly international character, and be free from the domination of any particular body. The date also should be postponed until 1892, in order to allow the time requisite for preparation, and to coincide with the approaching Jubilee of the University of Pennsylvania. The facilities for holding the Congress in Philadelphia are excellent, and they will be made fully available by the coöperation of the Philadelphia members of the Committee of Reception.

—The scientific men of Indiana are preparing to give the American Association for the Advancement of Science a warm welcome at Indianapolis the coming summer. If their efforts meet with the relative success that they did at the first meeting of the Association at that city in 1871, the Association will have occasion to congratulate itself. We hope however that the local committee will arrange that the excursions be postponed until after the close of the meetings so that the real business may not be interfered with too seriously. Indiana includes within its borders more original investigators in science than any state west of the Allegheny Mountains, and we have no doubt but that the interests of science will be well cared for at their hands.

General Notes.

GEOGRAPHY AND TRAVELS.

Col. Stanton's Recent Descent of the Colorado River.—Col. Robert Stanton, commander of the Denver expedition now exploring the comparatively unknown regions traversed by the Colorado river, has written to the Denver *Republican* a graphic account of the perilous journey down the wild stream from the head of the Granite gorge of the Grand canyon to the mouth of Diamond creek, to accomplish which required the time from January 24 to March 1. The expedition had to battle upon entering the Granite gorge with mighty cataracts and foaming torrents, sometimes letting their boats down with ropes, and at times portaging all the contents of the boats around rapids. Two of the boats were dashed against rocks and wrecked. Progress was extremely slow. At one point they were delayed five days while one of the wrecked boats was being reconstructed. Of that portion of the Granite gorge from its head to Bright Angel creek, Col. Stanton quotes from his note book, under date of February 7:

"The canyon is growing more and more picturesque and beautiful the further we proceed. The Granite has lost its awful and threatening look, and slopes back in beautiful hillsides of variegated black, gray, and green. Above this, next to the river, is a stratum of dark sandstone cut into sharp horizontal layers, standing in an almost perpendicular wall, jutting out in places to the edge of the granite, and studded all over with points standing out in the air, darker in color than those behind them, and the top edge cut into smaller points and crevices through which the light shines, giving a rough, beaded appearance.

VIEWS IN THE GORGE.

"At the side of the canyons, and from the bends of the river, the upper portions of the whole gorge are brought into view, showing the great marble and sandstone cliffs benched back far away from the river, while small mountains jut in close between the side canyons and wash nearly a mile and a quarter in height. As we sail along the smooth stretches between the rapids each turn brings some wonderful picture more beautiful than the last. As we look down the river or up a low side canyon, with the placid water between its polished walls of black and gray and green for a foreground, there rises above the dark sandstone tier upon tier, bencn upon bench, terrace upon terrace, stepping back further and further and higher and higher, and in their immensity of height and proportions seeming to tower almost over our heads. First above the darker sandstone come the flattened slopes of the line, and mineralized matter in horizontal layers of yellow, brown, white, red, and green.

"Then rise sheer walls of stained marble 1,000 feet or more, the lower portions yellow, brown, and red, and the coloring of red growing brighter as it nears the top. Above this, smaller benches of marble, at the top of each a little mesa covered with green grass and brushes, and above these a dozen or more terraces of scarlet and flame-colored sandstone, stained on their outer points with black, and the little benches between them relieved by the bright green of the grease-wood and bunch grass, the whole covered with, perhaps, a couple of thousand feet of the lighter gray, yellow, and white sandstone ledges, capped by pinnacles and spires, turrets and domes in every imaginable shape, size and proportion, with all their slopes covered and their tops fringed with pine, cedar, and pinion trees, whose bright green stands out in bold relief against the flaming colors of the sandstone, and the banks of pure white snow that cover the top and have run down into the many gulches along the sides."

A CHANGE IN THE SCENE.

Further on he writes: "From the southern portion of Powell's plateau to the mouth of the Kanab Wash the canyon assumes an entirely new form. The granite, except in a few patches, has sunk under the river, and the softer strata of sand and limestone which formed the great slopes above the granite have come down next to the river and rise from the water's edge in great talus slopes of from 300 to 600 feet high at a general angle of 40 degrees from vertical. The high cliffs of marble and red sandstone bench back from the top of these slopes. Although these outer peaks and cliffs have drawn in close upon the river the canyon itself—that is the inner gorge—is much wider than above, the width being measured between the tops of the great talus slopes. The river is broader, and it sweeps in gentle curves at the foot of the talus, which is covered with bushes, bunch grass, and large mesquite groves. On many of the long stretches where the river can be seen for several miles the picture is one of grandeur and beauty. Grand with its walls of bright colors towering 2,500 feet overhead, beautiful in its long green slopes, with the quiet waters sparkling in the sun at their foot, for the rapids are much less frequent, and stretches of still water are growing longer and longer.

"From the mouth of the Kanab Wash for about twenty miles down is perhaps the narrowest and deepest part of the great inner gorge. The lovely sandstone and limestone ledges have sunken under the river, and the marble and upper sandstones come close into the water. At the bottom the gorge is from 150 to 200 feet wide, and the river runs between vertical walls—vertical, however, for only about 80 feet up—and fills the whole space from wall to wall. The walls of this portion of the canyon—(and it comes nearer being a true canyon than any other part of the river)—rise above the water 3,000 feet, and they are almost vertical; the benches are narrower, and the vertical cliffs between the benches higher than in any other section. And yet, strange to relate, from one end of this section to the other there is a bench about 50 feet above high water, running almost parallel with the grade of the river, of solid marble wide enough to build a four-track railroad upon and not interfere with the perpendicular walls above or the river below.

IN FLOOD AND RAPID.

"The night before we reached Kanab the river rose four feet; it continued to rise for two days and two nights. How much the rise was I am not absolutely certain, but believe from good evidence it was fully ten feet. Just below Kanab Wash there is a rapid one and one-half miles long. On Tuesday morning we started down this rapid. We made this mile and a half in just four and one-half minutes. We then had for some time few rapids, but a rushing, singing current, forming eddies, whirlpools and back currents fearful to contemplate, much more to ride upon.

"About 2:30 p. m. we heard a deep, loud roar and saw the breakers ahead in white foam. With a great effort we stopped upon a pile of broken rocks that had rolled into the river. Much to our surprise when we went to look, the whole terrible rapid that we had expected to see had disappeared, and only a rushing current in its stead. While we stood wondering there rose right at our feet those same great waves, 12 to 14 feet in height and 100 to 150 feet long across the river, rolling down stream like great sea waves, and breaking in white foam with a terrible noise. We watched and wondered and at last concluded this was the fore front of a great body of water rolling down this narrow trough from some great cloudburst above. Believing that discretion was the better part of valor, we camped right there on that pile of rocks, fearing that although our boats would ride these waves in safety, we might be caught in one of these rolls just at the head of a rapid, and, unable to stop, be carried over the rapid with the additional force of these rushing breakers.

"The next morning, to our surprise, we found the flood had begun to recede. After an early breakfast we started on what afterwards proved to be the wildest, most daring and exciting ride we have had on the river. The canyon so narrow, the turns quick and sharp, the current rushing first on one side and then on the other, forming whirlpools, eddies and chutes, our boats caught first in one and then in the other, now spun around like leaves in the wind, then shot far to the right or left almost against the wall, now caught by a mighty roll and first carried to the top of the great waves, and then dropped into the 'trough of the sea,' with a force almost sufficient to take away one's breath, many times narrowly escaping being carried over the rapids before we could examine them, making exciting and sudden landings by pulling close to shore, and with bow up stream rowing hard to partially check our speed, while one man jumps with a line to a little ledge of rocks and holds on for his life and ours too.

A STRUGGLE FOR LIFE.

"At last the expected combination comes. We round a sharp turn and see a roaring, foaming rapid below, and as we come in full view of it we are caught in a mighty roll of flood wave.

"We try to pull out to an eddy—it is all in vain; we cannot cross such a current. We must go down over the rapid. In trying to pull out we got our boats quartering with the current, over the rollers and through the breakers up to the head of the rapid. In this position they travel a course, first in the air and then in the water, only to be compared to the spirals of a corkscrew. When we find we must go over the rapid, with great effort we straighten them round and enter in good shape, bow on. It lasts but a moment, the cross current strikes us and we are turned, go broadside down over the worst part of the rapid (which proves clear of rocks), then, turned and twisted about, we go through the rest of the fall in wild, wizard waltz, to music more weird than that of the bagpipe. At the end of the fall our sturdy boats float out into an eddy as quietly and gracefully as swans. Noble little crafts! May they, the Bonnie Jean and Lillie, live long enough to float on more peaceful waters than those of the Colorado river, over whose rushing torrents they have glided now near 500 miles and never once been upset. And peace be to the ashes (I should say splints) of the sweet Marie that we left in the dark canyon above."—*The Evening Star, Washington, D. C.*

GEOLOGY AND PALEONTOLOGY.

The Strength of the Earth's Crust.—The term crust is here used to indicate the outside part of the earth, without reference to the question whether it differs in constitution from the interior.

Conceive a large tank of paraffine with level surface. If a hole be dug in this and the material be piled in a heap at one side, the permanence of hole or heap will depend on its magnitude. Beyond a certain limit, further investigation and heaping will be completely compensated by the flow of the material. Substitute for paraffine the material of the earth's crust, and the same results will follow, but the limiting size of the hole or heap will be different, because the strength of the material is not the same. Assuming the earth to be homogeneous, the greatest possible stable prominence or depression is a measure of the strength of its material.

It is not believed that the earth is homogeneous, and with reference to the outer portion of the crust it is known that it is not composed of homogeneous shells. There is observational basis for the theory that the matter composing and lying beneath ocean beds and continents is lighter than the matter composing and lying beneath ocean beds, and many students of terrestrial physics entertain the theory that unit columns extending from the surface downward have everywhere the same weight, the height of each column being inversely as its mean density. In accordance with this theory, prominences and depressions of the surface exist in virtue of a principle of equilibrium, called isostatic.[1] Under hydrostatic equilibrium the surface of a free liquid is level; under isostatic equilibrium the surface of a non-homogeneous solid capable of viscous flow, is uneven.

There are thus two possible explanations of the inequalities of terrestrial surface, and these may be characterized severally by the terms rigidity and isostasy.

In connection with a study of Lake Bonneville, a large body of water temporarily filling a basin of Utah during Pleistocene time,[2] observational data were gathered bearing on the question of rigidity versus isostasy.

[1] For definitions of the new term "isostasy" and its adjective "isostatic," see Dutton in Bull. Phil. Soc., Washington, XI., p. 53, and Woodward in *Am. Jour. Sci.*, 3d Series, Vol. XXXVIII, 1889, p. 351.

[2] An account of Lake Bonneville may be found in the Second Annual Report of the U. S. Geological Survey, 1881, pp. 167-200.

1. The Wasatch mountain range is carved from a large block of crustal material, uplifted along a fault plane at one side. The block adjoining the fault plane on the opposite side is thrown down. Erosion s continually transferring material from the uplifted block to the downthrown block, and there is direct evidence that the mountain is steadily rising or the valley sinking, or both. Some advocates of the isostatic theory would regard this progressive relative displacement as a direct effect of the continual transfer of load. Under this view the mountain block has less density than the valley block, and the two are in isostatic equilibrium ; the unloading of the mountain block by erosion and the loading of the valley block by deposition disturb the equilibrium, and it is restored by vertical movement on the fault plane.

An arm of Lake Bonneville occupied the valley, filling it to an average depth of 500 or 600 feet, and this load of water was somewhat quickly added and afterward somewhat quickly removed. If the valley block were delicately sensitive to the application of load, it should be depressed about 200 feet by the access of water, and should rise a corresponding amount when the water was removed. But this did not occur. On the contrary, the depression of the valley, as shown by changes occurring along the fault plane, continued alike during the presence of the water and after its removal. It is therefore concluded that the local transfer of load from one orognic block to the other is not the primary cause of the progressive rise of the mountain and depression of the valley, and the question arises whether the mountain range may not be wholly sustained in virtue of rigidity.

2. Considering the main body of Lake Bonneville, it appears from a study of the shorelines that the removal of the water was accompanied, or accompanied and followed, by the uprising of the central part of the basin. The coincidence of the phenomena may have been fortuitous, or the unloading may have been the cause of the uprising. Postulating the casual relation, and assuming that isostatic equilibrium, disturbed by the removal of the water, was restored by viscous flow of crust matter, then it appears (from the observational data[3]) that the flow was not quantitatively sufficient to satisfy the stresses created by the unloading. A stress residium was left to be taken up by rigidity, and the measure of this residium is equivalent to the weight of from 400 to 600 cubic miles of rock.

From these phenomena and theoretic considerations arises the

[3] These data are not yet fully published, but will appear in a memoir on Lake Bonneville now in press, constituting Vol. I. of the Monographs of the U. S. Geological Survey.

working hypothesis that the measure of the strength of the crust is a prominence or a concavity about 600 cubic miles in volume.

If this hypothesis is strictly true, then there should be no single mountain mass and no single valley, due purely to the local addition or subtraction of material, having a greater volume than 600 cubic miles. At least four kinds of mountains and valleys are due simply to the addition and subtraction of material: (1) mountains of extravasation (such as volcanic cones), beneath which the pre-existent terranes lie undisturbed; (2) mountains of circumdenudation, produced by the removal of surrounding material; (3) mountains produced by extravasation *and* circumdenudation; (4) valleys of erosion, unaccompanied by phenomena of displacement.

A large number of such mountains and valleys exist, and some of the largest occurring in the United States have been mapped in contours by the U. S. Geological Survey, so that their volumes can be computed readily.

San Francisco Mt., in Arizona, a result of extravasation, has a volume of 40 cubic miles.

Mt. Shasta, probably due to extravasation only, has a volume of 80 cubic miles.

The Tavaputs Plateau, or Roan Mt., lying on the borders of Utah and Colorado, and produced by circumdenudation, has a volume of 700 cubic miles.

Mt. Taylor, and the Taylor Plateau, in New Mexico, resulting from extravasation and circumdenudation, have jointly a volume of 190 cubic miles.

The Henry Mts., resulting from volcanic intrusion and circumdenudation, have a volume of 230 cubic miles.

The Sierra La Sal, a mountain group of the same type, has a volume of 250 cubic miles.

The deeper portion of the Grand Cañon from the Colorado, from the mouth of the Little Colorado to the mouth of Kanab Creek, is due to the removal of 350 cubic miles of rock.

The Tavaputs Plateau slightly exceeds the hypothetic limit; the other illustrations fall within it.

In view of the phenomena cited, and of the considerations and comparisons adduced, it is believed that the following theorem or working hypothesis is worthy of consideration and of comparison with additional facts: *Mountains, mountain ranges, and valleys of magnitude equivalent to mountains, exist generally in virtue of the rigidity of the earth's crust; continents, continental plateaus, and oceanic basins exist* *in virtue of isostatic equilibrium in a crust heterogeneous as to density.*—G. K. Gilbert, in *Bulletin. Geol. Soc. America.*

Scott and Osborn on the Fauna of the Brown's Park Eocene.[1]—This memoir supplies an important desideratum, since we obtain through it the first intelligible view of the Mammalian fauna of the Brown's Park or Uinta (name preoccupied) horizon of the Eocene of North America. This formation, as is well known, occupies the summit of the Eocene series, and therefore intervenes between the Bridger below and the White-River above. The faunæ of the last-named horizons are tolerably well known, while for the Brown's Park series we have had to depend hitherto on the exceedingly unsatisfactory descriptions published by Marsh many years ago. The formation has, so far as known, a limited geographical extent, occurring at the south base of the Uinta Mountains in N. E. Utah only. This location was explored by the Princeton party under Professor W. B. Scott, whose observations on the geology constitute the introduction to this memoir.

The paleontological part of the memoir is an excellent model of what such a work ought to be, and the results are worthy of the care bestowed on its preparation. The species observed are eleven in number, which belong to as many genera. These are as follows: *Quadrumana*, Hyopsodus; *Glires*, Plesiarctomys; *Creodonta*, Mesonyx and Miacis; *Perissodactyla*, Epihippus, Diplacodon, Isectolophus, Amynodon and Triplopus; *Artiodactyla*, Protoreodon and Leptotragulus. Of these genera, Isectolophus, Protoreodon, and Leptotragulus were discovered by the Princeton expedition. Nothing of unusual novelty is stated with regard to the species and genera of the Quadrumana, Glires, and Creodonta, but the case is quite different with regard to the Ungulata. Ancestral forms of later types are here most distinctly indicated, and the authors must be congratulated on the important contribution they have thus made to the doctrine of evolution. They show that Epihippus stands in the line of the horses, as asserted by Marsh, but, unlike that author, they satisfactorily demonstrate that it intervenes between Pliolophus and Anchitherium. They also show that Diplacodon is the ancestor of the varied forms of the Menodontidæ of the lower Miocene, and the descendant of Palacosyops of the Bridger Eocene. Isectolophus is proven to be the parent of the tapirs, connecting that

[1] The Mammalia of the Uinta Formation. Part I., The Geological and Faunal Relations, and Part II., the Creodonta, Rodentia and Artiodactyla, by W. B. Scott; Part III., The Perissodactyla, and Part IV., The Evolution of the Ungulate Foot, by H. F. Osborn. Transactions of the American Philosophical Society, Philadelphia, 1889, Vol. XVI., p. 461; pl. v.; p. 112.

type with Systemodon, through some intermediate forms, as suggested by the present writer.[2] Amynodon is fully elucidated as far as cranial structure goes, and its relation to the primitive rhinoceroses pointed out. A new Triplopus (*T. obliquidens* S. & O.) is described, which is of larger size than the *T. cubitalis* of the Bridger, and the knowledge of the character of the genus is increased. Protoreodon S. & O. is of especial interest. It is essentially an Oreodont with the fifth crescent (metaconule) of the superior molar present as in the Eocene Artiodactyla generally. It is so much like Oreodon in other respects as to indicate its place as ancestral to that form, and it adds one more piece of evidence to sustain the view that the tetraselenodont forms are the descendants of the pentaselenodont Artiodactyla. The *Protoreodon parvus* S. & O. was an animal about the size of a raccoon. Leptotragulus is an equally interesting form, since it supplies the hitherto missing ancestor of Poëbrotherium. It is tetraselenodont, and differs chiefly from the latter and later genus in the freedom of the ulna and radius from each other. Thus the genera of Ungulata of this formation extend the phylogenetic lines by one period backwards, or they fill gaps hypothetically awaiting occupation.

The chapter on the evolution of the Ungulate foot, by Prof. Osborn, handles the subject in a masterly way. The author admits the fundamental propriety of the system proposed by Cope, but takes some exception to an application of it in detail in certain directions. The exception on which most stress is laid is the fact that in the equine line, after the development of diplarthry in the posterior foot, a tendency to revert to taxeopody appears. Prof. Osborn states that the above-mentioned system becomes here "not strictly applicable;" but as he has not demonstrated a return to absolute taxeopody, and as he admits the fundamental conformity of the system to nature, the objection cannot be said to have much weight. The condition in Equus shows only the effect of the increased dimensions of the median digit and the corresponding elements of the second tarsal row, to which the first tarsal row does not fully correspond.

Prof. Osborn also objects to Cope's theory of the origin of diplarthry by torsion, stating with reason that were this the only movement, the metarso-tarsal articulation cannot be accounted for. In other words, were the tarsus and carpus to be rotated externally on the metatarsus and metacarpus, dislocation of their articulation would take place. Prof. Osborn called my attention verbally to this point, and as I had not previously considered it, I supplied what I thought to be an ade-

[2] Article Perissodactyla, AMER. NATURALIST, 1887, December.

quate explanation in my late memoir in *The American Journal of Morphology.*[3] This was based on the fact already recorded by Allen in his analysis of the Muybridge photographs, that in recover the weight is borne on the inner edge of the foot, and therefore on the external sides of the heads of the metapodials. I did not then state with sufficient clearness what I now add, that the external torsion of the lower leg concerned in producing diplarthry is that which occurs, as I have pointed out, at recover, and it is therefore coincident in time with the transfer of the weight to the inner side of the foot, so that both strains occur together, and so dislocation cannot occur. In rapid movement, when the torsion-strain is most energetic, all the strains will be nearly contemporaneous; while in slow movements the torsion on plantation will be distinct, if existing, of which there is some doubt. Thus is directed and located the growth-energy, to which Prof. Osborn appeals as a sufficient explanation of the phenomenon of diplarthry.

The authors in a few instances, through some oversight, have misstated the opinions of the present reviewer. Thus Prof. Scott cites him as having regarded the genera Amynodon and Metamynodon as identical. This he has not done, as can be seen by his systematic descriptions of the two genera in "The Perissodactyla," (NATURALIST, 1887, p. 993). Prof. Osborn quotes my earlier proposition of 1885, that Triplopus is in the phylum of the rhinoceroses, and omits to mention the modified view expressed in "The Perissodactyla" (1888), that it is in the line of Hyracodon, and at one side of the rhinoceroses. The slender legs of the known species of this genus are, however, not to be regarded as a generic character, as is done by Osborn, and a stout-legged Triplopus is by no means an impossibility. Finally, Osborn accuses me of regarding carpal and tarsal displacement as having preceded in time digital reduction, because I stated that one consequence of displacement had been the loss of the inner digit. This accusation is quite inexcusable, as I have never thought it necessary to express any opinion on the subject. Phenacodus (with which I am somewhat familiar) shows that reduction preceded displacement, to say nothing of Hyrax, cited by Osborn. Reduction followed disuse, and it is only the inner digit that has suffered finally through displacement.—E. D. COPE.

Note on the Pelvis of Cumnoria (Camptosaurus).—In a recent examination of Mr. Lydekker's admirable volume on vertebrate paleontology, I was struck with the conspicuous perpetuation of an

[3] On the Mechanical Origin of the Hard Parts of the Mammalia, 1889, p. 171.

error which should have been corrected before now. On page 1152, referring to the Ornithopoda he says: "The ilium generally has its preacetabular process much elongated, although this is not the case in the type of *Camptosaurus;*" and on page 1158, "The posterior portion of the ilium of this species [*Iguanodon fittoni*] is indeed almost indistinguishable from that of *Camptosaurus.*" If one will compare the figure of the pelvis of *Camptosaurus dispar* on page 1153 with that of *Iguanodon dawsoni* on page 1158, he will be struck with the strong resemblance throughout, except of the anterior portion of the ilium." The fact is that the figure of the former is wrong. The anterior portion of the ilium of the type had been broken off and weathered, indications of which are distinctly seen in the specimen. Prof. Marsh had this demonstrated to him more than five years ago, and there are other ilia in the Yale Museum in which this process is complete. It is to be hoped that this figure will be banished from text-books in the future, and that no new genus will be made on the supposition that the process is wanting.—S. W. Williston.

BOTANY.

The Assimilation of Carbon by Green Plants from Certain Organic Compounds.—Under this title Mr. E. Hamilton Acton publishes in the Proceedings of the Royal Society (Vol. XLVII., p. 150) the results of an interesting series of experiments made by him to determine whether it can be produced in the assimilating cells of green plants when supplied with certain organic compounds, in the absence of carbon dioxide from the air. The following summary will give the essential parts of the paper.

The apparatus used consisted of a tall bell-jar, perforated at the top, and accurately ground at the bottom. Into the top an india-rubber stopper was accurately fitted, and through this were passed two bent glass tubes, each leading to a U tube filled with soda-lime. Inside of the bell-jar were placed a glass culture cylinder, a small dish of soda-lime, a couple of dishes of water, and a test-tube filled with a solution of caustic potash. The bell-jar was set upon a glass plate, and the contact was rendered air-tight by the use of a mixture of vaseline, resin and beeswax.

A normal "culture solution" was prepared with the following composition:

Potassium nitrate (KNO_3)	0.15 grams.
Magnesium chloride ($MgCl_2$)	0.10 "
Calcium phosphate ($Ca_3(PO_4)_2$)	0.05 "
Ferrous sulphate ($FeSO_4$)	0.025 "
Calcium sulphate ($CaSO_4$)	0.05 "
Water (distilled)	100. "

This was placed in the culture cylinder, and to this were added the organic compounds experimented with. The plants used were either cut branches, or plants with roots, and these were supported by a cork in the mouth of the culture cylinder, in the usual way. Applications of the organic compound were also made directly to the surfaces of the leaves of plants.

The plants used were first deprived of all their starch, either (a) by being placed in the dark for a sufficient length of time, or (b) by being placed under the bell-jar described above, where, having no access to carbon dioxide, the same result was obtained with greater convenience. After such preparation they were placed in the culture solution, to which an organic compound had been added. On exposure to light in some cases starch was formed, although all access of carbon dioxide was cut off, thus proving that the plants formed starch by conversion of the organic compounds. The results were as follows:

1. Neither acroleïn nor acroleïn ammonia (C_6H_9NO) were used by the plants. No starch whatever was formed.

2. With allyl alcohol (C_3H_6O) similar results were obtained.

3. With glucose (one per cent. solution) starch was produced in every instance.

4. With aldehyde no starch was formed.

5. With weak solution (0.05 to 10 per cent.) of pure glycerine starch was invariably formed.

6. With lævulinic acid no starch was formed.

7. With pure cane sugar starch was invariably formed.

8. With dextrine no starch was formed.

9. With inulin starch was formed.

10. With "soluble starch"[1] the cut branches formed starch, but those supplied with roots did not.

11. With glycogen no starch was formed.

[1] Soluble starch was prepared by rubbing wheat starch with cold water into a thin paste, and then pouring it into an excess of boiling water, and boiling for five minutes. On cooling, the solution was filtered through paper, and diluted to a strength of about one per cent.

12. With an extract of natural humus starch was formed in small quantities, in the case of rooted plants; in other cases no starch was was formed.

13. With the humus-like product obtained by the action of alkalies on cane sugar, no starch was formed.

The plants used were chiefly *Acer pseudoplatanus, Phaseolus vulgaris, Ranunculus acris, Cheiranthus cheiri, Tilia europæa, Alisma plantago, Scrophularia aquatica, Quercus robur, Campanula glomerata, Euphorbia helioscopia, Lilium candidum.*

The author concludes: "That green plants cannot normally obtain carbon for 'assimilation' from any substances except carbohydrates, or bodies closely related to them, not from aldehydes or their derivatives, and not from all carbohydrates even." "That a compound may be a source of carbon when supplied to the leaves, but not when supplied to the roots, and *vice versa.*"

The Yellow Water Crowfoot.—This common plant of the eastern half of the continent, known hitherto under the name of *Ranunculus multifidus* may have to bear the name of *Ranunculus lacustris,* given it by Beck and Tracy in the third edition of Eaton's Manual (1822). Professor Greene, in a recent number of *Pittonia,* points out the fact that this name appears to have priority. He also calls attention to the fact "that no one has yet stated whether *R. lacustris* be annual or perennial," saying farther that "probably nobody knows."

It probably lives for about a year. The seedlings appear late in the autumn along the banks, and on the bottoms of dried up pools, ready to make an early growth in the following Spring. I have never found any evidence of the full grown plants lasting through the winter. Possibly they may do so, in exceptionally mild winters, as is indeed the case with many other plants.—CHARLES E. BESSEY.

Atlas of French Plants.—Some months ago the first number of an important work by A. Masclef, was brought out by a Paris publishing house (Klincksieck,) under the title "Atlas des Plantes de France, utiles, nuisibles et ornamentales." When complete it will include two hundred colored plates, and about three hundred and fifty pages of text, at a cost of fifty francs. The pages and plates are of octavo size, and the latter are very well done. The work will prove a valuable one, especially to experiment station workers.

The Characeæ of Germany.—The fifth volume of the new edition of Rabenhorst's "Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz," is to be devoted to the Characeæ. The work is in the hands of Dr. W. Migula, of Karlsruhe, and promises to be of great interest and value. Parts I. and II., which have appeared since the first of the present year, are largely devoted to a discussion of general matters. In part II. we have an outline of Dr. Migula's system of classification as applied to the Characeæ. He insists npon their isolated position in the vegetable kingdom, and proposes the name Charophyta for the group, which contains about one hundred and fifty species (and subspecies) in the whole world. These are distributed among six genera, which in turn fall into two sub-families.

CHAROPHYTA.

Family Characeæ.—1. Sub-Family Nitelleæ.—Gen., *Nitella* and *Tolypella*.

2 Sub-Family Chareæ.—Gen., *Tolypelopsis*, *Lamprothamnus*, *Lychnothamnus* and *Chara*.

The German species of *Nitella* number thirteen, nearly all of which are described by the end of Part III. lately received. Good illustrations accompany the full text, and thus give us a most usefu' work.

ZOOLOGY.

Hoplophoria coralligens.—Is a new Actinian from the Bahamas, described by Dr. H. V. Wilson.[1] Only a single specimen was found. In general structure it was on the ordinary Hexactinian type. The mesenterial filaments were typical, and there were no acontia. The specimen was a female, with ovaries developed on but four mesenteries belonging to the primary cycle. Just beneath the circle of tentacles are four large organs which are diverticula of the gastrovascular space, and which are stinging weapons. These structures are not modified tentacles, but are homologised with the marginal sacs (randäsckchen) which were formerly regarded as eyes in many Actinians. Hoplophoria is regarded as a member of the Antheadæ, in which, besides the points enumerated above, only the six primary mesenteries reach the œsophagus.

[1] Studies from the Biol. Lab., Johns Hopkins Univ., IV., p. 379, 1890.

Dinophilus.—S. F. Harmer describes the anatomy of *D. tæniatus.*[2] The animal has two circles of preoral cilia, while each of the five body segments bears two similar circles, interrupted by the uniform ciliation of the ventral surface. The large brain nearly fills the preoral lobe, while the œsophageal commissures connect it with the widely separated ventral cords. These latter lie just outside the basement membrane of the skin, and are provided with five ganglionic swellings. The paired eyes are on the top of the brain; each consists of a pigmented sac filled with a clear substance. Below them is a pair of small sacs opening to the mouth, and innervated from the œsophageal cords. The mouth is ventral; the oblique œsophagus receives the ducts of the salivary glands and terminates in the large stomach. This latter is prolong behind into a dorsal cæcum, while below it communicates with the intestine. The anus is just above the tail. The body cavity is but slightly developed. Five pairs of nephridia are present, the hinder pair being converted in the male into vesiculæ seminales. In the young the testes consist of a couple of ventral bands, but in the adult these are enlarged and united both anteriorly and posteriorly. The ovaries are four-lobed. A penis is present, and Harmer has witnessed copulation. Harmer agrees with most observers in regarding Dinophilus as one of the Archianellida. This species is about 2 mm. long, orange in color, and occurred in tide pools at Plymouth, England. Specimens were abundant April 18th. None could be found June 26th.

Note on an American Species of Phreoryctus.—The family Phreoryctidæ is composed, as heretofore known, of one genus, containing three species of long and slender oligochæte worms, two of which have been reported from the continent of Europe[3] and one from New Zealand.[4] In Germany, one of the species, *P. menkeanus*, has occurred quite frequently in the water of deep wells. In America this family seems to have escaped observation, as has been already remarked, in fact, by Dr. Minot, in his article on Vermes in the *Standard Natural History.* Recent observations here show, however, that the species is an inhabitant of the subterranean waters of this region; and I have been fortunate enough to obtain three examples from a farm drain, where the tile was stopped by an ingrowth of the roots of trees.

[2] Jour. Marine Biol. Assn., United Kingdom, No. 2., p. 119. 1889.

[3] See Vejdovsky, "System und Morphologie der Oligochaeten," pp. 48-50.

[4] "On the Reproductive Organs of Phreoryctus." By Frank E. Beddard, M.A., *Ann. Mag. Nat. Hist.*, Ser. 6, Vol. I., No. 6 (June, 1888), p. 389.

This new form is clearly a species undescribed, distinguishable at once from the others by the lack of dorsal setæ on all but the anterior segments of the body. The ventral setæ, on the other hand, are very large and stout, with strongly hooked tips,—diminishing in size near the two ends of the body.

The following description will serve to identify the species.

Phreoryctus emissarius, n. s.

A very long and slender worm, six to eight inches, or more, in length (in alcohol), by .6 to .7 mm. in diameter,—the segmentation very distinct, the color pale red, the cuticle highly iridescent. The cephalic lobe is separated from the first segment by a rather deep lateral constriction. It is broadly rounded in front, and about two-thirds as wide as long. I do not see the transverse division of this lobe remarked by Vejdovsky and Beddard in the other species. Segments nearly quadrate, four hundred or more in number. (An imperfect specimen contained three hundred and seventy-five.) Setæ single, acute, the first segment with two very small ventral and no dorsal ones. Four rows on the following segments to the eightieth or ninetieth; on the remainder of the body only two rows, the dorsal setæ disappearing. The last of this series become very minute and variable, and are frequently wanting on here and there a segment preceding the last that bears them. The ventral setæ are very large and long, and strongly hooked, but diminish in size at the two ends of the body. They project into the cœlom, when retracted, a distance equal to two-thirds the whole diameter of the worm.

Two longitudinal blood vessels, both closely applied to the alimentary canal, one dorsal and one ventral, the dorsal one contractile. A pair of long contorted vascular arches in each segment, extending loop-like into the ventral cœlom, below the sub-intestinal vessel. Nephridia, a pair to each segment, opening upon the surface a short distance *in front* of the ventral setæ.

Champaign, Ill., April 14, 1890. S. A. FORBES.

Sea-Urchin Excavations at Guaymas, Mexico.—Since the publication of my paper [NATURALIST, Jan., 1890] on sea-urchin excavations, I have received a letter from Prof. F. W. Cragin, of Washburn College, Topeka, Kansas, from which I make the following quotations:

"During a short stay at Guaymas, Mexico, in the winter of 1882–'3, I collected for Washburn College a considerable number of sea-urchins of two species, of which you afterwards sent me the names [based on examination of examples of each which I submitted to you] which are *Echinometra vanbrunti* A. Ag., and *Cidaris thouarsii* Val. These were all collected on the sides of a great open sea-cave in the face of a beetling cliff in the outer portion of Guaymas Harbor, and were taken without exception, so far as I now remember, from holes in the solid rock. This was my first knowledge of the rock-boring habit of sea-urchins; but as I supposed the habit to be general with these species, and the matters of my observation to be well-known to all other naturalists, I did not venture to publish it. One fact which I observed, however, seems to me to be at variance with one of your conclusions. In collecting the urchins, I soon learned that if I wished to extract the specimens without injury to themselves, or, in case of the Echinometra, to avoid total failure, made more pointed by pricking my fingers, I must make up my mind in advance just how to seize them to best advantage and then to withdraw them quickly. If I was awkward or slow in any case, or hesitated and took a fresh hold from pricking my fingers, the Echinoderms took occasion to "set" a multitude of spines against the walls of their "geode," and, thus braced, could usually defy further efforts to remove them, save by such harsh means as fractured the bodies of the animals. I am therefore constrained to believe that on being disturbed by the violence of tide and storm-waves, to which they are here greatly exposed, they would set the spines, as they do in a case of human interference. It would certainly then be a rare thing that the action of the water should move them, though it is obvious that if it did succeed in moving one or more of its spines a little, the mutual erosion of spine and rock would be greater than if the spines were not braced. It seems to me, therefore, that very little erosion, so far as the action of the spines is concerned, would be caused by the sea-urchin washing about in the geode, but that the wear produced by the spines, and on the spines themselves, would be due to what might be called the *walking* of the spines; that is, the removing of a spine here and there from its position to such new positions as circumstances demanded. That certain of the spines are so used and become somewhat worn in the case of the two species above mentioned, is possibly indicated by the fact that some of them are obliquely truncated; yet the truncated end seems to be hardly smooth enough for a worn surface, and is perhaps a surface of fracture. Many of the spines have the tip perfect, but it is noticeable that in the Cidaris, whose spines are usually incrusted with species of Serpula and Spirorbis, the tip of the spine is bare or nearly so, and in some instances appears to have been worn bare. The rock in which the excavations were made was very hard, igneous or metamorphic, I think, though I took no note of its lithologic character."

The above quotation is interesting as giving a new location for sea-urchin excavations, although A. Agassiz has already mentioned the rock excavations made by the same species at Panama.

Sea-urchin excavations near San Diego, California, have also been called to my attention by Dr. Cleveland and Mrs. R. S. Eigenmann, and an account of the same from near the Santa Barbara Islands was given me by a fisherman.

A. Agassiz says: "On the coast of California the common *Strongylocentrotus purpuratus* occurs in the same way [as in the Azores,—'in cavities dug out of the solid rock,]; we find long tracts of the shore, where this sea-urchin is common, completely honey-combed and pitted by cavities and depressions, in which they seek shelter against the powerful surf continually beating against the rocks. The same species does not excavate in sheltered places, where sea-urchins can find protection between the interstices of large fragments of rocks, or ledges more or less sheltered from the direct action of the open sea." [Revision of the Echini, p. 706.] It would seem that these excavations are not uncommon to the west coast of North America, although very few definite localities where they occur have up to the present time been recorded.

As the author desires to gather information in regard to the distribution of sea-urchin excavations, and the extension or limitation of the habit among genera and species of the Echinoidea, he desires to correspond with any who may have observed this phenomenon on any coast. He wishes especially information as to the names of the species of sea-urchins which make the excavation, the kind of rock excavated, and peculiar circumstance connected with the species.

Boston, Mass., April 9th, 1890. J. Walter Fewkes.

The Ribs of Vertebrates.—At the last meeting of the Anatomical Society, at Berlin, Professor Hatschek presented some new evidence as to the homologies of the ribs within the vertebrate phylum. In Polypterus there are certain peculiarities which have been given different interpretations by different observers. In the body region each vertebra bears a pair of processes which extend from the centrum in a transverse direction, and are continued by a rodlike bone of considerable size. Just below this is a second delicate bony thread. In the caudal region the processes and their continuation diminish, while the ventral thread becomes larger and forms the hæmal arch.

According to some the ventral bones are homologous with the ribs of other fishes, while the dorsal rods are "flesh bones." According to others exactly the reverse is true. As tests, Hatschek calls attention to the fact that the muscles in the body of a vertebrate are divided into dorsal (epiaxial) and ventral (hypaxial) portions. In the fishes the ribs occur between the hypaxial portions and the somatopleur, while the ribs of Batrachia and Amniotes are new structures lying between the epi- and hypaxial portions. In the body regions of these forms the old fish ribs have disappeared, although they occasionally reappear in the caudal portion, old and new ribs coexisting together. Applying this test of position to the structures seen in Polypterus it is seen that the first view is the correct one, the dorsal half being the new or Batrachian rib. In Batrachia and Amniotes the rib articulates with the vertebral centrum by two articular processes which primitively represent a forked proximal extremity. Götte found that the rib in its development consisted of dorsal and ventral portions, which distally grow together while proximally they remain forked. Wiedersheim compared only the lower portion with the ganoid rib, and regarded the dorsal portion as a new structure. This seems to be negatived by the conditions found in the Batrachian tail. Hatschek farther concludes that the vertebrate skeleton should be divided into somatic and visceral portions, and that the former should be further subdivided into axial, dermal, and septal portions, the latter embracing the portions arising in the myosepta.

The Families of Ribbon-fishes.—In the American Naturalist for January, 1887 (Vol. XXI., p. 86), I have given a diagnosis of the Tæniosomi. We have now the data for determining the common and comparative characters of the best known and only certain representatives of the suborder. For the Regalecidæ Prof. Parker's valuable Memoir (T. Z. S., Vol. XII., pt. 1), and for the Trachypteridæ, a lately published monograph by Alexander Week (Studies Mus. Zool., Univ. Dundee, Vol. I., pt. 6), furnish the requisite information. The differences between the two families are greater than would have been anticipated, and necessitate a revision of the diagnosis of the suborder. The characteristics may now be expressed in the following terms:

TÆNIOSOMI.

Teleocephals with the scapular arch subnormal, posttemporal undivided and closely applied to the back of the cranium, between the epiotic and pterotic, or upon the parietal; hypercoracoid perforate at or near the margin; cranium with the epiotics enlarged, encroaching backward and juxtaposed behind, intervening between the exoccipitals and supraoccipatal; prootic and opisthotic represented chiefly by the enlarged prootic; the suborbital chain imperfect; the copular bones separated by intervening cartilaginous elements; the hypopharyngeals styliform and parallel with the branchial arches, epipharyngeals in full number (4 pairs), and mostly compressed; the dorsal fin composed of inarticulate rays or spines, separable into lateral halves, and the ventrals (when present) sub-brachial.

A myodome may be present or absent, none being developed in the Regalecidæ, but one being distinct and supplemented by a dichost in the Trachypteridæ. The families may be briefly differentiated as follows:

TRACHYPTERIDÆ.

Tæniosomes with the body moderately elongated and very compressed, the head short, the opercular apparatus abbreviated (the operculum extended downwards, the suboperculum below it, and the interoperculum contracted backwards and bounded behind by the operculum and suboperculum), ventrals pauciradiate in young, atrophied or lost in adult, the cranium with a myodome and dichost, the supraoccipital continued behind into a prominence, the epiotics confined to the sides and back of the cranium, and without ribs.

REGALECIDÆ.

Tæniosomes with the body very elongated and compressed, the head oblong, the opercular apparatus well developed (the operculum extended backwards, the suboperculum obliquely behind it, and the interoperculum extended upwards below the two), the preorbital chain oblique and widest at the second bones, ventrals represented by single elongate rays, the cranium with the myodome atrophied, and the dichost suppressed, the supraoccipital pushed forward by the extensive development of the epiotics which encroach forwards on the roof as well as back and sides of the cranium, and with short ribs.—THEO. N. GILL.

The Genera of the Podocnemididæ.—Through the kindness of Prof. R. Hertwig, of Munich, I have received the skull and cervicals of two specimens of the type of *Emys tracaxa* Spix. for examination. I am now able to give the characters of the known genera of the Podocnemididæ. Boulenger considers *Emys tracaxa* Spix. the type of *Peltocephalus* Dum. & Bibr., and *Dumerilia madagascar-*

iensis Grandid., the type of my Erymnochelys, generically the same as Podocnemis.

The genus Dumerilia was established by Grandidier, but since this name had been used different times before, I introduced the name Erymnochelys (*Zool. Anz.*, No. 285, 1888.) After this, Boulenger claimed that Erymnochelys mihi (Dumerilia, Grandid.) was a synonym of Podocnemis. In No. 296 of the *Zool. Anz.*, 1888, I gave the generic characters which distinguish Erymnochelys from Podocnemis. I said in Erymnochelys the jugal is in extensive connection with the quadrate ; this connection is absent in Podocnemis ; in Erymnochelys the prefrontals are produced in front and without median groove ; the cervical vertebræ form single condyles. In Podocnemis saddle-shaped vertebræ, as in birds, are present.

In the general shape of the skull Peltocephalus resembles Macrochelys ; Peltocephalus is in the same relation to Erymnochelys, as Macrochelys to Chelydra. Morphologically the skulls of Erymnochelys and Peltocephalus are very much alike ; but Peltocephalus has the saddle-shaped cervicals of Podocnemis.

The atlas of Podocnemis is entirely different from that of Peltocephalus and Erymnochelys. In Podocnemis the first intercentrum is small and free. In Erymnochelys and Peltocephalus it is large and internally united with the neuroids and the centrum of the atlas.

I give now a table of the characters of the three genera :

Podocnemis, Wagler.

Jugal and quadrate bones separated ; articular faces of anterior cervicals saddle-shaped ; first intercentrum small and free. Type : *P. expansa*, Schweigg.

Peltocephalus, Dum. and Bib.

Jugal and quadrate in contact ; articular faces of anterior cervical saddle-shaped ; first intercentrum large and suturally united with neuroids and centrum of atlas. Interparietal shield triangular with base behind. Type : *P. tracaxa*, Spix.

Erymnochelys, Baur.

Jugal and quadrate in contact ; articular faces of cervicals not saddle-shaped ; first intercentrum large and suturally united with neuroids and centrum of atlas. Interparietal shield triangular with base in front. Tpye : *E. madagascariensis*, Grand.

Note.—The condition of the atlas in Peltocephalus and Erymnochelys, must be considered as one from which the condition seen in the

Pelomedusidæ has been derived. In the Sternothæridæ (Pelomedusa, Sternothærus) there is no trace of a suture between intercentrum and the centrum of the atlas. If the sutures of the atlas in Peltocephalus or Erymnochelys would disappear, we would have the conditions of the Sternothæridæ. Erymnochelys and Peltocephalus agree with all known Pleurodira in the fact that the centrum of the atlas supports the neuroids; a condition never seen in the Cryptodira or Chilotæ (Tronychia). (Baur, *Ann. and Mag. Nat. Hist.*, July, 1889).—G. BAUR, PH.D.

Note on the Genera Hydraspis and Rhinemys.—Boulenger accepts in his catalogue of Tortoises the genera Hydraspis and Rhinemys. His genus Hydraspis contains seven species, *H. hilarii, H. tuberosa, H. geoffroyana, H. gibba, H. radiolata, H. rufipes, H. wagleri.*

His genus Rhinemys contains one species, *Rh. nasuta.*

Rhinemys is characterized: Neural plates present; parietal bones not expanded superiorly; parieto-squamosal arch very slender.

Hydraspis: Neural plates present; parietal bones expanded superiorly; parieto-squamosal arch strong.

The question is; first, can the name Hydraspis be adopted; aud second, is Hydraspis generically different from Rhinemys, Boulenger, non Wagl.

1. *Can the name Hydraspis be adopted?*

In 1811 Oppel[1] separated *Emys longicollis* from Emys as a "subgenus," for which he gave the following diagnosis; Collo longissimo, subtestam arcuate reflexo, non retractili; *e.g., E longicollis,* without creating a new name.

In 1828 Fitzinger[2] established Chelodina for "Emys longicollis und consorten." The type of Chelodina is therefore *Emys longicollis* Shaw.

Two years latter Bell[3] established the genus Hydraspis, with nine species (p. 512), *Testudo longicollis,* which I consider the type; *T galeata* of Schoepff, *T. planiceps* Schoepff, *Emys amazonica, E. viridis, E. depressa, E. macrocephala, E. tracaxa, E. rufipes* Spix.

Later on (p. 515) we find Hydraspis: sp. typ. *H. galeata* (*Testudo galeata* Auct.) It is quite evident that Bell's Hydraspis is simply a synonym of Fitzinger's Chelodina, and has no right to existence.

[1] Oppel, Michael, Die Ordnungen, Familien und Gattungen der Reptilien. München, 1811, p. 12.

[2] Fitzinger, L. J. Neue Klassification der Reptilien, Wien, 1826.

[3] *Zool. Journ.*, III., 1828.

In 1830 Wagler establishes the genera: Rhinemys, Hydromedusa, Podocnemis, Platemys, Phrynops, Pelomedusa.

Rhinemys contains the species: *Emys rufipes*, Spix., *Emys nasuta*, Schweigg, *Emys radiolata*, Spix., *Emys gibba*, Schweigg. The type of Rhinemys is *Emys geoffroyana* Schweigg. It is now proper to examine whether *Emys rufipes* Spix., is generically different from *Emys geoffroyana* Schweigg; in other words, whether Phrynops is different from Rhinemys. Through the great kindness of Prof. R. Hertwig, of Munich, I have received the skull of the type of *Emys rufipes* Spix. for examination. The skull is characterized by the very much expanded parietals, which are twice as broad as the interorbital space.

In *Emys geoffroyana* Schweigg, the type of Phrynops, the parietals are not so much expanded, but in all other respects Phrynops agrees with Rhinemys, and there can be no doubt that Phrynops is not different generically from Rhinemys.

The type of Rhinemys Wagler is *Rhinemys rufipes* Spix; the other species of Rhinemys are: *Rh. hilarii*, *Rh. tuberosa*, *Rh. geoffroyana*, *Rh. gibba*, *Rh. radiolata*, *Rh. wagleri*. Boulenger's Hydraspis is therefore synonym of Rhinemys.

2. *Is Boulenger's Rhinemys generically different from his Hydraspis?*

In Rhinemys of Boulenger, with the single species *Rh. nasuta*, the parietals have become very slender; in other words the reduction, which has already begun in some of the species of Rhinemys mihi (Hydraspis, Blgr.) has increased. This, and also the slenderness of the parieto-squamosal arch, is certainly no reason to distinguish this form as generically different from the others. According to Boulenger there are only four neural plates in his Rhinemys, six in his Hydraspis, but the question is, whether the number is constant in Hydraspis; the number in *Rhinemys rufipes* and *Rh. wagleri* is not yet known. Of course there is no doubt that if Boulenger's Rhinemys should even prove to be different generically from his Hydraspis, the name Rhinemys could not be used, and another name must be given. I think it best to consider *Emys nasuta* of Schweigg as a species of the genus Rhinemys Wagler, as adjusted by me.

I give now the following synomy:

CHELODINA Fitz., 1826=Hydraspis Bell, 1828.
Type *Ch. longicollis* Shaw.

RHINEMYS Wagler, 1830=Phrynops Wagler, 1830=Hydraspis (Blgr.)+Rhinemys (Blgr.), 1889.
Type, *Rh. rufipes*, Spix.

—G. BAUR, Ph.D.

The Genera of the Cheloniidæ.—Boulenger, in his Catalogue of Tortoises, admits only two genera of Cheloniidæ—Chelone and Thalassochelys. His genus Chelone includes Caretta or Eretmochelys, Euchelys and Onychochelys. His Thalassochelys includes Lepidochelys, Colpochelys, Cephalochelys and Eremonia.

I have examined a great number of skulls and skeletons of Cheloniidæ in different museums, and have reached the following conclusions, which partially at least have been published before:

1. Chelonia Brogn., 1799. *Jour. des Sciences des Lettres et des Arts*, par A. L. Millin. Vol. V., 6, 1799.

Orbit formed by: prefrontal, frontal, postfronto-orbital, jugal, maxillary.

Maxillaries separated by vomer.

Descending processes of prefrontals in connection with palatines.

Number of peripheralia, 11; No. 10 without connection with rib.

Type: *Chelonia mydas* L.

2. Caretta Ritgen, 1828. Eretmochelys, Fitz.

Orbit formed by: prefrontal, frontal, postfronto-orbital, jugal, maxillary.

Maxillaries separated by vomer.

Descending processes of prefrontals without connection with palatines.

Number of peripheralia, 11; peripherale 9 without connection with rib.

Type: *Caretta imbricata* L.

3. Thalassochelys, Fitzinger, 1835.

Orbit formed by: prefrontal, postfronto-orbital, jugal, maxillary.

Maxillaries in contact, not separated by vomer.

Descending processes of prefrontals in connection with palatines.

Number of peripheralia, 11; peripherale 9 without connection with rib.

Type: *Th. caretta* L.

4. Lepidochelys (Fitzinger) Gray, Colpochelys Garman.

Orbit formed by: prefrontal, postfronto-orbital, jugal, maxillary.

Maxillaries separated by vomer.

Descending processes of prefrontals without connection with palatines.

Number of peripherlia, 11 or more; connection with ribs as in Thalassochelys.

Type: *L. olivacea* Eschsch.

Through the kindness of Dr. O. Boettger I have received a skull of *Lepidochelys olivacea*, from West Africa, for examination. Later I found in the collection of the Smithsonian Institution a skull of a sea-tortoise from Ventosa Bay, Mex., collected by Prof. Sumichrast, of the same genus.

Lepidochelys olivacea Eschsch. is distinguished from *Lepidochelys* (Colpochelys) *kempii* Garman, by the very much more expanded pterygoids, and the large ectopterygoid processes. There are no ridges on the alveolar surfaces of the upper jaw, and there is an indication of a median keel at the symphysis of the lower jaw.

The specimens on which the genera Euchelys, Girard, and Onychochelys, Gray, have been established I do not know, neither do I know Gray's genera, Cephalochelys and Eremonia. *Chelonia depressa* Garman, which is considered by Boulenger as a synonym of *Chelonia mydas*, without indication of any reason whatever, a thing very often repeated by Mr. Boulenger, does not belong to the genus Chelonia at all. Through the kindness of Mr. Garman, I have examined the type, which is represented by a stuffed specimen. The lower jaw has a greatly developed hook very much like *Lepidochelys kempii* Garman, but there is a median ridge on the symphysis, something like *Lepidochelys olivacea* Eschsch. Until the skull of this species is known, it is impossible to decide whether it belongs to Thalassochelys, Lepidochelys, or, what I think probable, to a new genus.

Chelonia multiscutata Kuhl is possibly an abnormal specimen of *Lepidochelys olivacea* Eschsch. Kuhl described this species after a specimen in Groningen. According to a letter kindly received from Prof. Van Anhum (dated Nov. 21, 1887), none of the collections at Groningen contain the original.

There is a great number of species of Cheloniidæ, which have been described by different authors; future examinations will show whether these species are in existence or not. There is no doubt whatever that the Chelonia from the Pacific is a different species from the Atlantic; the skulls are the same, but there are great differences in the form of the carapace. I have seen a great number of young specimens of Chelonia collected by the Albatross on the Galapagos Islands. These have 1–6 peculiar dermal plates between the marginalia and the infra-marginalia. I propose to call these plates *submarginals*. It remains to be decided whether this species is the same as *Chelonia agassizii* Boc., or not.—G. Baur, Ph.D.

Zoological News.—Molluscs.—Garstang, in a catalogue of the Nudibranchs of Plymouth, England,[1] gives many instances of the protective coloration of these forms. The author catalogues thirty-six species, the whole making with the notes an admirable faunal list.

J. I. Peck describes[2] the anatomy and histology of the Pteropod *Cymbuliopsis calceola.* The muscles, digestive organs, nervous system, reproductive organs, nephridium, and heart were investigated. The nephridium does not communicate with the pericardium. In the individual studied no penis was found, although the gonad was in female cativity, and the receptaculum was full of spermatozoa.

Arthropods.—W. F. R. Wheldon thinks[3] that the tendency of zoeæ to develop their protective spines in one straight line, parallel with the long axis of the body, is of no little advantage in aiding the embryo to swim in a straight line, like men sculling in a narrow racing boat.

G. C. Browne catalogues[4] sixteen species of Copepoda, collected at Plymouth in 1888–89. The notes are largely synomymical.

Some interesting notes the on habits of Crustacea[5] are worthy of notice. Shrimps and prawns keep buried by day, and wander about by night; even those with the eyes extirpated show the same features. Crustacea find their food almost exclusively by scent, while it seems probable that they cannot see much, possibly not even each other. To light and shade, however, they are very sensitive. Certain crabs are fond of decorating themselves with seaweed, etc. The crab takes a bit of weed in its chelæ and deliberately tears it across. He then puts one end into his mouth, and after chewing it up, presumably to soften it, takes it out in his chelæ and rubs it firmly on his head or his legs until it is caught by the peculiar curved hairs which cover them. If not caught it is chewed again, and the process repeated. This is done by night as well as by day, and specimens deprived of sight will clothe themselves as do the others. It is noticeable that there is a marked bilaterality in the arrangement of this ornamention. It does not appear that it is for concealment.

[1] *Jour. Marine Biol. Assn.*, No. 2, p. 173, 1889.

[2] *Studies Biol. Lab.*, Johns Hopkins Univ., IV., p. 335, 1890.

[3] *Jour. Marine Biol. Assn.*, No. 2, p. 169, 1889.

[4] Ibid., p. 144, 1889.

[5] Ibid., p. 211.

EMBRYOLOGY.

The Continuity of the Primary Matrix of the Scales and the Actinotrichia of Teleosts.—In *Batrachus tau,* if transverse sections are prepared from embryos a few days after hatching, it will be found that a basement membrane underlies the whole of the epidermis, as an extremely thin layer. This layer of homogeneous matter covers the entire larval fish, and is interposed between the organs of mesoblastic origin and epiblast everywhere. In the fin folds there are linear and parallel thickenings of this thin lamina of basement membrane which eventually become the actinotrichia, as I have named the primary fibrous rays of all fishes. The mesoblastic cells which aid in developing the actinotrichia have a disposition to lengthen in a direction parallel to the latter.

The membrane over the rest of the body is continuous in Batrachus, and doubtless represents the matrix of scales in other forms. Its continuity shows that the matrix of scales was probably originally continuous in all fishes, and that the lateral bendings of the body in locomotion have been in part the efficient cause of the segmentation of the continuous layer, into, at first, oblique bands as in Callichthys, and then into lozenge-shaped tesseræ. These bands doubtless conformed in direction at first, in some cases, to the underlying muscle plates Later secondary modifications introduced other complications.

This evidence is at any rate highly interesting as pointing to the conclusion that the primary basis of the exoskeleton of fishes is conclusious, so as to form an unbroken cuticular investment of the entire mesoblast.

It also affords striking confirmation of my hypothesis[1] that the exoskeleton is to be traced phylogenetically to an uninterrupted cuticular or basement membrane occupying the position of the mesoglœa in cœlenterates such as the Medusae and Hydroids.

Aggregations of this cuticular membrane constitute the basis of the "cementum plates" of the teeth of fishes. The ganoin and variously modified enamel of ganoid scales is a derivative of the epidermis proper. The cementum plates grade very gradually into the various types of osteodentine, and into that form of dentine with ramifying tubules seen in some ganoids and known as cosmin. Such aggregations or local thickenings of the cementum have arisen in the first place as the con

[1] A physiological theory of the calcification of the skeleton. Proc. Am. Philos. Soc., Vol. XXVI, 1889.

sequence of the local aggregation in groups, due to local stimulation, of the underlying connective tissue cells.

The Teleosts accordingly still bear traces of having a great capacity for developing the matrix of a protective dermal skeleton ; far greater than in other types. In birds, mammals, reptiles, and batrachia, of a corresponding larval stage of development, the continuous cuticular or basement membrane beneath the epidermis, is either entirel wanting, or is never developed except locally at relatively much later stages.

There is also evidence to show that with the progress of evolution this primary superficial matrix has tended to be carried inward toward the cartilage so as to form the membrane bones, particularly on the head. Yet there are other regions where an engulfing of the superficial subepidermal calcifications in membrane occurs during the life of the individual. In the common sturgeon the preanal scales or scutes are superficial and exposed, except for their very thin covering of epidermis ; in the adult, on the contrary, these scales are so deeply embedded in the tissues as to be completely lost to sight externally, and lie so far below the epidermis as to be exposed only by recourse to the scalpe It is this peculiar circumstance that has given rise to the erroneous belief amongst ichthyologists that some of the abdominal scales of the sturgeons were "deciduous."

The continuous investment of the mesoblastic tissue of the larvæ of recent scaleless Teleosts, such as Batrachus, by a structureless basement membrane which can be identified with a true scale matrix shows how persistently the armature of the Devonian types still tends to be inherited, even by a form not developing true scales. It is probably a good illustration of what Eimer means by his theory of "constitutional impregnation," or, as one might say, saturation with inherited tendencies.

With the advent of the body-cavity, gut-pouches, and mesoblast of triploblastic types, the mesoglœa of the diploblastic type would be divided, that is to say, some of the matrix would be deposited upon the functionally inactive (in digestion) derivatives of the intestine, such as the notochord, while some would be deposited by the same secretory activity of the mesoblast upon the inside of the epidermis. This division, determined by purely physiological agencies, therefore gives both the matrix of the endoskeleton and that of the exoskeleton. The active translation of new matters, or metabolism, through the intestinal walls prevents the deposit of any cuticular membrane there, and it is only over the ametabolic notochord, which is an indirect derivative of the intestine, that such a deposit can take place.

The actinotrichia are at first joined together by a thin cuticular membrane; later, they separate more widely, and the intervening membrane between the actinotrichial fibres disappears. The latter also are not round at first, but flattened, or oval in cross-section. Their greatest diameter also corresponds to the direction of the plane of the membrane of which they form a part.

To the proximal ends of the two rows of actinotrichia the fin muscles were originally attached, as may still be seen in sharks, Dipnoans and Chimæroids. This insertion of the fin muscles, their serial action from before backward, as well as the necessary undulatory motion of the tail from before backward in the act of locomotion, must throw the fin folds into a lateral undulatory motion from before backward. This undulatory motion would tend to favor the breaking of the cuticular membrane under the epidermis of both sides of the fin into parallel threads, owing to the short flexures into which its substance must be thrown. In this way the genesis of the actinotrichia themselves may be traced to the direct action of physical causes. The subsequent cross-fracturing of the rays derived from a further development of the actinotrichia, I have elsewhere proved to be due to the interaction of the organism and the resistance offered by the surroundings to the motions of the fins.[1]

The thickness of the continuous subepidermal basement membrane in Batrachus, also varies in a singular and suggestive way. It is decidedly thicker on the dorsal aspect and on the upper portions of the sides of the body, and thinnest on the ventral aspect which is most protected in this form, which, as is well known, lives by preference at the sea-bottom resting on the mud.

In the earlier forms of fishes, such as Coccosteus, Mycterops, Pteraspis, Cephalaspis, etc., there was a tendency to form an unbroken dorsal cephalic shield. This tendency is still preserved in the evolution of the cranial plates of the sturgeon on the sides and top of the head, and is expressed on the body, in that the dorsal scutes are always the first to be developed. The development of the cranial exoskeleton in primitive forms, and in now existing types representing the latter, therefore coincides with this early appearance of traces of the superficial skeletal matrix in a subepidermal position on the dorsal aspect of the head and body in the existing larvæ of unarmored forms, which may be supposed to have lost such a defensive exoskeleton. The parallelism here pointed out is, at any rate, extremely suggestive, and if capable of further demonstration will show how persistently an extremely ancient character tends to be inherited. JOHN A. RYDER.

[1] Proofs of the effects of Habitual use in the Modification of Animal Organisms. Proc. Amer. Philos. Soc. Vol., XXVI., 1889.

MICROSCOPY.

Professor Butschli's Experimental Imitation of Protoplasmic Movement.[1]—Professor Bütschli, of Heidelberg, has recently made some extremely interesting observations upon a substance which simulates in a remarkable way the appearance and movements of protoplasm of an Amoeba, or of the plasmodium of Mycotozoa. He has been kind enough to send to me some oil in a suitable condition for use, with directions as to the exact details of the experiment. In my laboratory, by following his directions, the movements described by him have been observed in a satisfactory manner. In order to obtain the best results some experience and care is requisite, and probably cannot always be obtained by a single experiment. The subject is so interesting, and so fitted for further investigation by all who have leisure and taste for the study of the vital phenomena of the Protozoa, and of living protoplasm in general, that I think it will be of advantage to the readers of this journal to have Professor Bütschli's directions, which he has permitted me to publish, placed in their hands.—E. RAY LANKESTER.

March, 1890.

HEIDELBERG, February 1st, 1890.

You have kindly asked me how I prepared the protoplasma-like drops which I have described. As you yourself feel greatly interested in this discovery, and presumably a like interest exists among other English biologists and microscopists, I hasten to satisfy your desire, and to explain somewhat more fully the methods which I have described in a previous publication.

As you well know already, I use in the preparation of these globules,—showing protoplasma-like streaming,—ordinary olive oil. My first experiments were made with a small quantity of olive oil, which had been standing for a long time in my laboratory in a small bottle. By some happy chance this oil had just the right properties which are necessary for the success of the experiment, for not every sort of oil is suitable. As far as my experience goes it tends to show that the ordinary oil cannot be directly used, because it is too thin, or is perhaps deficient in other qualities on which the success of the experiment depends. In order, therefore, to prepare a suitable oil, I proceed in the following manner: A medium-sized watch-glass, or flat dish, is

[1] From the *Quarterly Journal of Microscopical Science*, Vol. XXXI. April, 1890.

filled with a thin layer of common olive oil, and is placed on a water-bath or in a small cupboard, such as are used for imbedding in paraffine, at a temperature of about 50° C. Under the influence of the higher temperature the oil gradually loses its yellow color and becomes thicker. The great point now is to select the right moment at which the oil will have attained the proper degree of thickness and viscosity, as also the other properties, which at present I am not able to define more exactly, but on which much of the success seems to depend. The exact moment can, however, only be found out by systematic trials. After the oil has been thickening for three or four days, a tria should be made with a drop of it in the manner described below Should the drop not become finely vesiculate, and exhibit little or no streaming, continue the heating process, and experiment again on the following day. If the oil should become too thick it will form good, frothy drops, but will scarcely show any streaming. In this case mix it with a small quantity of ordinary olive oil, and thus render it more liquid. If it has become much too thick it will form a good froth, but the latter dissolves very rapidly in glycerine.

You see that the process to obtain the suitable oil is somewhat slow but I do not at present know of any other method by which the resule can be reached more quickly and surely.

To prepare the vesiculate drops I proceed in the following way:— In a small agate mortar I grind a small quantity of pure dry carbonate of potash (K_2CO_3) to a fine powder. I then breath on the salt till it becomes slightly moist, and with a glass rod add to it a drop of oil, mixing the two constituents to a thickish paste. The success of the experiment depends, however, more upon the nature of the oil than upon the proportion of the oil and salt in this mixture. Then, with a glass rod or a needle, I place a few drops of the paste, about the size of a pin's head or smaller, on a cover glass, the corners of which are supported by small pegs of soft paraffine. I then place on a slide a drop of water, and put the cover-glass over this in such a manner that the drops of paste are immersed in the water, but are not much compressed, to which end the corners of the cover-glass have been supported by the paraffine. The preparation is then placed in a deep chamber, and remains there about twenty-four hours. The preparation is then washed out with water by applying blotting-paper to one edge of the cover-glass, and supplying water at the other edge from a capillary tube.

If the drops have turned out well, they will begin almost immediately after this to move about rapidly, and change their shape continuously. The water under the cover-glass must now be displaced by glycerine, diluted with an equal bulk of water, and the drops will then exhibit a vigorous streaming and forward movement, becoming gradually transparent. The amœboid movements are generally more distinct if the drops are somewhat compressed. If the drops do not show the streaming movement you may succeed in producing it by tapping the cover-glass slightly, by applying gentle pressure, or sometimes by breaking up the drops. For it seems as if at times incrustations were formed on the surface of the drops which prevent or impede the streaming movement, and which can, in part at least, be removed by the above-mentioned manipulations.

It is especially interesting to see how fast and beautifully the drops creep to and fro in water, or in half-diluted glycerine, even when they are not compressed. The streaming movement, on the other hand, is better seen if the drops are compressed, which may be done by inserting under the cover-glass a piece of broken cover-glass of medium thickness, and then removing the paraffine pegs. Then draw away the liquid until the necessary pressure is obtained. This streaming movement is better demonstrated twenty-four hours after the addition of the glycerine, as the drops will then be thoroughly cleared and transparent. Further, it is interesting to note that a progression of the drops takes place in the direction in which the streaming moves.

As this forward movement is rather slow in compressed drops, it is necessary to use a micrometer ocular to satisfy one's self of the advance.

Unfortunately the oils which I have prepared since my first experiments do not move and stream so well or so rapidly as those I employed then. The movement and streaming show themselves much more markedly and distinctly if they are examined on a warmed stage at a temperature of 50° C. If you should be in a position at your demonstrations to conduct the experiment at this temperature, the phenomena will certainly be much more evident.

From the preceding description you will see that it will be necessary, to obtain good results, to gradually get hold of the methods, and you must not doubt the correctness of the phenomena which I have described if the first trials do not give the desired results.

At all events, you will have at first to make some experiments so as to obtain an insight into the conditions and sort of phenomena, but I do not doubt that you will succeed in observing the appearances and in demonstrating them to others, though perhaps in not so vigorous a degree as I might desire.

I have lately made some other trials to render olive oil suitable for these experiments by heating it more rapidly. Although at present I have no entirely reliable results, it seems to me that by heating ordinary olive oil to 80°—90° C. for twelve or twenty-four hours, a suitable medium may be obtained.

Finally, I would like to remark that I am the last person to defend the view that these drops, exhibiting protoplasma-like movements, are directly comparable to protoplasm. Composed as they are of oil, their substance is entirely different from protoplasm. They may be, however, compared with the latter, in my opinion, firstly with regard to their structure, and secondly with regard to their movements. But as the latter depend on the former, we may assume that the amœboid movement of protoplasm itself depends on a corresponding physical constitution.

These drops, too, resemble organisms inasmuch as they continue for days to exhibit movements, due to internal causes, which depend on their chemical and physical structure. I do not believe that up to this time any substance has been artificially prepared which, in these two points, viz., structure and movement, has so much resemblance to the most simple forms of life as have these reticulated drops. I hope, therefore, that my discovery will be a first step towards approaching the problem of life from the chemico-physical side, and towards passing from vague and general hypotheses of molecular constitution to the surer ground of concrete conceptions of a chemical and physical nature.

It is, however, a special satisfaction to me to hear that in your country, which has given rise to so many and so celebrated men in biological science, my investigations are followed with interest and sympathy.

With friendly greetings, I am yours sincerely,

O. Bütschli.

ARCHÆOLOGY AND ETHNOLOGY.

The Use of the Phonograph in the Study of the Languages of the American Indians.—At the meeting of the American Folk-Lore Society in Boston, on April 19th, Dr. J. Walter Fewkes read a paper on experiments which he had lately made with the phonograph in recording the songs, legends, and folk-lore of the Passamaquoddy Indians.

The necessity for some means of accurately recording and preserving the languages of the Indians has lately been met by the invention of the phonograph. This instrument has now been brought to such a stage of perfection that it can be profitably used for that purpose. Hitherto a source of error in recording aboriginal folk-tales has been the liability of the translator to incorporate his own interpretations with those embodied in the stories as heard by him, and, as a result, erroneous interpretations have been introduced which it is difficult to eradicate. In order that folk-lore, as far as applicable to aboriginal races, may be placed on a scientific basis, an accurate record of the story as told by the reciter is necessary. This can be accomplished by the use of the phonograph, and the records thus made can be indefinately preserved.

The essayist visited, for the purposes of study, a remnant of the Passamaquoddy Indians near Calais, Maine, and obtained from some of the older men many fragments of legends, stories, ancient songs, country out rhymes and conversations. He also obtained from the lips of Noel Josephs, who sang it when the ceremony was last performed, an old song used in the "Snake Dance." The words of this song are archaic and the music is said to be very ancient. He also took records of war songs, a curious "trade song," and the song sung by the chief on the evening of the first day of the celebration of his election. These songs have been set to music from the records taken on the wax cylinders of the phonograph, and the words have been written out by the same means. In several of the legends obtained by the use of the phonograph, songs occur which are said by all the Indians to be very ancient. Forty cylinders were filled with these records, some of which are stories yet unpublished.

The results of this experiment have, it is claimed, shown that the phonograph is an important help to the student of Indian folk-lore, not only in preserving the tales, but also in an accurate study of the composition of the music and the language.

To indicate its value, the spelling of the words, as spoken by the machine is found, to convey, as nearly as possible by phonetic methods, the pronunciation of the Indian words.

These studies of the Passamaquoddy language were undertaken as a preliminary to a visit to the Zuni Indians for the purpose of working out the archæological and ethnological results of the Hemenway Expedition. A more extensive account of these phonographic studies of the Passamaquoddies will be published in the next number of the *Journal of American Folk-Lore.*—J. W. Fewkes.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

U. S. National Academy of Sciences.— The following papers were read at the meeting commencing April 15, 1890.

1. The effects of the inhalation of Nitrogen, Nitrous Oxide, Oxygen, and Carbonic Acid upon the Circulation: with special reference to the Nitrous Oxides, Anæsthesia and Asphyxia; H. C. Wood, presented by Dr. J. Billings. 2. On the Application of Interference Methods to Astronomical Measurements, A. A. Michelson. 3. Physiognomy of the American Tertiary Hemiptera, S. H. Scudder. 4. Totality of the Eclipse of 1889, December 22, D. P. Todd. Presented by the Home Secretary. 5. The Budding of Salpa considered in relation to the Question of the Inheritance of Acquired Characters, W. K. Brooks. 6. Recent Advances Towards a Knowledge of the Fishes of the Great Oceanic Depths, G. Brown Goode and Tarleton H. Bean. 7. A System of Classification of Variable Stars, S. C. Chandler. 8. On the Spectrum of Metals, H. A. Rowland. 9. On the Cheapest Light, S. P. Langley. 10. On the Relation of Secular Disintegration to certain Crystalline and Transitional Schists, R. Pumpelly. 11. On the Structure of the Green Mountains, R. Pumpelly. 12. The Interrelationships of the Ichthyopsida, Theo. Gill.

The following members were elected: George L. Goodale, Cambridge, Mass.; Russell H. Chittenden, New Haven, Conn.; Thos. L. Casey, Washington, D. C., and Richmond M. Smith, New York.

On the evening of Wednesday, April 16th, the Henry Draper Medal was presented to Prof. H. A. Rowland, of Baltimore, Md.

Prof. S. P. Langley resigned the office of Vice President, to take effect April 1, 1891.

Brookville, Indiana, Society of Natural History.—Annual meeting March 28th, Mr. E. R. Quick in the chair. The following officers were elected for the ensuing year:

President, C. W. McClure; Vice-President, E. R. Quick; Secretary, R. M. King; Corresponding Secretary, H. M. Stoops; Treasurer, A. W. Butler; Librarian, Edw. Hughes. Curators: Mammalogy, E. R. Quick; Botany, O. M. Meyncke; Ornithology, A. W. Butler; Entomology, C. W. McClure; Geology, C. F. Goodwin; Mineralogy, G. R. King; Archæology, H. M. Stoops; Icthyology and Herpetology, Joseph Fieber.

C. W. McClure presented a paper on "The Ox Worble," with especial reference to the damage it does by spoiling the hides of cattle in this vicinity. E. R. Quick read a paper on "Rats." He gave the date of the appearance of the common rat, as near as could be ascertained, in this vicinity, noted some of their habits, and gave special attention to the appearance of these animals within the past winter in unusual numbers at many points in the Ohio Valley. The following subjects were also presented by C. W. McClure, "The Early Blooming of Flowers," and "The Hibernation of Water Snakes (*Trop. sipedon*). By Edw. Hughes, "On the Occurrence of *Hyla pickeringii* and *Chorophilus triseriatus* in Franklin County, Indiana." By E. R. Quick, "Notes on the Breeding Habits of *Hyla versicolor.*"

SCIENTIFIC NEWS.

Edmond Hébert.—Died April 4th, 1890, Edmond Hébert, Professor of Geology in the Sorbonne, Dean of the Scientific Faculty of Paris, and member of the Institute of France. Prof. Hébert was three times President of the Geological Society of France, and was the first President of the International Congress of Geologists. He was born at Villefargeau, near Auxerre, and his father was a soldier of the republic and of the empire. Hébert was the most accomplished stratigraphic geologist of France, and perhaps of Europe, especially in the Cænozoic and Mesozoic departments. He was the author of many important papers and memoirs. He was a man of much energy and also amiability of character, traits which were exhibited in his personal appearance and manners.

Sir Richard Owen was recently attacked by paralysis, a circumstance which gave rise to premature reports of his death. At last accounts he was slowly recovering, but at his advanced age his situation is regarded as serious.

During this the third season the Marine Biological Laboratory will have the following corps of instructors: Dr. C. O. Whitman, Director, Howard Ayers, H. C. Bumpus, E. G. Gardiner, J. S. Kingsley, J. Playfair McMurrich, W. M. Rankin, W. A. Setchell.

The laboratory is located on the coast at Wood's Holl, near the laboratories of the United States Fish Commission. It has added to it this year a library, a lecture-room, and six more private laboratories.

The building consists of two stories: the lower for 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. By the munificence of friends the library will be provided henceforth not only with the ordinary text-books and works of reference, but also with the more important journals of zoology and botany, some of them in complete series.

The laboratory for investigators will be open from June 2d to August 30th. It will be fully equipped with aquaria, glassware, reagents, etc., but microscopes and microtomes will not be provided. There are fourteen private laboratories supplied with aquaria, running water, etc., for the exclusive use of investigators who are invited to carry on their researches here free of charge. Those who are prepared to begin original work, but require supervision, special suggestions, criticism, or extended instruction in technique, may occupy tables in the general laboratory for investigators, paying for the privileges a fee of fifty dollars. The number of such tables is limited to ten. Applicants for them should state precisely what they have done in preparation for original work, and whether they can bring a complete outfit, viz.: microscope, microtome, camera-lucida, etc.

The laboratory for students will be opened on Wednesday, July 9th, for regular courses of seven weeks in Marine Zoology and Botany, and Microscopical Technique. It is desired that students owning microscopes or microtomes should bring them, and applicants for admission should state whether this requirement can be complied with. The fee for workers in this department is twenty-five dollars, payable in advance. The number of students will be limited to thirty, 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 15th, without extra charge, but the regular courses of instruction will not begin before July 9th. In addition to the regular courses of instruction, consisting of lectures and laboratory work under the direct and constant supervision of the instructors, there will be two or more courses of lectures on special subjects by members of the staff. One such courses of six lectures will be given by Dr. McMurrich on the *Hydrozoa*. Similar courses on the *Crustacea* and *Echinoderms* will be given by Prof. Kingsley and Dr. Rankin. There will also be ten or more evening lectures on biological subjects of general interest. The first of these will be given by Dr. Whitman on July 9th.

Applications for places in either department should be addressed to Miss A. D. Phillips, Secretary, 23 Marlborough Street, Boston.

Rooms accommodating two persons may be obtained near the laboratory, at prices varying from $2.00 to $4.00 a week, and board from $4.50 to $6.00. By special arrangement, board will be supplied to members in the laboratory cottage at $5.50 a week. For information in regard to rooms, inquiries may be addressed, after May 1st, to Mr. H. C. Bumpus, M.B.L., Wood's Holl, Mass.

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THE CONCRESCENCE THEORY OF THE VERTEBRATE EMBRYO.

BY CHARLES-SEDGWICK MINOT.

THIS article, and the one to follow, owe their form to the fact that they have been written as chapters in my *Treatise on Human Embryology*. As this work cannot be published for some time to come, and as the chapters present certain views which are fundamentally different from those currently received by embryologists, I publish them separately. I believe that the right understanding of the early development of vertebrates depends upon the acceptance of Prof. Wilhelm His's view of concrescence. This view has not received the attention it deserves, for it is not based upon elaborate reasoning, but upon the direct observation of the process of concrescence in sundry vertebrates.

Incidentally it will appear that in my opinion neither Hertwig's Cœlomtheorie, nor Rabl's Theorie des Mesoderms, can be maintained for vertebrates; both of these theories involve the assumption that the vertebrate mesoderm arises as two lateral masses. This is true of no vertebrate; on the contrary there is probably hardly another fact in embryology so certainly established by innumerable observations as the fact that the vertebrate mesoderm *arises* as a single axial structure. It is only secondarily by the down-growth of the medullary groove and the up-growth of the notochord, that the mesoderm is divided by the meeting of these structures into two lateral masses. As regards Rabl's theory of the double origin of the vertebrate mesoderm, I think he would not have advanced that theory, had he not first fallen into the error of rejecting Prof. His's concrescence theory.[1]

That the fundamental difference between the mesothelium and mesenchym involved in the Cœlomtheorie cannot be maintained for vertebrates, I have pointed out elsewhere.[2] This impossibility has also been brought out afresh by the investigations of Bonnet, Ziegler, Strahl, Rabl, and others.

As briefly indicated in my article on Segmentation of the Ovum (AMERICAN NATURALIST, 1889, June and September), the vertebrate *diaderm* (stage with ectoderm and entoderm only), advances to the next stage of development by the concrescence of the two halves of the ectental line to form the structural axis of the future embryo. The process is somewhat complex, and needs therefore to be described in detail, the more so as it has still to be traced in mammals.

Historical Note.—The earliest observations on concrescence to form the embryonic axis are, so far as known to me, those of Rathke on leeches.[3] Nine years later, Kowalewski (Mem. Acad. Sci., St. Petersbourg, 7th Ser., XVI., 1871), recorded its occurrence among insects. Its recognition as a vertebrate mode of development we owe to the brilliant investigations of W. His; in his first paper, *26*, he describes very accurately and clearly the process of concrescence in the salmon; in his second paper, *27*, he describes concrescence in the sharks, and in his third paper, *28*, he discusses again the general bearing of his results. Semper in his great work on the relationship of annelids and vertebrates, *54*, was the first to make a direct comparison of the processes of concrescence in annelids, insects, and vertebrates. Unfortunately Balfour entirely failed to grasp the new conception, and by expressing himself very decidedly against it, *Comp. Embryol.*, II., 306–308, led many embryologists to discredit

[1] Rabl's criticisms of His are very much to be regretted. If the former always observes with the precision and accuracy of the latter, he will add to his already high reputation.

[2] Buck's Reference Handbook, Med. Sci., III., 176.

[3] Rathke and Leuckart, Beiträge zur Entwickelungsgeschichte der Hirudineen, Leipzig, 1862.

the discovery. Whitman, *67*, 91–94, has ably defended the comparison made by Semper, see above. Rauber, *46*, Kollmann, *33*, Ryder and others, *50*, *51*, have added to our knowledge of the phenomenon. Duval's researches on the chick, *18*, demonstrate concrescence there also, though the author appears unacquainted with the results of his predecessors. Minot, in the article Fœtus, in Buck's Handbook, III., 172, 173, accepts concrescence as the typical mode of vertebrate development.

Concrescence in Bony Fishes.—At the close of segmentation the germinal disc forms a cap of cells on the yolk. The disc (primitive blastoderm) spreads over the yolk gradually; when it begins to spread its edge is already thickened; this thickened edge corresponds to the ectental line; the thickening is known as the *Randwulst;* it is also called the blastodermic rim, which term Ryder and others have used. When the blastoderm has spread so as to cover perhaps a sixth or less of the surface, one point of the rim ceases to move; consequently as the expansion continues, the edge of the disc bends in behind this point on each side, until two parts of the blastodermic rim meet, as they come from opposite sides, and then grow together. This is illustrated by the accompanying diagram, Fig. 1; *Y* is the outline of the yolk; *bl*, the outline of the blastoderm; *d* the fixed point; the expansion of the blastoderm has brought the parts 1, 1, together, and they have united; the parts 2, 2, are about to meet and unite; then 3, 3, will meet; 4, 4, and so on until the two halves of the ectental line are brought together along their entire length; their junction marks the axis of the future embryo, and produces a longitudinal band of thicker tissue, which has long been known to embryologists under the name of the primitive streak. The primitive streak in the

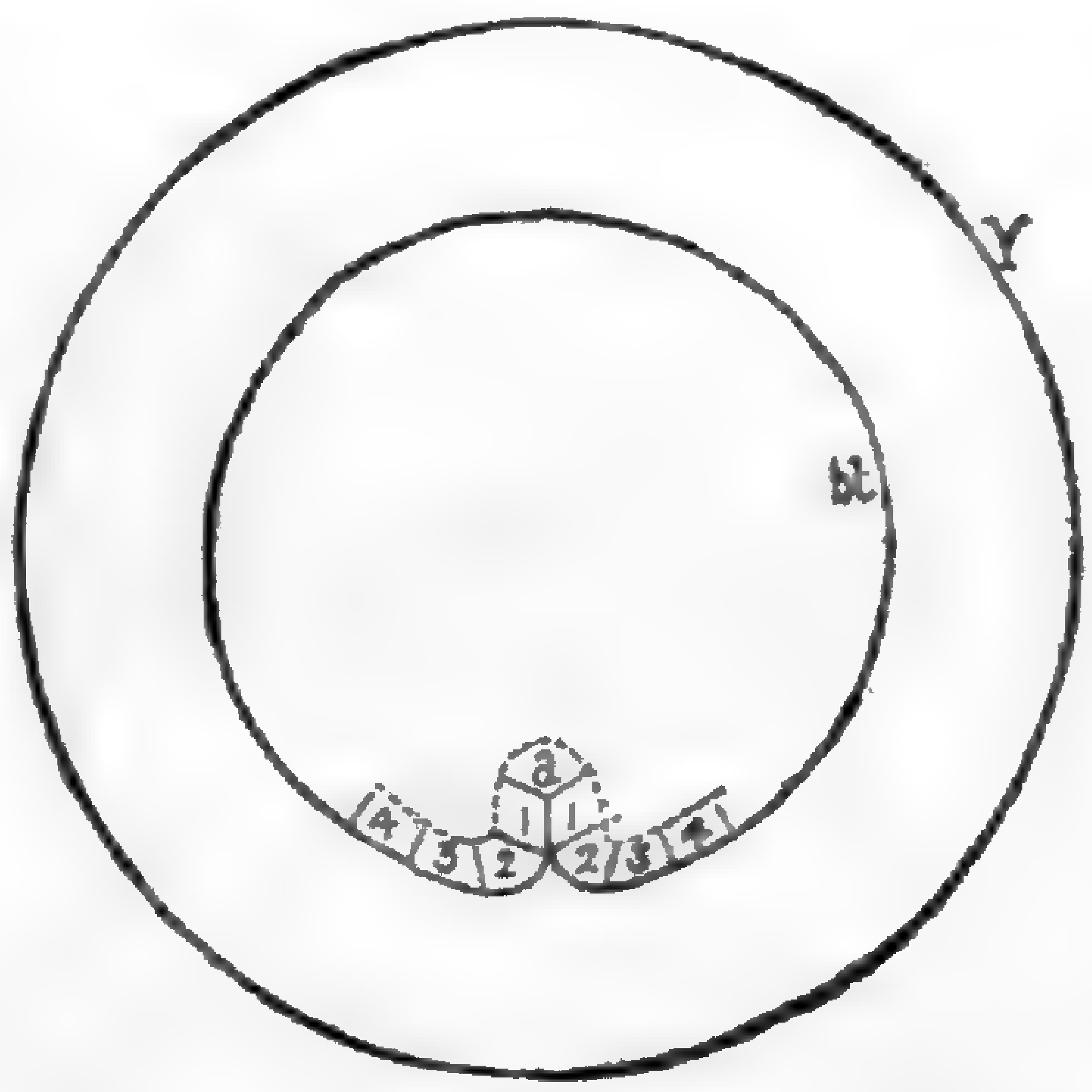

FIG. 1.—Diagram of vertebrate ovum seen from above to illustrate the power of concrescence: *Y*, outline of the yolk; *bl*, blastodermic rim; *a*, fixed point of rim.

anaminota is probably not identical with the so-called primitive streak of the amniota, but rather with the head process as explained later. The fixed point of the blastodermic rim marks the head-end of the embryo; the parts of the ectental line, which grow together next behind the fixed points develop into the head; those a little further back into the neck, and those further back into the rump and tail. The parts of the circular rim most remote from the fixed point, *d*, of course concresce last. The destiny of each portion of the ectental line is fixed before concrescence occurs. In fact in certain cases the differentiation of the tissues advances to a considerable degree in

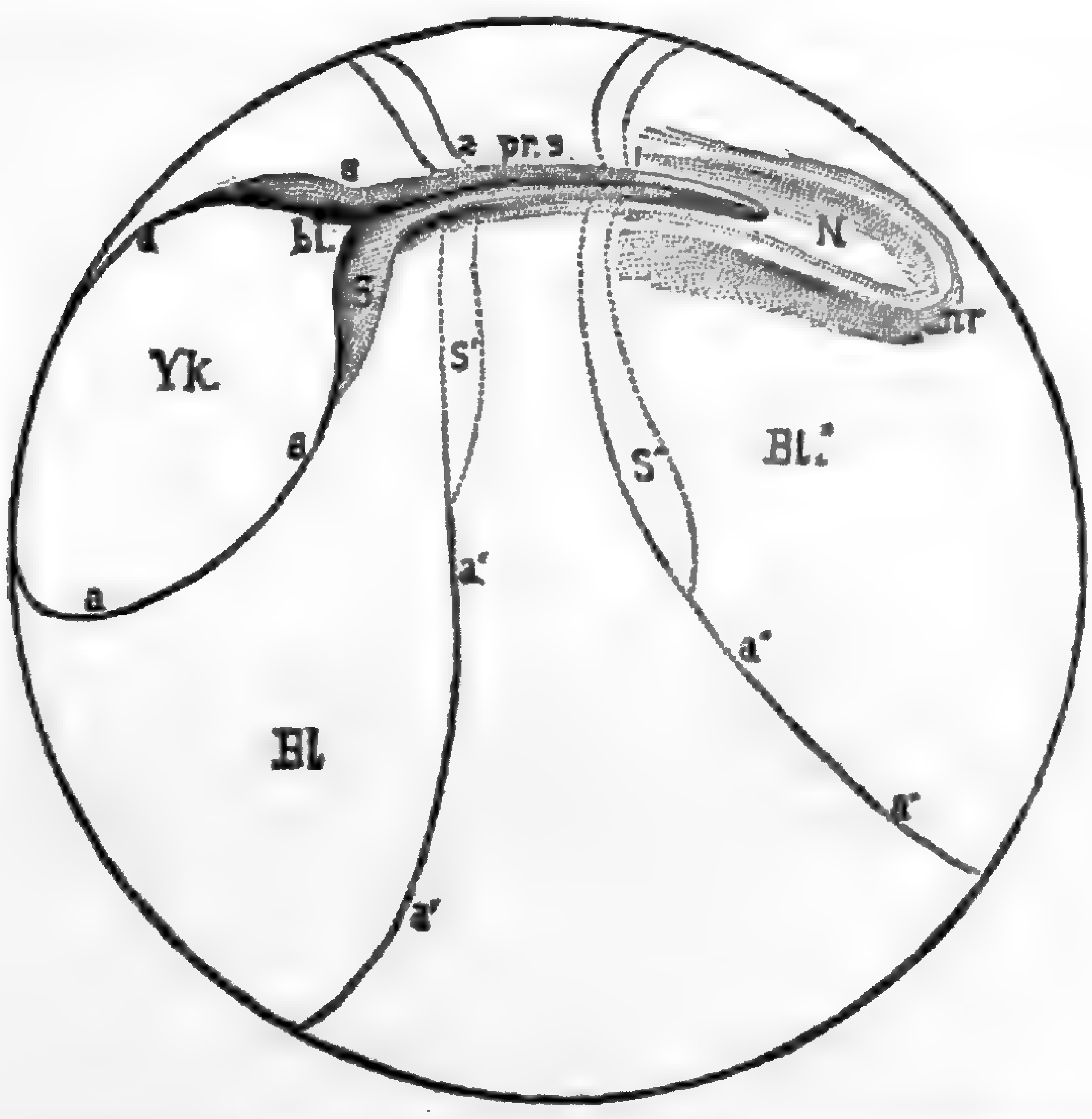

FIG. 2.—Diagram illustrating the growth of the blastoderm, and concrescence of its rim to form the primitive streak, *pr. s*. *N*, neural or medullary groove; *nr*, neural ridges; *Bl*, blastoderm; *S*, part of the blastodermic rim, termed the sichel in German; *pr. s*, primitive streak, *bl*, blastopore; *Yk*, uncovered yolk. Compare also the text.

the Randwulst before concrescence. This is strikingly the case in Elacate, in the ova of which the myotomes (or segmental divisions of the mesoderm) appear in the embryonic rim before its concrescence. (Ryder, 1885, *51*; compare also Ryder's observations on Belone, *49*.)

The accompanying diagram may assist to render clear the process of concrescence, Fig. 2. It is intended to illustrate the spreading of the ectoderm (germinal disc, blastoderm, *auct.*) over the yolk, and the simultaneous formation of the primitive streak. The whole ovum is represented as seen in projection; the proportions are such as have been suggested by the ova of flounders and frogs. Three successive stages of the expanding blastoderm are represented; the first position of the embryonic rim (ectental line) corresponds to the dotted line, $a'' \; a''$; the concrescence reaches only to the point marked 1; the lateral margins, s'', which are to concresce later, still form part of the edge of the blastoderm. At the next stage the ectoderm has grown very much, and has moved its edge to a', a', while the margins, *s*, have coalesced so that the primitive streak extends to 2. The extension continues, bringing the ectental line to *a*, *a*, *a*, *s*, and carrying the primitive streak back to 3; behind the primitive streak a small area, *Yk*, of the yolk is still uncovered, and corresponds to the so-called anus of Rusconi in frogs' ova. The portion of the ectental line bounding this area differs from that which is immediately concerned in the formation of the primitive streak, *s*; although it now lies behind the primitive streak, it was previously in front of it, when the blastoderm covered only the minor portion of the ovum. (See s'', $a'' \; a''$.) Ultimately the yolk is entirely covered by the blastoderm, thus fixing the length of the primitive. streak. It is essential to notice that the blastodermic rim (ectental line) divides into two portions, one, *s*, which forms the primitive streak, and another, a'', a'', which overgrows the ovum and at last closes over the yolk behind the completed primitive streak. That the processes are essentially as described becomes evident upon examination of the figures given by W. His, *26*, Kupffer, *39*, Coste, *14*, and others.

Underneath the entire length of the band of cells constituting the primitive streak is formed a cavity, which is transformed ultimately into the cavity of the alimentary canal and its appendages. It is termed the archenteron or entodermic canal (*Urdarm*). The mode of concrescence in elasmobranchs elucidates the formation of this cavity. In bony fishes the cells which form the walls of the archenteron lie so close together that the lumen of the canal is obliterated and does not appear until considerably later (*cf.* Balfour, Comp. Embryol., II., 75.)

Concrescence in Elasmobranchs—Our knowledge rests mainly on the researches of His., 27, and his follower Kollmann, 33. Fig. 3, *A*, is a generalized diagram of an elasmobranch ovum, representing the ectodermal disc, *Bl*, as seen from above, resting upon the yolk, which is not represented in the figure.

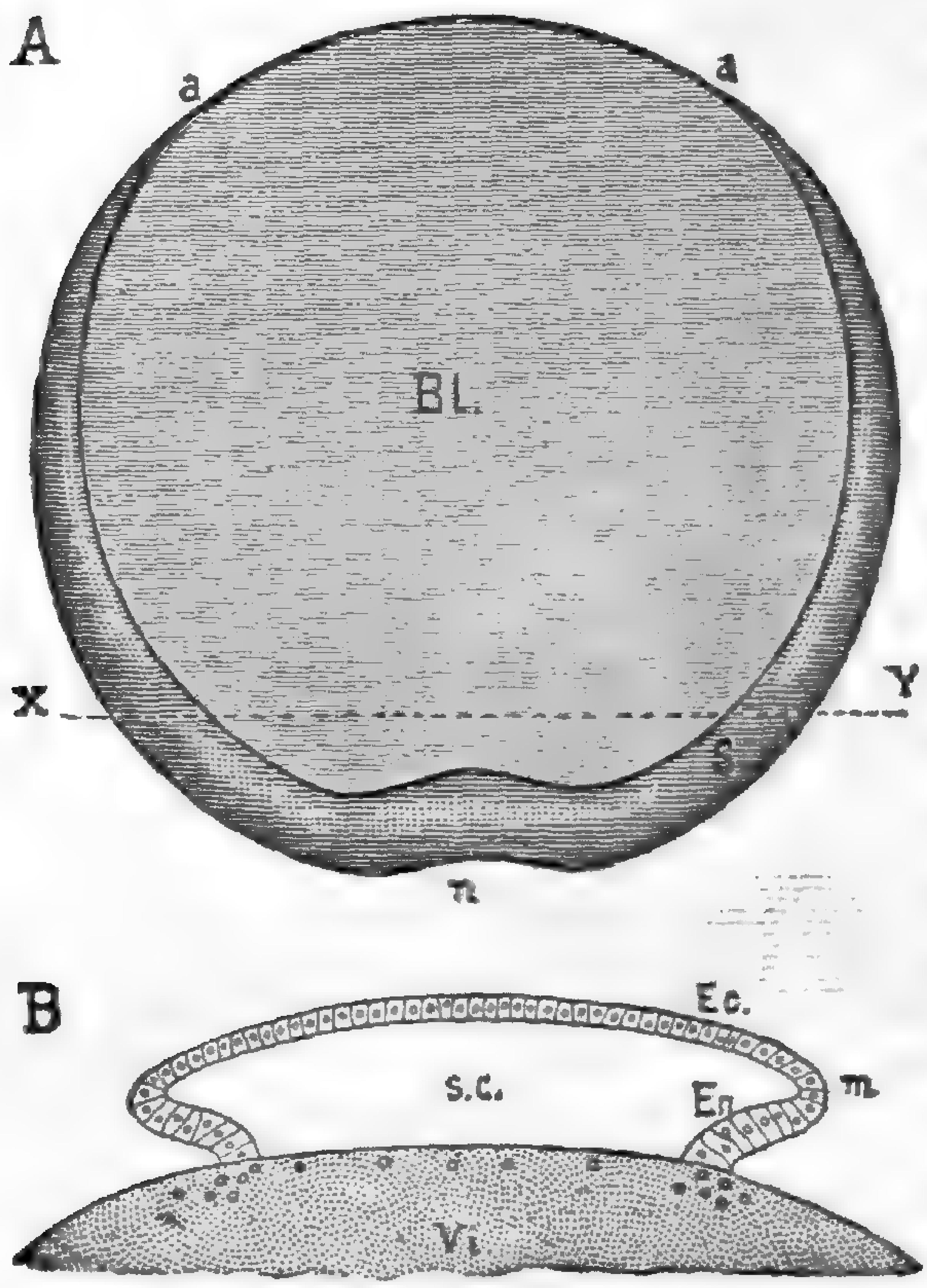

FIG. 3.—Diagram of an elasmo branch blastoderm to illustrate the formation of the marginal groove. *A*, surface view; *Bl*, blastoderm; *a*, *a*, anterior grooveless margin; *S*, (*Sichel*) marginal groove; *n*, marginal notch; *X*, *Y*, line of sections; *B*, section along the line *X*, *Y*, of *A*; *Ec*, ectoderm; *En*, entoderm; *m*, ectental line; *s. c.*, segmentation cavity; *Vi*, yolk with nuclei.

The first change noticeable in the disc after the close of segmentation is a groove running completely around its margin, between it and the yolk; as the disc grows and expands, the groove is no longer present along the front edge, *a*, *a*, of the blastoderm, but only on the sides and behind. About the same time there usually appears a distinct notch, *n*, which marks the fixed point of the margin, and the posterior end of the disc. If, now, a section be made across the line, *x*,*y*, the relations will be found to be essentially as represented in the diagram, Fig. 3, *B*; the disc rests on the yolk, *Vi*, which contains numerous nuclei; between the yolk and the ectoderm, *Ec*, is the segmentation cavity, *s. c.*; the groove is bounded above by a layer of cells, *en*, which are larger than those of the ectoderm, and have been produced by the yolk, *Vi*; sometimes there are cells lying in the segmentation cavity at this stage, the formation of the mesoderm having already begun. The essential point to note in this stage is, as Kollmann has shown, the division of the margin of the ectodermal disc into two parts, one, *a*, *a*, resting directly on the yolk, the other *s*, directly continuous with a layer of entodermal cells, *B*, *En*, forming a little groove under the margin of the disc. The two portions of the ectental margin have entirely distinct functions, as already stated: the interior, *a*, *a*, is destined to grow over and cover the

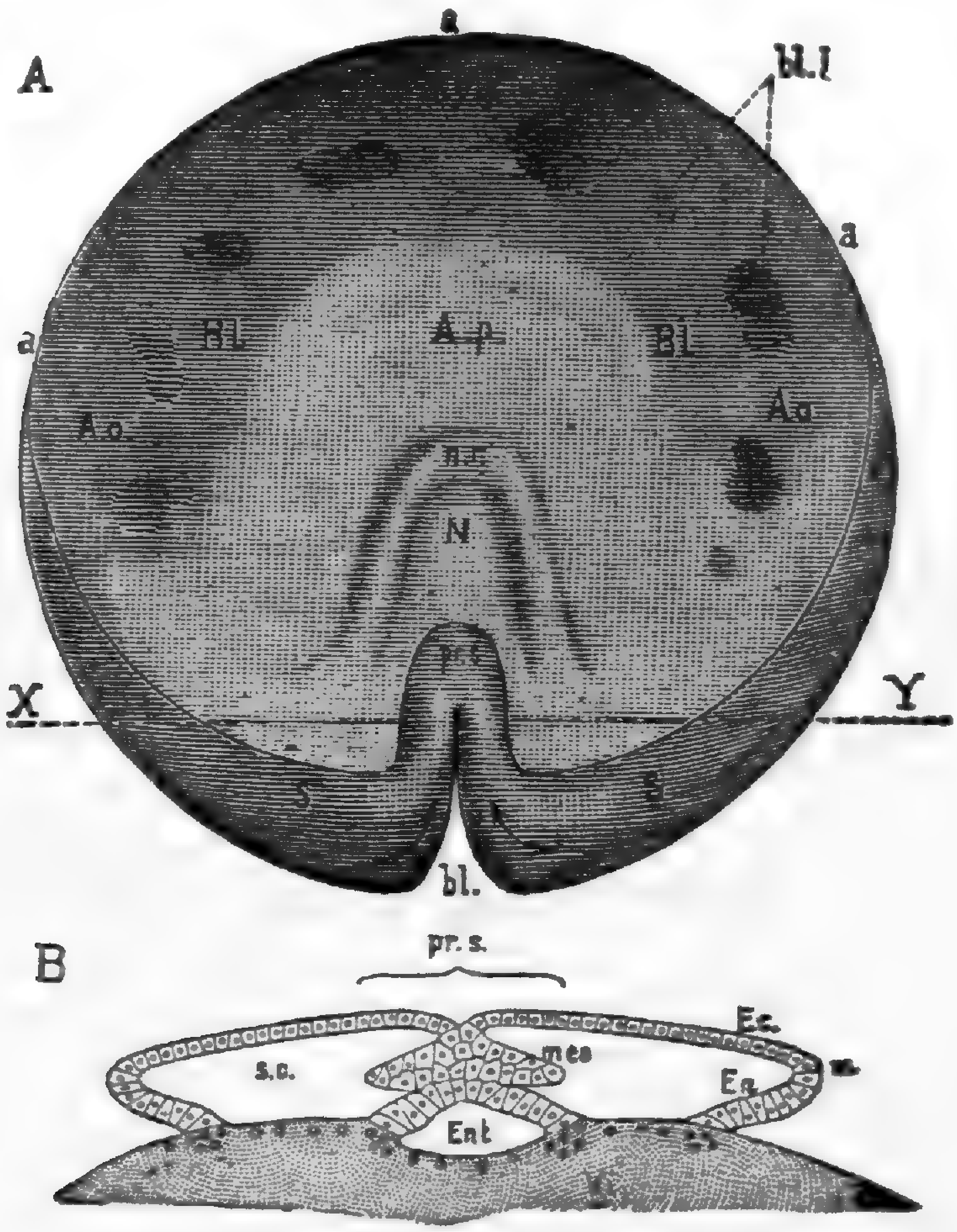

FIG. 4.—Diagram of a vertebrate blastoderm a little more advanced than Fig. 3.—*A*, surface view; *B*, section along the line *X*, *Y*; *Bl*, blastoderm; *a*, *a*, *a*, anterior margin *s.s.*, posterior margin (Sichel); *A*, *o.*, area opaca; *A.p*, area pellucida; *n.r.*, neural ridges; *N*, neural or medullary groove; *pr.s.*, primitive streak; *bl*, blastopore; *Ec.*, ectoderm; *m*, ectental margin; *En.*, entodermic cells; *Vi*, yolk; *mes.*, mesoderm; *s.c.*, segmentation cavity.

yolk by the extra-embryonic portion of the ectoderm: the posterior, *S*, is destined to form the primitive streak of the embryo.

Fig. 4 is similar to Fig. 3, but represents a more advanced stage. The ectodermal disk, *Bl*, is much enlarged, and its anterior grooveless margin, *a*, *a*, *a*, is relatively much more increased than the posterior grooved margin *S*; the centre of the notch, Fig. 3, *n* has remained nearly if not quite stationary, Fig. 4, *pr.s.*, while the margin, *s. s.*, of either side has been growing toward its fellow in the manner indicated by the arrows, and as they meet the two side margins grow together in the median line, making a longitudinal structure. The manner and results of the concrescence of the margins from the two sides to form a median longitudinal structure, become clearer in section, Fig. 4, *B*. The margin at the side, *m*, still shows the same relations as in Fig. 3, *B*; in the median line, however, the margins have met and intimately united, so that what were originally two grooves have completely united to form a single canal, *Ent*, bounded above by entodermal cells, below by the entodermal yolk, *Vi*. This canal is the primitive entodermal cavity. A moment's consideration renders it evident that the canal must be open posteriorly; this opening is the blastopore, *bl*. There are some further details to be mentioned; where the ectental margins have united in the median line, there appears a lateral outgrowth, *mes*, which is the beginning of the mesoderm; in some cases this mesodermic tissue appears before the margins concresce; when viewed from the surface the mesoderm can be seen through the ectoderm, as was observed long ago; it is this faint appearance which early writers call the primitive streak, it being the foreshadowing of coming organization. In the middle line there appears a little furrow known as the primitive groove, perhaps the homologue of the ciliated ventral furrow of annelids. The Fig. 4, *A*, also shows *in front of* the primitive streak the first trace, *N.*, of the central nervous system. The blastoderm is seen also to be divided already into two parts, the lighter area pellucida, *A. p.*, and the darker area opaca, *A. o.*; the latter also shows the first blood islands.

From their observations, His, Kollmann and others have inferred that at the anterior ectental margin, *a, a, a*, there are produced (from the yolk) cells, which grow in toward the embryo, and constitute part of the mesoderm, and are especially concerned in forming the first blood, which is produced always in the extra-embryonic area. This mesoderm of peripheral origin His has named parablast, a term which unfortunately has been employed differently by some subsequent writers. The ectoderm, entoderm, and axial mesoderm Prof. His groups under the collective name of archiblast. This view of the double origin of the mesoderm, although it has been adopted in a modified form by the brothers Hertwig, I am unable to accept.

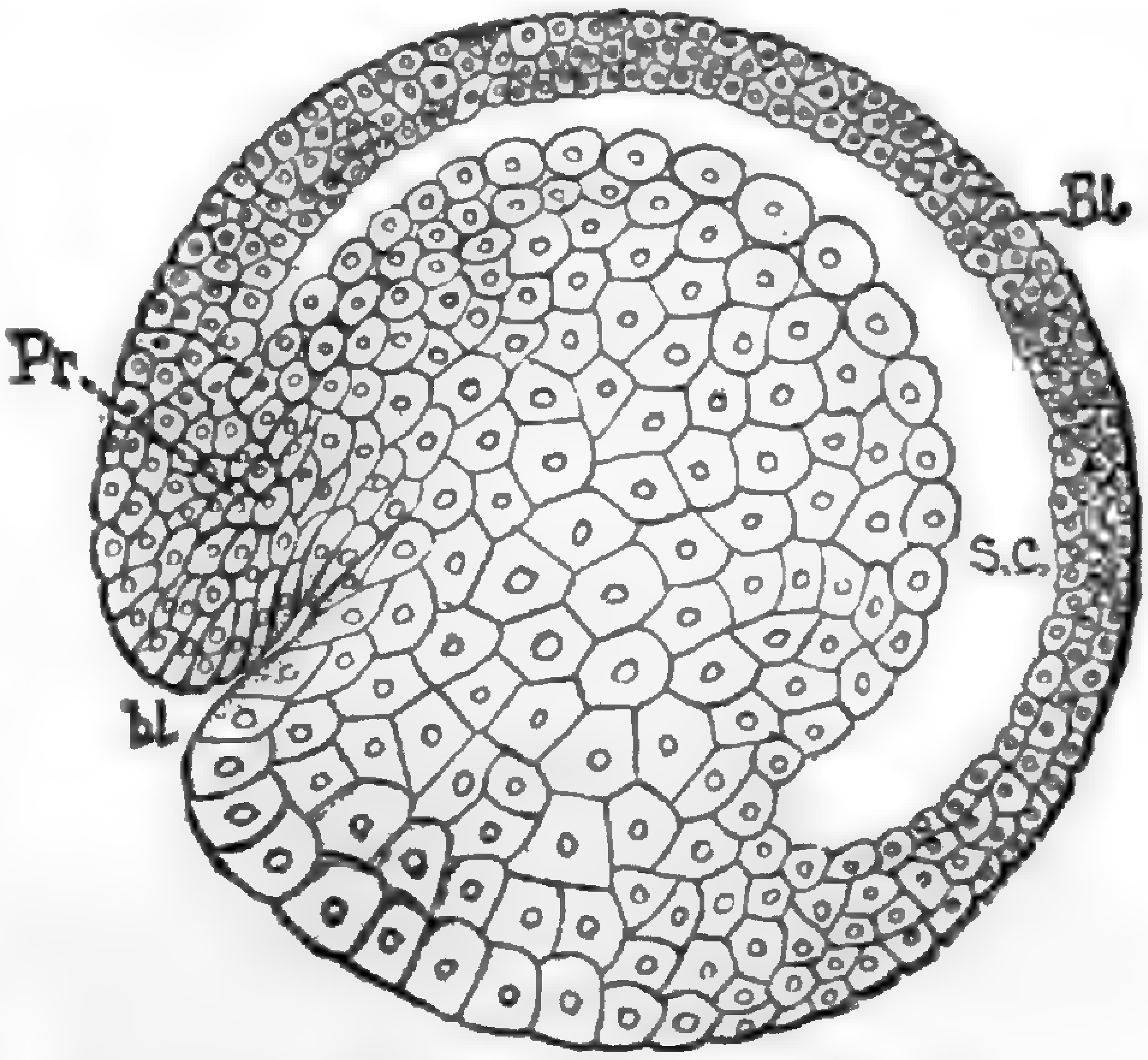

FIG. 5.—Ovum of axolotl; after Bellonci; longitudinal section to show the commencing formation of the primitive streak; *bl*, blastopore; *Bl*, blastoderm; *s.c.*, segmentation cavity.

Concrescence in Marsipobranchs, Ganoids and Amphibians. — As not only the constitution of the ovum, but also its early development, is very similar in the three classes named, we may consider them collectively in the present connection. The condition of the ovum at the close of segmentation I have already described,[3] p. 472 and figured, Fig. 4, *3*. The ectental line is not sharply defined, nor does there appear any groove around the edge of the blastoderm as in meroblastic ova. The small-celled ectoderm spreads over the yolk; while it is doing this a small cavity appears at the hind edge of the blastoderm, with a small opening to the exterior known as the blastopore, Fig. 5, *bl.*; the cavity runs forwards towards the segmentation cavity Fig. 5, *sc.*; above and in front of the blastopore the cells have multiplied and accumulated to form the beginning

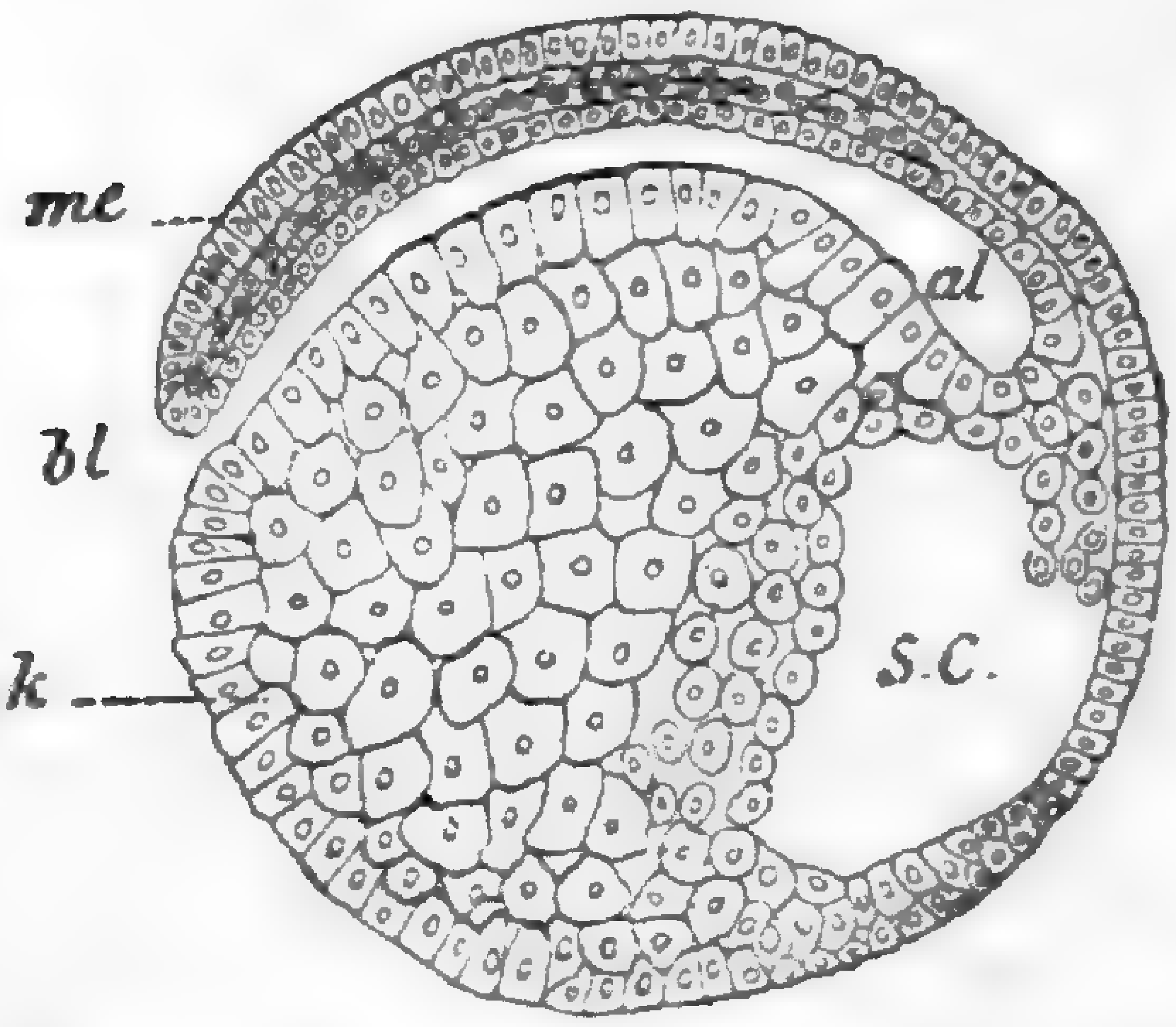

FIG. 6.—Ovum of Petnmyzon in longitudinal section, after Balfour.

[3] AMERICAN NATURALIST, 1889.

of the primitive streak, *Pr.* In the lamprey there is at this stage no such accumulation of cells; according to Shipley the ectoderm consists of a single layer of cells and the archenteron is bounded on its dorsal side by a single layer of cells also, between which and the overlying blastoderm there are no cells; the gathering of cells, corresponding to the primitive streak, does not arise until later. The cavity becomes that of the anterior end of the archenteron; it is sometimes designated as the blastoporic invagination. The archenteron, in the same measure as the blastoderm spreads over the yolk, grows at its hinder end away from the segmentation cavity, Fig 6, just as in elasmobranchs. A stage is soon reached in which nearly the entire length of the archenteron is formed, and nearly the whole yolk is covered. There is still a blastopore which leads into the cavity, and which has moved gradually backwards from its original position. Behind the blastopore lies the uncovered yolk, which in the frog's ovum is very conspicuous, because its whitish color contrasts with the dark color of the heavily pigmented ectoderm around it; this area of exposed yolk is the so-called anus of Rusconi. When the archenteron has completed its full length, the following disposition of the parts is found, Fig. 7. The archenteron is bounded below by the large mass of yolk cells, *vi*, and above by the epithelium, *ent*, of the entoderm; its posterior end curves up to open at the blastopore, *Bl*, passing through a mass of cells, which constitutes the hind end of the primitive streak; this portion of the archenteron is sometimes called the blastoporic canal. There is further a short prolongation, *Al*, of

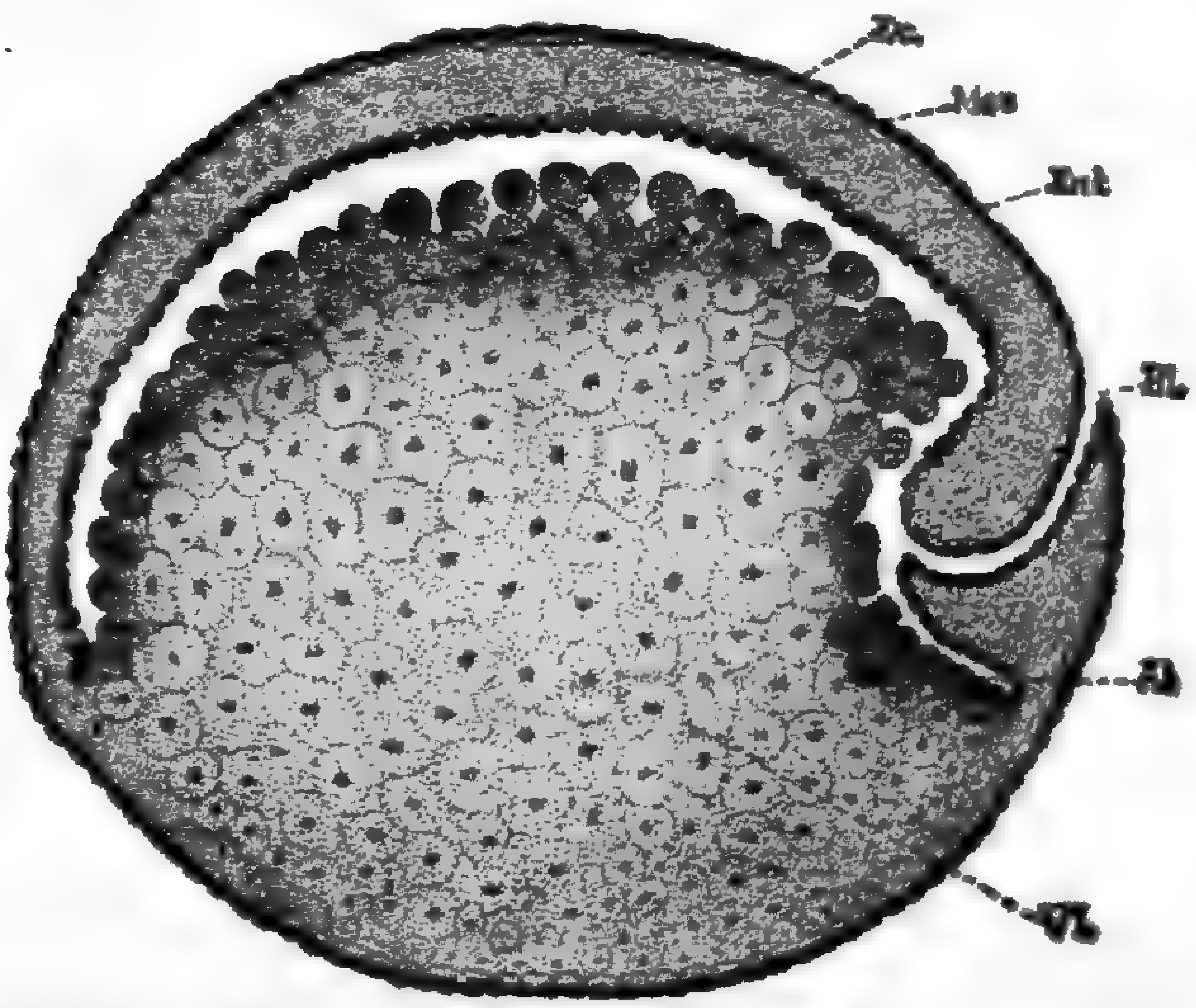

FIG. 7.—Longitudinal section of the ovum of a sturgeon after the formation of the entodermic cavity. *Ec*, ectoderm; *mes*, mesoderm; *Ent*, entoderm; *Bl*, blastopore; *Al*, diverticulum of the archenteron; *Vi*, yolk (after Salensky).

the cavity below the blastopore. This diverticulum has been homologized with the allantois. It is also very probably homologous with the more nearly spherical diverticulum found in a similar position in teleosts, and now known as Kuppfer's vesicle, from having been especially studied by C. Kuppfer, *34*, *35*, who has interpreted it as the teleostean allantois. Compare D. Schwarz, *53*, 197, Taf. XIII., Figs. 35, 37, etc. Around the blastopore is a mass of cells, continuous on the one side with the ectoderm, on the other with the epithelial entoderm lining the archenteron, and thirdly with a sheet of cells, *mes*, between the ectoderm, *ec*, and entoderm, *ent*.

The developmental phases just outlined seem to me to afford sufficient evidence of concrescence. Owing to the gradual transition between the ectoderm (blastoderm) and the entoderm (yolk cells), there is no sharp ectental line as in some types. Moreover there is no differentiation of the tissues at the blastodermic rim, but only after the cells are united in the axis, hence we cannot distinguish parts at the periphery of the blastoderm and follow their union in the primitive streak as we can in certain sharks and bony fishes. Nevertheless we find all the essential features of concrescence; the entodermal canal and the primitive streak begin at the edge of the blastoderm and grow at their posterior end away from the segmentation cavity and at the same rate the blastoderm overspreads the yolk.

Concrescence in Sauropsida.—The early development of the reptilian ovum is imperfectly understood, although several valuable memoirs have been published upon it. The ova present the peculiarity that the posterior end of the primitive streak is a solid mass, the blastoporic canal being closed until a quite advanced period, when it is temporarily opened. (Compare the section on the *Blastopore*.) It seems to me that the archenteron is formed by concrescence, in spite of the modified history of the blastoporic canal. Not only does the primitive streak begin its development at the edge of the primitive ectoderm (blastoderm or germinal disc) and grow backwards, but also the ectodermal cavity is formed underneath it, but there is no open blastopore so far as yet observed. This growth of the primitive streak and groove are very clearly demonstrated in C. Kuppfer's figures, *36*, Taf. VIII., Figs. 1-3. Moreover, Kuppfer and Benecke have found, in certain cases, the so-called "Sichel," or transverse thickening at the hind end of the growing primitive streak; this thickening is a portion of the blastodermic rim, and by the interpretation I adopt until better observations shall decide, it corresponds to the transverse thickening in a similar position in sharks.

The process of concrescence in birds was partly indicated by Koller's investigations, *30*, *31*, and has been carefully elucidated by Duval, *18*, I. The resemblance to concrescence as known in elasmobranches is very striking. Around the edge of the blastoderm appears very early a small groove; as the blastoderm expands the front portion loses the groove; one point, the centre of the groove, ceases to move, or at least moves much more slowly than the remainder of the blastodermic rim; as the expansion continues the edges of the two halves of the groove coalesce gradually behind the fixed point, thus producing the entodermal canal in the same manner as in sharks; cells accumulate at the same time and make the so-called primitive streak; most of these cells enter into the composition of the mesoderm. There is an uncertainty in Duval's account owing to his failure to distinguish between the segmentation and the entodermal cavities; as I have pointed out, AMERICAN NATURALIST, 1889, p. 475, Duval's subgerminal-cavity at the close of segmentation is the true segmentation cavity (blastocœle); his own account of the concrescence shows that the entodermal canal arises separately and behind the blastodermic or true segmentation cavity; but unfortunately neither his text nor his figures give satisfactory information in regard to the separation of the two cavities; Duval calls the entodermal cavity also the subgerminal, thus causing confusion, since subgerminal is properly applied only to the blastocœle.

In birds (hen's ova) there is a further peculiarity, which is, I think, probably to be found in all amniota, namely:—that portion of the edge of the ectoderm which does not share in concrescence, and which corresponds to the edge of the anus of Rusconi, closes over the yolk behind the primitive streak, so that the portion of the yolk which is left uncovered is remote from the embryonic area (or primitive streak). As a rare anomaly (see Whitman, *68*), a line is visible running in the ectoderm from the hind end of the primitive streak to the edge of the uncovered yolk; this line is to be interpreted as evidence of the growing together of the ectoderm behind the streak proper. The ectoderm, as it spreads over the yolk, receives no accretions from it, but accomplishes its expansion by proliferation of its own cells. Thus the uncovered yolk is bounded by the free edge of the ectoderm; this area, which may be called the yolk blastopore,[5] is comparable to the anus of Rusconi, from which it differs in position, being remote from, instead of close (as in the anus of Rusconi) to the primitive streak, for it is situated nearly opposite the embryonic area. In birds, according to Duval, *19*, the yolk blastopore (Dotternabel) is never closed by ectoderm, but remains covered by the vitelline membrane only until the mesoderm spreads over it. The growing edge of the ectoderm is somewhat thickened; it finally is reflected around the edge of the yolk blastopore, forming as it were a funnel, at the bottom of which is the yolk. (See Duval, *l. c.*)

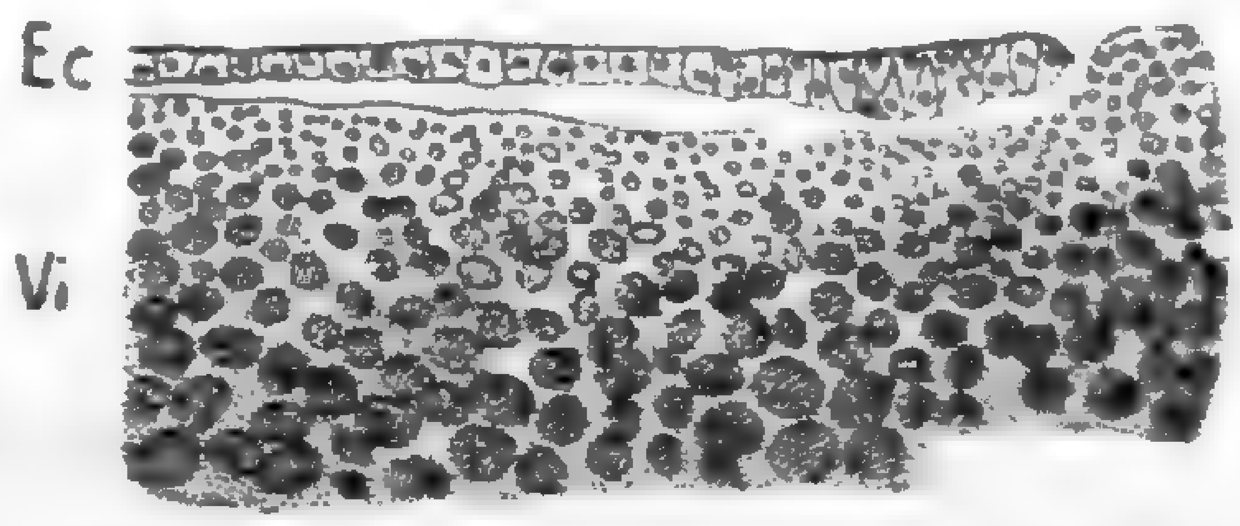

FIG. 8.—Hen's ovum; incubated six hours; anterior edge of the ectoderm, *Ec*, resting on the yolk, *Vi*; from a longitudinal section of the blastoderm in situ; after Duval.

Concrescence in Mammals.—There is, as yet, no direct evidence of concrescence in mammals, but strong indirect evidence. First, it is to be remarked that of no mammal do we know the exact history of the primitive streak, and secondly that what we do know accords fully with the history in the Sauropsida. There is a primitive blastoderm on the edge of which the primitive streak appears, and from its beginning the streak grows backwards as the germinative area expands. Now the mammals are derived from the reptiles, and it may be assumed safely that their early development is essentially the same as that of the reptiles, and what knowledge we possess agrees with this inference. Unfortu-

[5] Duval applies to it the name of ombilic ombilical.

nately the few authors who have investigated the primitive streak in mammals have failed to consider the problem, as the discoveries of His and his followers have rendered it necessary to consider it, namely, as the question: How is concrescence modified in mammals? It is therefore not surprising that we lack the necessary information. The organization of the mammalian primitive streak is described below. Provisionally, at least, we must assume that the streak follows the same developmental type in the highest as in the lower vertebrates.

Concrescence, Summary.—The evidence that concrescence is the typical means of forming the primitive streak in vertebrates is: (1) detailed and conclusive observations upon elasmobranchs, teleosts and birds; (2) exact and extensive observations on marsipobranchs, ganoids and amphibians, which concord with the theory of concrescence; (3) a great probability of its occurrence in reptiles, owing to the similarity of their development with that of birds; (4) a probability of its occurrence in mammals, because of the resemblance in the growth and structure of the primitive streak to that in other vertebrates. It seems to me therefore not premature to draw the generalization that *the vertebrate primitive streak is formed by the growing together in the axial line of the future embryo of the two halves of the ectental line.*

The development of the primitive streak may be described in general terms as follows:—At the close of segmentation the edge of the primitive blastoderm separates into two parts; one part (the anterior), as the blastoderm expands, spreads over the yolk, gradually covering it with ectoderm; the other part (the posterior) forms the primitive streak; it has in its centre one fixed point, consequently when the blastoderm expands the two halves of the posterior part of the ectental line are brought together, and gradually unite (concresce) along a line running from the fixed point radially backwards as regards the blastoderm. Consequently the segmentation cavity which is underneath the primitive blastoderm lies in front of the developing archenteron. While this goes on, cells grow out from the concrescing part of the ectental line into the space between the ectoderm and entoderm (or yolk); underneath the line of junction a cavity is formed, lined by entoderm, having cells on the dorsal, yolk on the ventral side; this cavity with its walls is the archenteron; the archenteron lengthens backwards as concrescence progresses; it has, whatever its length, a small entrance (the blastopore) at its hind end; the blastopore is ultimately obliterated; it is found to be temporarily closed in (all ?) amniota during the lengthening of the archenteron (and primitive streak). The cells which grow out from the ectental line constitute the first anlage of the middle germinal layer or mesoderm, and shining through the ectoderm they produce the appearance of a whitish line, which has led to the name of primitive streak. The characteristics of the mesoderm are described in the next section. Along the line of junction there often appears a slight furrow in the ectoderm, which is known as the primitive groove.

Significance of Concrescence. It will at once be evident that if the process of concrescence went on without the actual meeting of the two portions of the ectental line the result would be to leave the archenteron open along its entire length; the borders of the opening would be the ectental line; and this line, as I have shown elsewhere (AMERICAN NATURALIST, 1889), corresponds to the lips of the gastrula mouth; consequently we should have a gastrula with an elongated mouth. This condition is illustrated by the accompanying diagram. It agrees in all respects with the gastrula type; its most noteworthy peculiarities are two:—*first*, the enormous mass of yolk accumulated in the aboral portion of the entoderm; *second*, the elongation of the gastrula or archenteric cavity in a direction at right angles to the gastrula axis, *Xy*. If now the lips of the gastrula, Fig. 9, meet, and unite we should obtain at once the vertebrate type, cf. Fig. 4, B. Accord-

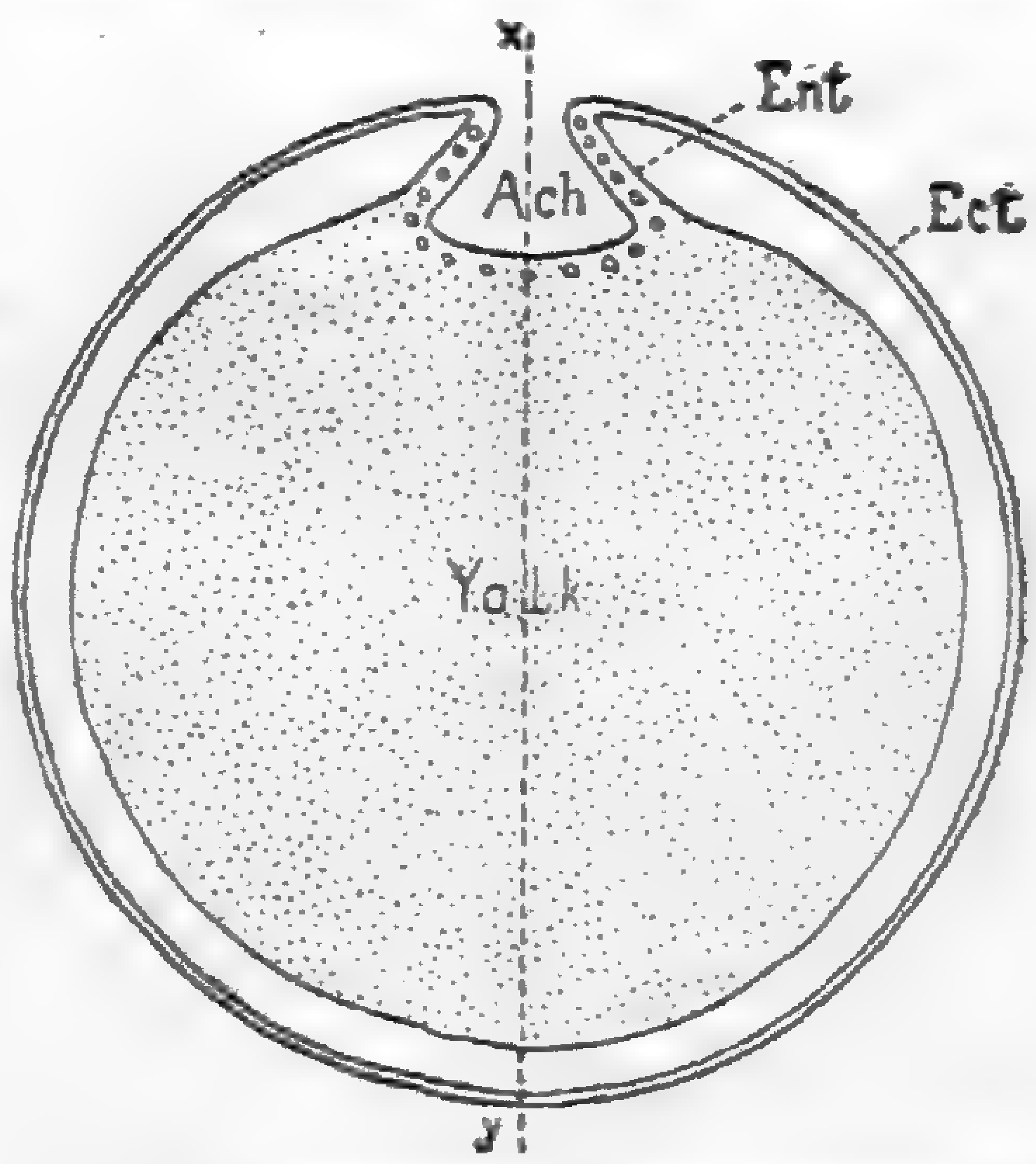

FIG. 9.—Diagram of a vertebrate embryo in which the lips of the gastrula mouth are supposed not to have concresced. *Ach*, archenteron; *Ent*, entoderm; *Ect*, ectoderm; *Yolk*, yolk-entoderm; *x-y*, gastrula axis.

ing to His's discovery this is precisely what takes place, only the lips are brought together first at one end, where they at once unite, while behind they are widely separated; but gradually they are brought together and unite throughout their entire length.

Concrescence is, then, a modified method of uniting the lips of a greatly elongated gastrula mouth. Why this modification is established we cannot say with certainty, though we may surmise with confidence that it is consequent upon the great accumulation of yolk in vertebrate ova.

The view here adopted enables us to speak positively as to the point where we are to look in vertebrates for the homologue of the invertebrate mouth. In annelids concrescence is very well marked whenever the ova contain much yolk; now in leeches and earthworms, the ectental line does not concresce along the entire axial line but on the contrary, as shown by Kleinenberg and Whitman, the foremost part of the germ bands (gastrula lips) do not unite but leave a small opening; when the permanent mouth is formed this opening is carried in and serves as the passage between the mouth cavity (Vorderdarm, stomodæum) and the archenteric cavity. The foremost part of the line of concrescence lies according to His' observations on fishes just where the optic outgrowths arise; hence we have to search between the origins of the optic nerves for traces of the invertebrate mouth.

(*To be continued.*)

THE PERSISTENCE OF PLANT AND ANIMAL LIFE UNDER CHANGING CONDITIONS OF ENVIRONMENT.[1]

BY PERSIFOR FRAZER.

DANA, in the Introduction to his Manual of Geology (1874), thus distinguishes between the Plant and Animal Kingdom, on the one hand, and the Crystal Kingdom on the other hand:

"The plant or animal, (1) endowed with life, (2) commences from a germ, (3) grows by means of imbibed nutriment, and (4) passes through a series of changes and gradual development to the adult state, when (5) it evolves new seeds or germs, and (6) afterwards continues on to death and dissolution. It has, hence, its cycle of growth and reproduction, and cycle follows cycle in indefinite continuance.

"The crystal is (1) a lifeless object, and has a simpler history; it (2) begins in a nucleal molecule or particle; (3) it enlarges by external addition or accretion alone, and (4) there is hence no proper development, as the crystal is perfect, however minute; (5) it ends in simply existing, and not in reproducing; and (6) being lifeless, there is no proper death or necessary dissolution."

In pursuing the subject more in detail this author states of both plants and animals that they "have the fundamental element of their structure, visible cells, containing fluid or plastic material, instead of invisible molecules."

As to this it may be said that while there are some reasons for believing, with our present knowledge of the nature of light, that the microscope will never reveal to us a single molecule, such a revelation is not at all impossible when one considers the gigantic strides which have been made in subduing the phenomena of nature to aid us in penetrating her secrets; but even if it be true that we shall never see a single molecule, it is not yet proven that a single molecule forms the unit of mineral building. There are

[1] An address delivered before the Pennsylvania Horticultural Society, May 20, 1890.

some reasons opposed to this view mentioned by Dr. Hensoldt in an interesting article on Crystallogenesis (*Am. Geologist*, May and June, 1890). If we could magnify objects 30,000 diameters, and not thereby reduce the illumination too much, we might see a single molecule. At present the limits thus far reached are some 1600 diameters. "But," Dr. Hensoldt says, "the particles of which crystals are composed can be clearly discerned with a $\frac{1}{10}$ inch objective,—very rarely in the finished crystal, but whenever a substance is examined under the microscope during the process of crystallization, and wherever the operation of crystalline forces can be observed under high powers of magnification. There are reasons for believing that each of these visible particles is an aggregate of molecules, just as a molecule is an aggregate of atoms, and that no single molecule is capable of manifesting polar forces of sufficient energy to enable it to play a part in crystalline economy. . . 'The angular hypothesis' which maintains that the fundamental force of a crystal is determined by the shape of its integral molecules, has very few adherents now . . . On the other hand, the spheroidal form of the planets, the tendency of fluids to assume the spherical shape and the mechanical facilities which the hypothesis of rounded particles offers in the grouping of molecules have induced later inquirers to adopt almost unanimously the views of Wollaston and Hooke. We are now in position to show . . . that molecules must be more or less spherical, and in the case of augmented molecules, . . . or the minutest parts of which crystals are composed, we have abundant direct proof of this, as their forms are revealed to us by a magnification of less than 1500 diameters."

Dana continues: "(2) The living being enlarges by means of imbibed nutriment through a process of evolution; and not by mere accretion or crystallization."

This use of "evolution" is vague, and an enlargement by other means than mere accretion is unsupposable. Whether the accretion is from without or within, exogenous or endogenous, there can be but one way of lengthening or widening or deepening an object, and that is by adding matter to it or by stretching further apart the particles of matter which it already has.

This is as true of a plant or animal as it is of a crystal, and until we learn what is the procedure in the act of growing manifested by plants and animals, we cannot assert that it is different from that in crystals. The framework of some living organisms is made up of minute crystals of carbonate of lime. It seems quite possible that the minutest component parts of either the cell or the perfectly visible crystal are crystalline, and that the next larger components, both in crystals and in organisms, are spheroidal bodies more or less resembling cells.

Another strong reason for believing that the smallest parts of organisms are crystalline in character, is the action upon them of polarized light.[2]

Without going more minutely into the explanation of these curious phenomena, it will be sufficient to say that bodies which are built up in such a manner as to exhibit greater density in one direction than another are said to be under the influence of polar forces of different degrees. Such building up is crystalline, and is apparent by the effect which the structure exerts on polarized light; and almost if not all organic solids show these effects.

Dana continues: "(3) It has the faculty of converting the nutriment received into the various chemical compounds essential to its constitution, and of continuing this process of assimilation as long as the functions of life continue; and it loses this chemical power when life ceases."

The crystal lives on what it can absorb from the liquids or semi-liquids, and from the gases surrounding it—probably never from the solids. In this it resembles the living thing.

Moreover, it separates out of a solution containing many things the materials which it needs to continue the growth of itself, and rejects the rest, either pushing them aside or enclosing them as foreign bodies within its own structure.

As to its losing this power when life ceases, the crystal's life or growth may be said to last so long as there is a menstruum in which it can derive material for its further accretions, and to cease when this menstruum is withdrawn. But it can be resumed

[2] As pointed out by the speaker in a lecture before the International Electrical Exhibition in 1884.

again at any time that it is placed under similar conditions, and in the meantime it may remain just as it was left when its growth ceased. This seems to me to offer a better distinction between the organic and inorganic than most others, viz: that when the force which produced the first and sustains it by constant replacement of matter ceases, it cannot again be resumed with the same results in the same being, but in the inorganic world this is possible.

Dana continues: "(4) The living being passes through successive stages in structure and in chemistry, from the simple germ to a more or less complex adult state, and finally evolves other germs for the continuance of the species; instead of being equally perfect and equally simple in all its stages, and essentially germless."

It would be expected that the crystal world would be found to resemble more nearly the less organized end of the organic world, and we should look for analogies to the simple amœbas. These are but drops of jelly in their simplest forms, which grow in size by absorption of what passes through them, and which break up into fragments, each of which becomes a new nucleus for a similar organism.

If these be considered germs, then the detached fragments of a large crystal which form new nuclei of similar crystals in a solution containing the materials out of which the chemical substance necessary to their being is obtained, are also germs. It is well to recall also that, though there may be innumerable other substances in the same solution than those entering into the formula of the crystallizing mineral, these latter will be excluded, and those which are necessary will be assimilated as truly as the stomach of animals or the organs of plants assimilate their nutriment.

In the more special distinctions which this author makes between plants and animals, there is nothing to arrest the conclusions which seem forced upon us by a consideration of the above general characteristics. These distinctions have relation to the absorption by the plant of carbonic acid, and by the animal of oxygen; of manufacturing organic food for the animal, by the plant, from inorganic material; etc, etc., which do not concern the main question of the essential continuity of inorganic with organic force, and the separation of the phenomena of the latter from those of the former by an indefinable line. No hard and fast line can be drawn to separate animal from plant, and none to separate plant from crystal. The force which is the cause of production and of change seems as if it were simply modified to suit the various structures which it builds. The material in all three kingdoms of nature is without doubt the same. One force—one matter—is foreshadowed here.

It will be advisable to look a little more closely at this material.

The most generally accepted hypothesis of the evolution of the solid earth on which we live begins with La Place's celebrated generalization of the condensation of tenuous material,—first to vapor; then to liquid; then to solid, at an intensely high temperature; and finally by cooling to the globe that we know.

Dr. T. Sterry Hunt (Chem. and Geol. Essays) has taken up the history where La Place leaves it, or at the stage where the in great part molten earth is covered by a thin shell of rock, like lava or basalt, upon which descend acid rains containing hydrochloric, sulphuric, and nitric acids, hitherto kept in suspension by the intensely high temperature. The crust on which these rains descend would necessarily be made of the lightest elements combined together; the heaviest would be found near the centre of the earth.

These lightest materials, which while in fusion floated on the rest like an ocean, would consist of silica and the alkalies and alkaline earths, with some of the rarer elements. On this subject a recently published memoir of Prof. F. W. Clarke, Chemist of the U. S. Geological Survey, is extremely interesting. Prof. Clarke has for the first time systematically investigated the composition of the crust of the earth for a depth of ten miles from the surface, by comparing a great number of analyses of the various rock strata of different parts of the world with each other.[3]

[3] Relative Abundance of Chemical Elements, by Frank Wigglesworth Clark , Philo sophical Society of Washington Bulletin, Vol. XI., pp. 131–142.

From the mean of 880 analyses he finds that the solid crust constitutes 93 p. c.; the ocean 7 p. c.; and the air much less than 1 p. c. by weight (so that the latter is added as a slight correction applied to the ocean).

Taking these figures, he has calculated from the above 880 analyses, made in all parts of our own country and Europe and throughly combined and sifted, the following curious table of the frequency of the various elements. He adds that the fifty odd elements not included here can hardly aggregate 1 p. c. altogether.[4]

	P. C.
Oxygen	49.98
Silicon	25.30
Aluminum	7.26
Iron	5.08
Calcium	3.51
Magnesium	2.50
Sodium	2.28
Potassium	2.23
Hydrogen	0.94
Titanium	0.30
Carbon	0.21
Chlorine and Bromine	0.15
Phosphorus	0.09
Manganese	0.07
Sulphur	0.04
Barium	0.03
Nitrogen	0.02
Chromium	0.01
Total	100.00

The effect of acid rains upon this slag-like material can easily be predicted, and the prediction agrees with the facts as observed. Thus the deduction from La Place's hypothesis would lead to a soil and air composed as we observe them, and the growth of all

[4] See Chem. and Geol. Essays, pp. 35-47.

things would necessarily be by accretion from the elements which predominated in this soil and atmosphere. This is also what we observe.

Some reasons for believing that life is simply one manifestation of force acting upon matter has been alluded to, but there are many other reasons. The demonstration of the correlation and conservation of force, by Graham, Helmholtz, Meyer, Joule, Tyndall and others, in the early sixties marks an epoch in the science of physics. Since the date of this beautiful generalization it has been the practice to calculate all forms of force in terms of heat or heat-units; and many experiments have shown that these heat-units were expended in carrying on the various life processes, precisely as they are in raising water into steam, and cooling the steam again into water by converting part of its heat into the mechanical motion of the parts of a machine.

Regarding an animal as a machine, and its food as the fuel to drive this machine, an approximate calculation has been made of the directions in which the combustion (or assimilation) of the food is employed during the daily use of their organs by animals, and the calculation has been found to agree quite closely with observed facts. It may be safely predicated, therefore, that the force which builds up the plant or animal is calculable in so many heat-units expended to so much work of this kind performed; i. e., to build an inch of sugar cane, as much force is required as would be represented by the burning of a given quantity of coal or wood, and the conversion of the heat thereby obtained into mechanical motion, etc. But the production of these heat-units must depend upon the ease with which certain elements or groups of elements can be broken up and formed into other groups; for this change, called chemical change, always results in the development of heat or its equivalent work. Keeping this fact in view, it is not difficult to understand why the bodies of plants and animals, which require for their very existence that these changes should be continually going on, should be composed of groups of elements easily broken up and re-formed, and of elements, too, which are known as combustibles, or those which greedily seek out and combine with oxygen.

The present state of our planet is this: First, an ocean of atmosphere resting on the surface of the globe, in which exist myriads of living things, composed largely of carbon and hydrogen,—both elements that combine with oxygen, evolving an immense number of heat-units These elements, carbon and hydrogen, while combining together, do so in such a manner that the combinations are easily broken up in presence of the oxygen, for which they have a stronger affinity. "Oxygen is absorbed and carbonic acid evolved in germination, at the birth of the young plant, and in flowering when it arrives at an adult state. In both instances starch is oxidized and converted, first into dextrine, and then into sugar for the nutriment of the young embryo, stamens, and pistils, and these processes are accompanied by a development of heat.

"The respiration of the cotyledonary leaves of the embryo, and of the corrolline envelope of the stamens and pistils, is, in every respect, a true oxidation or combustion of the store of saccharine matter, accompanied by the evolution of carbonic acid.

"Respiration is absolutely essential to the growth of plants, as well as animals."[5] It is true that the leaves of plants under the influence of sunlight decompose the carbonic acid which results from the vital processes, and unite with the carbon in the air; a process not found in the animal economy: but it is nevertheless true that combustion of carbon to carbonic acid and hydrogen to water by the union of these two elements with the oxygen of the air proceeds equally with plant and animal, and is the source of that heat which constitute their vital force.

Thus far it has been indicated that the plant and animal are such structures as are adapted to exist on a soil of silica, alumina, lime, the alkalies, iron, and a few other materials, bathed in an atmosphere of oxygen (diluted with nitrogen), at temperatures between — 50° and 120° Fahrenheit, and exposed to the rays of the sun.

"The protoplasm which is the real body of the plant cell, to which the most important incidents of its life are attached, is a sticky, colorless, transparent mass, always containing water, and

[5] Harland Coultas: " ant, an Illustration of the Organic Life of the Animal."

often drops of fat, crystals of carbonate of lime, and grains of starch. This protoplasm consists of inorganic and of organic matter, under which lattter term the albuminous materials and their products of modification or decomposition play an important part. The air-dried substance of the *Plasmodium septicum* contains, according to Dr. Rodewald, 29, 25 p. c. of ash, consisting of:

	P. C.
Lime,	64.34
Magnesia,	0.71
Potash,	1.42
Soda,	0.18
Oxide of iron,	0.13
Carbonic acid,	36.02
Phosphoric acid,	6.49
Sulphuric acid,	0.42
Chlorine,	0.21
	99.93

The ether extract of the protoplasm contains:

	p. c.
[6] Paracholesterin,	22.00
Fatty acids,	3.00

Leithicin, traces of glycerin, and resins.

Besides there are present hydro-carbons, albuminous matter, and other nitrogenous bodies, which are more products of decomposition of albumen.

"There are certainly disastase, fat emulsion-making ferments contained in it, besides plastin and albumen substance like fibrin, Myosin, Quenin, Sarkin, Xanthin, Carbonate of Ammonia, Butyric acid, and Coneisinic acid.[7]

All these substances are composed of carbon, hydrogen, oxygen and nitrogen, with small quantities of sulphur and phosphorus, etc.

[6] Paracholesterin is one of the isomeric alcohols of Cholesterin (Liebig's Annalen, Vol. 207, p. 229).

[7] Husemann, Pflanzenstoffe, 2d Ed., 1884.

A mean of two analyses of the albumen or stored food of the plant seed is:[8]

Carbon	53.21
Hydrogen	7.29
Oxygen	22.85
Nitrogen	15.78
Sulphur	.40
	99.43

The same elements enter into the composition of the protoplasm of animals, as may be seen from Robin's analysis of the amniotic fluid of a fecundated ovum, etc., etc. (Flint's Text Book of Physiology, p. 903).

In the main these elements of the protoplasm of both plants and animals may be regarded as hydro-carbons, or hydrogen and carbon with occasional nitrogen and oxygen, drawn from the soil and air into the plant, and from the plant into the animal, and expended by both as fuel, producing the motor known as vital force. It has been said that in the main constituent of this material were hydrogen and carbon, but it was not implied that these were the only constituents of this substance.

What we call "nature" acts in this as in so many other instances as a prudent speculator who will not entrust all his eggs to one basket. An analysis, however crudely conducted, will detect in the simplest food-stuff of plants, besides hydrogen and carbon, sulphur, phosphorus, chlorine, potassium, sodium,and calcium. More careful analysis of larger amounts of material will detect the presence of many other and rarer substances, iron, copper, iodine, etc. Still more delicate tests increase the number of chemical elements which are present, either as accessories, as "rare" or "very rare" concomitants.

It is not an unjustifiable generalization to say that the number of chemical elements contained in the "albumen" of a seed-sac or the amniotic fluid of a mammal increases with every increased

[8] See Dragendorff's Plant Analysis, p. 288, N. Y., Vail & Co., 1887.

effort to detect them, so that it is not at all unreasonable to conclude that practically the whole category of elements forming the superior part of the earth's crust, or floating as gases in the atmosphere, is represented in this material.[9]

Under the conditions of temperature, actinism (or the chemical effect of the sun's rays), barometric pressure, and constitution of the atmosphere and soil, the organic beings of our globe draw on their protoplasm for certain elements in excess of others, because under these conditions the decompositions and recompositions which take place are suited to maintaining life; but, should any or all of these conditions change; should the barometric pressure caused by the attraction of gravitation increase or diminish; should the proportion to each other of the constituents of the atmosphere suffer any marked variation; in any of these cases the present equilibrium would be disturbed; the oxidation and deoxidation of the materials now employed as the bases of organic structure would evolve and absorb too many or too few heat-units for the present system of life, and either this latter would change, giving rise to new animals and plants, or the materials which would be selected from the protoplasm for assimilation would be other than carbon and hydrogen, thus giving rise to different structures, composed of different materials, and behaving differently to heat and cold and chemical reagents.

In a paper on Animal Protoplasm, read before the Am. Phil. Soc., and printed in the AMERICAN NATURALIST in 1879, I considered the effect of changes of this kind on animals, pointing out that life being incomprehensible except as we could measure or weigh the phenomena which accompanied it, and these phenomena being such as would naturally occur among the substances by which we are surrounded, there was nothing to preclude the idea of living things colder than frozen mercury or hotter than molten platinum. This is true of the plant as well. As long as

[9] It would be apposite here to refer to Crooke's beautiful hypothesis of the evolution of the elements to show that each so-called element is probably only one physical manifestation of the same matter, made permanent by the peculiar conditions which surrounded it at its genesis, and that therefore in any mass of matter we have one or more forms of the single matter which constitutes all things. But this would lead us astray from the argument in hand.

force and matter exist, there is no reason to deny that they may produce the root and stem and leaves of the plant, of materials which will enter into the cycle of changes now effected at greatly higher or lower temperatures, thus preserving the rate and kind of change, while altering the materials which undergo it. This result would be a metasomatic evolution. On the other hand, the greater rapidity or slowness of these reactions might change the character of the organism, while the material remained unchanged, which would produce a metagenetic evolution. Or both substance and rate might alter, giving rise to an entirely different world, with different organisms and different processes, and as far from our present world as is the spiritual from the material.

To resume the case: 1. A careful study of the modes of growth in the three kingdoms of nature—mineral, plant, and animal—shows that there are strong analogies between them, the divergence being progressive in the order named, though many of the strongest characteristics, such as sensation, etc., of the highest or animal kingdom, are of such a kind that we are prevented from knowing their presence or absence in the other kingdoms.

2. The characteristics common to all three kingdoms are the presence of force; its action upon matter; and its renewal by the change of one form of matter to another, in the course of which energy is manifested.

3. In the crystal kingdom the restrictions on the existence and growth of the individual being least, and the variations of conditions and environment in which existence is possible, greatest, the individuals are more numerous and their composition more diverse, all of the known and unquestionably many as yet unknown elements uniting to form them.

4. As to the plant and animal kingdom the cycles of changes are based for the most part upon the disunion and separate combinations of carbon and hydrogen, because, at the existing temperature, pressure oxygen-atmosphere, and sunlight, these changes can be produced to the greatest advantage of existing kinds of living things and life forces.

5. With a much hotter or colder earth; an earth where the weights of bodies were much greater or much less they are now; an earth not surrounded by an ocean of oxygen gas; or an earth deprived of the chemical force of our sun; some changes would be made in the modes in which life is perpetuated now, to suit these changed conditions of the planet, *but it is extremely unlikely that life would be extinguished by them, unless the conditions changed too suddenly.*

6. The nature of these changes would be either: (a) to keep foreign matter flowing through the living body at about the rate it flows now, in which case the hydro-carbons would give place to some other group or groups of chemical elements to supply the framework of the plant or animals; or, (b) the rate of change of these groups of atoms being very much altered, the attributes of the living things of which they formed a part would be very much changed; or, (c) if both the elements themselves and the rapidity with which these resolved themselves into new combinations were changed, the diversity of the living things and of the world itself would be so different from what they are now that we have no means of forming the least conception of them.

7. But in no one of these cases is it likely that *life* would become extinct, though the present relations to each other of the three kingdoms of nature would cease to be.

ON THE CLASSIFICATION OF THE TESTUDINATA.

BY GEORGE BAUR.

BOULENGER, Döderlein, Zittel, and Lydekker have lately published more or less extensive works on the Testudinata. All these publications I have to discuss first before I shall undertake to give my own views on the natural arrangement of the group.

I begin with Boulenger. A general classification of the Testudinata was given by him in 1888 in the 23d volume of the 9th edition of the Encyclopædia Britannica, pp. 456–457.

The whole group was, after Dollo, divided into two sub-orders, I. *Athecæ*, II. *Testudinata*.

The Athecæ contained the single family "*Sphargidæ*," with the genera Dermochelys, Psephophorus, Protosphargis, Protostega, Psephoderma ? ; the Testudinata all the other Tortoises, which were divided in Cryptodira, Pleurodira, and Trionychoidea.

In the year following this classification was adopted by Boulenger in his catalogue of Chelonians[1], but the name of the second sub-order was changed into *Thecophora*. The whole order was called *Chelonia*.

A few months later Döderlein[2] published a classification of Testudinata. He distinguishes four sub-orders : *Atheca, Trionychoidea, Cryptodira, Pleurodira.*

Nearly at the same time the first part of the Reptilia of Prof. Zittel's "Handbuch der Palæontologie"[3] appeared, containing the Testudinata.

Zittel accepted three sub-orders of the Testudinate ; *Trionychia, Cryptodira, Pleurodira*. The Athecæ are not accepted, but considered a family of the Cryptodira.

[1] Boulenger, George Albert. Catalogue of the Chelonians, Rhynchocephalians and Crocodiles in the British Museum (Natural History), London, 1889, pp. 4–6.

[2] Elemente der Palæontologie, pp. 633–634.

[3] Zittel Karl G. Handbuch der Palæontologie. Vol. III., part 3. München und Leipzig, 1889, pp. 513–547.

Lydekker calles the whole order Chelonia, which he divides into two sub-orders, *Athecata* and *Testudinata*.

The Athecata correspond to the Athecæ; the Testudinata contain four sections: 1. *Amphichelydia;* 2. *Pleurodira;* 3. *Cryptodira;* 4. *Trionychoidea.* In the *Amphichelydia* are placed the Pleurosternidæ. "This section is formed for the reception of certain extinct Chelonians, mostly of Mesozoic age, which combine in a remarkable manner the characters of the two following sections [Cryptodira and Pleurodira], and may probably be regarded as the survivors of the earlier ancestral types from which those two sections took origin."

THE ORDINAL NAME FOR THE TORTOISES.

Boulenger and Lydekker use the name Chelonia; Zittel and Döderlein the name Testudinata. The name Chelonia has no right to stand, and must give place to that of *Testudinata*, as will be seen from the following table:

Boulenger, p. 4.—Order, *Chelonia.*

Cheloniens, Brongniart, Brit. Soc. Philos., II., 1800.
Testudinata, Oppel, Order Rep., 1811.

Baur.—*Testudinata*, Klein, 1751.

1751. *Testudinata*, Klein, Jac. Theod., Quadrupedum Dispositio brevisque Hist. Nat., 1751, p. 96.

1799. *Cheloniens*, Brongn, Mag. Encycl. ou Journ. des Sciences, des Lettres et des Arts, par A. L. Millin, T. VI., An. VII., 1799, pp. 184-201.

1802. *Testudines*, Treviranus, G. R., Biologie, Bd. I., p. 260, Göttingen, 1802.

1806. *Testudines*, Shaw, G., General Zool., Vol. III., Part 1., p. 5., London, 1802.

1806. *Chelonii*, Dumeril, A. M. C., Zool. Anal., Paris, 1806, p. 76.

[4] Lydekker R., in Henry Alleyne Nicholson and Richard Lydekker. A Manual of Palæontology, Vol. II., part III. Edinburgh and London, 1889, pp. 1082–1118. And Lydekker, Richard, Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History), Part III., containing the order Chelonia. London, 1889.

1822. *Chelonea*, Fleming, Philos. of Zool., Vol. II., p. 268, Edinburgh, 1822.

1825. *Fornicata*, Haworth, A. Tilloch, Phil. Mag., LXV., 1825, pp. 372-373.

1828. *Sterrichrotes*, Ritzen, F. F. A., Nova Acta Nat. Cur., 1828, Vol. XIV., Bonn, 1828.

1834. *Chelonia*, Carus, G., Lehrbuch der Vogl., Zool. Aufl. I., Theilp. 25, Leipzig, 1834.

The Athecæ.—I have shown in a paper published some time ago,[5] that the group Athecæ, or Athecata, as spelled by Lydekker, is an unnatural one, and that its members belong to the Pinnata, or sea-tortoises. I do not need to discuss this question fully again on this plate; I shall only give my principal reasons.

Protostega and Protosphargis, which are placed by Boulenger, Lydekker, Döderlein, among the Athecæ, are near the Cheloniidæ. In both true marginal bones (peripheralia) are developed. The skull of Protostega is like that of the Cheloniidæ; there is a free epipterygoid, and the descending processes of the parietals are present; also an ossified articular bone. Humerus and coracoid are in shape between those elements in Dermochelys and Cheloniidæ. It seems that Lydekker is inclined lately to accept my idea of the relationship of the Athecæ, for he says in the introduction to his Catalogue of Fossil Tortoises: "If the skull referred by this writer (Baur) to Protostega be rightly assigned, there will be evidence of a closer connection between the two groups (Cheloniidæ and Protostegidæ) than has hitherto been supposed. The skull from which I took these remarks is certainly rightly assigned," for it is the type of Protostega, and all the above points are mentioned by Prof. Cope[6] in his description, with figures, of Protostega; even Lydekker, who still sustains the Athecæ, will have to admit now that at least the Protostegidæ

[5] Baur, G. Die systematische Bemerkungen über die systematische Stellung von Dermochelys, Blainv. *Biol. Centraebl.*, Vol. IX., Nos. 5, 6. 1889, pp. 149-153; 180.191.

Nachtraegliche Bemerkungen über die esystematische stellung von Dermochelys Blainv., *Biol. Centraebl.* Vol. IX., Nos. 20, 21, pp. 617–619; see also my notes in *Zoöl. Anz.*, No. 238, 188, 1886; *Science*, Vol. XI., No. 268, 1888; *Zoöl. Anz.*, No. 285, 1888, and No. 298, 1889.

[6] Cope, E. D., The Vertebrata of the Cretaceous Formations of the West. Rept. U. S. Survey Territ., Vol. II., 1875.

are very near the Cheloniidæ, and belong certainly to the Pinnata. After it shall have been proved that in Protostega and Protosphargis an entoplastron is always absent, they will rank as a distinct family from the Cheloniidæ, to be placed between the latter and the Dermochelyidæ. I have shown now that Protostega and Protosphargis are true Pinnata; we have now to consider the remaining genera of the group: Dermochelys, Psephophorus, Eosphargis, and Psephoderma. I do not consider Psephoderma at all in this connection; it is, so far, impossible to determine the exact systematic position of this genus. Such dermal ossification as seen in Psephoderma may appear in any order of the Reptilia. I have shown that the absence of the descending processes of the parietals in the remaining three genera is an entirely secondary condition, that all Testudinata possessed originally an epipterygoid and the descending processes, and that in the Pinnata the tendency is present to abort these processes. I have shown that the character given by Boulenger to Dermochelys, that the lower border of the postfrontal joins the jugal and the squamosal, and is separated from the quadratojugal by the two latter bones, does not hold, for it is also found in specimens of Chelonia. But to convince everybody that Dermochelys and its fossil allies, Psephophorus and Eosphargis, cannot be separated from the Pinnata, I give the characters which are only found in the Pinnata, and in no other group of the Testudinata. These characters are:

1. The foramen palatinum, between palate and maxillary, is absent.

2. The articular faces between the sixth and seventh cervicals are plane.

3. The nuchol has a distinct process on the lower side for the articulation of the neuroid of the eighth cervical.

4. The small trochanters of the femur are united, and there is a fossa between these and the large trochanters. (This condition is also seen in the true land tortoises, Testudinidæ).

5. There is only one central line in the carpus; the intermedium reaches the first carpale, excluding the centrale from the radiale.

The characters, with the exception of No. 4, are typical for the Pinnata, but they are also typical for Dermochelys. *That the Dermo-*

chelyidæ represent a specialized branch of the Pinnata there cannot be any doubt whatever. The mosaik-like carapace and plastron of these forms is probably a secondary formation, which appeared after the dermal part of the ribs had disappeared entirely. The oldest Dermochelyidæ known are from the lower Eocene (Eosphargis). True Cheloniidæ are known already from the Cretaceous, and the intermediate Protostegidæ are from the same formation; *it is probable that the Protestegidæ have to be considered as the ancestor of the Dermochelyidæ.*

After it has been shown that the Athecæ are an unnatural group, and belong to the Pinnata, we have to consider the other divisions proposed. Boulenger, Lydekker, Döderlein, Zittel, all accept the groups Pleurodira, Cryptodira and Trionychia; these groups are certainly natural, as will be admitted by everybody; a new section was introduced by Lydekker under the name of Amphichelydia (*Quart. Jour. Geol. Soc.*, XLV., p. 518, 1889). "They are characterized by having a shell constructed on the plan of that of the Cryptodira and Pleurodira, in which mesoplastral bones and an intergular shield are developed. The pubis may articulate, without sutural union, with the xiphiplastral."

The skull and neck are unknown. The coracoid and humerus (when known) are of a Pleurodiran type (Lydekker, Cat., pp. 204, 205). This group is also natural, and corresponds to a sub-order to which I have given a different name in MSS., and the characters of which I can point out in full. The material on which these characters are based consists of nearly all parts of the skeleton, including skull and cervicals of *Compsemys plicatulus* Cope, the oldest American Tortoise, from the Jurassic of the Rocky Mountains. Most of the material was examined at the Peabody Museum, New Haven, Conn. Especially I have to state the interesting fact that *Compsemys* has a complete mesoplastron, and resembles very much Pleurosternum. This is another support for the view that the Camarasaurus beds correspond to the Purbeck and Oolite of England.

I give now the characters of the five sub-orders of Testudinata, which I adopt:

I. *Amphichelydia.*

Nasals free; a squamoso-parietal arch; descending processes of prefrontals joining vomer; stapes in an open groove of the quadrate; pterygoids narrow in the middle, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid well developed and free; dentary bones distinct. Cervical vertebræ with well-developed transverse processes, more in front of vertebra, with single articular faces, biconcave; dorsal vertebræ, sacral vertebræ, with well-developed ribs; ribs of sacral vertebræ connected with centrum and neuroid. Pelvis not anchylosed to the carapace and plastron. Epiplastra in contact with hyoplastra, entoplastron oval or rhomboidal; a complete series of peripheralia connected with the ribs.

II. *Pleurodira.*

Nasals free, or united with prefrontals; a squamoso-parietal arch present or absent; descending processes of prefrontals absent; stapes in a groove of quadrate generally closed on the outside; pterygoids broad, forming wing-like lateral expansions, not separating quadrate and basisphenoid; epipterygoid not free; dentary bones distinct and united. Cervical vertebræ with well-developed transverse processes generally in middle of vertebra, with single articular faces; sacral ribs rudimentary; sacral ribs connected with neuroids. Pelvis anchylosed to carapace and plastron. Epiplastra in contact with hyoplastra, entoplastron oval or rhomboidal; a complete series of peripheralia connected with the ribs.

III. *Cryptodira.*

No free nasals; a parieto-squamosal arch present or absent; descending process of prefrontals connected with vomer; stapes in an open grove, entirely covered by the quadrate behind; pterygoid narrow in the middle, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid free, or not free; dentary bones united. Cervical vertebræ with rudimentary transverse processes in front of vertebra; the posterior cervicals with double articular faces; sacral ribs well developed, and connected with centrum and neuroids. Pelvis free from plastron and carapace. Epiplastra in contact with hyoplastra, entoplastron oval, rhomboidal or T-shaped; a more or less complete series of peripheralia more or less connected with the ribs.

IV. *Chilotæ* (Trionychia).

No free nasals; no parieto-squamosal arch; descending processes of prefrontals connected with vomer or not; stapes entirely surrounded by quadrate; pterygoids broad, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid free; dentary bones united. Cervical vertebræ with very rudimentary transverse processes in front of vertebra; the posterior cervicals with double articular faces; sacral ribs well developed, and connected with neuroids only. Pelvis free from plastron and carapace; epiplastra separated from hyoplastra by the V-shaped entoplastron; marginal bones absent, or forming an incomplete series, not connected with the ribs.

RECORD OF AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

(Continued from Vol. XXIV., page 454.)

IT is the intention to catalogue here in systematic order all papers relating to the Zoology of North America, including the West Indies, beginning with the year 1889. An asterisk indicates that the paper has not been seen by the recorder. Owing to the method of preparation it is impossible to collect in one issue all the papers relating to any group, but it is hoped that succeeding numbers will correct this. Authors are requested to send copies of their papers to J. S. Kingsley, Lincoln, Nebraska.

VERTEBRATA, GENERAL.

HEITZMANN, C.—The minute structure of the Cornea. I. The so-called cells of the Cornea. *Microscope*, IX., p. 354.

CAHALL, W. C.—The teeth as evidence of evolution. AM. NAT., XXIV., p. 224, 1890.

STEARNS, R. E. C.,—Instances of the effect of musical sounds on animals. AM. NAT., XXIV., p. 22, 123, 236.

MORRIS, CHARLES.—From Brute to Man. AM. NAT., XXIV., p. 341, 1890.

MCCLURE, C. F. W.—The primitive Segmentation of the Vertebrate Brain. *Zool. Anz.*, XII., p. 435, 1889.—See AM. NAT., XXIV., p. 187.

TUNICATA.

MORGAN, T. H.—Origin of the Test Cells of the Ascidians. J. H. U., Circ., VIII., p. 63, 1889.—Results agree well with those of Van Beneden and Julin.

FEWKES, J. W.—New Invertebrata from California. Bull. Essex Inst., XXI., p. 134, 1889 [1890].—Describes as new *Clavellinopsis* [n.g.] *rubra.*

CYCLOSTOMATA.

MEEK, SETH E.—Note on *Ammocœtes branchialis.* AM. NAT., XXI., p. 640, 1889.

TELEOSTS (including GANOIDS).

EIGENMANN, C. H.—On the Development of California Food Fishes. AM. NAT., XXIII., p. 107, 1889.

MATHER, FRED.—The Eggs of an Eel. *Am. Mo. Micros. Jour.*, X., p. 15, 1889.

PACKARD, A. S.—The cave fauna of North America. Mem. Nat. Acad., IV., 1889.—Mentions cave teleosts.

MORRISON, WILLARD R.—A review of the American species of Priacanthidæ. Proc. Phil. Acad., 1889, p. 159.—Species recognized are *Priacanthus catafula*, *P. cruentatus*, *P. bonariensis* (So. America) and *Pseudopriacanthus altus.*

KIRSCH, PH. H., AND FORDICE, MORTON, W.—A review of the American species of Sturgeons (Acipenseridæ), Proc. Phila. Acad., 1889, p. 245.—Recognizes *Scaphirhynchus platyrhynchus*, *Acipenser medirostris*, *A. sturio*, *A. rubicundus*, *A. brevirostrum*, *A. transmontanus.*

HENSHALL, J. A.—Some observations on Ohio Fishes. Jour. Cin. Socy. Nat. Hist., XII., p. 114.—General article.

KIRSH, PH. H.— A review of the European and American Uranoscopidæ or Star-Gazers. Proc. Phila. Acad., 1889, p. 258. —American species *Kathetostoma averruncus*, *Astroscopus anoplos*, *Upsilonphorus Y-græcum*, *U. guttatus.*

MEEK, S. E. AND BOLLMAN, C. H.—Note on *Elegatis bipinnulatus.* Proc. Phila. Acad., 1889, p. 42.—Description of Long Island specimen.

GARMAN, S. W.—A large Carp and its History. Proc. Bost. Soc., XXIV., p. 167, 1889.—*Cyprinus carpio*, from Ayer, Mass., weighing 16½ lbs.

GILBERT, C. H.—Fourth series of notes on the Fishes of Kansas. Bull. Washburn College, II., p. 38.—Enumeration of species.

BEARD, J.—On the early development of *Lepidosteus osseus.* Proc. Roy. Soc., XVI, p. 108, 1889.—Segmentation, origin of germ-layers, nervous system, peripheral sense organs, notochord, nephridia, giant cells in nervous system.

MCCORMICK, L. M.—List of Fishes of Lorain Co., Ohio. Jour. Cin. Soc. Nat. Hist., XII., p. 127, 1890.—Nominal list of 128 species.

MEEK, S. E.—The Native Fishes of Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa, I., p. 161, 1889.—First part of a descriptive paper, including Catostomidæ, and enumerating 28 species.

JORDAN, D. S., AND FESLER, B.—Description of a new species of Orthopristis from the Galapagos Island. Proc. A. N. S., Phila., 1889, p. 36.—*O. lethopristis.*

IVES, J. E.—Mimicry of the environment in *Pterophryne histrio.* Proc. A. N. S., Phila., 1889, p. 344, 1890.—Comments on resemblances to Sargassum.

GILBERT, C. H.—Notes on the occurrence of *Gillichthys Y-cauda* at San Diego, California. Proc. U. S. Nat. Mus., XII., p. 363, 1889 [1890].—*G. guaymasiæ,* doubtfully distinct; *Gobius townsendi,* young of *Gillichthys mirabilis.*

JORDAN, D. S., AND EVERMANN, B. W.—Description of the yellow-finned trout of Twin Lakes, Colorado. Proc. U. S. Nat. Mus., XII., p. 453, 1889 [1890].—*Salmo mykiss macdonaldi,* subsp. nov.

BATRACHIA.

MORGAN, T. H.—Notes on the fate of the *Amphibian blastopore.* J. H. U. Circ., VIII., p. 31, 1889.—Preliminary paper, see *infra.*

PETERS, J. E.—Another specimen of *Hyla andersonii.* AM. NAT., XXIII., p. 58, 1889.

HAY, O. P.—Notes on the habits of some Amblystomas. AM. NAT., XXIII., p. 602, 1889.

HAY, O. P.—Notes on the life history of *Chorophilus triseriatus.* AM. NAT., XXIII., p. 770, 1889.

COPE, E. D.—The Batrachia of North America. Bulletin U. S. Nat. Mus., No. 34, 1889. (See AM. NAT., XXIII, p. 793, 1889.)

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BORDEN, W. C.—Origin and development of the fat-cells of the Frog. *Microscope*, IX., p. 101, 1889.—Nothing new.

RYDER, J. A.—Heterocercy in Batrachia. Proc. Phila. Acad., 1889, p. 155.—In Amblystoma larva.

MORGAN, T. H.—On the Amphibian blastopore. Studies Biol. Lab. J. Hopkins Univ., IV., p. 355, 1890. Forms studied were *Bufo lustiginosus, Rana halecina, Amblystoma punctatum.*

HAY, O. P.—On the structure of the skull of the larva of Amphiuma. Proc. A. A. A. S., XXXVIII., p. 286, 1889.—Abstract.

BOULENGER, G. A.—Description of a new Batrachian of the Genus Eupemphix from Trinidad. *Ann. and Mag. N. H.*, III., p. 307, 1889.—*E. trinitatis.*

ROBERTS, H. L.—Frogs Eating Snakes. AM. NAT., XXIII., p. 74, 1889.

TOWNSEND, T.—Twelve species of Coleoptera taken from the stomachs of Toads in Michigan, with remarks on the food habits of Toads. Proc. Ent. Soc., Washington, I., p. 167, 1889.

COPE, E. D.—Report on the Batrachia and Reptiles collected [by the U. S. Fish Commission steamer Albatross] in 1887-'88. Proc. U. S. Nat. Mus., XII, p. 141, 1889 [1890].—*Bufo agua* from St. Lucia, W. I.

REPTILES.

NORTHROP, J. I.—*Coluber obsoletus* [near Newburg, N. Y.]. AM. NAT., XXIV., p. 82, 1890.

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BAUR, G.—Revision meiner Mittheilungen in *Zoolsgischen Anzeiger. Zool. Anz.*, XII., 238.—Notes on osteology of various reptiles.

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COPE, E. D.—Tortoises sold in the markets of Philadelphia. AM. NAT., XXIV., p. 374, 1890.

SHUFELDT, R. W.—[No title] *Nature*, XLI., p. 181, 1889. —States existence of zygomatic arch in Heloderma.

BROWN, A. E.—Description of a new species of Eutænia. Proc. A. N. S., Phila., 1889, p. 421, 1890.—*E. nigrolateris* (Arizona).

STEJNEGER, L.—Descriptions of two new species of snakes from California. Proc. U. S. Nat. Mus., XII., p. 95, 1889 [1890]—*Lichanura orcutti*, *L. simplex*.

COPE, E. D.—Report on the Batrachians and Reptiles collected [by the U. S. Fish Commission steamer Albatross] in 1887-'88. Proc. U. S. Nat. Mus., XII., p. 141, 1889 [1890].—Three species from St. Lucia, W. I.

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Torrey, B.—Bicknell's Thrush breeding in Vermont. *Auk*, VI., p. 617, 1889.

Sennett, Geo. B.—Clapper Rails of the United States and West Indies compared with *Rallus longirostris* of South America. *Auk*, VI., 166, 1889.

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Bond, F.—*Myiadestes townsendi* apparently wintering in Wyoming. *Auk*, VI., 193, 1889.

Treat, W. E.—A fishing screech owl. *Auk*, VI., 189, 1889.

*Feilden, H. W.—On the breeding of *Puffinus auduboni* in the island of Barbadoes.—*Ibis*, p. 60, 1889.

Prince, W. C.—The northern phalarope in the Franconia Mts., N. H. *Auk*, VI., p. 68, 1889,

Elliott, H. W.—The cow-bird as a fly-destroyer. *Auk*, VI., p. 72, 1889.

Evans, Evan M.—*Calamospiza melanocorys* on Long Island, N. Y. *Auk*, VI., p. 192, 1889.

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DUTCHER, B. H.—Bird notes from Little Gull Island, Suffolk Co., N. Y. *Auk*, VI., p. 124, 1889.

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Lawrence, Geo. N.—Remarks upon abnormal coloring of plumage observed in several species of birds. *Auk*, VI., p. 46, 1889.

——An account of the former abundance of some species of birds on New York Island at the time of their migration to the South. *Auk*, VI., 201, 1889.

——A new name for the species of Sporophila from Texas, generally known as *S. moreleti*. *Auk*, VI., p. 53, 1889.—*S. m. sharpei*.

——An account of the breeding habits of *Puffinus audubonii* in the island of Grenada, West Indies, with a note on *Zenaida rubripes*. *Auk*, VI., p. 19, 1889.

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——*Helminthophaga pinus*, *H. chrysoptera*, *H. leucobronchialis* and *H. lawrencei* in Connecticut, in the spring of 1888. *Auk*, VI., 192, 1889.

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82, 1889.—Classification upon osteology, results in placing the raven at the head of the oscine series.

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EDITORIAL.

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

SENATOR EDMUNDS has introduced into the U. S. Senate a bill appropriating $500,000 for the endowment of a National University to be located in the city of Washington. It was referred to a committee. This is the outcome of a project which has been long entertained by some of the scientific officials attached to the departments of the government. A good deal may be said both for and contra this proposition. There is reason to doubt, in the first place, whether it is consistent with the character of our government to establish any central institution of this kind. Popular education has been one of the functions especially relegated to the state governments, and although the central government might well retain the power of compelling the former to attend to this important duty, so as not to imperil the welfare of the entire country, it can scarcely assume to create any system or institution of its own. But of course it is competent to establish and sustain such a university in and for the District of Columbia.

At one time the plan was to create the various scientific experts in the employ of the central government professors in the university. We hope that this feature is not embraced in the present bill. The gentlemen in question do not hold office at present during good behavior, but only during the pleasure of the appointing powers. Changes have been and will be frequently made, and these are not always improvements when considered from the standpoint of merit and competency. Then there is that poison of the official atmosphere of the capital called "departmental courtesy" or "comity." According to this unwritten law, no subordinate of one department, commission or bureau, may indulge in criticism of the acts of any other similar organization without risk of losing his head; and few appointments of persons known to indulge in such criticism, or to entertain opinions unfavorable to the abilities or accomplishments of persons in high positions, are made. This so-called comity is observed between departments, etc., in no way dependent on each other, and in quarters where independence should be expected and even encouraged. The effect of such a state of affairs on the efficiency of expert employees can be easily understood. Incompetency, which should call forth criticism, is shielded, and those who would protect the country from its consequences are muzzled, so far as the government employees and their numerous followers are concerned. It is a lamentable fact that good and otherwise independent men are affected by this false and injurious sentiment after a short residence in the official atmosphere of Washington. The effect on the expert service is necessarily to depreciate it. The inferior men go free, and, sustained by their colleagues, are thus enabled to impose themselves on legislators who are not generally familiar with specialties in science. Thus it has happened that our government and people have been sometimes made ridiculous in the eyes of the learned world..

Under such circumstances the employment of Government servants in responsible positions in a "National University" would prove disastrous. The best men would be sooner or later rotated out of office and inferior men would take their places. The institution would become a by-word among the universities of the country, and nothing would be gained, while much would be lost.

On the whole, the proposition embraced in Senator Edmunds's bill does not impress us favorably.

—In a late number of *Science*, Professor J. P. Lesley criticises our editorial of May on the coming meeting of the International

Congress of Geologists, and makes a number of statements that require notice. He desires to assume the responsibility of the proposition to transfer the meeting of the Congress from Philadelphia to Washington, stating with truth that it was he who introduced the proposition. He also states that in his opinion the meeting would be a failure if held in Philadelphia, and further that Major Powell, director of the U. S. Geological Survey, does not desire the Congress to be held in Washington. His conclusion is that the meeting had better not be held in America at all, but in Europe.

We did not refer to the fact that Prof. Lesley introduced the resolution above mentioned, for the reason that we desired to draw a veil over Prof. Lesley's connection with this matter, for obvious reasons. Now, however, that this gentleman has preceded us in describing his position, we feel no further delicacy in referring to it. Professor Lesley introduced the resolution to change the place of meeting in spite of the opposing representations of the other members of the Philadelphia committee present, —an opposition which has been since emphasized by the issue of a circular protest signed by Leidy, Hunt, Frazer, and Cope, to to which has been added, at his own request, the name of Senor Villanova, the Spanish member of the Bureau. The fact that Professor Lesley's colleagues are opposed to him in his views as to the holding of the Congress in Philadelphia should effectually silence his objections; for these are, we violate no confidence in saying, of a purely personal and most trivial character. That such motives should be permitted to disturb for a moment the Bureau of the International Congress is not to be thought of, although Professor Lesley's disloyalty to Philadelphia and to America may interfere with his usefulness in connection with the Congress when it meets there.

Professor Lesley states that Major Powell does not desire the meeting to be held in Washington. We are glad of it. We hope that it will not be held there, as good reasons for making a change at this late day are wanting. We will, however, observe that Professor Lesley's motion was not carried until one of Major Powell's had been adopted, viz.: that the Congress be not held in Philadelphia. The succeeding motions were mostly made by Major Powell, and were adopted by the votes of the members and beneficiaries of his survey, while opposing resolutions were voted down by the same persons. It is stated that after the result was reached Major Powell said that he did not desire the meeting of the Congress in Washington. This is quite probable. It is an old political method to profess to desire one thing while in the act of doing another, and persons who have had relations with the present head of the Geological Survey know that he is a thorough master of this kind of diplomacy. Professor Lesley, however, appears to have been taken in by it. We suspect that the Bureau of the Congress will not be taken in, and that they will not be seriously incommoded by these exhibitions which mean nothing but personal idiosyncrasy.

—THE Zoological Congress of Paris of 1889 has formulated a series of rules for the guidance of zoologists in the adoption and use of correct nomenclature. These reaffirm those proposed by the British Association for the Advancement of Science of a half century ago, and those adopted by the American Association at two different periods since that date. They insist, among other things, on the necessity of the presentation of a distinct diagnosis with a new name, in order to secure it recognition. This reaffirmation of the principal bulwark of honest nomenclature should serve as a hint to the American Ornithologists' Union to revise their somewhat ambiguous utterances on this subject; which savor more of the antiquarian than of the scientist.

—THE Zoological Society of Philadelphia has recently added some rare animals to its collection. The wolverine has been very seldom seen in confinement, and the possession of two specimens is a piece of good fortune on which the Society and superintendent are to be congratulated. The greatest novelties known have been in the department of reptiles, where a number of rare species from Florida and Arizona have been exhibited for the first time. Two new species have been received, and have been described by Superintendent Brown. They are the *Eutænia nigrilateralis*, from Arizona, and a new genus of Calamarian snakes from Florida. The latter is the most noteworthy addition which has been made to North American herpetology for several years.

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RECENT LITERATURE.

Lapparent's Course in Mineralogy,[1] second edition, is a valuable book to any one interested in the more theoretical method of discussing crystallography and mineralogy. By far the most interesting portions of the volume are those relating to crystallography and physical mineralogy. The first part is concerned with a discussion of the general principles of symmetry, and the development of the different crystallographic systems. The method of treatment is philosophical and clear. More emphasis is placed on the general laws governing crystallization than is usually the case in text-books of this class. The clear explanations of the relations of the different systems to each other, and of the development of these in accordance with the general law of symmetry, are, however, rendered somewhat obscure to the non-French reader by the use throughout the volume of the Lévy system of crystallographic notation, without the least reference in the text to the corresponding Naumann or Miller notation. That portion of the book devoted to the physical properties of minerals treats — 1, of the general laws governing the propagation of light; 2, those governing polarization and interference of light; 3, the mechanical, electric and thermal properties of crystals; 4, the grouping of crystals; 5, isomorphism and polymorphism; and 6, crystallogenesis. This second portion of the treatise is no less philosophical than is the first part. Many of the obscure points in physical mineralogy, merely touched upon or left unnoticed in most text-books, are treated here with as much fulness as could reasonably be expected. The importance attached by the author to the subject of mineralogical physics may be deduced from the fact that 140 of the 647 pages of the volume are occupied in its treatment, while 200 contain the morphological discussion, leaving 260 to include the description of mineral species, etc. The third portion of the work, that treating of the mineral species, is by no means as satisfactory as the first two parts. The description of the species are not sufficiently full, nor are the figures of crystals as good as they might be. On the other hand, the axial ratio of each species has been recalculated, and the results of recent measurements have been incorporated in the text. Quite a good deal of space is also devoted to the microscopic characters of many of the species, so

[1] A. de Lapparent; Cours de Mineralogie, 2d ed. 598 ills. 1 pl. 647 pp. Paris, 1890.

that, on the whole, the "Cours de Mineralogie" is better adapted to the wants of the well-rounded mineralogist than any other single book published. A table showing the relations between the crystallographic symbols of Lévy, Miller, Naumann and Dana, and an index of thirty-five pages, complete the volume. Before concluding this notice, it should be mentioned that the author finds no existing method of mineral classification satisfactory to himself. He divides the minerals into four groups, as follows: 1, the elements of rocks; 2, the elements of mineral deposits; 3, metallic minerals, and 4, combustible minerals; and uses this classification as the basis of the *systematic* portion of his book.

Lévy's Structures et Classification des Roches Eruptives.—Lévy's small volume[2] on the classification and structure of rocks is so entirely argumentative that no satisfactory analysis of it can be given in these pages. It is directed against Professor Rosenbusch's classification. Many instances are cited to show that the principles of this latter classification, when pushed to their legitimate consequences, must lead to the grouping together of rocks that have little similarity to each other, while, on the other hand, many that are evidently closely connected genetically must be widely separated in different groups. Lévy calls for a purely petrographical classification of rocks, independent of geological considerations. The author's cause would have appeared much stronger had his arguments been less sprinkled with claims to priority over Rosenbusch in the proposal of terms descriptive of rock structure. The book merits close study as an appeal to petrographers to cut loose from theoretical considerations, and to make their classifications, for the present at least, expressions of observed facts.

Thomas's Ohio Mounds.[3]—In these two papers Dr. Thomas continues to maintain his thesis, already noted in our pages, that the earthworks of Ohio were built by the ancestors of the Red Indians of historic time. In the second of the two papers, the Cherokees are shown to have been mound-builders since the advent of the whites; and our author tries to trace them northward, connecting them with the monuments in West Virginia (near Charleston), and also with the traditional Tallegwi. To this end the Walum olam is invoked to show

[2] M. Levy; Structures et Classification des Roches Eruptives. 95 pp. Paris, 1889.

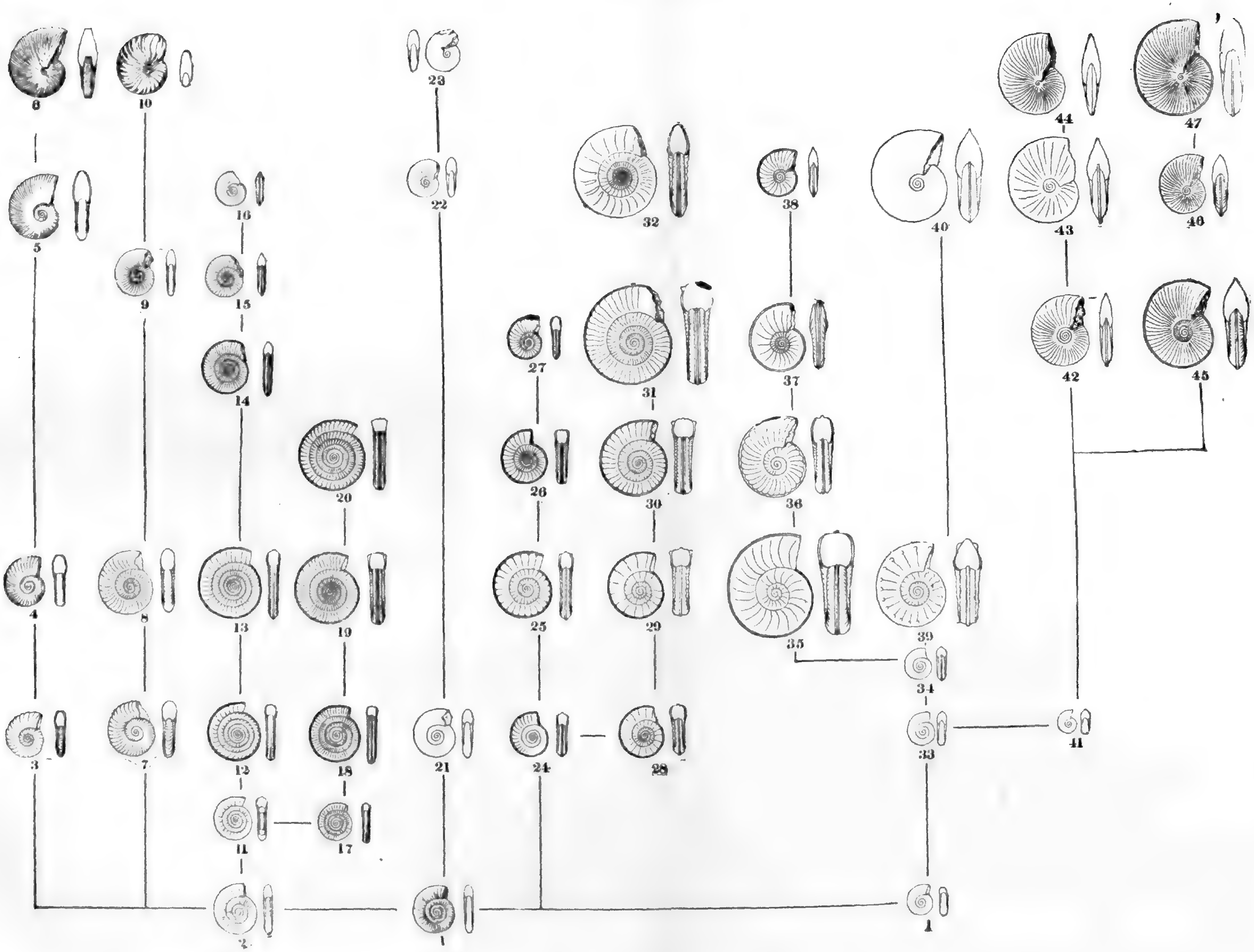
[3] Thomas, Cyrus: The Circular, Square and Octagonal Earthworks, of Ohio. Pp. 33 +iii. The Problems of the Ohio Mounds. Pp. 33 +ii. Washington Bureau of Ethnology, 1889.

that the Tallegwi formerly occupied Ohio, and were thence driven south by Huron-Iroquois and Lenapé. (We wish this bark record did not depend on Rafinesque for its authenticity.) While willing to agree with Dr. Thomas that the Cherokees have been mound-builders, we are not ready to admit that he has proved that they were the sole mound-builders, nor that he has connected them beyond a doubt with the Tallegwi, although we admit that there is a syllabic, rhythmic and vocal correspondence between the latter and the name Chellakee. In the second paper Thomas points out some of the errors of measurement in regard to the surveys of Squier and Davis' great work, besides giving accurate surveys made by the Bureau of Ethnology. "Accurate surveys," by the way, are rather amusing concoctions. We have seen a compilation of "accurate surveys" of the great Serpent Mound, the largest of which was nearly double the smallest, while two made the same week, varied about two hundred feet.

Pilling's Bibliographies.[1]—In these, as in the previously-issued Eskimo and Siouan lists, the Bureau of Ethnology has made a valuable contribution, not only for the student of American linguistics, but for those in other lines of American anthropology. The evident care bestowed upon them, the references to libraries where copies of the rarer works may be found, and the abundant bibliographical notes, make the series indispensable for all who wish to *know* something of the American Indian. To review such works is impossible; to point out omissions, or typographical errors, is but cheap criticism, but to call attention of those interested to the existence of such works is to do them a favor.

[1] Pilling, J. C.: Bibliography of the Muskhogean Languages. Pp. 114. Bibliography of the Iroquoian Languages. Pp. 208. Bureau of Ethnology: Washington, 1889.

PLATE XIX.



PHYLOGENY OF ARIETIDAE.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Genesis of the Arietidae.—This important memoir, by Prof. A. Hyatt, is the result of an effort to find a real demonstration of the theory of evolution. The methods of analysis used show the origin and rise of the ten series of species from one variety of one species, *Psiloceras planorbe*, the *Ammonites planorbis* Sow., and *Ammonites psilonotus* of Quenstedt. There are two varieties of this species, one smooth and one plicated. The smooth variety is the oldest in point of time of occurrence, and the development of the plicated variety, as well as its more recent station in time, show that it is a descendant of the smooth variety. The smooth variety is the ancestor of a series in which the forms become more involute and have more complicated sutures, but are smooth and have no keels, so that they may be accurately said to belong to the same genus, Psiloceras, as their smooth ancestor. This is pictured in Summary Plate XIV. as the central stock. On the right of this six series or genera are arranged, showing how these sprang, either directly or indirectly, from the same smooth variety of *Psil. planorbe.* On the left of the central stock or genus Psiloceras, four series are represented so as to show how these arose from the plicated variety of *Psil. planorbe.* Each series is in each case described as a distinct genus,—in fact the idea of the genus is founded upon its separability as a series of species branching off from the main stock or radical form. The last allusion to a cycle is due to the fact as shown in the Summary Plate XIV. that in each of the series there is a similar succession of forms. The forms from which each series arose were discoidal or open shells, with rounded whorls showing the internal coils plainly. As each series of forms was evolved from central stock or radical form in diverging lines like the spokes of a fan, each produced with curious iteration quadragonal whorls with keels and channels, or one or the other of these, along the periphery, and became covered with ribs on the sides. After this the successive species in each series became more and more involute in eight out of the eleven series; they lost their keels and channels, and their whorls became compressed, the abdomens at the same time tending to become acute. Thus the series of species, although diverging very much as compared with the smooth discoidal shell of *Psil. planorbe*, they were in reality parallel to each other, that is to say each went through with a similar cycle of changes; the discoidal smooth whorl became quadragonal, and acquired keel, channels, and ribs in the species representing the acme of their progress, while after the acmatic period of the species there was a tendency to produce shell, having more involute compressed and acute whorls. Throughout all of these, however, in each series a few characteristics were acquired and transmitted by which each series might be distinguished from its allied series,

Another result is that the whole of the group of the Arietidae arose and died out within the limits of the Lower Lias, and that there are three grand faunas, the earlier, the central, and the latest in time, these three agreeing in their general characteristics with the development and decline of the individual and with the cycle shown by each series. Thus the earliest faunas are everywhere composed in the mass of simple discoidal forms, the central of still discoidal shells, but these have keels, channels, and ribs; the latest faunas are characterized by the prevalence of involute, compressed, and often smooth shells. The method of classification was the result of practical work during which the young, adolescent, adult, and old age stages of many of the species mentioned, and in most of these species all of their known varieties were studied, these observations were correlated in all directions with the observed difference and resemblance of the species. Thus the characteristics of the young and adolescent stages were compared with the adult characteristics of the ancestral forms in each series, and the characteristics of the old age of each form with those of the descendants in the same series whenever they exhibited any similar degradational characters, which was the case in nearly all series. After the series had been established by this process, succession and relation of the forms was compared with their actual succession in the rocks, and the results showed agreement in every series, except where a series, as sometimes happened, occurred altogether on the same level. In order that the evidence could be judged by the reader, lists of names of species and their level of occurrence have been given in six different tables from five different basins in Europe. It was found while following out this last investigation that in some localities new forms had arisen, and that others had received their Ammonitic population wholly or in large part by migration. The former, which were called aldainic basins, are in strong contrast with the analdainic or unproductive basins. It was found that the aldainic basins formed a band running westward, beginning in the region of the Northeastern Alps, and that north and south of this band the basins were unproductive or analdainic. Among the aldainic basins, that of the Northeastern Alps showed by far the most ancient fauna, and all those in the aldainic zone to the westward exhibited less of the primitive or radical Psiloceran forms. Thus it is shown that even taking the minute sub-divisions of the Lower Lias, those heretofore supposed to be of the same age, by studying the life histories of the species and following out their genesis, it may be shown that they belong really to a successive series whose relations in time can be determined by the relations of their faunas.

This memoir is issued in one of the volumes of the Smithsonian Contributions to Knowledge, and also in the series of the memoirs of the Museum of Comparative Zoology, Cambridge, Mass. It is illustrated by fourteen plates, four of which are arranged phylogenetically. Plate XIV. is here reproduced as Plate No. XIX.

Explanation of Plate No. XIX.

The three preceding plates do not illustrate the biological relations of the Arietidæ as a whole with sufficient clearness, and this plate has been added for the purpose of supplying the deficiency. The series of Psiloceras has been placed in what may be deemed its true position, between the plicatus stock and the levis stock; otherwise, the arrangement is the same. The resemblances of the morphological equivalents in each series can be readily seen by following the forms along horizontal lines from left to right. The independence of the origin of these representative forms can be studied by following up the series in vertical lines, which represent descent. To a large extent, also, the more obvious differential characters which distinguish each series become appreciable by the same process.

Psil. planorbe, var. *leve*, Fig. 1; var. *plicata*, Fig. 2.

Schlot. catenata, Fig. 3, is the radical of this series.

Schlot. angulata, Fig. 4, is evidently a transition to the next species.

Schlot. charmassei, Fig. 5. The whorl is more involute, but the degenerate characters of compression in the whorls and shallowing of the abdominal channel begin to appear.

Schlot. boucaultiana, Fig. 6. The involution has attained its maximum, and the degeneration of the pilæ and channel is well marked.

Wæh. curviornatum (sp. Wäh.), Fig. 7, is undoubtedly distinct from *Schlot. angulata*, and is one of the radicals of this series.

Wæh. haploptychum (sp. Wäh.), Fig. 8.

Wæh. toxophorum (sp. Wäh.), Fig. 9, is a degenerate shell, having compressed whorls, and pilæ crossing the abdomen, as in the proximate radical *Wæh. curviornatum*. It is, however, more involute.

Wæh. emmerichi (sp. Wäh.), Fig. 10, shows a notably involute shell, with degenerate pilæ and compressed whorls.

Cal. tortile, Fig. 11, is the radical of this series.

Cal. carusense, Fig. 12, has similar young to that of *tortile* below.

Cal. nodotianum, Fig. 13, is very similar to *carusense*, but with more compressed whorls and better developed pilæ.

Cal. cycloides (sp. Wäh.), Fig. 14, shows compressed degenerate whorls.

Cal. castagnolai (sp. Wäh.), Fig. 15, is more degenerate than the last, but slightly more involute.

Cal. abnormilobatum (sp. Wäh.), Fig. 16, is a dwarfish and more degenerate form than *Castagnolai*, but has more involute whorls.

Cal. laqueum, Fig. 17, is an extreme form of this species, which approximates very closely to a true *spiratissimum*. This figure is therefore placed to the right, and under *Verm. spiratissimum*.

Verm. spiratissimum, Fig. 18, shows typical form, with but slight channels.

Verm. conybeari, Fig. 19, shows normal untuberculated variety, with stout whorls and deep channels.

Verm. ophiodes, Fig. 20, exhibits the tuberculated pilæ of this species.

Psil. aphanoptychum (sp. Wah.), Fig. 21, is one of the Plicatus stock of Psiloceras.

Psil. kammerkarense (sp. Wäh.), Fig. 22, shows the more involute and plicated form of this subseries.

Psil. mesogenous (sp. Wäh.), Fig. 23, is an involute shell belonging to the true Levis stock.[1]

Arn. semicostatum, Fig. 24. The figure represents the nearly full-grown shell; but if the keel were absent, the smooth whorls of the young would closely resemble the adult whorls of *Psil. planorbe*, var. *leve*.

Arn. hartmanni, Fig. 24, exhibits young and adult characters like those of the preceding.

Arn. tardecrescens, Fig. 26, belongs to another subseries of forms than that in which it is placed, but it serves to show that quadragonal whorled shells with channeled abdomens existed in this genus.

Arn. bodleyi, Fig. 27, shows a slightly degenerate compressed whorl, and is the terminal form of the subseries containing *Hartmanni*.

Arn. kridioides. Fig. 28 gives a view of the transition between Arnioceras and the lowest species of Coroniceras. The smooth young straight pilæ and divergent side of the adult whorl are clearly shown.

Cor. sauzeanum. Fig. 29 shows the later nealogic and ephebolic stages, having the peculiar divergent sides, flattened abdomen, and prominent

[1] Two subseries ought to have been shown here, but in trying to reduce the size of the plate the forms have been placed in the same line. A similar liberty has been taken with the subseries of Caloceras and Arnioceras, but this does not interfere with the truthful presentation of the general zoölogical relations of the forms.

tubercles of a typical coroniceran form. The young, however, still retain the smooth aspect, indicating derivation from Arnioceras.

Cor. rotiforme. Fig. 30 represents a form similar to *Cor. coronaries.*

Cor. lyra, Fig. 1. This is as a rule much smaller than *rotiforme.* The sides are more convergent, and the whorl more compressed and less numerous than in that species.

Cor. trigonatum, Fig. 32, exhibits the effects of the premature development of old age characters. Fig. 1 on the extreme right shows the dwarfed form of *Psil. planorbe,* var. *leve,* from which both the arnioceran as well as the agassiceran series may have been derived in Central Europe.

Agas. lævigatum. Fig. 33 shows the more compressed variety of this species.

Agas. striaries, Fig. 34. The striations were too fine to be represented.

Ast. obtusum. Fig. 2 shows the stouter variety with well marked channels with stout gibbous whorls and broad abdomen. This has young almost identical with the adults of the stout varieties of *Agas. lævigatum.*

Ast. turneri. Fig. 36 shows typical variety, with flattened sides and deep channels. It is notable more involute than *obtusum.*

Ast. brooki. Fig. 37 shows an extreme involute variety of this species, with very convergent sides and narrow abdomen. The channels are almost obliterated, and the keel very prominent.

Ast. collenoti. Fig. 38 gives a view of this remarkable dwarfed form, in which degeneration of the pilæ and the channels and convergence of the sides have produced morphological equivalence with *Oxyn. oxynotum* and *guibali.* The amount of the involution is greater than in any preceding species of the same series.

Agas. scipionianum. Fig. 39 shows the stouter, heavily tuberculated variety, which has young almost identical with the stouter varieties of *Agas. striaries.*

Agas scipionis. Fig. 40 shows an aged specimen in the Museum of Comparative Zoology, with extreme involute whorls, but keel still prominent. The degeneration of the adult as regards the pilæ and form can, however, be inferred from this figure. The old of *Scipionianum* at the same age is much less changed, and does not exhibit increased involution of the whorls.

Oxyn. oxynotum, Figs. 41, 42. The first figure shows the young of a variety in which at an early stage there is close likeness to the young of *Agas. striaries,* and the adults of *Agas. lævigatum.*

Oxyn. simpsoni. Fig. 43 shows the stouter form and slightly greater involution of the whorls in this species when compared with *oxynotum.*

Oxyn lymense. Fig. 44 shows the greater involution of whorls as compared with any preceding form of the same subseries, and the very acute degenerate whorl.

Oxyn. greenoughi. Fig. 45 shows the stout form of the whorls better defined, and pilæ of this subseries as compared with the *oxynotum* subseries.

Oxyn. lotharingum. Fig. 46 shows the smaller size of this species, and the degeneration of the pilæ. The involution of the whorls is, however, greater than in any preceding species.[2]

Oxyn. oppeli. Fig. 47 shows the extremely involute form of the Middle Lias. The stout whorls indicate that no great amount of degeneration had taken place. It may have been a direct descendant of *greenoughi.*

The Age of the Gay Head Bluffs at Martha's Vineyard.— At the last annual meeting of the Geological Society of America, Mr. Lester F. Ward remarked: "My principal object in coming to this meeting was to listen to this paper, as I was associated with Mr. White in his work and am deeply interested in it.

"I desire merely to emphasize the great importance of the results at which he has arrived. Not until the past season has anything definite been known of the fossil flora of Martha's Vineyard, the few fragments figured by Hitchcock not having been determined, and having no geognostic value. As Mr. White has remarked, the ablest geologists in the country have long been at work upon the question of the age of the Gay Head beds, and, as shown by the older as well as by recent papers, especially those of Professor Shaler, great differences of opinion and doubt as to their age have prevailed.

"The discovery by Mr. White of undoubted Cretaceous fossil plants has settled that question as far as the particular strata from which these plants were found are concerned. In all his recent papers, including the one read before the Society on Thursday last (pp. 443–452), Professor Shaler has insisted that all except the very base of the Gay Head section is Tertiary and even Miocene or Pliocene.

"I do not pretend that the entire section at Gay Head and Nashaauitsa cliff is necessarily Cretaceous. The plants were found in the Gay Head section near the middle, and it is very possible that, considering the extent of the beds and the length of the section the overlaying strata may be Tertiary, even Miocene. But if if there is a great thickness lying above these beds, so there is a great thickness lying beneath them, and therefore the section must extend far down into the Cretaceous. It would seem then that Mr. White's investigations during one short season have done more to settle the age of these beds than all that has been done before.

[2] The extreme old age of this form is marked by decrease in the amount of involution of the whorl, and also by the loss of the prominent hollow keel.

"I gladly testify to the indefatigable zeal with which Mr White pursued his investigations against the greatest difficulties and discouragements. It required much careful thought and labor to ascertain in what particular manner the plants were preserved; but after this had been fully settled he was very successful in finding them, although they were not abundant; and he persisted until his collection amounted to five barrels of very excellent material, which is being elaborated at the National Museum."

F. J. H. Merrill said: "It is seldom that an opportunity is afforded for determining the true stratigraphy of the Gay Head section. The speaker visited it in 1884, and concluded as a result of his examination that the beds were extensively repeated by faulting; but on visiting the locality in 1887, with Professor N. S. Shaler, he found the aspect of the section so much altered by landslides that he was unable to show the evidence upon which he had based his conclusion. Subsequent exposures have again revealed the truth as reported by Professor Shaler at this meeting (*ante*, pp. 443–452). During his first visit the writer found a number of clay-ironstone nodules enclosing fragmentary leaf-prints, which were considered by Dr. Newberry to be of Cretaceous age, but the impressions were poorly preserved and their nidus in the section was uncertain, so that no decisive value could be attached to them. Although the Cretaceous leaf-prints reported by Mr. White were undoubtedly in place, they do not prove the Cretaceous age of the whole Gay Head section. They are from the lower half of the series. The greensand beds, which are in the upper half, contain Miocene Tertiary fossils, shark teeth of the genera *Charcarodon* and *Oxyrhina*, bivalve casts, probably of *Tellina biplicata*, Say, and fragments of crustaceans. This greensand deposit is apparently secondary, having been derived from some pre-existing bed and re-deposited under conditions of disturbance and violence abnormal to greensand beds. The crustacean fragments in particular have been much rolled and wave-worn. On this evidence we may conclude that the greensand beds were laid down not earlier than the close of the Miocene.

"The opinion of the writer that the Gay Head strata were post-Pliocene was chiefly based on the evidence of a stratum of post-Pliocene sand, which is the uppermost member throughout the section, being repeated frequently by faults at one point containing fragments of *Venus mercenaria* and other Quaternary shells. As this bed is apparently comformable to those beneath it, the writer concluded that a considerable portion of the Gay Head series, if not the whole of it, was laid down in post-Pliocene time. It may be, however, that future investigation will demonstrate the presence of Cretaceous, Tertiary, and Quaternal strata at Gay Head."—*Bulletin Geol. Society of America, Vol. I.*

The Age of the Laramie.—At the meeting of the Geological Society of America, held at New York, December, 1889, Mr. Lester F. Ward remarked: "I take it that the discussion here to-day should avoid, as far as possible, repetition of the statements that have already been published. Like Dr. Newberry, I have in my hands a large amount of material, both from the typical Laramie group and from the Fort Union group, which has not been published. A few years ago, as you all probably know, I did publish a paper on the Laramie group, to which I prefixed a prefatory discussion in regard to the probable age of that group. In that discussion I admitted that there was the same lack of identity between the Fort Union fossil plants and those of the lower Laramie which Dr. Newberry has pointed out. In further investigations of this material (for at that time I had only studied a small portion of it, except in a very general way) I have not had any occasion to alter my opinion in that respect, and I am to-day prepared to say what I said then and what Dr. Newberry has said this morning, viz., that so far as the floras of the Fort Union group and of that which was originally called the Laramie beds of Colorado, Wyoming, and New Mexico are concerned, they are not identical—they are very different.

"I hazarded a possible explanation in case the geologists and animal paleontologists eventually establish the synchrony of those beds, viz., that possibly the latitude taken in connection with a different topography such as may have existed in the two regions might account for the great difference in the floras. But I also expressed the opinion that in all probability there would eventually be found a difference of age—how great it would be premature for me to say. The great difference is not so much in the species as in the general facies of the two flora. There are eight or ten identical species[1] in the Laramie and Fort Union, but these weigh very little in comparison with the more important fact that

[1] The species common to the Laramie of Colorado and Wyoming and the Fort Union group, as shown in the table of distribution given in my Synopsis of the Flora of the Laramie Group (Sixth Annual Report U. S. Geol. Survey, 1885, pp. 443-514), as follows: *Sequoia langsdorfii, Sabal campbellii, Quercus olafseni, Juglans rhamnoides, Juglans rugosa, Ficus tiliæfolia, Magnolia hilgardiana, Trapa microphylla.*

These are exclusive of several species thus far only found in the Laramie of British Columbia, one of the America areas, as also of a number of more or less doubtful cases.

in the lower Laramie—the original Laramie formation—there is a large predominance of such genera as *Ficus*, and also many palms, which, to the mind of a paleobotanist naturally and probably correctly suggest a warmer climate.

"Whatever may be true in regard to the difference of age—and it seems to me that the two must go together—I am quite satisfied that a warmer climate prevailed during the period of the deposition of the Wyoming and Colorado beds than that which prevailed during the deposition of the Fort Union beds. Among the leading genera of the upper beds are *Populus* and *Platanus*. Some of these forms are, I admit, very irregular and peculiar, but they are not found in any such abundance least, grow in the colder climates, and very few species of *Ficus*, very few in the lower beds. They are more northern forms—forms which now at genera of palms, are found, so far as my own collection is concerned, in the Fort Union beds. Moreover, as Dr. Newberry has stated, there are forms in the Fort Union which have an exceedingly recent facies, but I am very loath to argue from this a Tertiary age. For instance, there are what seem to be the leaves of the identical species of hazel which grows now in the eastern parts of the United States; yet I hesitate to argue from this that the formation is necessarily very recent.

"In fact, the material from the Fort Union formation which is still in my hands (partly for the reason that I was unable to identify it with the published flora of the globe, and partly because I was unable to publish more at that time) inclines me to believe that there would really be, as I then stated, no inconsistency in assigning to the Fort Union an age as ancient as the closing period of the Cretaceous system. Some of the facts I might enumerate here, but this would be perhaps tedious; but some of the forms are certainly not to be identified with any of the genera that have been found in the fossil or the living state. Such forms cannot be regarded as having geological importance in fixing age, yet they go a long way in the direction of showing us that the age may be more ancient than has been supposed. The genus *Trapa* has been found in both groups, but I am not thoroughly satisfied that the species are identical. In my anxiety not to multiply species, I called it by the name given to the form described by Lesquereux from the Point of Rocks beds, though it may prove to be a distinct species; yet we may never know, from the fact that the material collected by him was inadequate. I have collected from the Fort Union beds specimens of that plant containing entire rosettes of leaves as they would lie on the surface of the water, and showing to my mind that it must have belonged to the genus *Trapa* or a closely related form. The Point of Rocks material contained nothing but isolated leaves—that is to say, there were no rosettes and there were no stems —simply the form and nervation of the leaves. These point to the genus *Trapa,* and the probability is that they belong to that genus.

"The evidence afforded by the beds at Black Butte station, where the great saurian was discovered by Professor Cope, is perfectly conclusive of the identity of the age of the beds from which that fossil was taken with that from which the leaves of that particular locality were taken. We have at the National museum a specimen of the bone from that creature, adhering to the opposite side of which is one of the characteristic Laramie leaves. I have been on this spot, and collected other fossil plants from the same immediate locality.

"Now, with regard to the error, if error there be, in harmonizing or identifying the Laramie and Fort Union deposits: I suppose the responsibility for this must largely rest upon Dr. C. A. White, who has made a very thorough and exhaustive study of the entire region, as he defines it from the standpoint of its molluscan fauna; and it seems to me that his identification of the two groups—and I have conversed with him very freely and very much upon this subject, and what I say is from memory of the oral statements made by him—was in the nature of a broad, geological generalization. He, in his extensive labors in that field, simply came upon the salient fact, that throughout the larger part of the region now occupied by the Rocky Mountains is abundant evidence that there existed at a remote period, somewhere near the close of the Cretaceous or beginning of the Tertiary period, a great land-locked sea, originally somewhat salt, later brackish, and finally nearly fresh; and that the deposits which were made at the bottom of the sea are apparently continuous all the way up from the pure marine deposits of the upper Fox Hills group to the highest of Fort Union deposits; and he even ventures to say he has traced it in some places still higher into strata which are admitted to be Tertiary.

"I have one fact of my own observations which may be worth stating, and which may not be known to all. About 15 miles above the town of Glendive, on the right bank of the lower Yellowstone river, there is a cliff, known as Iron bluff, which is colored very bright red from having the carbonaceous matter burned out, and which is full of fossil plants. It is also full of the characteristic Laramie shells, such as Dr. White has described and has daily met with throughout the Laramie series. These shells, he informs me, are identical all the way through the Laramie from bottom to top. There is nothing to indicate that there is any difference in the age, so far as the indication from the shells is concerned. This bluff is right on the bank of the Yellowstone river, and the railroad cuts through it, which makes the cliff there conspicuous. Immediately below there is a short anticline, apparently a little island about a mile in extent, filled with characteristic Fox Hills Cretaceous fossils. I have been on the ground and collected large numbers of them, and everywhere we meet with them: the wheels of the wagon as one drives over them crush the shells, so abundant are they; and there is do doubt that this is a typical Fox Hills bed, in Dr. White's understanding of the term "Fox Hills." Now, as far as I can tell, and so far as he could tell from a careful study of the ground, this Iron bluff deposit—this Laramie or Fort Union leaf-bed—rests directly and immediately upon the Fox Hills bed. If there is any difference of age there is no indication at that point that it has been wanting from lack of comformity or from any other cause; and it is certainly a very natural conclusion that when one deposit rests comformably upon another at one point, and when at another point two formations, the lower one being the same as in the first case, have the same order and arrangement, the age of the overlying beds in both regions is the same. That seems to be as clear a case of geological reasoning as we have.

"I observe that our friends across the border, of whom we have representatives here, are still using the term Laramie for this formation. It seems to me that the bulk of their Laramie is nothing more or less than our Fort Union, and they seem to be somewhat in doubt (at least so I learn from reading a paper which reached me only a day or two before I left Washington, with a Christmas greeting from Sir William Dawson); and I do not know but that we might as well settle the question in the way he has settled it in that paper as in any other way. He simply says that the time may yet come when, in fixing our arbitrary position for the line between the Cretaceous and the Tertiary, we may be obliged to draw it through that continuous deposit which we call the Laramie group.

"Dr. Newberry's memory is entirely at fault when he says that in my "Synopsis" I called the Laramie and Fort Union group Tertiary. I have been criticised for arguing that they are Cretaceous. As a matmer of fact, I did not call them the one or the other, or argue for either view. I first gave a perfectly unbiased review of opinion, in which the advocates of each view were allowed to state their case in their own words. I then did what had never before been done. I presented the evidence from the fossil plants upon both sides in tabular form, getting together for the first time a fairly complete list of all the upper Cretaceous species the existence of which had generally been ignored in the discussion of the question. These as well as the Eocene species of all parts of the world were directly compared with the Laramie species. The very careful analysis of this table which I made showed that the Laramie flora occupies an intermediate place between that of the upper Cretaceous (above the Dakota group and Cenomanian) and that of the Eocene. The only conclusion I drew, if conclusion it can be called, was that the whole discussion was a war of words, often unworthy of the talent that had been expended upon it."

PROF. J. J. STEVENSON said: "I should like to say a word or two about the section that Dr. Newberry has put on the board. The statement that the Colorado group cannot be differentiated in Colorado is not altogether correct. It is true that in a considerable area beyond the Arkansas range it is a very difficult thing indeed to differentiate the Colorado group; but along the plain in front of the Rocky Mountains in Colorado and New Mexico there is not the slightest difficulty in recognizing the Fort Brenton as a mass of black shale; the Niobrara above that, gray to blue limestones separated by black shale; then the Fort Pierre, drab to yellow sandy shales, containing nodules of limestone and iron ore, while above that and quite easily separable from it we find in northern and central Colorado the Fox Hills group. This is the Cretaceous along the waters of the South Platte, where the Fox Hills group is characterized all the way, from the bottom to the top, by a nodose fucoid, *Halymenites major*, which was at one time a very interesting topic of discussion. The Fox Hills group in central Colorado is upwards of one thousand feet thick, consisting mostly of sandstones, some of them calcareous and rich in Fox Hills fossils, with some beds of coal, which have been opened in the neighborhood of Greely. At Cañon City, Colorado, the Fox Hills group is only about 250 feet thick, that being the vertical extent of the *Halymenites*. In that interval are the important coal beds and numerous sandstones or shales containing plants which doubtless answer to those of the plant bed which I found on one occasion near Evans, on the South Platte, but which I could never find again. Further southward, near Trinidad, Colorado, the Fox Hills is only 80 feet thick, that being the vertical range of the *Halymenites*. In that field, however, the Fox Hills has been included in the Laramie; but the Laramie group above the great coal-bearing series is easily separable from the *Halymenites* sandstone. Southward, in New Mexico, the *Halymenites* or Fox Hills sandstone entirely disappears.

"The point I wish to make is that the upper Missouri section of the Cretaceous is distinctly recognizable as far south as central Colorado. Beyond that southward the Fox Hills thins out until it disappears in New Mexico, but the other members of this section can be recognized without any difficulty in front of the Rocky Mountains and around their southern end to the Rio Grande."

PROF. E. D. COPE said: "It seems to become more complicated the more we investigate, and a greater number of problems arise to be solved. What Professor Stevenson has just stated is established. I can demonstrate from my own observation what Dr. Hayden has stated —that is, the conformity of the four or five gradations with the Laramie above. There seems to be absolutely no disturbance or want of conformity in the upper Missouri between those three horizons. I could get the Pierre fossils in the bottom of the bluff and Fox Hills in the middle and Laramie at the top. On the question of the Laramie's position in the Cretaceous or Tertiary series the vertebrate fossils throw some light. The reptiles and saurians are Cretaceous. I have discovered in New Mexico the Puerco series just above the Laramie, and in that I have about a hundred species of the mammalia. I have also discovered mammalia in the Laramie. Professor Marsh has added some species to those previously known. These species are of identical character with the Puerco mammals, although there is no species identical with any in the Puerco, where there is not a single Cretaceous reptile. The mammals of the Laramie are, like the saurians, rather Cretaceous than Tertiary; but the character is not so pronounced."—*Bulletin Geol. Soc. Amer., Vol. I.*

Prof. Marsh on Hallopus and other Dinosaurs.—In the May number of the *American Journal of Science* a paper is published by Prof. Marsh, entitled, "Distinctive Characters of the Order Hallopoda." The conclusions which I have reached, after a study of the type specimen, do not agree at all with those of the Professor. I cannot find sufficient evidence for the correctness of the following statements:

1. "There were but four digits in the manus, the first being short and stout, and the other slender."

2. "The fibula was slender and complete, but tapered much from above downward. Its position was not in front of the tibia below, as in all known Dinosaurs, but its lower extremity was outside, and apparently somewhat behind, the tibia."

3. "The calcaneum is compressed transversely, and much produced backward. It . . . strongly resembles the corresponding bone in some mammals."

There is no definite proof that the bone called "calcaneum" represents this element, or that the first digit of the hind-limb was entirely wanting.

Hallopus is a true carnivorous Dinosaur, near to Compsognathus, there can be little doubt. This opinion was expressed already by Prof. Williston in 1878, in a paper published in a Journal of the Kansas Academy of Science, the title of which I cannot give at this moment.

In the following paper a new order of Dinosaurs, "Ceratopsia," is created. *Ceratops* Marsh, 1889, is the same as *Monoclonius* Cope, 1876. This I can state with absolute certainty, having examined the types of Ceratops and Monoclonius. Neither "Ceratopsidæ" nor "Ceratopsia" can be adopted on this reason. The so-called "Ceratopsia" are characterized by Professor Marsh in the following way:

"(1), The skull surmounted by massive horn-cores; (2), a rostral bone forming a sharp, cutting beak; (3), the teeth with two distinct roots; (4), The anterior cervical vertebræ coössified with each other; (5), the pubis projecting in front, and no post-pubis."

To this I have to make the following remarks:

1. The skull of Phrynosoma is surmounted by stout horn-cores, but nobody will place it on that account in a separate order. On the same reason the horned members of the Cervidæ could be placed in a different order from the hornless forms.

2. Some of the pigs and edentates have a peculiar bone in front of the nose, not present in other mammals, but nobody places these forms in a separate order on this account.

3. If the teeth would really have two distinct true roots, as Prof. Marsh states, this perhaps would be of ordinal character, but I do not believe it. These "two roots" are probably produced by splitting of the tooth by the young one following.

4. In Buceros among birds, also in some of the Plesiosauria and Ichthyosauria, the first two vertebræ are firmly coössified; are they placed in separate orders therefore?

5. "The pubis projecting in front, and no post-pubis." Everybody knows to-day that what is called by Prof. Marsh the pubis is the pectineal process, and that his post-pubis is the true pubis. The statement that there is no post-pubis I do not believe before it has been demonstrated that the bone called pubis by Prof. Marsh and repre-

sented complete, is really complete. I doubt it, and believe that there was a "post-pubis," which is simply broken away in the specimen.—GEORGE BAUR, Ph.D. *New York, May 7th, 1890.*

[NOTE ON THE ABOVE.—The "two-rooted teeth" described by Prof. Marsh, and referred to above by Dr. Baur, are not such in point of fact. The appearance of two roots is produced by the absorption of the middle part of a single root by the crown of the successional young tooth. After the absorption has progressed sufficiently far, the less direct of the two branches is generally broken off, so that teeth with both preserved are less abundant than those with a single half-root. Teeth of this kind were figured by Leidy as belonging to Trachodon, and were described by me as representing the new genus Dysganus in the Proceedings of the Philadelphia Academy for 1876. They are very abundant in the Laramie formation.—E. D. COPE.]

Extinct Quadrumana.—Professor Gaudry has published in the new Memoirs of the Geological Society of France an interesting paper on the *Dryopithecus fontanii* Lartet, of which a new mandible has been recently discovered in France. This mandible is more perfect than any hitherto obtained, as it has the symphysis with the incisor teeth, and all the molars except the last of one side. Prof. Lartet supposed that the genus Dryopithecus approached nearer to Homo than any of the existing apes, on account of the probable later appearance of the m^3 (wisdom tooth) than in the latter. Prof. Gaudry's specimen shows that the symphysis is longer than in any of the existing anthropoids, and that the anterior premolar is relatively larger. Its relationships are therefore not towards Homo, but away from him, and towards the true monkeys. The last inferior molar was evidently erupted at about the same time as the inferior canine, and not before it, as in many monkeys; but Gaudry shows that in several monkeys and apes the period of protrusion of the m^3 is the same as that seen in the Dryopithecus. The latter is nearer to the gorilla in dentition than to either the orang or chimpanzee. It was smaller than either.

Under the name of *Dolichopithecus ruscinensis*, M. Charles Deperet describes in the *Comptes Rendus*, a species of monkey, of which a skull was found by Dr. Bonneman near to Perpignan, together with numerous other bones. The dentition is in general that of Macacus, but the limbs have the slender proportions of those of the Semnopithecus. The genus is then close to the Mesopithecus of Gaudry, from which, indeed, M. Deperet does not satisfactorily separate it. It differs from the *M. pentelici* by its larger size, larger face, and larger heel of the last inferior molar. The monkey of the Val d' Arno, *Aulaxinus florentinus,* is still smaller, and has a much shorter muzzle.

MINERALOGY AND PETROGRAPHY[1]

Mineralogical News.—The long expected monograph by Brögger[2] on the minerals of the syenite-pegmatite veins of the augite syenite and nepheline syenite region of Southern Norway has at last made its appearance. The special part of the volume, which describes in great detail seventy mineral species, is prefixed by an introduction of 235 pages, in which the geology of the region is discussed and the eruptive nature of the pegmatite veins is proved. An abstract of this portion of the work will be given in another place. Of the seventy mineral species recognized in the veins five are of sulphides, one is a sulpho-salt, three are oxides, three are hydroxides, one is a haloid compound, one a ferrate, two are borates, two phosphates, two are members of the zircon group, three belong to the epidote group, two to the group of the datholites, three to the garnets, three to the micas, two to the nepheline group, two to the leucophanes, seven to the pyroxenes, four to the hornblendes, four are members of the melanocerite group, three are feldspars, seven are zeolites, and nine others are various silicates. The only carbonate detected, beside two fluo-carbonates, is calcite. It is evidently impossible to mention even all of the important discoveries made by the author in his studies of the wonderful suite of specimens collected by him. We can only refer briefly to the most important of them. Measurements of *löllingite* yielded $a : b : c = 6689 : 1 : 1.2331$. Tabular crystals of *hydrargillite* gave $a : b : c = 1.7089 : 1 : 1.9184$; $\beta = 85° 29' 10''$. These are occasionally untwinned, but more frequently twinned forms are found in which the twinning planes are ∞P (corresponding to DesCloizeaux twins par. $\infty \bar{P} \infty$), $\infty \bar{P} \infty$ (occasionally), $\frac{1}{18} P_{\bar{3}}$ (?), and oP; and a fifth form in which the twinning plane is perpendicular to oP. Optically, plates of the mineral act uniaxially. *Xenotime*, while containing many elements, yielded upon analysis figures that may be reduced to correspond to the formula $Y_2 (PO_4)_2$ An examination of thin sections of *orthite* (*allanite*) shows its extinction in $\infty P \infty$ to vary between 37½° and 28½° in acute β. The plane of the optical axes is perpendicular to $\infty \grave{P} \infty$, and the double refraction is negative. Analysis of carefully purified *homilite* gave:

SiO_2	Al_2O_3	Fe_2O_3	Ce_2O_3	B_2O_3	FeO	CaO	Na_2O	H_2O
31.83	2.72	.88	.24	16.51	16.74	29.54	.75	.79

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. f. Krystall.*, XVI. Specialler Theil, 664 pp., XXVII. Pl.

Single crystals are described, and twins following four twinning laws are well illustrated in the plates. The optical properties of the mineral are briefly sketched. Several varieties of ***garnet*** are mentioned, two analyses of which are worth recording. The black-green garnet of Stokö and the yttrium garnet of the same localiy contain resectively:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	Y_2O_3	MnO	MgO	CaO	Na_2O	H_2O
34.90		8.97	20.43			2.40	tr.	31.38		1.27
31.51	3.52	2.01	26.68	2.15	.38		.38	30.78	.79	.43

Nordenskjöldite, with an axial ratio of $a : c = 1 : .8221$, has a composition corresponding to Ca $(BO)_2$ SnO_4. ***Astrophyllite***, as the result of new measurements, is concluded to be orthorhombic with $a : b : c = 1.0098 : 1 : 4.7556$. Its fracture figure (on the perfect cleavage parallel to $\infty P \infty$) consists of two lines crossing each other at angles of about 81° and 98°, the smaller of which is bisected by the vertical axis. The gliding planes correspond very nearly to those of the dome $\frac{1}{4} P\breve{\infty}$. The axial plane is the base, with b the positive acute bisectrix. A new analysis of carefully purified material shows slight differences from the previously published analyses, and corresponds closely to the formula $R_4'' R_4'$ Ti $(SiO_4)_4$. ***Leucophane*** crystals to the number of twenty gave good enough reflections to enable Brögger to determine without difficulty their orthorhombic symmetry, $a : b : c = .9939 : 1 : .6722$. The axial plane is the macropinacoid and c is the negative acute bisectrix. $2E_{na} = 74° 15'$. ***Melinophane*** crystalizes in the tetartohedral division of the tetragonal system. Optically it is uniaxial. Chemically it differs from leucophane [Na_3 (F Be)$_3$ Ca_3 $(SiO_3)_6$] in containing more beryllium [i. e. it is $Na_2(FBe)_2$ $(Ca_2O)_2$ Be_2 $(SiO_3)_6$]. A thorough discussion of the characteristics of ***acmite*** and ***ægerine*** leads to the view that they are well marked varieties of the same pyroxene, closely related to diopside. Acmite is nearly always twinned, while ægerine is usually in simple crystals. ***Låvenite*** according to the most recent measurements has $a : b : c = 1.0963 : 1 : .7151$ and $\beta = 69° 42\frac{1}{2}'$. ***Wöhlerite*** usually occurs in twins, whose twinning plane is the orthopinacoid. When placed in the conventional position for pyroxene its axial ratio becomes $a : b : c = .9966 : 1 : .3547$ with $\beta = 89° 18' 50''$. Its absorption is $C > B = A$, and pleochroism varies between yellow and colorless shades. ***Låvenite*** and ***Wöhlerite*** are regarded as zirconium pyroxenes, closely related to the corresponding triclinic pyroxene ***hiortdahlite***. ***Polymignite*** crystals are orthorhombic, as is well known, with the axial ratio .7121 : 1 : .5121. Their hardness is 6–6.5, and density 4.77–4.85. Chemically and morphologically the mineral is closely related to *æschynite,* with which it forms a group distinct from all other natural mineralogical groups. When placed in a position corresponding to the usual one for æschynite its axial ratio becomes $a : b : c = .4681 : 1 : .7192$. Measurements of the best *arfvedsonite* crystals gave $.5496 : 1 : .2975$ as the axial ratio for this species, with $\beta = 75° 44\frac{1}{2}'$. The analysis of a large crystal yielded (after treating with acid to dissolve magnetite):

SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	Na_2O	K_2O	H_2O
49.90	2.62	32.99	.05	.57	12.88	.10	1.07

Pterolite is regarded as an alteration product of barkevikite, consisting of a mixture of lepidomelane and ægerine, and *ainigmatite* is thought to be identical with cossyrite. An optical examination of *katapleite* proves it to be monoclinic with $a : b : c = 1.7329 : 1 : 1.3618$ and $\beta = 89° 48\frac{1}{2}'$, and not hexagonal as formerly supposed, although it assumes the hexagonal symmetry when heated to 140°. Two varieties of the mineral are recognized. The first is a yellow variety to which the name katapleite is assigned, and the second a blue variety which is called *soda-katapleite.* The composition of the varieties is given as follows:

	SiO_2	ZrO_2	Al_2O_3	FeO	CaO	Na_2O	H_2O
I	41.56	32.53	1.02		5.21	9.74	9.35
II	44.04	30.94		.10	.87	14.94	9.24

Tritonite, according to Brögger, does not crystallize in the regular system, but is probably rhombohedral and hemimorphic. In this case $a : c = 1 : 1.114$. The analyses that have been published as those of *Erdmannite* are thought to be analyses of a mixture of a melanocerite mineral with a member of the homilite group. *Eukotite-titanite* is a deep brown variety of sphene, with most of the optical and crystallographic properties of this mineral, but differing from it slightly in composition, which is as follows:

SiO_2	ZrO_2	TiO_2	CeO_2.	Ce_2O_3	Y_2O_3	CaO	FeO	MgO	Na_2O	K_2O	Loss
30.22	.18	34.78	2.57		.59	24.38	3.84	.50	.86	.27	.31

The *soda-orthoclase* of Fredriksvärn turns out upon close examination to be an intergrowth of such fine lamellæ of albite and orthoclase, that upon examination with low powers of the microscope, a section of this mineral behaves as if monoclinic. Brögger calls it *cryptoperthite. Eudidymite* has been carefully examined and its properties well established. It is a monoclinic mineral, resembling in appearance heulandite. Its axial ratio is $a : b : c = 1.7107 : 1 : 1.1071$, and $\beta = 86° 14'$

27″. It occurs in tabular crystals, with a perfect cleavage parallel to the base; a hardness of 6 and a specific gravity of 2.553. The extinction in $\infty P\grave{\infty}$ is inclined $58\frac{1}{2}°$ to *c* and 27° 45′ to the clearage parallel to oP. $2V_a = 29° 55'$ for sodium light. Very exact measurements of a large number of *natrolite* crystals from Little—ar ö indicate that the mineral is monoclinic with $a : b : c = 1.0165 : 1 : 1.3599$, and $\beta = 89° 54' 52''$, and not orthorhombic as is usually assumed. The orthorhombic symmetry, which is ordinarily observed, is due to twinning parallel to the orthopinacoid. These monoclinic natrolites differ from the ordinary orthorhombic form in containing a small quantity of potassium. The extinction angle increases with the potassium content. *Bergmannite* and *brevicite* are shown by the author to be either natrolite, or mixtures of this mineral with several other substances.

New Minerals.—*Hambergite.* A single specimen of this mineral is of grayish white color, and is orthorhombic with ∞P, $\infty P\bar{\infty}$, $\infty P\breve{\infty}$ and ∞P. $a : b : c = .7988 \; 1 : .7267$, and hardness=7.5. Sp. Gr.= 2.347. Plane of the optical axes is $\infty P, \breve{\infty}$ and *c* is the acute bisectrix. 2Vna= 87°7′ (observed) or 87° 40′ (calc.). Analyses yielded: BeO=53.25%; H_2O=10.03; B_2O_3=36.72; =(HO) Be_2BO_3.——*Johnstrupite* was originally confused by Brogger with mosandrite, which it resembles in many respects. Careful observation shows its axial ratio to be $a : b : c = 1.6229 : 1 : 1.3594$. $\beta = 86° 55\frac{1}{2}'$, and the plane of its optical axis the clinopinacoid, with the positive acute bisectrix inclined $2\frac{1}{2}°$ to *c*, in which it closely resembles mosandrite. The latter mineral however is reddish brown when fresh, while johnstrupite is brownish green. That they are two distinct minerals is shown by their composition, which corresponds respectively with the formulas $(OH)_6F_2H_{12}R_4Na_2Ca_{10}Ce_2(SiO_4)_{12}$ for mosandrite, and $F_7H_2R_3 Na_8Ca_{12}Ce_2MgAl(SiO_4)_{12}$ for johnstrupite. The similarity in composition and morphological properties between these two minerals and epidote leads the author to regard them as members of same group.——*Calciothorite* is a deep reddish brown amorphous substance, with a hardness of 4.5 and a sp. gr. of 4.114. Its composition is:

SiO_2	ThO_2	Ce_2O_3	Y_2O_3	Al_2O_3	Mn_2O_3	CaO	MgO	Na_2O	H_2O
21.09	59.35	.39	.23	1.02	.73	6.93	.04	.67	9.39,

corresponding to $5ThSiO_4 \; 2[Ca_2SiO_4]$+ca. $10H_2O$.——*Hiortdahlite* is a triclinic pyroxene occurring in small, thin, tabular crystals of a yellowish or yellowish brown color Its crystallographic constants are $a : b : c = .9981 : 1 : .3537$, $\alpha = 89° 30' 57''$, $\beta = 90° 29' 6'$, $\gamma = 90° 6' 10''$. The crystals are elongated in the direction of the vertical axis, and are flattened in the direction of the macropinacoid. Like wöhlerite, nearly all hiortdahlite crystals are twinned. In the latter case the twinning plane is at right angles to the vertical axis, and the combination face is the macropinacoid. The axial angle is large. The optically positive first bisectrix is sharply inclined to the vertical axes. The extinction on the ∞ P$\bar{\infty}$ is 25° and on ∞ P$\breve{\infty}$ is about 15½°. No well marked cleavages are observed in any sections. The specific gravity is 3.235—3.267, and the composition:

SiO_2	TiO_2	ZrO	ZrF_2O	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	H_2O
31.89	1.50	2.88	22.00	.34	.94	.96	32.53	.10	6.53	.58

——*Cappelinite*, the discovery of which was announced some years ago by Brogger, occurs in hexagonal prisms with ∞ P, $\frac{1}{3}$ P and P. *a* : *c* : =1. : 1.2903. Their double refraction is negative and their composition is as follows:

SiO_2	B_2O_3	Y_2O_3	La_2O_3	CeO_2	ThO_2	BaO	CaO	Na_2O	K_2O	Loss
14.66	16.98	52.62	2.97	1.29	.80	8.29	.67	.53	.22	.61,

corresponding to the molecular combination of $R_2^{IV}(SiO_3)_2$ and $R^{IV}(BO_3)_2$. The hardness of the mineral is 6, and its specific gravity is 4.407. It is regarded as a member of the melanocerite group, to which also the following named mineral is supposed to belong. This mineral, *karyocerite*, is likewise hexagonal. Its axial ratio is 1 : 1.1845, and its specific gravity 4.295. It differs from melanocerite in containing much more cerium and thorium (CeO_2 and ThO_2). It occurs in nut-brown tables with a rhombohedral habit.——*Weibyeite* occurs in small crystals with a tetragonal habit. In form they resemble zircon, but are really orthorhombic, as their optical investigation shows, with the vertical axis that of least elasticity. *a* : *b* : *c*=.9999 : 1 : .64. It was impossible to separate the mineral from the pairsite associated with it, but an analysis of the mixture leads to the view that weibyeite corresponds in composition to the formula $[(Ce,La,Di)F]_2(CO_3)_2$.——*Barkevikite*, although long known as a variety of hornblende, has received but little attention in recent years. A new analysis shows it to have the following composition:

$TiSiO_2$	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O
42.46	11.45	6.18	19.93	.75	10.24	1.11	6.08	1.44

Although chemically not very different from arfvedsonite, its physical properties readily distinguish it from this species. The extinction is 12½ in the acute *β*, while in arfvedsonite it is in obtuse *β*.

This latter mineral is pleochroic in blue and green tints, while the former is pleochroic in brown and brownish red tints. Barkevikite is an essential constituent of the augite syenite occurring between the fjords of Christiania and Langesund.——*Spangolite* is proposed by Penfield[3] as the name for a hydrated sulphate and chloride of copper, occurring, probably, somewhere in the Globe District, Arizona. The new mineral incrusts cuprite, and is associated with azurite and atacamite (?). It is rhombohedral, with its crystals bounded by oP and a series of pyramids of the second order. The cleavage is perfect parallel to oP. Etched figures produced on the basal plane by the use of dilute acids are bounded by oP and scalenohedral faces. They are all very clear, and all have an undoubted rhombohedral symmetry. By reflected light the mineral is dark green, while by transmitted light it is light green. Pleochroism is slight. The double refraction is strong and negative, with $\omega = 1.694$, $\varepsilon = 1.641$. Hardness on oP is 2, and on the pyramidal faces 3. Specific gravity is 3.141. The average of four analyses gives:

SO_3	Cl	Al_2O_3	CuO	H_2O
10.11	4.11	6.60	59.51	20.41

corresponding to $Cu_6AlClSO_4 + 9H_2O$.

BOTANY.

Some Reasons for Varieties not soon Wearing Out.—The direct result of a union of two or more distinct protoplasmic masses, in plant life, is a condensed, inactive, and transportable condition of the life of the species, that is, a seed or spore. Among lower plants this reproductive union usually takes place in the simplest manner, and at times that are determined by unfavorable circumstances for a further continuance of the life of the species in its ordinary rapidly-growing condition. Thus the moulds form their resting spores when the prospects are that resting spores will be most needed to carry the life of the species over the approaching period of cold, drought, or lack of food supply. The uniformity of the coming and going of the seasons has its parallel in the uniformity with which the higher plants produce their annual crop of seeds. In the great struggle for life that is going on, it is perhaps true that some species have found it to their advantage to form their seed early, and long before the time when the season

[3] *Amer. Jour. Science*, May, 1890, p. 370.

of approaching winter should suggest it. It may be that such species have learned by sad experience that with them it is early seeding or none at all.

In the lowest forms of life there is not even the union of protoplasm for the formation of the inactive state. The resting spores of the Bacteria are, as far as we know, ordinary cells, the protoplasm of which is unusually protected by a thick cell wall. As we rise in the scale of plant life, the points of origin of the two protoplasmic elements become more widely separated. In the pond scums (Spirogyra) it may be that the contents of adjoining cells unite to form the zygospore. Among flowering plants this question brings in review the subject of sexual separation, as worked out in the various lines of dimorphism, dichogamy, etc., until we arrive at the diœcious plants. From the bacterium resting spores, formed out of the contents of a single cell, the two lines diverge until we find their opposite extremities separated by diœcism; a condition in which for the formation of an offspring, corresponding functionally with the primordial spore, there must be the union of a particle of protoplasm of one community of individuals (tree or herb) with another of a separate and otherwise independent community.

Another parallelism of differentiation may be seen. Among the lower forms of life there is but little variation among the units; the one reflects the other, and species are founded upon differences that are only determined by using the micrometer. The higher types show not only a greater variation in the units, but the communities made up of these have their distinct peculiarities. One white pine or maple is not like all others of its kind.

It may, perhaps, be stated as a rule that where there is the greatest separation of the sexes, within the limits of the law, there is the greatest variation, or the extreme tendency to vary. If the union is between different species, there are new lines of variability bestowed upon the offspring. If this hybrid unites with another distinct hybrid, it is easy to see that the current of tendencies is again made doubly complex, and if the offspring is able to bear the load that the law of heredity throws upon it (now a broken law), the result will be a set of plants almost as easily turned in their course as autumn leaves floating on a sluggish stream.

Reproduction by union is a deeply laid plan among the higher orders of plants. Many plants during one year prepare for its occurrence in the next. Pollen to be shed in the spring is prepared the previous autumn, and the female germ cells are also already made to receive the quickening dust. If we may judge of importance by complication of structure, the process of bringing distant particles of protoplasm together seems the leading end of many plants. If seeds fail the plant has failed. Perennial plants, and those that are easily propagated non-sexually, are less subject to the law of "union or death" that prevails among annuals and biennials.

Reproduction by union among the lower forms of life is primarily to place the species out of the jeopardy that otherwise might follow untoward circumstances, and also to facilitate its more thorough distribution. When we arrive as high in the scale as the ferns we find that the union takes place once for all in the life of the fern plant, and that the direct and immediate result is not a spore, but a plant upon which the spores are afterwards borne annually in great numbers without further fertilization. Each spore in germination produces a small, delicate scale of cells, the prothallus: one protoplasmic mass, the germ-cell of the archegonium, grows into a fern plant after it has been stimulated by the commingling with it of the male elements. Cases are on record where the fern plant has developed from the prothallus without the intervention of the antherozoids, but they are rare. A few plants may go on for many years producing crops of spores, but it is the rule that it shall not begin this life of spore-bearing until a union has taken place. In the moss the union precedes the formation of each capsule, and each capsule bears a multitude of spores. For the same number of spores it is easy to see that fewer unions are required in the moss than in the pond scum, and more than in the fern. Although this union enters into the plan of reproduction, its influence is far-reaching. Only the mathematician can write the figures representing the number of spores produced by a tropical tree fern through its long existence.

The moulds and low-water plants may rejuvenate by union upon seemingly the slightest provocation. In the moss it means much more than in the lower forms, and in the ferns it means infinitely more. As we pass beyond the cryptogams, and study the flowering plants, may it not be safe to conclude that here, where the structures in the sexual apparatus are vastly more complicated than upon the prothallus, we have results that are correspondingly more lasting? It suffices for the banyan-tree, that covers many acres, and the impulse of fertilization lasts through the lifetime of the oldest trees, which is estimated to be not less than four thousand years. Every seed that falls from the giant red-wood has its spore in the vitality stimulated by the original union. If this be not true, then we are forced to believe that the union was only serviceable, like the starch and oil in the cotyledons, for the initial growth of the seedling. Whatever view we take, the assumption holds that a union among flowering plants is more significant than with the ferns and allied cryptogams. If this assumption seems reasonable, it is not unsafe to conclude that it is not easy to limit the time that the offspring of any union may exist.

On the same basis it may be asserted that the wider the union the more vigorous the progeny, and the more certain it will be to succeed. This statement rests on a broad basis of fact. Darwin's work on "Cross and Self Fertilization in the Vegetable Kingdom" is a corroboration of the statement, that "Nature abhors continual close fertilization." If the rule be reasonable among weed plants, it will appear even more so among domestic vegetation, in so far as wideness of fertilization is concerned. Nature has but comparatively few varieties. They may take the initial step, but be crowded out, the struggle being oftentimes too fierce. Among cultivated plants the conditions are very different. The plants are removed from the intense action of the law which determines the "survival of the fittest." The weeds are the best fitted to survive, but the hoe befriends the weaker and better (for man) species. Cultivated plants, therefore, lead a life of comparative peace, and their energies are expended along the lines that the cultivator desires to follow. Variations appear, and are carefully watched and propagated, and in time a new sort is established. The conditions are vastly more variable under which cultivated plants exist than those of their wild allies. This leads to a wide range of characteristics even in the same variety. Unions, therefore, are here more powerful, under the rule that wild is more potent than close fertilization. Each individual is the balance-sheet of a long series of forces, both of within and without.

The two controlling laws of life, which for brevity's sake may be stated as: Like produces like, and, like produces unlike, doubtless act everywhere. But the first prevails in the lower forms of plants while the second dominates over the higher. As an extreme instance note the human race with its millions of individuals, no two of which are unmistakably alike. Even here the greatest variations are in the more highly developed classes or nationalities. The type of gentleman is more variable than the type of the Hottentot. The dominant motive of the former is not so constant and all-absorbing as in the latter.

The wild plant exerts all its powers to keep even with its rivals. The cultivated plant has thrown down its arms, and is active in building those structures that are useful to man. To rear young through seed may be lost from sight in part when man is satsified that the labor shall be along other lines. Man becomes the responsible party, and only the refractory and therefore worthless species will not acknowledge him as master when he treats them like King.

There is therefore a strong argument in favor of the view that cultivated varieties should remain intact indefinitely if conditions for growth remain constantly favorable.—BYRON D. HALSTED, *Rutgers College.*

The Causes of Cypress Knees.—From the teleological standpoint the the buttress function of the cypress knees was ably advanced in the last number of the AMERICAN NATURALIST, and while reading the article it occurred to me that the swaying of the trunk by winds would unavoidably produce a pulling strain upon roots at any angle with the tree, with a tendency to the elongation of such roots, particularly the outermost ones, and with the rebound or push of the tree in the opposite direction there would occur angularities at the points of greatest stress, in such outer roots, with sap exudation at such angles, and the piling up of indurated tissue in such forms as we find in the "knees." Recollecting that Herbert Spencer had dealt with plant morphology in a general way, I looked up the reference, and believe that his Chapter II., Part V., Vol. II., Principles of Biology, covers the subject admirably, especially in the words of Sec. 279: "Many commonplace facts indicate that the mechanical strains to which upright gravity plants are exposed, themselves cause increase of the dense deposits by which such plants are enabled to resist such strains."—S. V. CLEVENGER, *Chicago.*

ZOOLOGY.

Phymosoma.—A. E. Shipley has recently published his complete paper[1] on the anatomy of the West Indian gephyrean *Phymosoma varians*. Above the mouth is the horseshoe-shaped lophophore, which bears a varying number (but always even) of tentacles; below is the vascular lower lip. Both lip and lophophore have a skeleton which gives attachment to the retractor muscles. The nervous system consists of a bilobed brain connected with the ectoderm within the lophophore. This gives rise to three pairs of nerves, one supplying the pigmented tissue of the region in front of the mouth, the second sending branches to the tentacles, while the third, sending a branch on either side of the œsophagus, unites below in the ventral nerve cord, which shows no traces of double origin, and which is not ganglionated. From it arises at intervals a single median nerve, which later divides

[1] *Quarterly Jour. Micros Sci.*, XXXI., p. 1, Apr., 1890.

and forms a circular nerve around the body. The circulatory system is closed. It consists of two plexuses, one in the lophophore, and the other in the lower lip. These are connected with a reservoir or dorsal tube lying on the œsophagus, and at the junction of reservoir and plexuses there is a large blood sinus almost completely surrounding the brain. The animals are diœcious, the generative organs occurring at the points of origin of the ventral retractors. Mr. Shipley thinks that the evidence presented by Phymosoma lends additional weight to the view that Phoronis should be regarded as related to the Gephyrea inermia.

Molluscs of the Albatross Explorations.[2]—The United States Fish Commission steamer Albatross made collections on her voyage from the Chesapeake through the Straits of Magellan and north to California. Mr. Dall has reported upon part of the molluscs. As might have been expected, the cruise resulted in many novelties and varieties in forms from depths of over one hundred fathoms. The account opens with an interesting discussion of the environments of deep sea life, and its effect upon the molluscan fauna. It is interesting to note that molluscs which belong to phytophagous groups are, from the absence of plant life in the deep sea, obliged to put up with a diet of Foraminifera, and as a result the digestive organs are greatly increased in calibre, the termination of the intestine prolonged beyond the body, so that the fæces are deposited away from the gills. Deep sea mollusc shells are remarkably free from those countersunk holes produced by the radula of carnivorous gastropods, a fact which leads the author to conclude that they do not live in perpetual conflict with each other; that the struggle is against environment rather than against molluscan enemies. The systematic portion begins with the brachiopods (why this association of brachiopods and molluscs?) and then follow acephals and gastropods. In the text are numerous interesting points, among them the fact that the embryos of *Scaphella magellanica* possesses a membranous protoconch, the existence of which explains the peculiar apex of the shell of the adult.

The Organs of Bojanus in the Unionidæ.—Dr. Walter M. Rankin has recently reinvestigated the structure of the organs of Bojanus in *Anodonta cygnea.*[3] The organs are paired, the two being connected by a transverse tube. Each nephridium consists of four portions. A nephrostome leads from the pericardium into the anterior

[2] Proc. U. S. Nat. Mus., XII., 1889 [1890].

[3] *Jenaische Zeitschrift*, XXIV., p. 227, 1890.

end of the glandular portion of the nephridium. This latter portion runs backward beneath the pericardium until it reaches the posterior adductor muscle. It then bends upward and enters a three-chambered portion lying in the angle between the pericardium and posterior adductor. From thence the organ runs forward parallel to the glandular portion, until, at about the level of the nephrostome, the ureter goes downward and outward to the exterior. The histological characters of the different portions are described. In returning from the different portions of the body the blood mostly enters the sinus venosus, but some goes directly to the chambered portion of the nephridium. That which enters the sinus can pass through numerous openings, so as to bathe the external surface of the nephridial cell-walls. By careful maceration with nitric acid, Dr. Rankin traced the nerve supply of the organ, and finds that it receives an anterior innervation from the cerebro-visceral commissures, and a posterior from the visceral ganglion. The question of the taking up of water is discussed. Dr. Rankin describes the valves in the course of the circulatory organs, and thinks that their position and mode of action is sufficient to explain all the phenomena of expansion of the foot, etc., without recourse to the absorption of water.

The Dorsal Papillæ of Nudibranchs.—Dr. W. A. Herdman enumerates[4] three types of projections upon the dorsal surface of the Nudibranch molluscs. These are (1) the dorsal tentacles (Rhinophoræ); (2) the true branchiæ, and (3) the dorsal papillæ (Cerata). The last—Cerata—are regarded as outgrowths of the epipodial ridge, and frequently are considered as organs of respiration. They may be divided into those which contain diverticula of the liver (hepatocerata), and those which are mere outgrowths of the body wall (parietocerata). Dr. Herdman thinks that these cerata play at most but a moderate part in respiration, and thinks this is shown by the fact that they coëxist in many forms along with the true branchiæ, and that in all cases they contain no more numerous blood vascular spaces than does the adjacent skin. On the other hand, he regards them as protective either by causing the animal to resemble closely its surroundings, or, as in the case of Eolis, by making the animal conspicuous, and warning all fishes, etc., to let it alone because of the stinging organs in the cerata. These last are described and figured. The hepatic cæca extend a considerable distance into the tentacle, and then are continued directly into a "connecting tube," which in turn opens into the cnidiphorous sac, which is evidently an invagination of

[4] *Quart. Jour. Micros. Sci.*, XXXI., p. 41, 1890.

the ectoderm, containing numbers of large cells filled with thread cells. Herdman confirms the view, lately disputed, that the hepatic cæca are in communication with the exterior *via* the connecting tube and the external orifice of the cnidiphorous sac.

Zoological News.—General.—C. F. Marshall returns to the discussion of the histology of the muscle fibre.[1] After a discussion of some of the recent literature and a reply to Rollett's criticisms of the network theory, Marshall reaffirms his belief in the view that in rapidly contracting muscles (transversely striated) the portions differentiated to perform the contraction form a regular and highly modified intracellular network the longitudinal fibres of which produce the contractions, while the transverse meshes give the striated appearance to these muscles. He farther describes the development of the network in the trout and rat, and concludes that its transverse portions are directly connected with the muscle corpuscle, the longitudinal with the nerve end. The network developes first at the surface, and extends centripetally, and each muscle fibre appears to be developed from a single cell.

Worms.—*Chætobranchus* is a new genus of Oligochætes described[2] by A. G. Bowman from fresh water of Madras. It is remarkable in having elongate processes (a pair to a segment) on the dorso-lateral portions of the body. These processes diminish in length from before backward, until at about the middle of the body they appear as mere warts upon the surface. As each contains a loop of the lateral blood-vessel as well as a diverticulum of the cœlom (and some of the dorsal setæ) they are regarded as respiratory in function. Reproduction by fission was observed, but no budding zone was recognised.

Arthropoda.—A. D. Michael has been studying the variations in the female reproductive organs of Uropoda,[3] a genus of Acarina. In these forms the ovipositor is replaced by a "vestibule" leading from the vagina to the exterior. This structure is quite complicated, and is surrounded by complex organs. In *U. ovalis* these structures are arranged so that during copulation the spermatozoa pass into the receptaculum seminis, but are prevented from entering the vagina, while later they may be forced into the latter organ. In *U. vegetans* the relations are much the same. In *U. krameri* the vestibule is adapted for stripping the shell from the egg at the time of laying, so that the larvæ emerge from the egg at the time of oviposition.

[1] *Quart. Jour. Micros. Sci.*, XXXI, p. 65, 1890.

[2] *Quart. Jour. Micros. Sci.*, XXXI, p. 83, 1890.

[3] *Jour. Roy. Micros. Socy.*, April, 1890.

Mr. Cecil Warburton, in an interesting study[4] of the spinning habits of the spider *Epeira diademata*, comes to some conclusions at variance with those usually held. By entrapping spiders while spinning, and then studying the spinnerets with the lens, he finds that the line does not usually consist of many threads fused together, but ordinarily of two or four distinct threads. His paper is supplementary to and to a large part confirmative of a recent one by Apstein. Experimentation of the same kind is easily conducted, and will lead to interesting results.

Cœlom and Nephridia in Palæmon.—W. F. R. Weldon finds[1] that shortly after injecting a one per cent. solution of indigo carmine into the tissues of the prawn, it will be found aggregated in the anterior portion of the thorax. He finds there a cephalothoracic sac extending from the gonad forward to the anterior end of the body, giving off at each anterior angle tubes which connect the organ with the green gland. The structure of this latter differs from Grobbin's account. From the above it appears probable that Weldon has here the long sought Arthropod cœlom, and the conclusive evidence that the green glands are true nephridia. The close connection of the gonad with the cœlomic sac is also suggestive. This goes far toward supporting the views of Lankester and Sedgwick that the cœlom and blood-vascular spaces of the Arthropods are distinct, and that the general perivisceral space of a crayfish or a grasshopper is not to be compared with the body cavity of an annelid or vertebrate.

Fishes.—The results of the deep sea dredging by the U. S. Fish Commission are now being published by the U. S. National Museum. The first paper is by Messers. Goode and Bean, and includes seventy new species. A list of all known deep sea fishes accompanies the description of these. Among the novelties is a new genus of Chimæridæ, which has an extremely elongate muzzle. There are many other interesting forms. The fishes collected by the steamer Albatross are the subject of a report by Prof. C. H. Gilbert. Ninety-six species of this list are new. They are mostly from the Pacific Ocean near the Galapagos Islands.

The expedition to explore the waters of the Valley of the Tennessee, sent by the U. S. Fish Commission under Prof. Jordan, have published their report. They found fourteen new species, the genus most largely represented by novelties being Etheostoma, of which the largest known species, *E. rex* Jord., was obtained. No exploration of this region has been made since that by Prof. Cope in 1869.

[4] *Quart. Jour. Micros. Sci.*, XXXI, p. 29 1890.

[1] *Jour. Marine Biol. Assn.*, No. II., p. 162, 1869.

Reptiles.—Mr. Boulenger figures in the proceedings of the Zoological Society of London the *Python curtus* of Hubrecht, a species long overlooked, but which is widely distributed in Malaysia, continental and insular.

M. F. Bocourt describes and figures in the last number of Mision Scientifique de Mexique the Colubrine snakes of that country, including Pityophis, Spilotes, Coluber, etc. The plates are admirable.

Prof. E. D. Cope describes, in the late Proceedings of the U. S. National Museum, the reptiles and Batrachia obtained during the voyage of the U. S. Fish Commission steamer Albatross around S. America to the west coast of N. America. He rehabilitates the genera Batrachyla Bell, and Nannophryne Gthr., which were founded upon species from Patagonia, describes a new Zachænus from that country, and a new Phyllodactylus and Tropidurus, each from the Galapagos Islands. He shows that in Tropidurus it is the females that are more brilliantly colored than the males, contrary to the rule in the allied genera Sceloporus and Liocephalus. The colors are red, while in Sceloporus they are blue.

Mammalia.—In the Bulletin of the American Museum of Natural History of New York, Dr. E. A. Mearns, U. S. A., describes a number of new Mammalia from Arizona. They are as follows: *Sciurus hudsonius mogallonensis, Fiber zibethicus pallidus, Hesperomys leucopus arenicolus; Sigmodon hispidus arizonæ; Lepus allenii; L. melanotis, Dipodomys merianii; D. chapmanii; and Cynomys arizonensis.*

EMBRYOLOGY.

Prof. Weismann on the Transmission of Acquired Epilepsy.—The chief instance favoring the transmission of acquired characters which Prof. Weismann finds difficulty in explaining is evidently the series of experiments with reference to artificial epilepsy in guinea-pigs performed independently by Brown-Sequard and Obersteiner. I judge that Prof. Weismann himself regards this as the case presenting the greatest difficulties for his theory, since he has treated it in particular twice in the Essays upon Heredity, summarily in pages 81-82, and at length in pages 310-319, written in 1887, and also since he refers to it as "the only definite instance which has hitherto been brought forward in support of the transmission of acquired characters." (P. 319.) Prof. Weismann acknowledges the results of the experiments to be that various lesions of nervous substance in guinea-pigs are followed by epilepsy, and the offspring are often affected with nervous disorders, and sometimes with epilepsy. He defends his theory in two ways, first, by referring to infection as the true cause, and not heredity (p. 82, pp. 312-315); secondly, by pointing out the difficulty of conceiving the method of transmission upon either a preformation or epigenetic theory (pp. 315-319). Both these lines of argument are, it will be noticed, in the region of hypothesis and supposition.

As to the first point, there is no distinct evidence, as he himself admits, that epilepsy is caused by bacillus; and, in fact, in some cases it cannot be (p. 314), and yet he conceives that the transmission is by a bacillus from an infected part reaching to and attacking germ-plasm. The question here, as often elsewhere in the Essays, is resolved not so much into a matter of fact as a matter for conception. But how does the bacillus hypothesis simplify the problem for the imagination? If the microbe reaches the germ-cell how can it attack it any more than a "molecule of the brain of an epileptic animal?" (p. 310). If it could attack the germ-plasm, we have still the same fundamental difficulty as with transmission of acquired character, namely, as to how the bacillus can excite in the germ, not epilepsy itself, which is impossible, but such a peculiar disturbance of some peculiar molecular order that epilepsy will result after the many stages of evolution in a certain part of a certain tissue in the developed animal. That is, we must bring against the bacillus theory the same objection which he brings against the epigenetic when he asks how the germ-plasm can receive, "not indeed the peculiar structure of the stage itself, but such a molecular constitution as will ensure the ultimate appearance of epilepsy in the offspring." (P. 318). Prof. Weismann concludes that there is transmission, but one "which cannot depend upon heredity, and is in all probability due to infection." But if this method of infection is admitted, do we not have here, in a wide but true sense, heredity, a real transmission of acquired character, the acquired infectious (?) disease is transmitted to offspring; the offspring alike inherit it, whether we suppose the method of transmission to the sperm or germ-cell be by transference of bacillus, or of diseased molecules, or of gemmules, or any other way. By acknowledging that the continuous germ-plasm is affected, no matter how, but by or through acquired character, so that the character reappears in offspring, does not Prof. Weismann really concede the point at issue?

With reference to the second point, the *reductio ad absurdum* of other theories, it is quite possible to urge against the continuity theory itself many of the same objections which Prof. Weismann brings against the gemmule and epigenetic hypotheses. The inconceivability as to number and complexity of gemmules is quite matched by the inconceivable complexity of a germ-plasm, which in the sixth generation is composed of 32 ancestral germ-plasms, in the tenth generation of 1024, etc., even if the reduction by one-half be accomplished for each generation as explained pp. 357, ff. Moreover, must not each of these germ-plasms be divided by the vast number of ova or spermatozoa which appear in any individual's lifetime, and which are all potential for a possible conception? I am not aware that Prof. Weismann treats this point; but at any rate it is difficult to see how, upon his hypothesis, we can escape getting down within a few generations to the ultimate unit which "cannot be divided without the loss of its essential nature." (P. 357.)

The fundamental difficulty, the causing from a remote part of the organism such a peculiar effect upon the germ that the disease reappears in the developed organism, this problem is unsolved by the bacillus hypothesis, as also by the gemmule and epigenetic hypotheses. But do we need these hypotheses? This must be granted, that the germ-plasm, whether continuous or not, is a living being within the body and also of it (cf., pp. 103, 170, 267, *et passim*); that the law of interdependence of function—disorder in one function exciting sympathetic affections in others—applies to reproduction; that farther, the reproductive function is specially sensitive to nervous disease, as nervous exhaustion, for instance, which causes mutilated spermatozoa, and so weakens for future development. Moreover, specific causes will produce each its particular effect upon the germ for its whole development. But does this sympathetic affection need to be conceived as actual transference of bacillus or gemmule? May it not rather be regarded as a dynamic response in a dynamic whole, a transference of abnormal motion rather than matter? It seems probable that epilepsy, for example, could cause specific changes in the germ, but this may not be heredity, which is a specific effect of such a nature as to bring about this special disease in the offspring after many and diverse stages of evolution. It is certainly most difficult to conceive how this telepathy can be secured, but it is always to be remembered that at bottom it is a question of fact rather than conception. By a series of experiments we must trace the effects of nervous disorder upon spermatozoon and ovum, and how this effect is carried through conjugation and development.

It would be rash in our present knowledge to say that all influences made upon the germ are of the transmitting type; but as to this case of artificial epilepsy we may affirm that such evidence as we have points to general and even special heredity of acquired character through some affection of the germ produced by that character. A nervous disorder, epilepsy, tends to produce in offspring some nervous disorder. It is plain that if there is any effect upon the offspring from this disease, it is upon the nervous tissue rather than upon any other tissue or function, and this deserves to be called general heredity; and so far as the special disorder is communicated, this may be called specific heredity. If a nervous disease tends to produce in offspring nervous disease of any kind, this is so far heredity.

It seems to me, then, that Prof. Weismann's theory of non-transmissibility of acquired character fails even when tried by his own presentation of this test case, but it is certainly to be desired, as he intimates (p. 82) that the series of experiments should be carefully and thoroughly followed up. We certainly owe much to Prof. Weismann's hypothesis, but it is not too much to say that it is still unproved in point of fact, and unsatisfactory as yet to the scientific imagination, at least so far as artificial epilepsy is conserved.—HIRAM M. STANLEY.

ARCHÆOLOGY AND ETHNOLOGY.[1]

Prof. F. W. Putnam, Curator of the Peabody Museum of American Archæology and Ethnology, in Cambridge, closes his last report in the following manner:

"Thus there are the following elements to be taken into consideration in any endeavor to trace the present North American tribes and nations back to their origin. First, small, oval-headed, paleolithic man. Second, the long-headed Eskimo. Third, the long-headed people south of the Eskimo. Fourth, the short-headed race of the southwest. Fifth, the Carib element of the southeast. All these elements must be studied with their differences in physical characteristics, in arts and in languages. From a commingling of all, with greater or less predominance of one over the other, uniting here and subdividing there, through many thousand years, there has finally resulted an American people having many characteristics in common, notwithstanding their great diversity in physical characteristics, in arts, in customs and in languages. To

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

this heterogeneous people the name Indian was given, in misconception, nearly four hundred years ago, and now stands as a stumbling-block in the way of anthropological research; for under the name resemblances are looked for and found, while differences of as great importance in the investigation are counted as mere variations from the type.

"It is in such museums as this at Cambridge that the facts are now being gathered, and we may hope in time to be able to determine aright the complicated history of the ancient people of America."

Without sanctioning the classification of human races in North America, adopted as above by Prof. Putnam, I cite with commendation and approval the idea expressed in the last paragraph. The average archæologist of the United States has been in times past but little more than a collector of Indian relics. He sought to gather or obtain rare or handsome objects, and these qualities measured their value in his eyes. Such collections, viewed from the standpoint of the real archæologist, are of but little if any value. Their real service to the science of archæology begins when they shall be put to the use suggested by Prof. Putnam; when, in either large or small collections, better in the former, they can be spread out, assorted, classified and divided, they may assist in determining the races of people, as has been attempted by Prof. Putnam in the foregoing paragraph.

Classification of Arrows or Spear-heads or Knives in the National Museum.—Collectors of Indian relics have gathered in all times past quantities of arrow-heads, called "flints," but usually without any attempt at classification or arrangement. The National Museum has sought to make a classification by which these implements may be recognized and described. Such an attempt was made some years ago, but the divisions were so close and the distinctions so finely drawn that it was scarcely possible to follow them. It made so many classes that one could not remember them all, nor identify to which one a given object belonged. In the classification just made the divisions have sought to be broadened and the lines between them deeply drawn and easily recognized. It is as follows:

STONE, ARROWS OR SPEAR-HEADS OR KNIVES.

Class—Leaf-shaped—Sub-class A. Thin and finely-chipped implements of the form of a laurel leaf—elliptical and pointed at both ends. They correspond substantially with the French Solutreen type of the Paleolithic period of the Stone Age.

Sub-class B. These may be thicker and ruder than Sub-class A. Some are more oval, and the bases are not pointed, but are either straight or convex. This class includes the leaf-shaped argillite implements found by Dr. Abbott in the Delaware river gravels at Trenton, N. J.

Sub-class C. Long, thin blades, with nearly straight edges, more like a dagger or poignard. The base may be either convex, straight or concave. Many of them show traces of attachment to a handle by means of bitumen or gum. They are peculiar to the Pacific Slope.

Triangular.—This class includes all forms approaching a triangle, whether the bases or edges be convex, straight or concave. They are without stems, and, consequently, without shoulders, but in some specimens the concavity of the base produces barbs.

Stemmed.—This class includes all varieties of stems, whether straight, pointed or expanding, and all varieties of bases and edges, whether convex, straight or concave.

Sub-class A. Lozenge-shaped.

Sub-class B. Shouldered, but not barbed.

Sub-class C. Shouldered and barbed.

Note. Nearly all of these convex bases are smooth, as though they had been worn. The purpose or cause of this is unknown.

Peculiar forms.—These have such peculiarities as distinguish them from all other classes, but by reason of their restricted number or locality can scarcely form a class of themselves.

Sub-class A. Beveled edges. The bevel is almost always in one direction.

Sub-class B. Serrated edges.

Sub-class C. Bifurcated stems.

New Archæological Discoveries.—These seem to be made in every land with about equal frequency. I have wondered if the average archæologist (I do not expect it of mere collectors) has ever thought of the evidence afforded by the number of these discoveries as to the length of time of prehistoric human occupation, or the density of the prehistoric population. As mere finds of stone hatchets or arrow-heads, spear-heads or knives, bits of pottery, shell, bone, etc., these discoveries are regarded by the finders as of value only to the amount of money for which the objects can be sold. This value is practically nothing compared with what it might be to science if the locality, conditions, association of the objects when found, were accurately noted and truthfully recorded, so as to be used in making up the history of prehistoric man.

Archæologic or Archæological.—Which is correct, or are both correct? Is there any difference in their meaning, or any distinction in the phrases or senses in which they can be used? If both words mean exactly the same thing, why not discard one or the other, and why use them indifferently?

Human and Animal Remains.—(Dr. J. L. Wortman).—The proper collection and preservation of human and animal remains is important. Not infrequently, material of high scientific value is allowed to perish through lack of knowledge of effective method of preservation. Some of the methods are so crude, and the skill of collectors so primitive, that the material when collected is almost worthless. Many remains looked upon by the inexperienced as hopelessly decayed, can, in the hands of the experienced collector, be made of interest and importance to science.

It is a popular error that the anatomist can restore or reconstruct a skeleton from a few scattered fragments. Where the structure of the animal is known this may be done, but with imperfectly known species the entire skeleton is indispensable to a complete knowledge of its osteology. This is true of the human species for the determination of these racial differences or affinities displayed in their skeletons. For these purposes not only one, but many skeletons may be required, and it should be the object of the collector to provide the requisite material, and in such a condition as to be of the highest possible scientific value.

The best method of procedure is perhaps open to question. It depends upon a variety of conditions, such as character of matrix or soil, the condition of the skeleton, its state of preservation, mode of burial, etc. The best method of precedure can only be indicated in a general way. Suppose a skeleton rather friable, buried in loose, dry earth. How shall he proceed? Unnecessary and dangerous explorations with the coarser instruments, such as pick and shovel, must be avoided. Approaching the skeleton, he should explore it with care, using some small instrument, say a hand-trowel. He should make due allowance for the prominences, as the anterior superior curve of the spine, possibly the ribs, as they are frequently found in their natural position; the frontal eminence of the skull, etc.

After the superimposed earth has been removed, cut a trench a foot or so deep on either side of the skeleton, at enough distance to avoid injury to any of the bones—this for convenience in removing the earth from around the bones. Begin at either the head or feet, and remove the dirt bit by bit with the trowel, supplemented by small scrapers of wire flattened and ground to a chisel edge. These will be useful in cleaning out the cavities. The earth can be brushed away, and the specimens kept clean for observation, using softer brushes as required, so that no injury may be done to the bones. If the specimen crumbles upon exposure to the air, so as to endanger its safety, expose only a small surface of the bone at a time, apply the preservative, and let it dry, after which a little more can be exposed, and so continued until the skeleton is finished.

If the bones are in a fair state of preservation, an entire skull, or, for this matter, the whole skeleton, may be exposed, cleaned with the brush, and the preservative applied. Before applying the preservative remove the dirt thoroughly from the surface of the bone. If this is neglected the preservative when applied will cause the dirt or earth allowed to remain to adhere so firmly that it cannot afterwards be removed without serious damage to the specimen.

Take a skull, for example, part of a skeleton buried in its natural position. One would begin, say at the forehead, and remove the dirt, little by little, until the whole is more or less exposed, using the small implements according to necessity; and so continuing, with care that the bone is not broken, until the whole is neatly and thoroughly cleaned. It is a good practice to leave the dirt in the deeper parts of the cavities, such as the nose, the deeper parts of the orbits, etc. Next use the preservative, giving a thin coat upon the more exposed portions, avoiding for the present the uncleaned cavaties, that no dirt may be cemented to any portion of the bone. After the preservative is well dried remove the skull from its bed, taking special pains to avoid breaking it. Next remove the lower jaw, being watchful that none of the teeth are lost, clean the cavities and the interior, and finally paint it thoroughly both inside and outside with the preservative.

In the vicinity of where the root of the tongue has been will generally be found the hyoid or tongue bone or bones. In the adult or aged person they generally consist of one piece, somewhat in the form of the letter U, but in the young, and sometimes in the old, they consist of separate pieces. They should always be preserved with the greatest care, and placed with the skull to which they belong. The collector should familiarize himself with their appearance, either by examining a recent skeleton or by consulting some standard work upon human anatomy. This method can be continued for the rest of the skeleton, and can be employed for other animal remains.

The preservative which has proved best in my hands (and I speak from a large experience with almost all known material) is the ordinary shellac dissolved in commercial alcohol. The first coat or two I use tolerably thin so that the porous bone may take it up. It may be found necessary to use several coats before the specimen can be handled, and it is always best to finish off with a thick solution. The judgement and experience of the collector must be his guide in this matter, as it is impossible to lay down any definite rule.

Notwithstanding many coats of shellac the articular extremities of the long bones may be still friable, while their shafts are moderately strong. This I have been able to remedy by plunging them (the articular ends) into hot wax. The wax should not be too hot nor should they be left in too long. A minute or two is enough for their complete saturation. It may also be necessary to give the bodies of the vertebræ and the weaker parts of the innominate bones to a similar treatment.

The foregoing description applies to skeletons buried in dry earth. Where it is damp or wet no attempt should be made at removal until the earth is dry. All but two or three inches of the super-imposed earth can be removed, and left for a few days' sunshine to put it in proper condition. Loose teeth or fragments of bone should be carefully gathered up, wrapped in separate packages and placed with the skeleton. Every bone should be preserved and nothing thrown away.

Instructions for the proper packing and shipment of skeletons can be briefly stated as follows: Number each skeleton and pack it in a separate box. If the skull is unusually liable to breakage it is a good plan to provide a separate box for it also, but it should bear the same number as the skeleton to which it belongs. It will be found that the best material for packing is either soft paper, chaff, or very soft straw or hay, and after each layer sift the interstices *full* of sawdust or bran. This, if well done, will prevent all movement or shaking of the specimens. Breakage of this kind is fatal, and generally results in permanent injury to the specimen.

What has been said as to the preservation of human remains applies more to skeletons buried in mounds or graves, and surrounded by loose soil. In the case of cave burial the bones are generally surrounded by or enclosed in a hard lime cement, which cannot be removed except with hammer or chisel, requiring the appliances and skill of a well-appointed laboratory. In all cases of this kind it is best to take the specimen out in a block of the matrix if possible, and pack as before directed, and ship it in this condition.—J. L. Wortman.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—March 19th.—Dr. H. V. Wilson read a paper, On the Formation of the Alimentary Canal and the Lateral Line in Teleosts. Photographs of the spinning work of spiders were exhibited by Mr. Horace P. Chandler, and remarks on the same were made by Mr. J. H. Emerton.—J. Walter Fewkes, Sec.

Biological Society of Washington.—April 19th.—The following communications were read: Dr. W. H. Dall—Exhibition of Original Drawings of the Fur Seal and Steller's Sea Cow, executed by a member of Behring's Expedition of 1742; Dr. C. Hart Merriam—Historical Review of the Faunal and Flora Divisions that have been proposed for North America; Prof. Jos. F. James—On Variation, with special reference to certain Paleozoic Genera; Mr. B. T. Galloway—Observations on the Flora of Missouri; Mr. C. L. Hopkins—Characteristic Vegetation of the Cliff Dwellers Cañon near Flag Staff, Arizona.

May 3d.—The following communications were read: Dr. Robert Reyburn—The Life History of Micro-organisms, with its Relation to the Theory of Evolution; Dr. George Vasey—A New Grass Genus; Prof. W. H. Seaman—The Place of Biology in Public School Instruction; Mr. F. A. Lucas—The Present Status of the Aurochs.

May 17th.—The following communications were read: Dr. Erwin F. Smith—A New Species of the Genus Aphis; Mr. T. S. Palmer—Some Early Views of the Geographical Distribution of Species; Mr. Frederick W. True.—Exhibition of a Specimen of *Lophiomys imhausii*, a rare and remarkable Rodent from Africa; Prof. W. H. Seaman—The Place of Biology in Public School Instruction.—Frederick A. Lucas, Secretary.

Archæological Association of the University of Pennsylvania.—April 25th.—Dr. C. C. Abbott, Curator of the Museum, read a paper on Implements from the Workshop of a Prehistoric Coppersmith.

The Indiana Academy of Science began its spring meeting at Greencastle, Indiana, Thursday evening, May 8. Prof. C. A. Waldo presided. Prof. C. Leo Mees delivered an address upon "Inertia, with reference to Electricity." Friday was devoted to an excursion to Fern Cliff, an interesting region some miles from Greencastle. In the evening a number of short accounts were given of the experiences of the day, with discussion of the local natural history. The speakers were Profs. J. C. Arthur, C. A. Dryer, C. W. Hargitt, Stanley Coulter, D. H. Campbell, C. A. Waldo, and O. P. Jenkins. Dr. J. P. D. John presided. Saturday the members visited Eel River Falls. The Academy was hospitably entertained by the citizens of Greencastle.

Chicago Academy of Sciences.—April 8th.—Lieut. F. M. Beall, Signal Officer U. S. A., presented a paper: "The Recent Cyclone and its Attending Tornadoes."—C. E. WEBSTER, Recorder.

Proceedings of the Natural Science Association of Staten Island.—April 10, 1890.—Mr. Ira K. Morris presented a brass spur, of Spanish fashion, which was lately plowed up on the Poor House farm, and read the following paper in connection with it:

This spur was found by one of the workmen on the county farm, while ploughing, in February last. It is composed of solid brass, and the wheel must have originally been at least one and a-half inches in diameter. Much surprise is expressed by Staten Islanders at the finding of a spur of its pattern in such an out-of-the-way place. Yet, it seems possible to trace its simple history.

During the Revolution there stood a small Holland cottage, built of stone, and with long, sloping roof, on or near the spot where the County Alms House is now located. The story is handed down to us that it was occupied by a sturdy patriot whose open hatred for royalty and whose unfriendliness to the British soldiers gave considerable annoyance to General Howe, who directed that a guard must be placed upon the premises until some breach should be committed sufficient to cause his arrest.

The mounted patrol of the Island was under the command of Lieutenant-Colonel Simcoe, of the "Queen's Rangers," and it is said that that notorious officer frequently visited the old cottage, not so much to test the loyalty or watch the movements of its owner, as to enjoy the companionship of his beautiful daughter.

Colonel Simcoe did not dress strictly in accordance with the British army regulations, and I have seen a portrait of him in which he wore the Spanish spur, with its large wheel. Appreciating, as he must have, the superiority of this spur over the small, fine wheel worn by the Englishmen, it is only reasonable to assume that his men were provided with it also. During the exciting period following the earnest appeal of Colonel Aaron Burr to General Washington, to besiege the fortifications on Staten Island, especially at "Richmond towne," a detail of Simcoe's mounted men was made daily for many months. Skirmishes frequently occurred near the old cottage, between American troops from New Jersey and the "Rangers" and their native Tory friends.

It was near the close of the war that the severest, and from what we now know, the last skirmish occurred in that vicinity. During a severe storm, and under the cover of intense darkness, a detachment of Americans crossed the Kills, and losing their way, wandered about for some time until attracted by a light in the window of the old cottage. Simcoe's men were lurking about the premises at the time, and listened to the directions given by its occupant concerning the whereabouts of the British soldiery.

As soon as the Americans had departed Simcoe's subordinate entered the cottage and informed the unfortunate man what he had seen and heard, at the same time stating that he had authority to execute him without trial or delay. The man appealed for mercy until he could acquaint General Howe (who was renowned for his leniency and kindheartedness) of the facts, and the daughter prayed for an interview with Colonel Simcoe, whom she believed would save her father's life. But justice and mercy were unknown among the brutal "Queen's Rangers," from the Lieutenant-Colonel down to the humblest private; yet they well suspected the influence that the pretty girl might exercise under the existing circumstances. As "murder" and "plunder" were ever the watchwords of that infamous organiza tion, there seemed to be no time to lose. The guard drew near, with the exception of the pickets, and, with the assistance of ever-willing Tories, all the occupants of the cottage were pinioned to their chairs. The husband and father was taken out to a tree, a rope quickly placed around his neck, and in a few seconds he was suspended from a limb, and his soul was hurled into eternity. The tree on which this execution took place stood in front of the old "farmer's house" on the county farm, and I once conversed with an an old Staten Islander who remembered it well. Decayed and worm-eaten, it could no longer bear its own weight, and it fell to the ground in a terrible wind storm that swept over the Island about 1827.

The "Spanish" spur, as it is called to day, and of which this relic is a fair specimen, is not an invention of the Spaniards. In a cumbrous form it bears equal date with the establishment of battle armor, such as was used by the Egyptians considerably more than ten centuries before the Christian era. During the Crusades—the third, if I mistake not—the spur was "remodeled" by order of Cœur de Lion, and made in the exact style of the relic here presented. About two centuries ago the "changers of fashion" thought it too heavy for light riding, and the English spur, with its small wheel and thin footpiece, was substituted. In Spain and other European countries, as well as in Mexico and the Western States of our own country, the Spanish spur is used almost exclusively.

Although there is a popular belief to the contrary, it is far less "cruel" than the fine English spur. A horse once well broken to its use need only to hear the familiar "clink," "clink," as his rider paces beside him, before mounting, to go for half a day at a time without necessitating its use.

It is with pleasure that this relic, mystical though its history may be, is presented to the Association. While its true story may never be told, it is nevertheless safe to assume that it played its part in the grand drama that shook the world in "the days that tried men's souls.

A specimen of the violet spotted salamander (*Amblystoma punctatum*) was shown, in which the tail was bifurcated, each branch being about half an inch in length. It was captured by Mr. John Tynan in the Snug Harbor woods, and presented to the Association.

SCIENTIFIC NEWS.

The next meeting of the British Association will be held at Leeds, in week commencing September 3d, under the Presidency of Sir Frederick Augustus Abel, C.B., D.C.L., D.Sc., F.R.S., V.P.C.S.

The general Committee will meet on Wednesday, the 3d of September, at 1 P.M., for the election of sectional officers, and the despatch of business usually brought before that body. On this occasion there will be presented the report of the Council, embodying their proceedings during the past year. The General Committee will meet again on Monday, September 8, at 3 P.M., for the purpose of appoint-officers for 1891, and of deciding on the place of meeting in 1892. The concluding meeting of this Committee will be held on Wednesday, September 10, at 1 P.M., when the report of the Committee of Recommendations will be received.

The first general meeting will be held on Wednesday, the 3d of September, at 8 P.M., when the President will deliver an address; the concluding meeting on Wednesday, the 10th of September, at 2.30 P.M., when the Association will be adjourned to its next place of meeting.

At two evening meetings, which will take at 8.30 P.M., discourses on certain branches of science will be delivered.

There will also be other evening meetings, at which opportunity will be afforded for general conversation among the members.

Sectional Meetings.—The sections are: A, Mathematical and Physical Science; B, Chemical Science; C, Geology; D, Biology; E, Geography; F, Economic Science and Statistics; G, Mechanical Science; H, Anthropology.

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