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THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

Vol. XXIX. JULY, 1895. No. 343

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PHILADELPHIA, U. S. A.
THE EDWARDS & DOCKER CO.,
518 AND 520 MINOR STREET.

Entered at the Philadelphia Post Office as second-class matter.

THE

AMERICAN NATURALIST

VOL. XXIX. July, 1895. 343

THE SYMBIOSIS OF STOCK AND GRAFT.

BY ERWIN F. SMITH.

Under the title, Ueber Transplantation am Pflanzenkörper, (pp. VI, 162, Pl. XI, figs. 14), Dr. Hermann Vöchting, Prof. of botany in the University of Tübingen, has contributed a study on the relations of graft and stock which is of unusual interest. After some consideration of the literature of the subject he discusses (1) Methods of grafting, (a) Grafting of like parts in normal and abnormal positions; (b) Grafting of unlike parts; (2) The symbiosis of scion and stock; (3) Histological investigations. The author's conclusions relative to the mutual relations of stock and graft rest upon careful experiments covering a period of some years. His first experiments consisted in the union of parts of the same and related varieties of the red beet. The top of a plant recently grown from the seed but sufficiently large was cut away and young shoots from two-year old blossoming plants were grafted on. These cions were taken from the base of recently developed shoots and bore from two to three vegetative buds. These buds grew into short, fleshy sprouts plentifully provided with leaves which resembled those of the *first year*, i. e. were not like those on the blossom shoot from which they were taken. Subsequently the axis also became thickened but to a less degree. The shoots did not produce blossoms but elaborated food for their own use and that of the root. The roots also increased in circumference in proportion to the amount of their nourishment. This growth was excentric and preponderatingly under the cion. The following year blossoms were produced in the ordinary manner and death followed. *Conclusion:* If these shoots had remained on the parent plant, they would have blossomed the same season and died in the fall. Inserting them on the young root changed them into a vegetative state and prolonged their life for a whole year. In this case the young root exerted the controlling influence. In another experiment plants at the commencement of the second year were divided into two lots. The plants of one set were forced into a rapid development of blossoms; the others were restrained from blossoming by being kept in a cool place. The tops of the retarded plants were cut away and cions from the forced plants were inserted. The result of this experiment was quite different. These cions developed blossoms in the normal way. None of them remained short or formed the tufts of broad leaves which were peculiar to the sprouts in the previous experiment. In this case the leaves had long petioles and rather narrow blades as in ordinary blossom shoots. Here likewise the roots increased in size near the inserts, i. e. around them and below. *Conclusion:* Grafting on young and old roots leads to very different results.

Knight's law, expressed still more clearly by van Mons, that only its own nature controls the development of the cion, is not universally true. Cion and stock mutually influence each other always. Sometimes one preponderates in influence, sometimes the other. The control exercised by the stock in these experiments with the beets is ascribed to movement of assimilative matters (stoffwechsel). The young root grows and stores up reserve materials, chiefly sugar. The old root does not grow, gives up its reserve materials, and dies after it is emptied. "It is plain," says the author, "that the manner of growth of the bud, i. e. its development into a vegetative or floral shoot, depends less upon itself than upon the parts bearing reserve substances, especially the roots."

In the middle of June, segments were removed from old roots, then producing blossoms, and were inserted into young, actively-growing roots, only recently developed from the seed. There was union of tissues but no increase in circumference, no radial growth. When these inserted pieces were examined the following winter they were, unexpectedly, found full of sugar. The cells bore abundant plasma, fine nuclei, and seemed to be in good condition, although at the time of their insertion they had given up the greater part of their reserve materials. The only possible conclusion is that the root inserts had formed new cane sugar out of the materials brought to them by the young roots. Old beets were set into young roots and in this way also their life was prolonged, the old parts dying only a little earlier than the young roots. In this case they showed no such quantity of sugar. Inasmuch as these old roots did not increase in thickness in spite of their good nourishment by the young roots it might be inferred that they are not capable of it, but such an inference would be wrong. Segments of old roots taken in the middle of March and inserted into the basal parts of panicles in rapid development showed a marked growth, what the author calls,—" ein sehr auffallendes Verhalten." They began a new process of development, grew up above the surface of the stem on a level with which they were originally inserted, and ended by forming swellings of various sizes and shapes. When the piece of root was inserted upside down it was swollen at the upper end, when it was inserted right end up the swelling was at the lower end. The stem around the insert also finally enlarged, sometimes only above the insert, sometimes also at both sides. The growth of these root-inserts was very remarkable. Under normal conditions the same pieces would have made no growth whatever. Planted in the blossoming stem they began to grow, and this growth was so energetic in some cases that the pieces increased to several times their original volume. Dr. Vöchting is in doubt as to the cause of this behavior, but concludes from it that there is no necessary relation between growth and the storing of sugar since he found these growths very poor in sugar although the cells appeared to be active.

Some attempts were made to unite annuals and perennials. The tomato was used for a stock, the author not being aware, apparently, that the tomato is not strictly annual but frequently lives far into the second year and even longer in green houses and in warm climates. In the first series of experiments cions of *Solanum dulcamara* were grafted on. They made a good union and more growth than any shoots on the parent stem. In the fall the plants were removed to a house. Gradually the leaves fell off, but the sprouts remained fresh for a time. They died, however, in December or January, the disturbance beginning below with the stock. It was thought that owing possibly to the fall of the leaves and the cessation of the activity of the graft, it had not sufficiently stimulated the stock, so another experiment was made using as cions Solanum capsicum and S. *pseudocapsicum*, which hold their leaves over winter. A good union was secured and the plants developed fine tops and prospered until winter. In early winter the stocks became diseased at the root and the tops died quickly. One plant, however, held on longer and toward the end of December the part of the stock above ground formed adventive roots. In January the graft turned yellow and died. *Conclusion:* These experiments do not show that the life of annuals can be prolonged by grafting perennials upon them but it is not certain that such an end might not be reached by the use of other plants. An experiment was also made on *Mercurialis annua* which bears staminate and pistillate flowers on different plants. Portions of male and female plants were united by grafting but the result was negative, the sex remaining distinct. Mention is also made of a staminate Ginkgo tree in the Botanical Garden at Basle into which a pistillate branch was grafted many years ago. This has grown into a stately system of branches but the sexual parts are just as distinct as on separate trees. The same result has been reached in the same garden with *Acuba japonica.*

Plants of varied color and form were also grafted together. The more recent discussion of the symbiosis of cion and stock turns chiefly on the subject of the transmissibility of panachure and on the possibility of graft hybrids. A portion of the white and yellow spotting of variegated leaves is unquestionably pathological and is readily transmitted by grafting. Since we do not know the cause of this disease, we can form no definite idea as to its method of transmission, yet the whole process of transmission gives the impression of an infection. How this takes place we do not know, but it seems as if it must be through the wandering of specific material particles out of the variegated cion into the stock. Concerning the transmission of non-pathological peculiarities such as colors, especially those held in the cell sap, the author thinks that they cannot pass directly into the stock, but that something must pass that is able to produce them. He saw in Bonn, Lindemuth's experiment in which violet color was transmitted from a potato cion to the green stock, and says it was so. His own experiments are as follows: *Coleus.* Many experiments with characteristic forms. The unions were easily affected and the plants were kept into the second year and some into the third year. *Conclusion:* In no case was there any transmission of color from the graft to the stock, or from the stock to the graft. Neither was there any influence on the form or nervation of the leaves. Cion and stock retained their original peculiarities unchanged. *Tradescantia:* The shoots of *T. zebrina* and *T. quadricolor* were grafted on the green *T. Sellowi.* The cions reached a considerable length but in no case was there any transmission of color. *Beets* (salad, fodder, and sugar): (a) *Union of different colored beets.* Dr. A. Maclean of Colchester, England, was the first to try this in 1853. He joined the root of a red beet to that of a white Silesian beet. They united but the red part remained sharply delimited from the white. There was no transmission of color or of form. In the author's own experiments white and orange, white and red of various shades, and yellow and light and dark red beets were united. In part of the experiments roots were joined to roots; in others shoots, to roots. With one exception there was no transmission of color from cion to stock or vice versa. Each part retained its own color. The blending of colors did not occur even in the region of the union. Microscopic examinations were made and the place of union could be seen very distinctly. The exception was as follows: The shoot of a red beet was worked on the root of a white mangel wurzel? (Futterrübe) and subsequently a red color appeared in the swelling around the inserted cion. No such color was visible on the rest of the root, nor could any such be found on other ungrafted roots of this variety. It would seem that the color in this root was due to the influence of the graft and that this experiment supports Lindemuth's observations. Nevertheless this case is not entirely beyond suspicion since colored beets are apt to develop most color in the vicinity of wounds, and because all varieties of beets are nearly related and though apparently constant may possess latent peculiarities. (b) *Union of bodies of different sizes.* Very large white beets were grafted on small dark red ones and vice versa, the parts being about the same size when united. In the first case the plants grew more than in the second, i. e. because they had a larger leaf surface for assimilation. (c) *Union of varieties having unlike shapes.* Each grew after its own manner uninfluenced by the other. M. Gaillard tried grafting Cucurbitaceous plants and got the same result. White, green and yellow colocynths were united but there was no blending of colors.

Several attempts were made to procure graft-hybrids. The author wholly failed to get variegated hyacinth flowers by a union of different bulbs. Even when the union took place between blossom stalks there was no mixture. In experiments with potatoes his results confirm Lindemuth's. There was no mixture. Many experiments were tried using well marked and constant varieties very distinct in color and form. He discarded the tubers and worked with young, well-rooted shoots which were removed from the tubers, set out in the earth, and grafted as soon as they were a short distance above the ground. As soon as the cions were healed on, the plants were put into a hot bed. They remained here until the fall of the leaves in autumn, care being taken to remove all the green leaves which appeared from time to time on the stock so that it should be nourished only by the vegetation of the cion. At the close of the experiment the tubers were found to possess all of the peculiarities of the mother plant. The cions did not produce any change either in color or form. In Strasburger's experiment of grafting Datura on potato and getting atropin in the tubers, if the malformation of part of these tubers was due to the presence of atropin then it is a case of poisoning and not of a change in the specific nature of the stock due to the cion, as Strasburger also admits. From the observations of Lindemuth there can be no doubt that many of the reports of graft hybrids rest on errors. Master's reported an experiment made by Maule of Bristol and exhibited a photograph showing *Helianthus tuberosus* grafted on *H. annuus* and the roots of the latter bearing tuberous growths. This experiment was repeated by M. Carriere, a very careful observer, and on the roots of his *Helianthus annuus* appeared two budless black swellings with a rifted surface, and in general resembling certain dahlia tubers. In the vicinity of these were other forms which more nearly resembled the artichoke. This experiment should be repeated. *Conclusion:* Either there are no such things as graft hybrids or else they are limited to a small number of plants.

ON A SUPPOSED CASE OF PARALLELISM IN THE GENUS PALAEOSYOPS.

BY CHARLES EARLE.[1]

The object of the present paper is to attempt to show that in the extinct perissodactyle Palaeosyops, the species developed at least two parallel series, both of which may have lead to some permanent result. In other words, from a very thorough study of the known species of this genus, I am lead to the conclusion that the genus Titanotherium may have had a polyphyletic origin. This will be impossible to prove until we know more of that intermediate form *Diplacodon.*

Little has been attempted in the construction of the phylogenies of species of fossil mammals, although a great deal has been done in this respect in regard to genera. I attempted it in my "Memoir on Palaeosyops," but the recent acquisition of new material proves that I made some mistakes in my phylogenetic scheme. As our knowledge of Palaeosyops now stands, we know considerable about the structure of the skeleton in a number of well defined species, and in some cases the complete osteology is known.

Professor Cope was one of the first to call attention to the phenomenon of the parallelism of genera. Professor Scott[2] in his series of valuable papers has placed before us a thorough exposition of what we have to attempt in paleontological investigation, and especially the relation of the latter to the facts of evolution. In the "Deep River Mammals" he remarks[3] "only very rarely can we construct a phylogeny of species as distinguished from that of genera, and the latter are too vague for the purpose."

[1] American Museum of Natural History, New York.

[2] Phylogeny of the Tylopoda. Journal of Morphology, Vol. p. .

Osteology of Mesohippus and Leptomeryx. Journal of Morphology. Vol. V, p. 301.

The Mammalia of the Deep River Beds. Proc. Am. Phil. Soc., 1894.

[3] Page 119.

Quite a large number of species of Titanotherium have been already described, but as a whole this genus is remarkably homogeneous in the characters of the species, and it is very uncertain how many there really are. The deeply concave or saddle-shaped skull is typical, I believe, of all the known species. The case with Palaeosyops is quite different, as this genus exhibits a great variety in its specific forms, fully as great, if not greater than Palaeotherium of the Middle Eocene of Europe.

Within the past summer some exceedingly valuable material of Palaeosyops has been collected for the American Museum of Natural History by Mr. O. A. Peterson of the Museum; and this has just been described in bulletin form by Professor Osborn. We are greatly indebted to this bulletin for its important information in regard to the stratigraphical relations of the skulls of Palaeosyops. This material was collected in the country just south of the Uinta Mountains, and the deposit which occurs in this area was always supposed to pertain only to the Uinta or Upper Eocene. Mr. Peterson discovered skulls of a species of Palaeosyops in this region, namely, *P. megarhinus*, which is typical of the Bridger proper, and, in fact, he found one skull of this species or a variety of the same, which is the earliest one known of this form. This skull came from the base of the beds under the Uinta, which is considered to be the bottom of the Bridger. Mr. Peterson informs me that Palaeosyops occurs from this position in the beds as far up as just beneath the Uinta proper. Furthermore, in the uppermost of the transition beds, between the Bridger and Uinta proper, Mr. Peterson discovered a number of large skulls of a supposed new type of Palaeosyops, but I think I can quite safely say that this form really belongs to the genus *Telmatotherium* Marsh (*Leurocephalus* S. & O.). The characters of these skulls nearly demonstrate my views as to the phylogenetic relationship of Palaeosyops to Telmatotherium, and in my memoir on the former genus I remarked "I consider that Telmatotherium is the most highly specialized genus of the Palaeosyopinae approaching more closely in its dental characters (skull unknown at that time) to Diplacodon than any other genus of the subfamily, Telmatotherium should, therefore, hold an intermediate position between Palaeosyops and Diplacodon."

It is interesting to note that these newly discovered skulls of Telmatotherium are merely greatly enlarged ones of the *P. megarhinus* type (see fig. 2), and that other skulls in the collection of the American Museum show the transition stages between the generalized form of *P. megarhinus* and that of the Telmatotherium type from the uppermost part of the transition beds already referred to.

In the Bridger proper or the area of southwestern Wyoming, just north of the Uinta Mountains, occur at least three well defined types of skulls of Palaeosyops, namely, that of *P. paludosus*, with frontal region strongly convex and occipital portion broad and heavy (see fig. 3). The character of the teeth in this species is very primitive, but it has a specialized form of skull.

2. The type which Marsh called Limnohyops. I recognized this as a good genus in my memoir, but I now believe that it should be included in Palaeosyops. In *P.* (*Limnohyops*) *laticeps* the skull is saddle-shaped like that of Titanotherium, and I called particular attention to this fact in the paper already quoted (see fig. 1).

3. The *P. megarhinus* type of skull is the most primitive of all, there is hardly any depression on the dorsal surface, and the sagittal crest is well defined. The teeth are tending towards those of Telmatotherium, as they have broad and angular crescents, with a reduction of the intermediate tubercles (see fig. 2). I wish to emphasize particularly that in the Bridger proper, the saddle-shaped type of skull was established, and contemporaneous with it was the much more primitive skull of *P. megarhinus*. I accordingly did not suspect that the latter was in the direct line leading to Diplacodon. However, the discovery of the skull of this species south of the Uinta Mountains and its relationship to Telmatotherium, has made necessary some changes in the phylogeny of the species of Palaeosyops, and I now find that there were two well defined lines of Palaeosyops tending in the characters of their skulls and dentition towards Titanotherium, and that these two

series were parallel in many of their characters, although the *P. megarhinus*-Telmatotherium division did not commence to differentiate those characters which are found in Titanotherium as early as the *P. laticeps-P. vallidens* series.

In the following table I have arranged some of the species of Palaeosyops phylogenetically and in three parallel columns, two of which are supposed to contain persistent types. The third column contains the more specialized species, which are are supposed to have died out.

In conclusion I wish to emphasize the following points:—

The first series exhibits transition in the structure of the the teeth and skull which is quite gradual, although in the most highly differentiated form of this line, namely, Telmatotherium sp. nov. (type specimen in American Museum collection), the dorsal contour of the skull is slightly convex and not saddle-shaped as in Titanotherium. This series began to differentiate later, as already shown, than the second series; this is proven by the presence in the Bridger proper of the supposed earliest members of the two lines, namely, *P. megarhinus,* which has a skull with a nearly straight dorsal contour, and the ancestor of the second line, namely, *P. laticeps,* with a skull which is deeply concave like that of the White River genus Titanotherium.

2. The changes from *P. laticeps* to *P. vallidens* parallels that of the first series in many ways, notably the increased height of the crowns of the molars, reduction of the intermediate tubercles, increase in size of the skull, and lastly some indications of the development of horns.

3. The great variety of species occurring in the genus Palaeosyops indicates progression and advancement towards a higher type, although we observe that a number of the species probably left no descendants. In the genus Titanotherium, which was approaching extinction, we see fewer well marked species and much closer similarity between them than between those of Palaeosyops.

TABLE.

Parallel Series I. Persistent Types.	Parallel Series II. Persistent Types.	Specialized Forms. Non-persistent.
1. *P. megarhinus* (variety) Earle. Skull small, sagittal crest long and high. Last superior molar with hypocone. From base of Bridger.	1. *Palaeosyops* (*Limnohyops*) *laticeps* Marsh. Skull saddle shaped as in *Titanotherium.* Zygomatic arch strong and robust. Nasals long and slender. Superior molars with short crowns and well developed intermediate tubercles. Last upper molar with hypocone. Bridger Proper.	*Palaeosyops paludosus* Leidy. Skull short and broad, with frontal region strongly convex. Teeth primitive, with low crowns and well developed intermediate tubercles. Bridger Proper.
2. *P. megarhinus* Earle. Skull larger, sagital crest not as prominent and long. No frontal depression. Molar insertion strongly depressed, zygomatic arch narrow and slender as in Diplacodon. Nasals elongated and broad distally. Molar crowns tending to become elongated and intermediate tubercles reduced. From the Bridger Proper.	2. *Palaeosyops vallidens* Cope. Skull saddle-shaped and much larger than the above species. Zygomatic arch not depressed at the molar insertion and rising gradually from the cheek. Molar crowns not as high and angular as in *Telmatotherium*, but show a reduction of intermediates. Last superior molar with hypocone rudimentary. Rugosities at junction of frontals and nasals, ? incipient horns. Washakie Eocene.	*Palaeosyops* (*Limnohyops*) *fontinalis* Cope. A small species with molars of the Telmatotherium type, namely, with rather high crowns, angular crescents, with hypocone on M 3 as large as protocone. Bridger Proper.
3. *Telmatotherium cornutum*, Osborn. Type in American Museum. Skull twice as large as former species. No sagittal crest, frontal region slightly convex and temporal ridges widely separated. Character of molar and zygoma, as well as nasals, the same as in *P. megarhinus.* Molars with crowns high and crescents more angular, no intermediate tubercles. Indications of incipient horns. Transition beds of Bridger, just below the Uinta proper.	*? Telmatotherium hyognathus S. & O.* This species is represented by a large jaw in the Princeton collection. Generic reference uncertain. Washakie.	

BIRDS OF NEW GUINEA (MISCELLANEOUS).

BY G. S. MEAD.

(*Continued from page 417*).

Considerable uncertainty exists in regard to the different species of *Rectes.* The lines of division between them have not been clearly drawn; accordingly, we are in possession of more names than birds, the difficulty arising from insufficient information as to the size, age, locality and even sex of the specimens described. Passing over two or three doubtful forms we meet with a species new to science when D'Albertis and Salvadori first saw it. It is *R. brunneiceps.* The back and scapulars are a bright cinnamon, the head and neck a clouded brown, the breast, abdomen, under sides of wings and tail fulvous. The ground color therefore, is not as distinctly laid as in most, if not all, of the other forms.

Rectes aruensis is a handsome little bird of a very bright chestnut body, a crested head entirely black, and throat, breast, wings and tail the same. Under parts are of a deep tawny buff. The black on the breast is prolonged in a shield-like figure as far as the abdomen. Length, ten inches.

Rectes jobiensis has a warm reddish brown thoughout excepting where, as on the head, the coloring takes a lighter dye. The under parts are not materially different in coloration, a paler or deeper shading of the prevailing tint only being noticeable. Even the bill has the same general complexion. The female is similar to the male with the advantage of a somewhat larger size. As indicated by the specific name, *jobiensis* comes from the island of Jobie, northwest of the mainland in Geelvink Bay. He is a handsome bird like most of his kind, the erectile crest, which, however, is scarcely more than the head feathers considerably ruffled, adding to his conspicuous appearance. Not much is known of his habits or of any of the Rectes. The total length of the present species is a fraction over nine inches.

Pseudorectes, classed as a separate genus, are so like the Rectes in most respects as to make special description, if entered upon at all, of obvious necessity. It will be sufficient here, while pointing out that the differences lie chiefly in the form of the crests, bill and, in the case of *Melanorectes* (a third genus), nasal bristles, to mention a few species and add one or two details as marks of identification. *Pseudorectes cristatus*, now placed in this genus, is noticeable for its crested head. Its general color is dull red, shading and paling on certain parts of the body, wings and tail. In size and appearance *Pseudorectes ferrugineus* is like the other species. Male and female differ imperceptibly. Above darkish brown predominates shading off or brightening on the wings and tail. Beneath is a soft buff. The bill, legs and feet dusky. *Pseudorectes leucorhynchus*, or white-bellied wood shrike, is another species with the customary coat of snuff brown, tail brighter, head darker, under parts a warm buff as far as the throat, which becomes tawny. Bill yellow. Tail nearly one-half the total length, measuring more than five inches. A synonym is *Colluricincla leucorhyncla*, sometimes classified as *Rectes*.

The third genus, *Melanorectes*, represented by the species *nigrescens*, is fairly well indicated by its name. The general color of the male is dark, black on the head, black or sooty on the under parts. Bill black, legs plumbeous. The female is ruddy and dusky brown, rejoicing in a brighter garb than her mate, although the tints are neutral rather than positive. The length is seven inches.

The *Rectes*, or to be more exact, *Rectes dichrous*, is the only bird according to Mr. Goldie, that the natives will not eat.

New Guinea contains several species and sub-species of the genus *Chibia*, the native name for the Drongo shrike, birds of from 10 to 13 inches in length, belonging to the family of the *Dicruridæ*. They are black in color with a purplish or greenish sheen, rather long, square cut tails, wings somewhat longer, both reflecting lustre more or less faint, strong, curved beaks imbedded in bristling hairs, and, in some instances, long, delicate, flexible hair-feathers on the head. It seems hardly essential to separate this genus from *Dicrurus*. In fact, most travelers in New Guinea have employed the latter name exclusively in describing these birds, but Mr. Sharpe's decision is in favor of the first mentioned. *Chibia carbonaria* is perhaps the most common member of this genus, being met with near Port Moresby and elsewhere in New Guinea as well as on adjacent islands. It is 12 inches long, black all over, with green or purple gloss sometimes, glittering as from metal, but on the face of a velvety softness. The bill and legs are also black. A smaller form inhabiting the Aru Islands has been called *Dicrurus assimilis.*

Another variety, *Chibia megalornis,* belongs to Ke Island, to the east of Aru. Here the gloss and reflections are about the same as already recorded, with perhaps an added glint of blue and darting gleams of steel. Bead-like points show here and there on the breast as on the other species. Hackles appear on the neck of a greenish tinge. The bird is about 11 or 12 inches in length with tail about half as long.

A little bird living in Southern New Guinea, though not confined to that region, may frequently be seen flitting about among the trees in the bush, engaged in a busy search for food. This is *Collyriocincla brunnea* of the *Prionopidæ.* It is a brown and gray bird, the brown washed with gray as on the wings, becoming altogether white on the cheeks, or gray obtruded upon by brown, as along the the tail and on the crown; below a muddy tint running whitish and white on the belly and under tail-coverts. A glow of yellow shows on the under wing-coverts. The length is only between 8 and 9 inches.

Closely related to the foregoing, by some authorities regarded as of the same class, by others formed into a separate genus, are small birds termed *Pinarolestes;* little shrikes they may be called. The species *P. megarhynchus* is common enough throughout the archipelago. The prevailing color is a dark brown, streaked on the breast a deeper hue. Total length 8 inches; the female a trifle smaller.

Near Port Moresby, of recent years so well known a spot in Southern New Guinea, may be met more or less frequently a few species of the *Oriolidæ,* one of which, of the genus *Sphecotheres,* is especially noticeable. It is about the average size of the oriole, has some bright color, though the general tone is sober, and has that bare or bald circlet around the eye which imparts a singular aspect to the face. The bird in question is *Sphecotheres salvadorii,* so named from the eminent Italian ornithologist. There is much olivaceous, becoming almost yellow around the body, running into a bluish gray about the throat and side face, white on the abdomen, yellow on the upper portion, white in wide patches on the outer tail feathers, the inner ones black, jet black on the crown as far as the staring spaces enclosing the eyes. The female is clad in dusky brown or slate mainly, mottled by darker spots on the upper surface, the under parts with running spots or irregular lines of olive or dusky over a pale yellow ground. The tail is marked similarly with that of the male, only brown takes the place of black, and dull yellow of white on some of the feathers. Clear white occurs about the vent and an open spot around the eye. Mr. Stone collected this bird as well as *Oriolus striatus,* a true oriole, common, probably, over the island. In this case the general coloration is not greatly unlike that of the female above described, with, however, a purer brown both above and beneath; but the distinctive feature of the *striatus,* as the name implies, rests in the streaks which appear almost everywhere in narrow or broader lines over the body and even monopolize the crown of the head. In fact, about the only parts free from these long black, brown or gray streaks are the wings and tail, yet these are lined off or margined with slightly different tints. The female does not show markings at variance with those of the male. The length is a good 12 inches.

Hattam Thickhead (*Pachycephalopsis hattamensis*), is a small bird about 7 inches in length, found in the mounains of Northwest New Guinea. The sexes do not differ in color or size. Back and wings are a deep olive which becomes a mere line on the wing-coverts; these are almost black. The under-wing coverts and tail are a light brown somewhat varying in shade. The head and nape of neck are gray, the lores white, as are also the chin and throat. Lower down this changes into a greenish yellow, shading off on the abdomen. Bill and feet dark.

The Blue-bodied *Eupetes*—*Eupetes cærulescens*—is a small thrush-like bird about 8 inches in length. D'Albertis speaks somewhat doubtfully about its habits. It runs along the ground, he says, and does not appear to perch upon the trees. Gould, however, figures it on low branches. In color it is not unlike our shrikes, although darker and more uniform, the prevailing tint being a soft bluish grey. Black is seen on the face and as a narrow rim surrounding the pure white throat. A less clear gray is spread on the under tail feathers; otherwise the gradations of the uniform steel blue are scarcely observable. The bill is sharp and black ; legs and feet black. The noticeable feature of this bird is the pure white throat, the white extending well down on the breast and half way round the neck. This feature is characteristic of this fine group of birds and marks them out at once.

The Manucodes form in their several species a beautiful class of richly plumed birds, sometimes numbered with the *Paradisea*, but belonging rather to the crow family. They are however a glorified crow in their sparkling dress and imperial bearing. One of the most conspicuous for size and elegance is the Curl-crested bird of paradise, as he is sometimes styled —*Manucodia comrii.* This species is of a wondrously lustrous black throughout; it fairly blazes out with the very intensity of brightness, so that all the possible combinations which rays of light fastening upon a gleaming black surface are capable of forming, here display themselves in changing blue, violet, green, purple, etc. The dazzling effect is greatly magnified and heightened by the appearance as it were of beads and spangles of feathers upon the flat surface of the body. Upon these the reflections of light seize and glitter with a fitful radiance. To no bird, therefore, can the term sparkling be applied with as much appropriateness as to the Manucodes, Especially are these short, crisp, curl-feathers producing the strange effect abundant on the breast. In fact, they cover it, while reaching around the sides and upon the shoulders. The head, too, with its double crest of compact, thick feathers, is almost as heavily bejewelled. In addition to the short convoluted feathers, another singular feature should not be overlooked: upon the long, heavy tail-feathers may be seen superfluous feathers, somewhat loosely laid and extending not quite the length of those below. These take the shape of the keel of a boat not unlike the tail of our crow blackbird in flight, though devoid of the trimness and elegance that marks that fine bird. The habitat is the D'Entrescasteaux group of islands. The bird has a strange, low, far-penetrating whistle. The bill and feet of the *comrii* are dull black. The bill is long and powerful. The total length of the bird is between 17 and 18 inches. The nest of this manucode has been found on the lower branch of a breadfruit tree near the end. It was composed of small vines and twigs rudely heaped together. The eggs were long and pointed and more than an inch and a half in length. Their color was buff or fawn blotched with purple dots and streaks.

Considerably smaller, but quite as brilliantly adorned is the *Green* Manucode—*Manucodia chalybea*—whose habitat is the mountains near the seacoast. Although green would seem to be the distinctive color of this species, yet the play of blue over the basal black is almost as much in evidence; both these tints are evanescent. The little recurved feathers cover the head, neck and throat and the breast as far as the abdomen. The tail is also boat shaped and reflects blue, violet, purple from a smooth surface. The back is rippled over in blue, green and lilac waves of light whenever the bird moves or the angle of vision is changed. But it is on and by means of the spangled feathers that the most exquisite effects are produced. At times they seem to dart forth light like sparks on burnt paper. The length of this manucode is about 14 inches.

Another species of Catbird besides those already mentioned is the Black-naped--*Aeluroedus melanocephalus*. The resemblance is close among the several branches of this group of birds. Here as with all the rest grass green and pale yellow are the prevailing tints. In this instance the breast, head and neck are liberally marked with black spots or streaks. White with similarly black-tipped feathers takes the place of the yellow on the throat and cheeks. White terminates the tail feathers and is also found on the abdomen. There are spots of ochre on some of the wing feathers. The crown of the head is much dotted with black while the nape is almost entirely black. The length of this species is between 11 and 12 inches. The habitat the Astrolobe Mountains.

Mafoor Island Cuckoo-shrike—*Graucalus mafoorensis*—has a breast that is beautiful with wavy horizontal lines of white on a black ground color ; these lines extend over part of the under wings. In the female the lines are broader, forming narrow stripes, thus giving the appearance of being almost equally and alternately black and white. Otherwise the bird is a soft drab color uniformly spread. Its local habitat seems to be Mafoor Island in Geelvink Bay.

A bird met with frequently along the Fly River and elsewhere in New Guinea as well as in the adjacent islands is a kind of starling—*Mino* or *Eulabes dumontii* or *Gracula dumontii*—often seen sitting on the tops of dead trees, like the Twelve-wired bird of paradise and the Wattled bird. It is about ten inches in length, stout and well built. The body is a fine black with purplish and greenish reflections strongest on the shoulders. Some gray down feathers appear on the neck; on the wings a prominent white patch but small when the bird is not in motion, is to be noted. The under tail-coverts are white sheathing the black tail. The abdomen is bright yellow, as are also the bill and feet. The eyes darker, almost brown. Around the eyes large bare spaces covered with a dull colored skin only, call particular attention to this Grakle. There are also bald spaces extending from the roots of the bill to the chin and throat. The sexes are alike. By some strange oversight in Stone's little volume, this bird is called the Golden oriole. It may be, however, that this traveler confounded Dumont's grakle with an allied genus not altogether unlike an oriole, namely *Gracula orientalis* or *Melanopyrrhus orientalis*, which is not uncommon near Port Moresby and other parts of New Guinea. This showy bird has the head of a bright rich orange. The same deep color marks the rump, lower back and upper tail-coverts. Under parts around the vent show almost as deep a hue. All else is a glossy green-reflecting black, save a few yellow feathers near the neck. Bill, feet and eyes are light yellow. Length, 10 inches. Another species—*Melanopyrrhus* or *Gracula anais*, has less vivid orange than *orientalis*, but is marked similarly excepting on the head which instead of a rich yellow is glossy black, the bright color not appearing until a broad collar is seen round the neck and throat.

D'Albertis in his Journal describes another Mina, very scarce, which he considered new to science. The male has the "head, neck and breast of a rich orange golden color; throat and sides of the head, dark blackish green; abdomen above and below black, each feather margined with dark shining green; rump and tail-coverts deep golden orange; belly yellow, under tail-cover white tipped by a light yellow, wings and tail black, primaries white spotted, bill, eyes and feet, yellow." The traveler named the bird *Mina robersonii.*

The Chestnut-backed Eupetes—*Eupetes castanonotus*, is a small, noticeable bird found among the Astralobe Mountains in Eastern New Guinea, and in those of the northwest. The general color above is a rich chestnut. The lower back, rump and upper tail-coverts a clear blue. Wing-coverts are a bright blue with the shaft lines plainly visible. Some reddish stains tinge the scapulars while some small black feathers may also be descried. The tail is of a dull blue cast with clearer edges. The head is banded by a pale blue stripe above the eyes. Black markings diversify the face and run as a narrow rim around the pure white throat and cheeks. The under parts are a bright blue. At the termination of the under tail-feathers are broad patches of black. The length of the male bird is 9 inches. The female is somewhat smaller, differing further in having the entire upper surface chestnut without any blue. The tone is duller, however, excepting on the lower back and rump.

Beccari's Scrub Robin—*Drymoedus beccarii*—is a plain bird, distinctively Australian in character, found in the mountainous regions of New Guinea. The general color above is a lightish brown, wing-coverts ashy brown and black barred with white. Middle tail feathers brown tipped with white. The head is of a darker brown with a spot of black beneath each eye. The cheeks and throat are a dingy white. Under parts are of a paler brown running into ashy along the sides. Under tail-coverts brown, under wing-coverts dusky tipped with wide white bars. Bill black. Feet light. Length, 7 inches.

A Moluccan Bulbul—*Criniger chloris*—is a rather long, slender bird of a shaded yellow color, about 8.5 inches in length. The head is dark, almost black, sides of the throat slightly speckled. Tail is long and broad. Bill long and black. Feet black. Iris black. Male and female alike. This graceful bird inhabits Batchian and Gilolo, falling, therefore, within the geographical limits of Papua.

Though dull in color the Naked-faced Honey-eater—*Melipotes gymnops*—is not the least interesting of the division of birds to which it belongs. Very many of the honey eaters are remarkable for their rich variegated plumage and the elegance of their forms. New Guinea contains numerous species peculiar to its own territory, while sharing with other portions of Malaysia the possession of many more. The species just noted comes from the Arfak Mountains. It is a small bird with a total length of 8.5 inches only. The prevailing color is dark brown cinereous, deepest on the back and shoulders. The face is bare and of a dingy yellow or mud color; a tint almost the same is seen on the thighs and near the vent. These are the only parts which can boast of any brightness. The abdomen and lower breast present a slightly mottled or striated appearance because of the presence of straggling light feathers over the dark slate ground color. The under tail is also of a slate color unrelieved excepting by the white quills. Bill and feet black, the former short and sharp. D'Albertis classified this honey-eater as a new genus and new species, calling it also a beautiful bird. It hardly deserves this epithet as we have seen.

Among the many Lories of New Guinea, one of the loveliest in harmonious blending of rich colors is the Red-fronted *Chalcopsitta scintillata*, Temm. It is of small size, only a foot long and of a warm, soft green plumage set off with carmine and black. The forehead is a velvety crimson running into black on the crown. Crimson appears also on the bend of the wings, on the under side of the wings intermingled with yellow, on the thighs and on some of the tail feathers; these tail feathers, exquisitely tinted with yellow at their extremities, are rounded and overlapped in a curiously beautiful fashion. All else the color is a predominating green, frequently flushed with red or grained with yellow. Bill and feet black, eyes yellow. The sexes are not easily distinguished.

ON A NEW CLASSIFICATION OF THE LEPIDOPTERA.

By A. S. Packard.

The taxonomic importance of Walter's most interesting discovery that *Eriocephala calthella* has maxillæ constructed on the type of those of biting or mandibulate insects, *i. e.*, with an inner and outer lobe (lacinia) beside the palpi, was apparently overlooked by him as well as others, though its bearings on the phylogeny of the Lepidoptera as, however, insisted on by Walter, are, it seems to us, of the highest interest. The presence of the maxillary lobes, homologous with the galea and lacinia of the Mecoptera (Panorpidæ) and Neuroptera (Corydalus, Myrmeleon, as well as the lower orders Dermaptera, Orthoptera, Coleoptera, etc.), in what in other important respects also is the "lowest" or most primitive genus of Lepidoptera, the lacinia being a rudimentary, scarcely functional glossa or tongue, and not merely a vestigial structure, is of great significance from a phylogenetic point of view, besides affording a basis for a division of the Lepidoptera into two grand divisions or sub-orders, for which we would propose the names *Lepidoptera laciniata* and *Lepidoptera glossata.*

Sub-order I. Lepidoptera laciniata.

Walter thus writes of the first pair of maxillæ: "The other mouth-parts also of the lower Micropteryginæ have a most primitive characteristic. In the first pair of maxillæ of *Micropteryx calthella*, *aruncella*, *anderschella* and *aureatella*, cardo and stipes are present as two clearly separate pieces. The former in *M. calthella* and *aruncella* in comparison with the latter is larger than in *anderschella* and *aureatella*. In the last two species, the cardo is still tolerably broad, but reduced. The stipes are considerably longer than the cardo in the two last species, while it is of the same thickness. From the stipes arises the large 6-jointed palpus maxillaris, folded two or three times and concealing the entire front of the head and all the mouth-parts. *At its base, and this is unique among all the Lepidoptera, two entirely separate maxillary lobes arise from the stipes. The external represents the most primitive rudiment (anlage) of a lepidopterous tongue.*" (Fig. 1.) It is evident from Walter's figures and description that this is not a case of reduction by disuse of the tongue, but that it represents the primitive condition of this lobe or the galea of the maxilla, and this is confirmed by the presence of the lacinia, a lobe of the maxilla not known to exist in any other Lepidopterous insect, it being the two galeæ which become elongated, united and highly specialized to form the so-called tongue or glossa of all Lepidoptera above the Eriocephalidæ,[1] which we may regard as the types of the *Lepidoptera laciniata*.

Another most important feature correlated with this, and not known to exist in *Lepidoptera glossata* is the presence of two lobes of the second maxillæ, besides the 3-jointed labial palpi, and which correspond to the *mala exterior* and *mala interior* of the second maxillæ of Dermaptera, Orthoptera, Platyptera, Corrodentia, *i. e.*, Perlidæ, Termitidæ and Odonata, and also, as Walter states, to the ligula and paraglossæ of Hymenoptera. In this respect, the laciniate Lepidoptera are more generalized than Neuroptera, Trichoptera, or Mecoptera.

Walter thus describes the two lobes or outer and inner mala of the second maxilla: "Within and at the base of the labial palpi is a pair of chitinous leaves provided with stiff bristles,

[1] In his paper on the larva of Eriocephala, etc. (Trans. Ent. Soc. London, 1894, p. 335), Dr. Chapman separates the old genus Micropterya into two families: *Eriocephalidæ* and *Micropterygidæ*. His group *Eriocephalidæ* I here regard as comprising the types of the sub-order *Lepidoptera laciniata* or *Protolepidoptera*.

being the external lobes of the underlip formed by the consolidation of the second pair of maxillæ, and which reach, when extended, to about the second-third of the length of the second palpal joint. Its inner edge is directly connected with the inner lobe (mala interna). The latter are coalesced into a short, wide tube, which, by the greater size of the hinder wall, opens externally on the point, also appearing as if, at the same time, cut off obliquely from within outwards.

"The outer anterior edge of the tube forms a strongly chitinous semi-circle which, becoming thinner, finally passes into the delicate membranous hinder wall. Also anteriorly a delicate membrane appears to cover the chitinous portion.

FIG. 1.

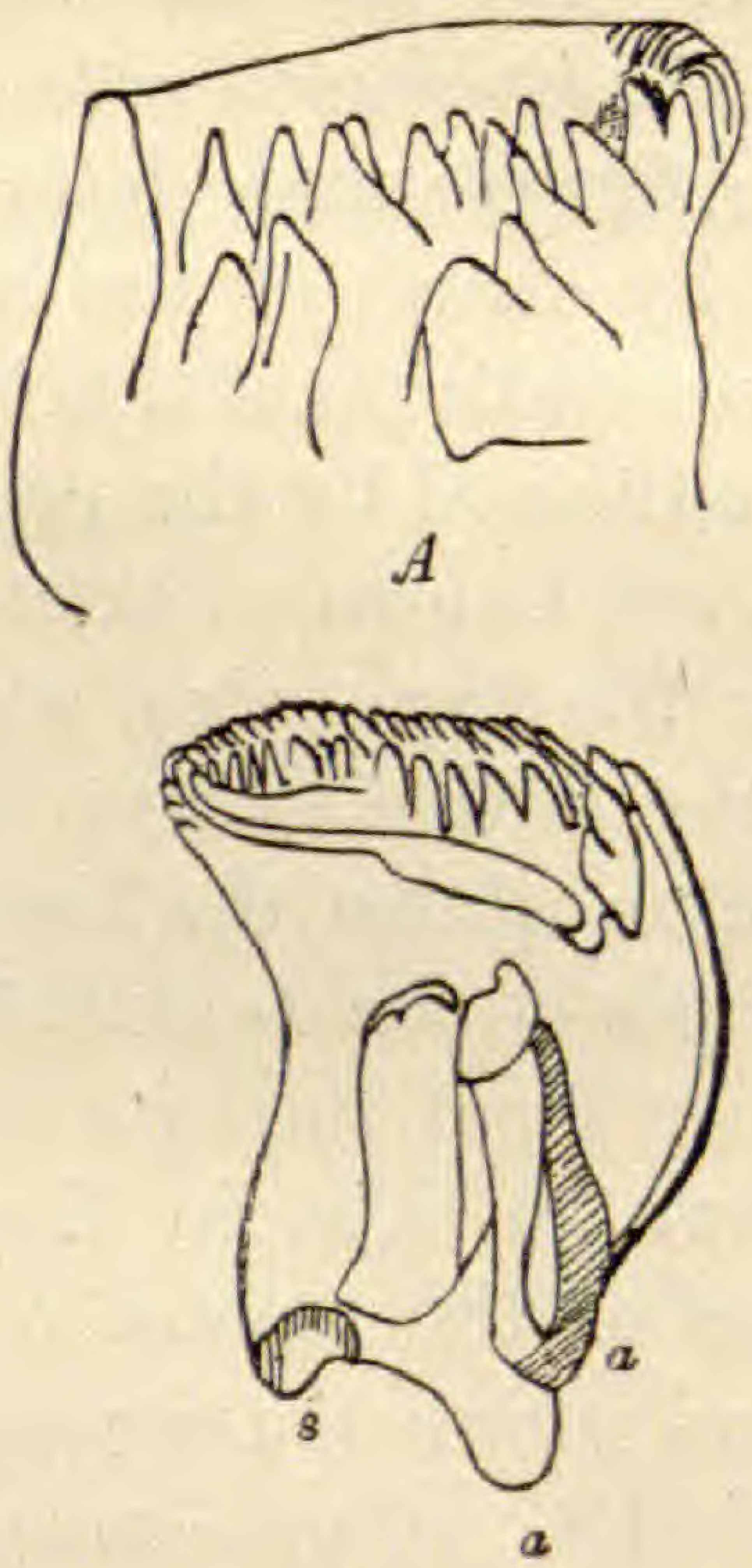

FIG. 2.

"We have here, in opposition to the weak, naked under lip represented by a triangular chitinous plate of the Lepidoptera, a true ligula formed by the coalescence of the inner lobes of the second maxillæ into a tube, as in many Hymenoptera, and with free external lobes, which correspond to the paraglossæ of Hymenoptera."

Walter has also detected a paired structure which he regards as the hypopharynx. As he states: "A portion of the inner surface of the tube-like ligula is covered by a furrow-like band which extends close to the inner side, is coalesced with it and in position, shape, as well as its appendages or teeth on the edge may be regarded as nothing else than the hypopharynx."

While he refers to Burgess' discovery of a hypopharynx in *Danais archippus*, he remarks that this organ in the lower Micropteryginæ (Eriocephalidæ) exhibits a great similarity to the relations observable in the lower insects, adding: "The furrow is here within coalesced with the inner side of the labium, and though I see in the entire structure of the head the inner edge of the ligula-tube extended under the epipharynx as far as the mandible; I must also accept the fact that here also the hypopharynx extends to the mouth-opening, as in all other sucking insects with a full-developed under lip, viz., the Diptera and Hymenoptera."

Another feature of importance, diagnostic of this suborder, is the mandible (Fig. 2), which, in form, size and the teeth are closely related to those of the lower mandibulate orders, being, as Walter states, in the form of true gnawing jaws, like those of the biting insects. They possess powerful chitinous teeth on the opposed cutting edges, 12 to 15 on each mandible, and also the typical articulating hook-like processss by which they are joined to the gena, and corresponding cavities are in the latter. In Micropteryx and other of the more generalized moths, the mandibles in a very reduced form here survive as functionless vestiges of the condition in Eriocephala.

Turning now to the head and trunk, we find other primitive characters correlated with those just mentioned.

The head is of moderate size, as wide as the body, with small compound eyes, and with two ocelli. The occipital region is well developed, as in the epicranium; the clypeus and labrum are of moderate size.

The generalized nature of the thorax is especially noteworthy. Tho prothorax is seen to be very much reduced, the two tergites being separate and minute, not readily seen from above. The rest of the thorax is very long, exhibiting but little concentration.

The mesothorax is but slightly larger than the metathorax, the mesoscutum is very short, the scutellum rather triangular than scutellate.

The metathorax is but little shorter and smaller than the mesothorax, and remarkable for the widely separated halves of the scutum, a Neuropterous character (compare Ascalaphus and Corydalus) in which it differs from Micropteryx. The slope of the scutellum is that of a low, flattened triangle.

As regards the abdomen, attention should be called to the disparity in size and shape between the sexes, also to the male genital armature, which is very large and completely exserted, and reminds us of that of Corydalus, in which, however, the lateral claspers are much reduced, and also that of certain Trichoptera (Sericostoma, Tinodes, Stenophylax, Hydropsyche, etc.).

The larval characters of this sub-order it would be difficult to give, for in the remarkable larva of *Eriocephala calthella* as described and figured in Dr. Chapman's elaborate account, we appear to have a highly modified form, entirely unlike the simple apodous larva of Micropteryx, and perhaps quite unlike the primitive stem-form of Lepidopterous larvæ. We are indebted to Dr. Chapman for mounted specimens in a slide kindly given us by him. The body is broad and flattened, the segments very short in proportion to their width, the prothoracic segment, however, very long in proportion to the others, but the surface rough and corrugated, not with a hard, smooth dorsal plate as in many Tinidæ, Tortricidæ, etc., since it is not a boring insect. The eight pairs of abdominal prop-like tubercles, which we should hardly regard as homologues of the abdominal legs, are, like those of the Panorpidæ, simple tubercles armed with a curved spine. The tenth or last abdominal segment is armed with a pair of dorsal spines, arising from a tubercle. The singular flattened and fluted setæ represented by Chapman are unique in Lepidopterous larvæ. He also describes a trefoil-shaped sucker on the under side of the ninth and tenth abdominal segments, "very unusual;" though as it appears to be paired, it does not, as Chapman thinks, seem to us to indicate "a further point of relationship to Limacodids."

Chapman states that "the head is retractile, so far, that it may occupy the interior of the second thoracic segment," and he says that "the antennæ are remarkably long for a

Lepidopterous larva." He remarks that there are "two strong mandibles, with four brown teeth," and adds: "two pairs of palpi are also visible—two- and three-jointed, apparently those usual in Lepidopterous larvæ, but I have not defined their relations. There is also a central point (spinneret?)"

I add rough sketches of the mouth parts, so far as I could draw them with the camera from specimens mounted in balsam by Dr. Chapman. The labrum (Fig. 3, *lbr.*) is less divided than usual in Lepidopterous larvæ, but is not, in this respect, much unlike that of Tineids *e.g.* Gracilaria (see Dimmock's Fig. 2, p. 100, Psyche, iii). The four-jointed antennæ (Fig. 3A *ant.*), ending in two unequal setæ, are of very unusual

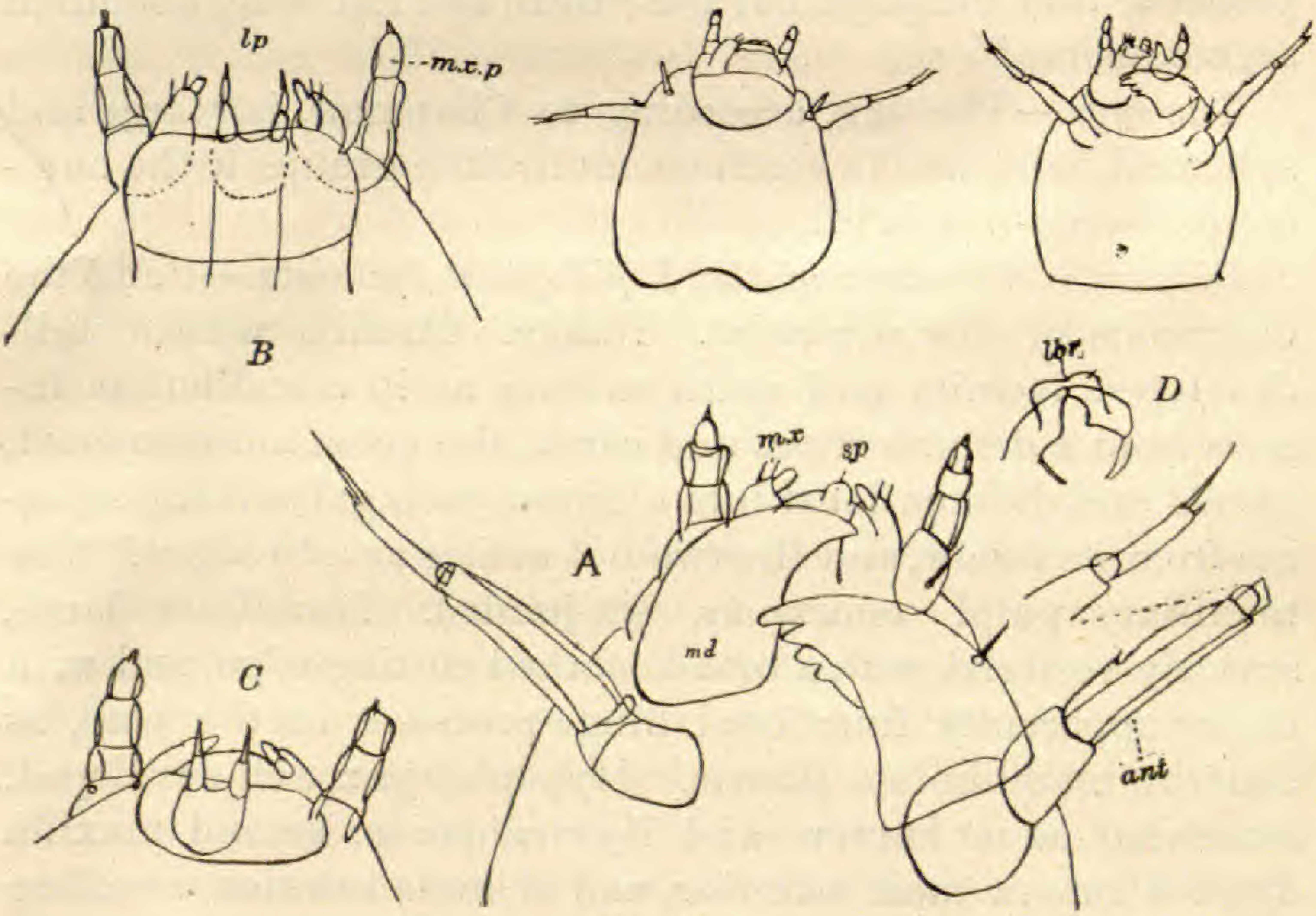

FIG. 3.

size and length, and so are the maxillary palpi (Fig. 3B *mx.p.*) which are much larger than in any caterpillar known to me, and greatly in disproportion to the maxillary lobes; the maxillary itself differs notably from that of other caterpillars; what appears to be the lacinia is palpiform and two-jointed. The labium and its palpi are much as in Gracilaria, but appear to be three-jointed, with a terminal bristle (it is possible that there are but two joints). Unlike the larva of Micropteryx, that of Eriocephala does not appear to possess a well-marked spinneret; while it is easy to see it in the former genus, in Eriocephala I can only detect a lobe which appears to be simply the rudiment (*anlage*) of a spinneret (unless the latter is in my specimen bent under the head); but this organ needs further examination on fresh specimens. It would be interesting if it should be found that the spinneret is in a generalized or germinal condition, as compared with that of Micropteryx.

The pupa.—Unfortunately, we are, as yet, ignorant of the pupa form. Dr. Chapman has only found the head-piece of the pupa, but refers it to the "Incompletæ," and thinks it probable that the pupa has the "third and following abominal segments free"

The eggs.—The egg, according to Chapman, is "large and spherical," and laid in confinement in little groups, to the number of twenty-five in all.

Diagnostic characters of the Lepidoptera laciniata.—I add the characters of this sub-order. Imago. Maxilla with a well-developed lacinita and galea, arising as in mandibulate insects from a definite stipes and cardo, the galea not elongated, united and differentiated into a glossa, each galea being separate from its fellow, and the two not acting as a "tongue." The maxillary palpi enormous, six-jointed. Mandibles large, scarcely vestigial, with a broad, toothed cutting-edge, and with them apparently functional hinge-processes at the base, as usual in mandibulate insects. Hypopharynx well-developed, somewhat as in Diptera and Hymenoptera; second maxilla divided into a mala exterior, and a mala interior, recalling those of mandibulate insects; palpi three-jointed. Thorax and prothorax very much reduced; metathorax very large, with the two halves of the scutum widely separate.

Venation highly generalized; both fore and hind wings with external lobe or a "jugum" as in Trichoptera, veins as in Micropteryx and showing no notable distinctions compared with those of Micropteryx; scales generalized; fine scattered setæ present on costal edge and on the veins. Abdomen elongate, with the male genital armature neuropteroid, exserted, the dorsal, lateral and sternal appendages very large.

Eggs spherical. Larva, in form, highly modified, compared with that of Micropteryx, with large, four-jointed antennæ and very large three-jointed maxillary palpi; no spinneret? No abdominal legs, their place supplied by a pair of tubercles ending in a curved spine on segments 1–8; a sternal sucker at the end of the body. Pupa libera?

Sub-order II. LEPIDOPTERA HAUSTELLATA.[2]

This group may be defined thus: Maxillæ with no lacinia, the galeæ being highly specialized and united with each other to form a true tubular haustellum or glossa, coiled up between the labial palpi. The maxillary palpi large and fine or six-jointed in the more generalized forms, usually vestigial or entirely wanting in the more modern specialized families. Mandibles absent, as a rule, only minute vestiges occurring in the more generalized forms. Wings both jugate and frenulate, but mostly the latter, tending to become broad and with highly specialized scales, often ornamented with spots as well as bars, the colors and ornamentation often highly specialized; the thorax highly concentrated, the metathorax becoming more and more reduced and fused with the mesothorax; the abdomen in the generalized forms elongated, and with large exserted male genital armature.

Pupa incomplete, the abdominal segments 3 to 6 or 7 free, in the more generalized primitive forms, the end of the maxillary palpi forming a visible sub-ocular piece or "eye collar;" or a flap-like piece on the outside of the maxillæ; the labial palpi often visible; clypeus and labrum distinct; paraclypeal pieces distinct; no cremaster or only a rudimentary one in the generalized primitive forms.

Larva with usually a prothoracic or dorsal chitinous plate; the armature consisting, in the primitve forms, of minute one-haired tubercles, the four dorsal ones in a trapezoid on abdominal segments 1–8, becoming specialized in various ways in the later families into fleshy tubercles, or spines of various shapes. Five pairs of abdominal legs, with hooklets or crochets forming

[2] If the term *haustellata* should be thought inapplicable from its frequent use by former authors, the term *Lepidoptera glossata* could be used instead.

a complete circle in the more generalized forms (in Hepialidæ several complete circles), the hooklets in the latter more specialized groups, usually forming a semicircle situated on the inner side of the planta.

This sub-order may be sub-divided into two series of super-families and families, the *Paleolepidoptera* and the *Neolepidoptera.*

I. Paleolepidoptera (*Pupæ liberæ*).

The characters of this group are those of Micropteryx, whose larva has a well-developed spinneret; though it has no abdominal legs, the other features are so truly lepidopterous that the absence of legs may be the result of reduction by disease, rather than a primitive feature.

The pupa (Fig. 4) has entirely free antennæ, mouth-parts and limbs, and bears considerable resemblance to that of a caddis-fly. The mandibles are enormous, and, as described by Chapman, are adapted for cutting through the dense coccoon. The maxillæ are separate and curved up on each side and partly concealed by the labial palpi, not extending straight down as in the *Pupæ incompletæ* and *obtectæ;* the maxillary palpi situated just in front of the mandibles extend outward and forward, reaching to the antennæ. The labrum is deeply cleft and strongly setose, as is the epicranium; the clypeus is square, with a singular, white, delicate membrane, the use of which is unknown. The hind legs extend beyond the end of the abdomen, which is simple, not terminating in a cremaster; the sides of the segments bear a single large seta.

The trunk characters are much as in Eriocephala. The head is larger and squarer, the eyes very small; there are two ocelli present; the clypeus and labrum short and small.

The prothorax is very much reduced, much as in Eriocephala; the metathoracic scuta show an advance over those of Eriocephala in being united on the median line instead of separated; the metoscutellum is very large, larger and more scutellate than that of Eriocephala.

The shape and venation of the wings (Fig. 5) are nearly identical with those of Eriocephala, being long, narrow and pointed, both pairs nearly alike in size and venation, except that on the hinder pair there is a "jugum" or angular fold: scales are of generalized shape all over the wing. The pres-

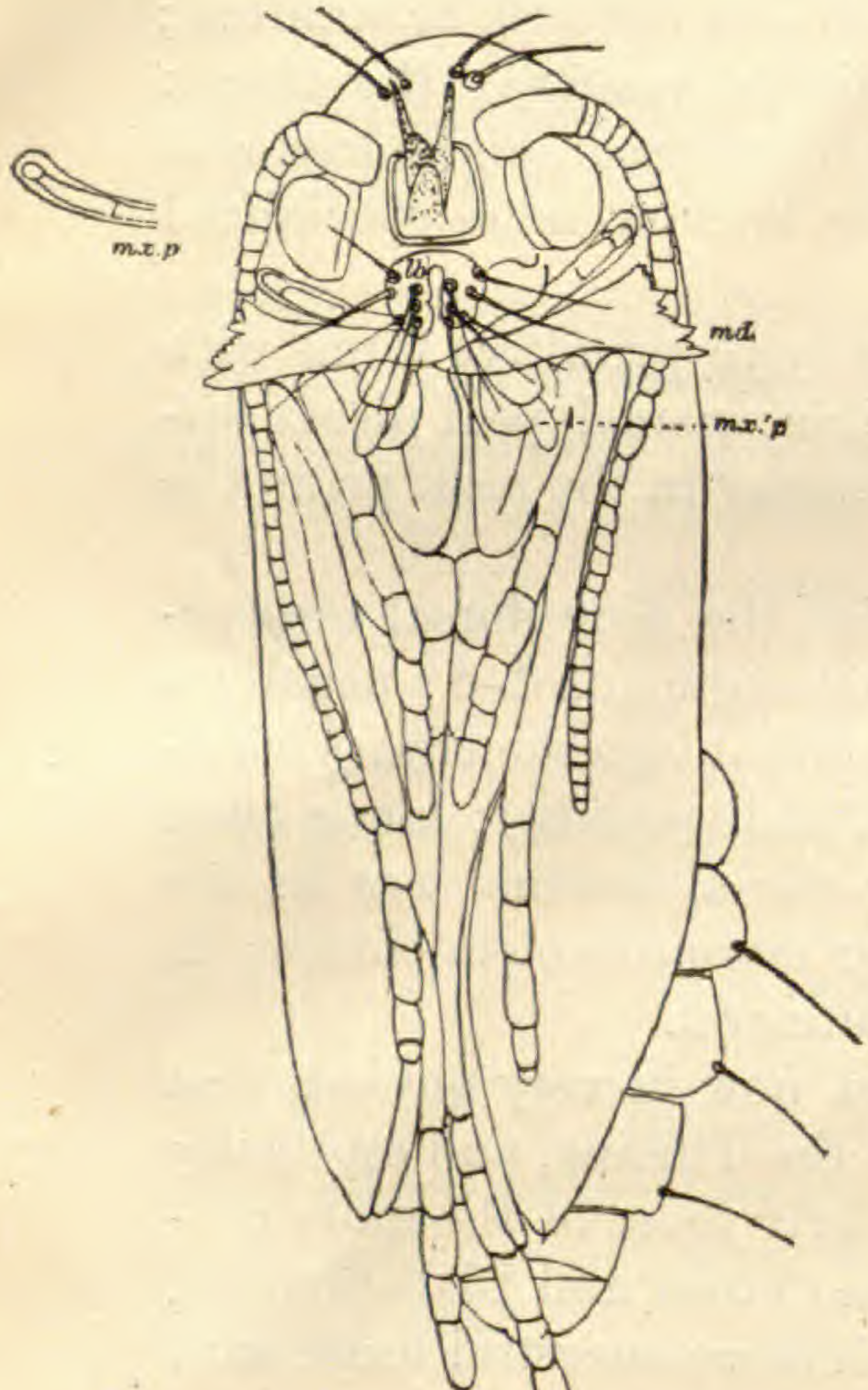

FIG. 4.

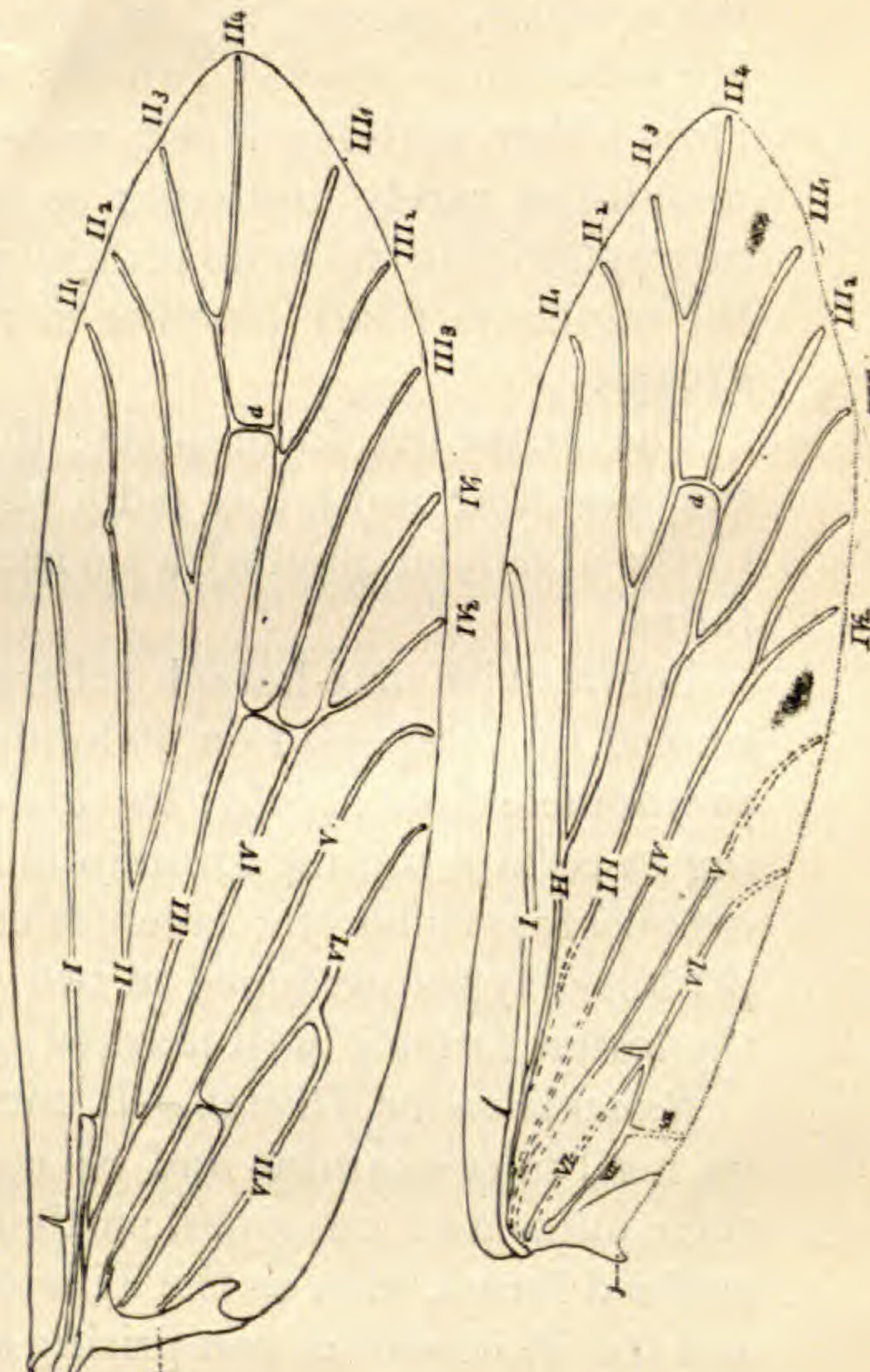

FIG. 5.

ence of a jugum on both pairs of wings is significant, since in Trichoptera, they are also present in both pairs of wings.

II. Neolepidoptera.

This series may be divided into two sections, corresponding in the main to the *Pupæ incompletæ* of Chapman (the Eriocephalidæ and Micropterygidæ included by Chapman being removed), and his *Pupæ obtectæ*, for the first of which we would suggest the name *Tineoids*, and for the second, the large broad-winged forms or Macrolepidoptera or Platylepidoptera.

Tineoids or *Stenopterygia.*

These are Tineoid forms with many vestiges of archaic features, usually with narrow wings, of dull hues or with metallic bars, or with highly specialized shapes of scales and spots, and the venation generalized in the earlier forms. The maxillæ are sometimes aborted (wholly so in Hepialidæ); maxillary palpi either well-developed, more or less reduced, or wanting; mandibles rarely occurring as minute vestiges; the thorax neuropteroid in the more primitive forms becoming shorter and the segments fused together in the later or more specialized groups.

The pupæ are incomplete; the more primitive forms with the eye-collar and labial palpi visible; paraclypeal pieces distinct; abdomen often with no cremaster in the most primitive forms.

Larvæ with one-haired tubercles, the four dorsal ones arranged in a trapezoid on abdominal segments 1–8; usually a prothoracic dorsal plate; the abdominal legs sometimes wanting in certain mining forms (and Cochliopodidæ); larvæ often case-bearers or borers; crochets on the abdominal legs in the primitive types arranged in two or more complete circles; in the lowest forms a well-marked spinneret.

Remarks on the Tineina.—It must now be very obvious that we need to re-examine and revise the Tineina, and especially their pupæ and imagines, particularly those of the more generalized forms, such as the Tineidæ (Tinea and Blabophanes), and the Talæporidæ, comprising all those ancestral forms with broad wings and a generalized venation which may have given rise to the neolepidopterous families.

Then careful studies should be made on the Adelidæ, Choreutidæ and Nepticulidæ, and other families and genera in which the mandibles have persisted (though in a vestigial condition), and also those with functional or vestigial maxillary palpi, such as Tineidæ, Gracilariidæ, Elachistidæ, etc.

It is evident that the classification of the Tineina will have to be entirely recast; instead of placing the Tineidæ, with their broad wings and generalized venation at the head of the Tineina as done in our catalogues and general works, they should go to the base of the series, not far from the Micropterygidæ. On looking over the venation of the Tineidæ represented on Spuler's Plate XXVI, it is evident that the very narrow-winged genera, such as Coleophora, Ornix, Lithocolletis, Nepticula, Gelechia, Cemiostoma and Œcophora, are highly modified recent forms, when compared with Tinea and Blabophanes as well as the Adelidæ (Adela, Nemotois, Choreutidæ, Simaethis and Choreutis) and justify Chapman in associating them with the Pyraloids in his group of *Pupæ obtectæ*.

Family *Prodoxidæ*.—This group is represented by Tegeticula (Pronuba) and Prodoxus. The eye-collar (maxillary palpi, Fig. 6, *mx p*) is larger than in any of the other Tineina, and the group is thus intermediate between the Neo- and Paleolepidoptera. The pupa, as well as other stages, have been well-described by Riley, who, however, has overlooked the eye-collar, though he figures and describes the remarkable "maxillary tentacles." I am disposed to regard the latter organ as the maxilla itself, and to consider that the "maxilla" of Riley is the lacinia or inner lobe of the maxilla, but have had no material for examination. Should this prove to be the case, it would carry the family down among the *Lepidoptera laciniata*.

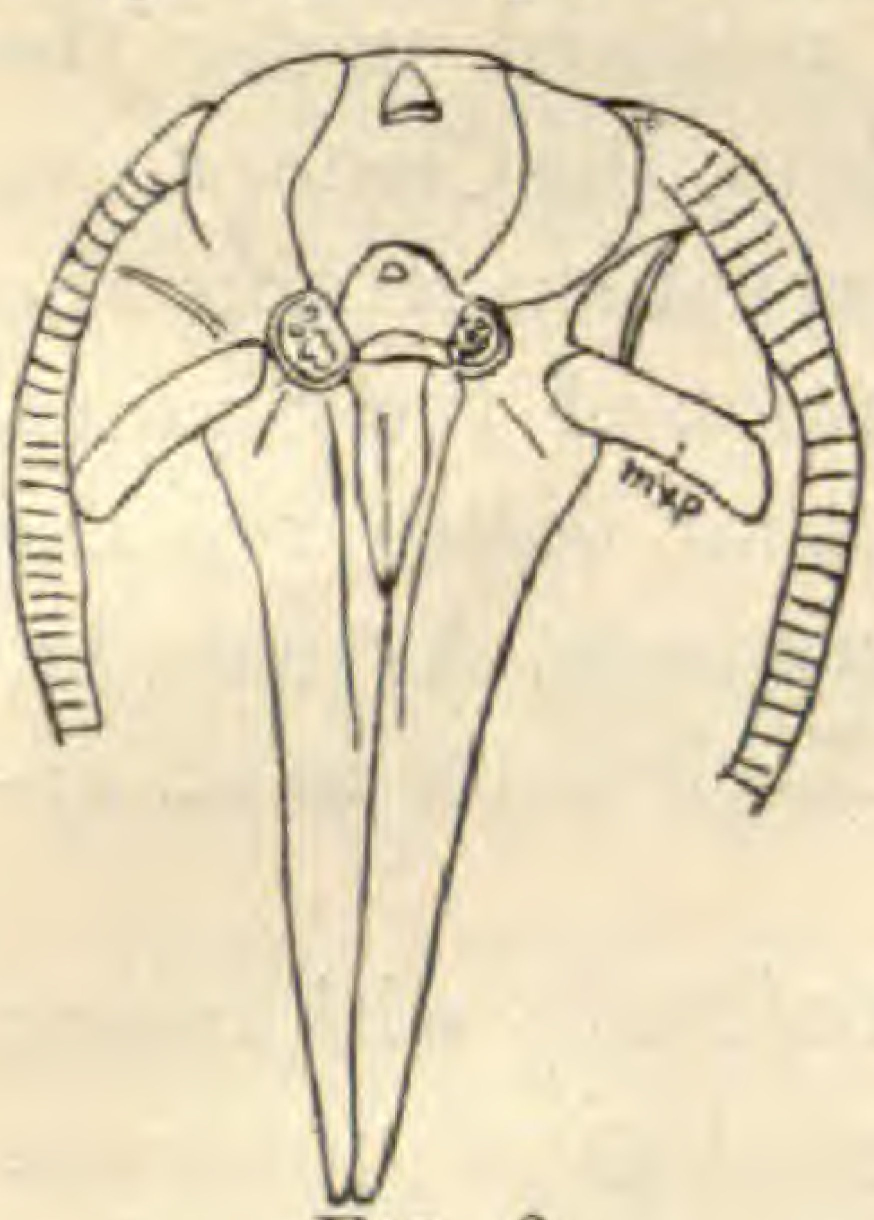

FIG. 6.

(*To be continued.*)

RECENT LITERATURE.

Some Recent Text-books and Student Guides.—For several years the crying need of American teachers has been a text-book of zoology which, in contents and manner of treatment, should be of use in American colleges and technical schools. All that our publishers had offered us were books which were far behind the times, and some were far behind any times unless we go back to that long ago when father Adam was posing as a systematist and was giving the animals their names. So the American student has had to depend on European works. Sedgwick's translation of Claus, notwithstanding its outrageously high price and its short comings in treating of the vertebrates has been used extensively. With Dr. McMurrich's Invertebrate Morphology[1] the demand is partially met—partially since the work deals only with the Invertebrates. Now the American teacher can refer his students to a brief and yet modern account of those animals fortunate enough to lack back bones, with the assurance that they will find, clearly expressed, the essential facts of structure and development. In his general treatment Dr. McMurrich follows the time honored precedent, first dealing with protoplasm and the cell, next with the Protozoa and the passing to the Metazoa and their various subdivisions. In these the sponges are retained under the Cœlenterata (spelled Cœlentera) while, rightly we think, the Ctenophores are regarded as a distinct branch. A bit of conservatism retains the Nemertines in the flat worms, and the close association of the Sipunculids and Gephyrea. Like von Kennel, one author disregards the Arthropods, presenting instead three "types" Crustacea, Arachnida, and Tracheata, and (*pace* Lankester) treating the Xiphosures as an appendix to the Crustacea.

In his general treatment the author exhibits a familiarity with recent literature and discusses at some length such morphological questions as the origin of metamerism, the iner-relationship of arthropods, affinities of the Mollusca, etc. The illustrations are largely process cuts and while they have, in most instances, a freshness which is pleasing there is not infrequently an exasperating inaccuracy or vagueness in many of the diagrams and copies. Thus the student puzzling over the oviduct of the barnacle will have no assistance as to its termination from fig. 181, while one looking for the number of cardiac ostia in Limulus will be misled by fig. 196. But the most serious errror which we have noticed relates to Peripatus. In fig. 220, which is copied from Sedgwick, the term cœlom is extended to all the cavities of the body which Sedgwick shows are pseudocœliac, and the peculiar feature that the true cœlom is *restricted* to the gonads, the sac at the inner ends of the nephridia, and the nephridia and genital ducts is no where noticed in the text. The typography and press-work of the volume are good and we are glad to see that the publishers have dropped the fat

[1] A text-book of Invertebrate Morphology by James Playfair McMurrich. New York. Henry Holt & Co., 1894 80 pp. vii+660.

and dumpy style in which they issued the earlier volumes of the "American Science Series."

At last there is a convenient work on the anatomy of the cat;[2] a work which is devoted to the cat and the cat alone; which does not discuss foreordination or total depravity, Grimm's law or the price of stocks; which tells the student plainly how to cut up the useful laboratory animal, tells the names of the various parts, and gets through when it is through. The little work of Messrs. Tower and Cutter is handy in size, clear in directions and intelligible in its figures and diagrams. It is the book we long have sought aud mourned because we found it not.

Comstock's Manual for the Study of Insects.[3]—For several years teachers and students of entomology have been waiting in eager anticipation for the completion of the work upon which Professor and Mrs. Comstock have so long been engaged. Now that it has appeared they have no reason to regret the delay, for the book is by far the best manual available to the student. It contains 700 pages, 800 figures on the text and six full page plates, one of which is colored. Practically all of the illustrations are original with the authors, the great majority of them having been especially engraved for this book by Mrs. Comstock. These figures for the most part are of unusual excellence, and the plates, especially IV, V and VI are of rare artistic value, and in my judgment are the finest examples of insect illustrations in black and white that have appeared in America. Any entomologist would be glad to frame these for his study or laboratory, and it is to be hoped that the publishers will see fit to print these plates on large paper for this purpose.

In the preface the authors state that the book has been prepared especially with reference to the needs of the student who desires to determine " the names and relation affinities of insects, in some such way as plants are classified in the well-known manuals of botany." It has been possible to carry out this idea only with the larger groups, the number of species precluding the possibility of making keys to species. The keys go far enough, however, to be of great value to the teachers and student.

Nineteen orders of insects are recognized, in the following sequence —Thysanura, Ephemerida, Odonata, Plecoptera, Isopoda, Corrodentia,

[2] A laboratory guide for the dissection of the cat by Frederic P. Gorham and Ralph W. Tower. New York, Chas. Scribners Sons, 1895, pp. ix+87.

[3] A Manual for the Study of Insects by J. H and A. B. Comstock. Ithaca, N. Y. Comstock Publishing Co., 1895. Price $3.75.

Mallophaga, Dermaptera, Orthoptera, Physopoda, Hemiptera, Neuroptera, Mecaptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera, Coleoptera, Hymenoptera. The first chapter is devoted to zoological classification and nomenclature, and the second to the near relatives of the insects—crustaceans, scorpions, spiders, mites and myriapods. In the third chapter appears a general discussion of the characteristics of the class Hexapoda, together with a table for determining the orders of insects. Then follow nineteen chapters, each devoted to one order of insects.

The Manual must prove for many years to come the *sine qua non* of the student of American insects. The authors are to be congratulated upon the happy completion of so many years of earnest work, and entomological teachers will be heartily glad to be able to give a satisfactory answer to the query so often asked regarding a text-book for those desiring to take up the study of insects. The accompanying plate shows samples of the engravings in the book.—CLARENCE M. WEED.

In Bird Land.[4]—In this little volume Mr. Keyser has recorded a series of observations made on the birds about Springfield, Ohio. A rare descriptive power combined with a warm love for the feathered tribes makes the writer a most delightful depicter of scenes in bird life. Domestic and social habits, out-of-the-ordinary conduct, their schemes for making a living and a variety of other interesting bits of information, the result of the author's personal gleaming in field and forest, at all seasons of the year, are discussed in an easy, colloquial style that is extremely entertaining.

A list of birds seen in the vicinity of Springfield during the year, numbering 134 species is given in the appendix.

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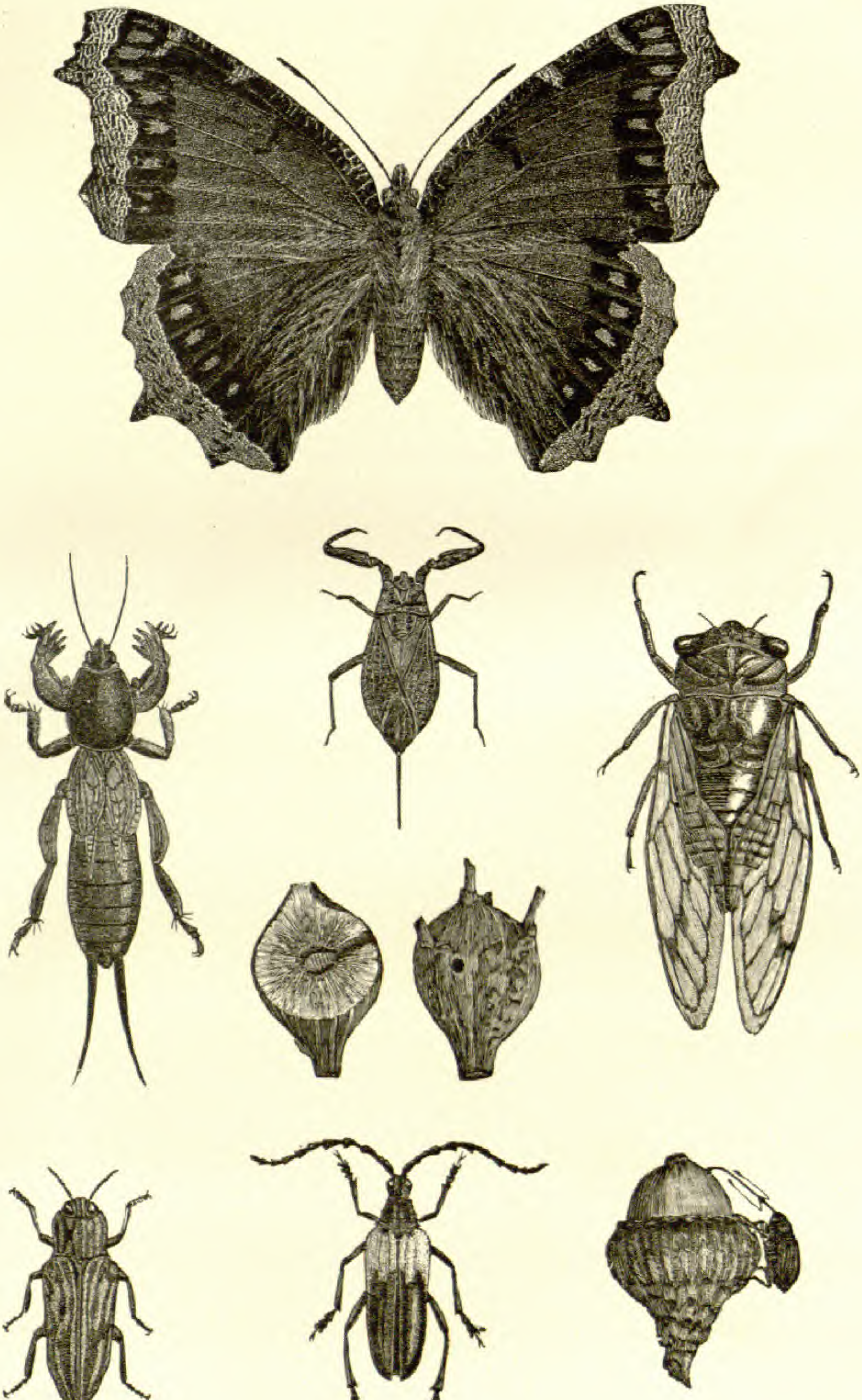
[4] In Bird Land. By L. S. Keyser, Chicago, 1894. A. C. McClurg & Co. Publishers.

PLATE XXVIII.



ENGRAVINGS OF INSECTS

FROM COMSTOCK'S MANUAL

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General Notes.

MINERALOGY.[1]

Vicinal Planes and the Variation of Crystal Angles.—Miers[2] has measured by means of a specially constructed goniometer[3] the changes in the form of crystals during their growth. Potash and ammonium alum is a substance whose apparently octahedral crystals are subject to noticeable variations in the size of the octahedral angle, and whose faces are sometimes vicinal in character. Miers began an investigation to determine whether the angles subject to variation have different values at different stages in the growth of the crystal, and if so, whether the faces change their inclination during growth, provided the crystal is held fixed. He has made the following important observations:

(1.) The faces of the regular octahedron are never developed on alum growing from aqueous solution.

(2.) The reflecting planes (which are often very perfect) are those of a very flat triangular pyramid (trisoctahedron).

(3.) The three faces of this triangular pyramid may be very unequal in size.

(4.) The trisoctahedron which replaces one octahedral face of a crystal may be different from that which replaces another face of the same crystal.

(5) During the growth of the crystal the reflecting planes change their mutual inclinations; the trisoctahedron becomes in general more acute, i. e., deviates more from the octahedron which it replaces as the crystal grows.

(6.) This change takes place, not continuously, but *per saltum*, each reflecting plane becoming replaced by another which is inclined to it by a small angle (generally about three minutes).

(7.) During growth the faces are always those of trisoctahedrons; but, if for any reason, as rise of temperature, re-solution occurs, icositetrahedrons are developed.

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Abstract of paper read before the British Association. Nature, **50** pp. 411–412. (August 23d, 1894.)

[3] See these notes, March, 1895.

Thus it is shown that, in this case at least, crystals do not grow by the deposition of parallel layers of substance, but that new faces are constantly being developed which obey the law of rational (though not simple) indices. Their mutual inclinations in the case of alum show that the face to which they approximate is always the octahedron with angle 70° 31¾′, hence the faces of this form do not vary their inclination as supposed.

Determination of the Principal Indices of Refraction for the most Important Rock-making Minerals.—Zimanyi[4] has determined by the method of total reflection (using a modified Kohlrausch total reflectometer) the principal indices of refraction, and hence, at the same time, the double refraction, of the more important rock-making minerals. He has found that methylene iodide, which has not before been used with the total reflectometer, is a particularly good enclosing medium, since it was found to suffer scarcely any change in the course of an entire year. His paper gives the results of a very extensive series of determinations on no less than fifty-five species or varieties. A few of the determined values are given below:

Mineral.	*Mean index of refr.*	*Double refr.*	*Opt. Char.*
Albite (Schmirn).	1.5337	0.0105	+
Elæolite (Laurvik).	1.5350	0.0042	—
Nepheline (Vesuvius).	1.5407	0.0050	—
Orthoclase.	1.5222	0.0064	—
Sodalite (Ditro)	1.4834		
Nosean (Laach).	1.4950		
Hauyne (Latium).	1.5027		
Leucite (Vesuvius).	1.5086		
Cordierite (Bodenmais).	1.5396	0.0091	—
Muscovite (Buckfield).	1.5861	0.0388	—
Augite (Pojana).	1.7000	0.0250	—?
Biotite (Diff. localities).	1.5600–1.5894		
Tremolite (Diff. localities).	1.6117–1.6135	0.0252–0.0270	—
Actinolite (Diff. localities).	1.6150–1.6257	0.0271–0.0280	—
Tourmaline (Diff. loc.)	1.6324–1.6357	0.0184–0.0239	—
Amphibole (Kafveltorp).	1.6463	0.0163	+
Sillimanite (Saybrook).	1.6641	0.0200	+
Olivine.	1.6710	0.0359	+
Zoisite (Tyrol).	1.7010	0.0050	+

[4] Zeitsch. f. Kryst., XXII, pp. 321–358 (1894).

New Minerals.—Igelstrom[5] describes several supposed new minerals from Sjögrube, Gouv. Orebro, Sweden, which are either massive or so poorly crystallized that their symmetry could not be definitely determined. Their names and supposed compositions are as follows:

Lamprostibian.—A qualitative analysis showed the presence of much Sb_2O_5 and FeO, with smaller amounts of MnO, As_2O_5, PbO, "and other substances;" from which the mineral is supposed to be an antimonate of iron and manganese.

Elfstorpite.—A qualitative determination yielded much H_2O, As_2O_3 and MnO, with traces of CaO and MgO, hence the mineral is supposed to be a very hydrous arsenate of manganese.

Chlorarsenian.—Anhydrous arsenate of manganese (from qualitative tests).

Rhodoarsenian.—Analysis furnished the following formula:
$(10\ RO\ As_2O_5)+10\ (RO\ H_2O)$ in which R=Mn, Ca, and Mg.

Basiliite.—$(Mn_2O_3)_4\ Sb_2O_5+7\ Mn_2O_3.\ \ 3\ H_2O$.

Sjögrufvite.—$2\ (RO)_3\ As_2O_5+Fe_2O_3.\ \ As_2O_5+6\ H_2O$, in which R= Mn, Ca, and Pb.

Doelter, The Characters of Gems.—Eight years ago Groth issued a very interesting popular introduction to the study of gems, intended for the general public and also in a special way to inform jewelers of the delicate mineralogical methods which may be made use of by them for the determination of stones.[6] Great stress was laid upon the optical method of investigation, and a special microscope was designed and constructed for the use of jewelers. Doelter[7] has recently published a more pretentious work, and one of a somewhat more practical character. The book is essentially a manual and includes some 260 pages. It contains a great deal of matter and this is very well arranged. Doelter shows that in spite of the delicate nature of the optical methods, they can only rarely be applied on cut gems. The specific gravity test, particularly when heavy solutions are used, is the most delicate test, and also the one most easily applied. In addition, the examination with the dichroscope, and chemical and hardness tests, are applied in some cases. The artificial reproduction of the different gems in the laboratory, and the technical methods of imitat-

[5] Zeitsch. f. Kryst., XXII, pp. 467–472 (1894).

[6] Grundriss der Edelsteinkunde, Engelmann, Leipzig, 1887.

[7] Edelsteinkunde, Bestimmung und Unterscheidung der Edelsteine und Schmucksteine, die künstliche Darstellung der Edelsteine, von Dr. C. Doelter. Veit & Comp., Leipzig, 1893.

ing the valuable gems are given in detail. The greater part of the work is devoted to the detailed descriptions of the individual types of stones. In the third part of the work is given a systematic method of examining a stone, with a key for use in the determination. A chapter is devoted to the means of identifying the various imitations in use in the trade. A list of 250 trade names of gems, with the scientific name of the mineral and the group in which it belongs in parallel columns, will prove of great value for reference.—W. H. HOBBS.

PETROGRAPHY.[1]

Rock Differentiation.—Harker[2] contributes an interesting article on rock differentiation in his study of the gabbro of Carrock Fell, England. The hill in question consists of bedded basic lavas, gabbro, granophyre and diabase in the order of their intrusion. The gabbro is of especial interest, since it presents a simple example of rock differentiation. In its center the mass is quartziferous. Toward the periphery it passes gradually into an ordinary gabbro, and immediately upon the border into an aggregate composed largely of titaniferous magnetite. In explaining the causes of this gradual transition in chemical and mineral composition, the author discards the theories usually proposed to explain similar phenomena, and concludes that, in the case under discussion, the separation of the magma into its parts took place during the period of crystallization by concentration of the crystallizing substances. The concentration is greatest for those minerals belonging to the earliest stages of the rock's history, hence it is thought that the differentiation took place by diffusion in a fluid magma, and that in those parts of this magma richest in basic minerals crystallization first occurred. As the crystals separated, the supply of the crystallizing substance was kept up by diffusion from other portions of the magma into the basic portions.

Another interesting feature of the gabbro mass relates to the contact effects produced by the rock in the surrounding basic lavas, some of which are enclosed as fragments in the midst of the gabbro. Their isotropic base has crystallized, and some changes have been produced

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

[2] Quart. Journal Geol. Soc., 1894, p. 311.

in the composition and structure of their phenocysts. At the immediate contacts of the different rocks a commingling of their materials seems to have taken place. Mica has been generated in the gabbro, and the groundmass of the lavas has disappeared, leaving a plexus of small feldspar laths imbedded in a clear mosaic of quartz or of quartz and feldspar.

The Metamorphism of Inclusions in Volcanic Rocks.— In a memoir presented to the French Academy of Sciences, Lacroix[3] gives a very full resumé of the conclusions reached by him in the study of the action of modern volcanic rocks on the inclusions imbedded in them. The conclusions are based on the results of late studies as well as on those reached several years ago.[4] The author finds that the basaltic and the feldspathic effusives act differently toward foreign fragments imbedded in them. The former act principally through their high temperature, fusing the most easily melted components of the inclusions, while the trachytic rocks act more effectively in producing mineralogical changes through the aid of the mineralizers, mainly water, with which they are abundantly provided. The physical and chemical changes suffered by the material of the inclusions are discussed separately and fully. Often the fragments in the basalts are reduced by fusion to a few grains of their most resistant components, while the fragments in the trachytes have lost only their micaceous constituents by fusion. Consequently the metamorphism in the latter cases is supposed to have been produced at a comparatively low temperature, although the new minerals produced in number exceed by far those produced in the basaltic inclusions at a much higher temperature. With respect to the effects produced on rocks in situ, it is found that basaltic and trachytic lavas act alike—mainly through their heat. The metamorphic action in both cases is comparatively slight. The similarity in the effects produced by the two types of lavas in this case, when compared with the dissimilar effects produced upon their inclusions, is explained as a consequence of the fact that all lavas, when they reach the surface, lose their volatile constitutents, and so, of necessity, can affect alteration in contiguous rock masses solely by means of their high temperature. In other words, the alteration of inclusions is effected at a depth beneath the surface, while the alteration of rocks in situ is a surface phenomenon.

[3] Mèmoires présentés à l'Acad. d. Sciences de l'Institut de France, xxxi.

[4] See American Naturalist, 1894, p. 946.

The Petrography of Aegina and Methana.——The lavas of the island of Aegina and the peninsula Methana in Greece are andesites and dacites that have broken through cretaceous and tertiary limestones. Washington[5] separates the rocks into the two groups above-mentioned on the basis of the SiO_2 contents. Rocks containing above 62% of SiO_2 he classes as dacites, those containing less than this amount as andesites. The dacites are divided into hornblende, hornblende-hypersthene and biotite varieties, and the andesites into hornblende, biotite-hornblende, hornblende-augite, hypersthene and hornblende-hypersthene varieties. All the rocks are more or less porphyritic, and all contain more or less glass. Tridymite is present in the hornblende andesites from the Stavro district. The trachyte described by Lepsius from near Poros is a biotite-hornblende-andesite. Brown and green hornblendes are both present in the Grecian rocks, but not in the same specimens. The green variety is characteristic of the pyroxene free andesites, and the brown variety of those rocks containing an almost colorless pyroxene as one of its essential components. This association of the two hornblendes indicates that their formation is dependent upon differences in chemical composition of the magmas from which they separated, as well as upon the conditions under which their separation took place.

In almost all of these rocks there are segregations of the same composition as that of the enclosing rocks, except that they are more basic. Two classes of segregations are observed. The first are hornblende-augite-andesites, containing brown hornblende and no glass; the second class is composed of green hornblende in a glassy base with plagioclase laths. The brown hornblendes are often changed to opacite, surrounded by a zone of colorless crystals of augite. In those segregations in which the hornblende is of the green variety, no such alteration is observable. The glass in these segregations is so different from that of the rock in which they occur, that it cannot be regarded as portions of the latter. The author is inclined to regard these bodies as fragments of earlier lava flows buried deeply beneath the latter ones.

In his discussion on the general relations of the different rocks of the region, the author states that "in general * * * the more acid the rock the more vitreous the groundmass, the smaller and more microlitic the crystals in it, and the larger and more abundant the phenocysts."

After remarks on the chemical relations of the different rock types to each other, and a discussion of the Aegina-Nisyros region as a

[5] Jour. of Geology, Vol. II, p. 789, and Vol. III, p. 21.

"petrographical province," the paper closes with the statement that although the lavas of the region under discussion are so similar to those of the Andes, nevertheless, the original undifferentiated magmas of the two districts were quite dissimilar.

Maryland Granites.—The granite and associated rocks on the east side of the Susquehanna River in Cecil County, Maryland, have been made the subject of study by Grimsley.[6] In the northern portion of the area investigated, the granite is but little sheared, while in its southern portion the rock is very gneissic. The two portions of the area are separated from each other by a band of staurolite-schist. Though the rocks of both areas were originally the same in composition, it is thought that the northern granite may be the younger, since it is intruded by dykes of what appears to be a dynamically metamorphosed gabbro, while, on the other hand, the southern granite intrudes a basic rock that apparently grades into gabbro. Both granites are biotitic varieties, and both are eruptive in origin. The northern granite is remarkable for the epidotization of its feldspar, which is predominantly plagioclastic, and for the occurrence in it of numerous dark basic segregations. Many rare minerals, such as zircon, magnetite, tourmaline, cubical garnets and sphene were found in large quantities in the soil produced by its decomposition. The northern contact of the northern granite is somewhat abnormal in its characters. The granite appears to become more basic toward the contact, and the basic phases are cut by apophyses of the normal acid rock.

An analyses of the granite follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Feo	MnO	CaO	SrO	BaO	MgO	Na_2O	Li_2O	H_2O	P_2O_5	Total
66.68	.50	14.93	1.58	3.23	.10	4.89	tr.	.08	2.19	2.65	tr.	1.25	.10	= 100.32

Alabama Cherts.—Hovey[7] has recently examined a series of cherts sent him from Alabama. Those from the Lower Magnesian series consist almost entirely of chalcedony, with the addition of a little quartz and opal. The rocks are fine-grained mosaics that are mottled by reason of variations in the fineness of their grains. The quartz appears to be secondary, as it fills cavities in the chalcedony. A few scales of limonites and dust particles are present in almost all sections. No well-defined organic remains were detected in any. The cherts from the Lower Carboniferous, on the other hand, contain numerous

[6] Jour. Cin. Soc. Nat. Hist., Apr.–July, 1894.

[7] Amer. Jour. Sci., 1894, xlviii, p. 401.

remains of calcareous organisms, which are cemented together by chalcedony exhibiting a tendency to form concretionary granules. In some specimens, genuine spherocrystals of this mineral were detected. Chemical analysis of both classes of cherts show the absence of opal. The author regards the rocks as chemical precipitates.

GEOLOGY AND PALEONTOLOGY.

The Californian Coast.—A. G. Lawson presents the following as the sequence of events which have led to the present topography of the Coast of California north of the Golden Gate:

I. A development in Pliocene time of a great coastal peneplain with correlative accumulation of marine sediments.

II. The orogenic deformation of parts of this peneplain and folding of the Pliocene strata.

III. The reduction of the soft upturned Pliocene strata to base level.

IV. The progressive uplift of this peneplain to an elevation of from 1600 to 2100 feet above sea land, the adjacent mountainous tracts participating in the same movement.

V. The advance in the new geomorphic cycle to a stage of early maturity.

VI. A very recent depression of about 100 miles of the coast adjacent to the Golden Gate, and the consequent flooding of the stream valleys by the ocean.

This history is in harmony with the disastrophic record of the coast south of the Golden Gate presented by Mr. Lawson in a former paper. (Bull. Univ., Cal., Vol. I., 1894).

Disintegration of Granite.—Of the agencies concerned in the disintegration of the granite rocks in the District of Columbia, U. S., Mr. G. P. Merrill considers hydration the most pronounced and universal in its effects. During an examination of material from the region under discussion, both granite and dioritic rocks with smooth even faces taken from depths of a hundred feet or more were examined, and many, which under casual inspection showed no signs of decomposition, were found to disintegrate rapidly into coarse sand after a short exposure to the atmosphere. The author's explanation of this behavior is that the minerals composing the rocks (with the exception of the quartz) underwent partial hydration, but, held in the vise-like grip of the surrounding rock, were unable to expand to the full extent of loss of cohesion. When freed from compression, expansion and further hydration took place, the mass became spongy, and, freely absorbing water, fell into sand and gravel. This idea led to a series of experiments, and from an average of several determinations, Mr. Merrill obtained an approximation of 1.88, which represents the degree of expansion which the rock undergoes in passing from its fresh condition into that of undisturbed soil a foot beneath the surface. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Dolomites of the Northwestern States.—The Magnesian series distributed through southern Wisconsin and Minnesota, extending into northwestern Iowa have been studied by C. W. Hall and F. W. Sardeson. From paleotological evidence the authors divide the series into four alternating formations of dolomites and sandstones belonging to the Upper Cambrian and a fifth of dolomite which may be considered a part of the Ordovician.

As to the origin of the dolomites, the authors do not commit themselves to any theory, but point out that the porous condition of the dolomite and the freedom of the sandstones and arenaceous shales of the series from the several impurities so universal in recent rocks of this character suggest that the original rock mass, which was a limestone of the same constitution as those now forming within ocean areas —that is, a carbonate of lime with a percentage of magnesium carbonate—has become dolomitic through the removal of the calcium carbonate. (Bull. Geol. Soc. Am., Vol. 6, 1895.)

The Silver Mines of Lake Valley, New Mexico.—These mines are situated about six miles from the old Sante Fé trail, and fifteen miles from the Rio Grande. The ore deposits lie close to the surface and are marked by large outcrops of black flint and iron. An interesting account of the working of these mines was read before the Amer. Inst. of Mining Engineers by Mr. Ellis Clark, in which he gives the following theory of the ore-formation:

"It has been held, almost from the time of their discovery, by those familiar with the deposits of silver-ore at Lake Valley, that the one must have come up in solution from below, that it came along the 'blanket' of iron-flint, and that it was in some way dammed up or stopped by the overflow of porphyrite, which may be said, in a general way, to overlie the outcrop of the 'blanket.' On the strength of this hypothesis, numerous diamond-drill-holes and shafts have been sunk, and those that were continued to a sufficient distance (seldom more than 150 feet) have encountered the iron-flint blanket, but invariably with its silver-contents lacking.

"A later and more probable hypothesis is that the silver of the mines was originally contained in a great overflow of silver-bearing porphyrite, perhaps coming from Monument Peak, which covered a square mile or more in the immediate vicinity of the mines. In the erosion of this porphyrite, the silver in it was leached out, the greater portion segregating itself in the Bridal Chamber and the workings connected with it, and the remainder going to the Bunkhouse and the connected Incline and Bella workings. The greatest distance that any large body of ore has been found from the line of the porphyrite is 500 feet, and most of the workings are within 200 feet of that line.

"The writer's own observations have shown him that a distance of about 250 feet from the porphyrite the ore decreases in grade, and that at a distance of 300 feet there is little that can be profitably shipped. The Bunkhouse workings appear to have been in a cavern, in which the ore was deposited rapidly, and not by the slower process of a dissolution of the limestone and a synchronous substitution of the silver-bearing manganese. In many places in this working the manganese is pulverulent and non-adherent to the limestone walls; and when thoroughly cleaned off by brushing, the face of the limestone has precisely the same weathered appearance as that of an outcrop, and looks as though it had been freely acted upon by the atmosphere, possibly assisted by the rays of the sun. Something of the same sort may be studied in the Last Chance workings at a depth of 20 feet from the surface, while the Bunkhouse workings lie at a depth of from 50 to 60 feet.

"The evidences of a previous cavern or cavity in the blue limestone at the Bridal Chamber are not so marked, but the indications are such that in the writer's opinion a comparatively rapid deposition appears more probable than a gradual substitution, such as was very likely the case in the Incline workings, the Bella Chute, the Thirty Slope and the Twenty-five Cut workings.

"In a property of the extent of the Lake Valley mines, which has yielded at least $5,000,000, there always remains the possibility of new finds through the expenditure of small amounts of money. The contact between the two limestones is an established fact; and there are but few places on the southeastern portion of the property where this contact cannot be reached at the moderate depth of 150 feet. Thus far, the explorations made at a distance from the porphyrite have been barren of commercial results; but from the occurrence of the one in chutes, which, although constituting a part of the 'blanket,' vary in width (being generally narrow close to the surface and widening in depth), it is possible that large bodies, somewhat of the nature of the Incline or the Bella Chute, may exist still in the unexplored portions of the property.

"The occurrence of new bonanzas, such as the Bridal Chamber and the Bunkhouse, is scarcely to be expected, as the conditions under which they appear to have been found, that is, the triple contact of the Blue and Crinoidal limestones and the porphyrite, are not known to exist at any points as yet unexplored, and the overflow of porphyrite, has been so thoroughly prospected as to leave but little unexplored ground of that class.

The most promising quarter for further exploitation would seem to be the extension of the Grande chute cut at some point south of the John's shaft workings, where, as before mentioned, large chutes of iron-flint, too low in silver for profitable working, were cut. Other points which should be prospected are the extension of the Bella Chute beyond the point where it has been cut off by the Columbia fault." (Trans. Am. Inst. Mining Engineers).

Erosion of Submerged Limestones.—The limestones in the bottom of a certain portion of Lake Huron are undergoing a peculiar kind of erosion, which, from want of better terms to describe the process, which may be called honeycombing and pitting. Mr. Robert Bell has made a study of this phenomenon and after considering the physical characteristics of the eroded rocks, their age and the possible origins of the erosions, the author arrives at the following conclusions. The erosion is due to:

I. The internal structure of the limestone itself.

II. A small quantity of acid in the water acting for a great length of time.

III. A considerable depth of water, the hydrostatic pressure seeming to promote the dissolving of the rock.

IV. Freedom from sediment during the long time required.

V. The rock must be exposed to the open or free action of the water.

VI. Shifting currents in the water appear to assist the process. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Irrigation of Western Kansas.—Prof. S. W. Williston believes that the cultivation of the western third of Kansas now known as a semi-arid region can be made possible by the utiligation of the so-called underflow of the uplands of that region. The gathering ground of this water, according to Williston, is an exposure of Tertiary sandstone which rests on an impervious marine deposit known as the Colorado Cretaceous. The dip of the chalks and limestones is towards the northeast where erosion in the valleys and along the eastern border has exposed the contact between the sandstone and limestone, springs are found, and pools of water, and even flowing streams, which, however, are soon absorbed through the adjacent soil.

The problem then is how to bring the water of this underflow to the surface economically. The limits of this water-bearing area should be determined and the amount of water that can be counted upon estimated. (Kansas University Quart., April, 1895).

Plistocene Deposits in Switzerland.—At a recent meeting of the Geological Society of London, Dr. C. S. Du Riche Preller read a paper on fluvio-glacial and inter-glacial deposits in Switzerland. The former consists of conglomerates and the latter are lignite deposits near the lakes of Turish, Constance, Zug and Thun, which together with analagous deposits at the base of the Eastern, Western, and Southern Alps, constitute further evidence of two interglacial periods, and therefore of three general glaciations, the oldest being of Upper Pliocene, and the others Middle and Upper Plistocene age respectively. As regards the origin, age and the time required for the formation of several of the Swiss deposits referred to in the paper, the author arrives in several respects at conclusions differing from those recently enunciated by others. The author also argues that the first interglacial period was probably of shorter duration than the second; and in confirming his former conclusion that every general glaciation marks a period of filling-up, and every interglacial period marks a period of erosion of valleys, he avers that, if this conclusion be correct, it must needs be destructive of the theory of glacial erosion. (Nature, April, 1895.)

Geological News. PALEOZOIC.—In a memoir recently published in the Trans. Roy. Soc., Dublin, Messrs. Lavis and Gregory confirm the conclusions reached by Mr. Mœbius that the phenomenon of Eozoon is due to mechanical and chemical alterations. In the rocks examined by the authors the Eozoon resuted from the alteration of calcareous rocks enclosed in a magma heated to fusion—a true metamorphism. (Revue Scientifique Fevier, 1895).

Mr. Walcott notes the occurrence of Olenellus in the limestone of the Green Pond mountain series of northern New Jersey. He considers the discovery a positive addition to the data for working out the stratigraphy of the series. Occurring as it does, in a limestone that merges above and below into beds of conglomerate that are essentially of the Green Pond mountain type, it proves that the conditions under which this characteristic formation was formed, began in lower Cambrian time. (Am. Journ. Sc., 1894).

MESOZOIC.—It is well known that Triassic rocks have yielded large quantities of good coal in Virginia and North Carolina, but it is only within the last year that coal in paying quantities has been found in Pennsylvania Trias. Early in 1894 a vein of anthracite coal of fine quality, twenty-six inches thick, was discovered at Arcola Station, on the Perkiomen railroad, about twenty-five miles from Philadelphia. The rock in which it occurs is red sandstone of Triassic age.

Other instances of the occurrence of coal in Montgomery Co. reported by Mr. Oscar Franklin as follows: In the new red sandstone at Norristown; at Gwynedd in the same formation, and at Lower Providence, Lansdale and Hatboro. A systematic search of the slates underlying the sandstone in Montgomery Co. would, perhaps, disclose beds of workable coal in more than one locality. (Journ. Franklin Inst., 1894).

In Colorado College Studies for 1894, Mr. F. W. Cragin notes 2 new reptiles and 3 new fishes from the Neocomian of Kansas. They are described under the following names: *Plesiosaurus mudgei* represented by a femur, humerus and dorsal vertebræ. *Plesiochelys belviderensis* represented by several costal bones, neural bone and a vertebra. *Mesodon abrasus* represented by vomerine teeth. *Lamna quinquelateralis* and *Hybodus clarkensis* based respectively on a vertebra and on a fin spine. Figures accompany the descriptions.

CENOZOIC.—After reviewing the evidence for changes of elevation of the Atlantic coast of North America, Mr. N. S. Shaler states that since the beginning of the Glacial epoch the eastern shore of North America from the Rio Grande to Greenland has, though with many minor oscillations, been prevailingly lowered. The fauna of the Caribbean District points to a recent subsidence of that region, including the peninsula of Florida. The flooding of the Amazon and La Plata

Rivers, together with a number of lesser streams affords similar evidence for the eastern coast of South America. Africa and Australia appear to have been but little, if any, subjected to recent depressions, while Asia and especially Europe afford clear evidence of extensive subsidence in recent times. On the whole, it would seem that in the disturbances of the relations of land and sea, the tendency is a gradual withdrawal of the coast line towards the center of the continents. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Further evidence in favor of the theory of the igneous origin of the serpentine of the Coast Ranges is found by Prof. Laplache in the study of the Lherzolite-Serpentine rocks of the Potrero, San Francisco. The petrographical character of these rocks show undoubtedly their derivation from an eruptive rock in this area. (Bull. Dept. Geol. Cal. University, 1894).

BOTANY.[1]

A Protest Against the "Rochester Rules."—Quite recently, a protest, signed by seventy-four American botanists, has been distributed, as a contribution to the literature of the nomenclature question. It protests "against the recent attempts made in the United States to change botanical nomenclature on theoretical grounds." This rather vague statement evidently refers to the action of the botanists of the Botanical Club of the American Association for the Advancement of Science taken in Rochester in 1892, and reaffirmed in Madison in 1893. Why the grounds of the action taken at Rochester are considered by the protestants to be theoretical is not made plain; certainly the protestants do not wish to affirm that the men who are prominent in the reform of nomenclature are theorists, nor can they mean that a discussion of nomenclature reform by working botanists is itself theoretical, since a suggestion is made approvingly of an early consideration of the whole subject by a representative international congress.

There is much in the protest with which most botanists will agree, but much of what is said does not apply to the Rochester Rules. Thus the proposition that "one of the most essential features of an efficient

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

botanical nomenclature is a cosmopolitan character," is not to be questioned, and the Rochester movement was intended to be a step toward such a result. So also the first rule proposed by the protestants, viz.: that "ordinal names having long-established usage should not be subjected to revision upon theoretical grounds," is one with which few will disagree, and this again was not referred to in the Rochester Rules. The rule requiring the retention of "long-established and generally known generic names" is a curious one. Starting out with the positive statement that they should be retained, we are next told that "the scope of this rule is left to the discretion of writers"!! How about those whose discretion results in a more rigid scrutiny of such doubtful names? Under the rule, who shall judge between us when we disagree? Moreover, it is urged upon writers that generic nomenclature should not depart far from Benthams and Hooker's Genera Plantarum, Baillon's Histoire des Plantes, and Engler and Prantl's Natürlichen Pflanzenfamilien—"*for the present*"*!* No plank relating to a doubtful question in politics could be more ambiguously drawn so as to provide that flexibility necessary to meet individual preferences. After permitting individual discretion, and allowing some departure (less than the vague distance, "a") from three somewhat different standards, and this only for the present, how much efficiency is left in the rule?

The third rule is scarcely less curious than the second. It is that "in specific nomenclature the first correct combination is to be preferred." Of course. Nobody is asked by the Rochester Rules to prefer any other than the first correct combination. The form of the rule is absurd. The protestants certainly do not wish us to infer that there may be a second "correct combination"—or possibly more. That would be a peculiar priority rule, indeed! But this is not what the protestants wished to say. They probably meant to say that "the correct specific name of a plant is that which it first bears after it has been referred to the proper genus," at least this is what the context suggests. The argument for this rule of priority under the genus, as against the third of the Rochester Rules, can not be said to be well sustained. Many of the earlier references of species to genera from which they had subsequently to be removed, can not, in justice, be regarded as cases of "description under an incorrect genus." Are we simply to ignore the fact as of little importance that Linné described a plant now known as *Steironema ciliatum* ninety years earlier than the date of its transfer from *Lysimachia* to *Steironema?* It is very difficult to see wherein the binomial has any advantage over the specific name in point of stability, or in certainty as to its origin. The instability of specific names is greatly exaggerated by the protestants, and it was to cure the evil so much dreaded by them that Rule III of the Rochester Rules was formulated. At the end of the discussion, however, the whole case is surrendered by the protestants in requiring botanists in the present and future "to preserve scrupulously the specific name without alteration in transferring species from one genus to another."

The fourth rule proposed, which insists upon a sharp line of demarkation between specific and varietal names is not unreasonable to those who hold that species differ radically from varieties. There are still some people who believe in the fixity and original independence of species, and hence of varieties, also, and for whom the facts of development and evolution have no significance. For such, the rule is a logical necessity. The final pronouncement (5) that the principle "once a synonym always a synonym" is recommended as "an excellent working rule for present and future use," is stultified by the addendum to the effect that it "may not be made retroactive." The framers of these rules appear to have a horror of anything which is retroactive, as if for a rule or law to be retroactive were very bad or very dangerous. The word is held up as a sort of bug-a-boo to frighten us. What do they mean by recommending the present use of the rule "once a synonym always a synonym," but forbidding its retroactive use. What is there so sacred in the work of the years preceding the appearance of this protest that it should be spared the application of a principle which the protestants declare to be "an excellent working rule?"

It is necessary to notice but one more of the many curious things in this remarkable document, viz.: the statement that "these rules are designed to apply only to phænogams [sic] and vascular cryptogams." What will the algologists do, and the fungologists, and bryologists? Are they to be allowed to wander around in darkness and disorder, when, by a stroke of the pen, their outlying provinces of the botanical kingdom might have had the benefits claimed by the protestants for their rules. If these rules are good, there is no reason for restricting their application so as to exclude any department of descriptive botany.

CHARLES E. BESSEY.

The Missouri Botanical Garden.—The attention of botanists is called to the facilities afforded for research at the Missouri Botanical Garden at St. Louis. In establishing and endowing the Garden, its founder, Henry Shaw, desired not only to afford the general public pleasure, and information concerning decorative plants and their best use, and to provide for beginners the means of obtaining good training in botany and horticulture, but also to provide facilities for advanced research in botany and cognate sciences. For this purpose, additions are being made constantly to the number of species cultivated in the grounds and plant houses, and to the library and herbarium, and, as rapidly as it can be utilized, it is proposed to secure apparatus for work in vegetable physiology, etc., the policy being to secure a good general equipment in all lines of pure and applied botany, and to make this equipment as complete as possible for any special subject on which original work is undertaken by competent students.

A very large number of species, both native and exotic, and of horticulturists' varieties, are cultivated in the Garden and Arboretum and the adjoining park, and the native flora, easily accessible from St. Louis, is large and varied. The herbarium, which includes nearly 250,000 specimens, is fairly representative of the vegetable life of Europe and the United States, and also contains a great many specimens from less accessible regions. It is especially rich in material illustrative of Cuscuta, Quercus, Coniferae, Vitis, Juncus, Agave, Yucca, Sagittaria, Epilobium, Rumex, Rhamnaceae, and other groups monographed by the late Dr. Engelmann or by attachés of the Garden. The herbarium is supplemented by a large collection of woods, including veneer transparencies and slides for the microscope. The library, containing about 8,000 volumes and 10,000 pamphlets, includes most of the standard periodicals and proceedings of learned bodies, a good collection of morphological and physiological works, nearly 500 carefully selected botanical volumes published before the period of Linnaeus, an unusually large number of monographs of groups of cryptogams and flowering plants, and the entire manuscript notes and sketches representing the painstaking work of Engelmann.

The great variety of living plants represented in the Garden, and the large herbarium, including the collections of Bernhardi and Engelmann, render the Garden facilities exceptionally good for research in systematic botany, in which direction the library also is especially strong. The living collections and library likewise afford unusual opportunity for morphological, anatomical and physiological studies, while the plant house facilities for experimental work are steadily increasing. The E. Lewis Sturtevant Prelinnean library, in connection with the opportunity afforded for the cultivation of vegetables and other useful plants, is favorable also for the study of cultivated plants and the modifications they have undergone.

These facilities are freely placed at the disposal of professors of botany and other persons competent to carry on research work of value in botany or horticulture, subject only to such simple restrictions as are necessary to protect the property of the Garden from injury or loss. Persons who wish to make use of them are invited to correspond with the undersigned, outlining, with as much detail as possible, the work they desire to do at the Garden, and giving timely notice so that provision may be made for the study of special subjects. Those who have not published the results of original work are requested to state their preparation for the investigation they propose to undertake

Under the rules of Washington University, persons entitled to candidacy in that institution for the Master's or Doctor's degree, may elect botanical research work as a principal study for such degrees, if they can devote the requiste time to resident study.

William Trelease, *Director.*

A New Astragalus.—On June 25, 1892, I started out for a collecting trip from the village of Long Pine, Brown Co., Nebraska. On the outskirts of the village, I came across a patch of *Astragalus lotiflorus,* and mingled with it were plants of similar form and habit, but separated by their extreme hirsuteness. I collected a few of each, knowing that the latter form was new to me, at least; but, not having in my possession all the *Astragali,* even of Nebraska, did not know that it would be new to others. On my next visit, a month later, I found that a flock of sheep had grazed everything to the ground, eating, probably, fruit and all. Many subsequent visits have resulted in determining that the form is very scarce. A few scattered plants have been found along a roadside 100 rods north; none elsewhere, except that a few days' later in the same year, Mr. J. A. Warren found *one plant* in Clay County in southeastern Nebraska. This spring I have been able to find but two plants, the species *lotiflorus* itself being very scarce in the same localities. The new plant is undoubtedly a variety of *A. lotiflorus* Hook., and is described as follows:

Astragalus lotiflorus Hook., var. *nebraskensis.,* n. var. Biennial, or shortlived perennial; the long, very slender tap-root sparsely or not at all fibrous for several inches above; stems 2 to 5 inches long, prostrate-spreading and scarcely ascending, in the larger forms, nearly erect in the smaller, numerous from a crown at or above the surface, stouter than the root; simple; hirsute throughout with white hairs, the half-grown fruit being scarcely visible; leaves 3 inches in length, on furrowed petioles, one inch long; leaflets 7–13, short-petioled, oblong to oblanceolate, very variable, slightly acute to obtuse, less hirsute on the upper surface; stipules ovate, acuminate, scarious-margined, inclined to be scarious with green veins; flowers like *lotiflorus*, very small, yellowish-white to pale lilac, one to three in a raceme almost sessile in the axils of leaves, peduncle lengthening to half an inch in fruit; *not* like *lotiflorus* in equalling the leaves; calyx with lanceolate, acuminate teeth, persistent; legume right-angled from the peduncle, half-ovate or slightly crescent-shaped, acuminate 1 inch long, 4 lines. deep, sessile in the calyx, thick chartaceous, one-celled, sometimes cross-wrinkled; seeds in two rows, short-kidney-shaped, numerous.

Specimens have been deposited in the herbaria of the Botanical Survey of Nebraska, University of Minnesota, and Columbia College.

—J. M. Bates.

Long Pine, Neb., May 20, 1895.

VEGETABLE PHYSIOLOGY.[1]

The Action of light on Bacteria.—Under the above title Dr. H. Marshall Ward contributes an interesting article to the *Philosophical Transactions* of the Royal Society of London, Vol. 185 (1894), pp. 961–986. While his experiments have not been confined to the anthrax bacillus, most of those here detailed were made with this organism. The spores were sown in melted agar which was then poured into Petri dishes in the usual way. Portions of these agar films were then exposed to direct sunlight and to the arc light. On the shaded parts of the agar the colonies derived from these spores grew until they completely covered it, while they wholly failed to develop at first, but finally did so in small numbers on the parts exposed to direct sunlight for several hours. After exposure the cultures were placed in an incubator at 20–22° C., only being taken out to examine and photograph. By 3–4 hours exposure to direct bright sunlight and subsequent incubation for a few days, figures and stenciled letters were brought out very distinctly on the surface of the inoculated plates. That this effect is due to insolation has been shown by various writers and is now generally accepted, and that the effect is due to the direct

[1]This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

action of the light on the organisms and not to any indirect action on the culture medium, has been brought out pretty clearly by Prof. Ward's labors. That the agar remains unchanged and is still suited to the needs of the organism is shown by the fact that some colonies do always finally appear on the insolated spots. Their appearance is explained by supposing that some spores were covered by others and thus partially protected from the action of the light, which might well be the case, especially when thick sowings were made. The next step was to determine, if possible, whether one part of the spectrum was more effective than another, the conclusions of previous experimenters being very contradictory. First, a fresh culture was covered by a card board in which five circular holes were cut. One of these holes was left uncovered, one was covered by ordinary window glass, one by a dark blue glass, one by a light blue glass, and finally, one by a peculiar brownish-purple glass which absorbed most of the blue and violet rays of the spectrum. This plate was then exposed to sunlight for some hours and afterwards put into the incubator. In 18 hours there were four distinct white spots on the agar corresponding to four of the five holes in the card board, and later on that spot corresponding to the uncovered hole became the most distinct. There was also on the agar at first a fainter spot corresponding to the hole covered by the brownish-purple glass, but this spot became more and more indistinct and disappeared after the fourth day, enough colonies having developed finally to wholly efface it, thus showing that the light strained through this glass simply retarded the development of the spores. The inference was, therefore, quite strong, that the blue-violet rays largely screened out by this glass must be the effective ones. Two-chambered, ebonite cells with side walls of glass were then constructed. Into one of the cells filtered distilled water was put as a standard for comparison and into the other cell was put solutions of various substances such as aesculin, sulphate of copper, bichromate of potash, quinine, fuchsin, etc., which cut out certain rays of the spectrum. Infected films of agar were then exposed to the action of sunlight passed through water and these solutions. The light which passed through the layer of water cleared a spot on the plate every time. The result of passing the light through a solution of aesculin, which cuts out most of the blue and violet rays, was similar to that obtained by the use of the brownish-purple glass, i. e. it did not kill the spores but only retarded their germination, the insolated places being nearly obliterated in 111 hours and entirely so a little later. When sunlight was passed through a solution of potassium bichromate the result was still more striking, not a trace of any germicidal influence being visible. From the foregoing it is apparent that the red, orange, yellow, and true green rays of the spectrum have no bactericidal action. Finally, portions of infected plates were submitted to the direct action of portions of the solar spectrum, passed through a grating as narrow as practicable (1 mm.) and through quartz plates instead of glass. These exposures confirmed the preceding and show that the infra-red, red, orange, and yellow rays of the spectrum are absolutely without effect, the spores exposed to these rays germinating as readily as those on the non-exposed parts of the film. So far as could be determined by the methods used, the bactericidal influence begins where the green shades into the blue, reaches its greatest intensity in the blue-violet in the vicinity of Fraunhofer's line G, and fades out in about the middle of the violet, the more refrangible half of the violet and the ultra violet showing no influence. Subsequently, in conjunction with Prof. Oliver Lodge of Liverpool, many experiments were tried with a powerful arc light. Even 8–12 hour exposures produced only a transient bactericidal effect when its rays had to traverse the glass covers of the Petri dishes, and in course of the experiments it was discovered that even the thinnest plate of glass is so obstinate a barrier to the bactericidal rays that it was not possible to use it and quartz had to be substituted. When this was done, 8–12 hour exposures served to kill the spores of Bacillus anthracis, and even 6 hours exposure killed great numbers of them. Exposures of infected films to the spectrum of the arc light gave results in the main confirmatory of those previously obtained. Here again the infra-red, red, orange, yellow, and green rays were without perceptible effect, but the germicidal influence did not begin in the blue-green but just beyond it in the blue, and its influence was visible into the ultra violet, the maximum effect being reached just beyond the violet. With both sun and arc light there is for a day or two after the colonies begin to appear a curious blurring of the margins of the insolated spots which gradually disappears as the colonies develop and which is attributed to halation. The germicidal effect of the arc light is so powerful, when not destroyed by glass screens, that Prof. Ward thinks it might be turned to practical account in the disinfection of hospitals, cattle sheds and similar places. In these experiments the distance of the light was two feet. The author is inclined to think that not only the lower forms of life but also all protoplasm is sensitive to these rays of the spectrum and that the higher plants escape injurious effects by having provided themselves with natural color screens. Among other low organisms which he has found sensitive to direct sunlight are a violet water bacillus from the Thames, B. fluorescens liquefaciens, a pink bacterium (probably B. prodigiosus), the hay bacillus, the potato bacillus, and various yeasts and other fungi.

The role of Calcium and Magnesium.—Bokorny seems to have proved (*Bot. Centrb.*, 62:1) that Ca and Mg are essential to the formation of the necleus and chlorophyll bodies. His experiments were with Spirogyra, Zygnema, and Mesocarpus in Aluminum beakers in distilled water to which nutrient salts were added: (1) Ca withheld; (2) Mg withheld; (3) Ca and Mg withheld; (4) Complete. The algæ were under observation 6 weeks. In 1 there was a gradual decided shrinkage of the chlorophyll bands although starch continued to form. In 2 the nucleus and pyrenoids also shrank, the former to ¼ natural size or to complete disappearance. In 3 the nucleus shrank decidedly and the pyrenoids seemed to become smaller. In 4 the cell-organs remained normal and the plants continued bright green.—ERWIN F. SMITH.

ZOOLOGY.

The Faunal Regions of Australia.—At the Adelaide meeting of the Australian Association for the Advancement of Science, Mr. Hedley gave a brief summary of the views held by leading naturalists in regard to the Faunal Regions of Australia, and also presented his own. The substance of his remarks were as follows:

The discrimination of the various provinces into which the Australian fauna and flora group themselves has been frequently attempted. To the earlier naturalists, from a study of scanty material and with little or no personal knowledge of the continent, four divisions of east and west, temperate and tropical, seemed natural and sufficient. Horker's "Essay on the Australian Flora" paved the way for a better understanding of the relations which various localities bore to each other. Owing to fundamental errors of his interpretation of Australian Geology, Wallace's treatment of the subject in "Island Life" is of but slight value. To the writer, the most successful arrangement of the various biological regions yet proposed is that sketched by Prof. Tate, in his address to the first meeting of this Association. The author accepts two main biological divisions—the *Autochthonian*, developed in west

Australia, and the *Euronotian*, seated in eastern Australia and Tasmania; a subsidary division, less in value and derivable from both of the above, is the *Eremian* or desert fauna and flora.

Taking this disposition as the basis of my remarks, I would observe that eastern Australia contains two distinct biological populations, where Professor Tate has located one, the *Euronotian*. This title, I propose, should be reserved for that fauna and flora characteristic of Tasmania, Victoria, and southern New South Wales; while the second and very distinct fauna and flora developed on the coasts of Queensland and northern New South Wales would best be described as Papuan. Indeed, so distinct is this latter, that a separation of Australian life into Papuan and non-Papuan seems to the writer to be the primary division to be made of the Australian fauna and flora.

The types encountered by a traveler in tropical Queensland, or rather in that narrow belt of tropical Queensland, hemmed in between the Cordillera and the Pacific, all wear a foreign aspect. Among mammals may be instanced the cuscus and tree kangaroo; among reptiles, the crocodile, the *Rana*, or true frog, and the tree snakes; among birds, the cassowary and rifle birds; among butterflies, the Ornithoptera; among plants, the wild banana, orange and mangosteen, the rhododendron, the epiphytic orchids, and the palms; so that, in the heart of a great Queensland "scrub," a naturalist could scarcely answer, from his surroundings, whether he were in New Guinea or Australia. It may be supposed that late in the Tertiary epoch, Torres Straits, now only a few fathoms deep, was dry land, and that a stream of Papuan life poured into Australia across the bridge so made.

Sharply defined from the tropical jungle above mentioned are areas occupied by strictly Australian vegetation, which are left invariably in possession of the poorest tracts of land. From the rich lands, formerly no doubt possessed by them, everywhere have they been ousted by the invading flora.

Regarding the origin of the Eurontian fauna and flora, sundry facts collected by Mr. H. O. Forbes, in his paper on the Chatham Islands, would suggest a South American source. Assuming that, in or before the Miocene, continuous land extended from Terra del Fuego to Tasmania, the derivation of the Australian marsupials appearing in the Pliocene from their South American allies, *Prothylacinus* and *Amphiproviverra* of the Eocene, would be clear. Mr. Forbes adduces strong confirmatory evidence from Professor Parker who, on embryological grounds, does not hesitate to assume as ancestors of certain Australian crows a form allied to the American Dendrocalaptine birds. The distribution of the parrots and the cystignathous frogs appears also to sustain the theory. The extinct alligator, *Palimnarchus*, found in Queensland and New South Wales associated with *Diprotodon*, strengthens the chain of evidence, as does the occurrence in Tasmania and Australia of *Gundlachia*, otherwise an exclusively American mollusc.

As the name implies, the *Autochthonian* is the oldest member of the Australian faunas and floras. The date of its arrival in Australia and the route which it traversed are lost in antiquity. Seeing that many resemblances exist between our vegetation and those of Timor and the southeast Austro-Malayan islands, perhaps these lands afforded the passage to Australia.

Summary.—Superimposed, one above another, may be distinguished three divisions of Australian life. The earliest is the Autochthonian. Possibly this arrived from the Austro-Malayan islands, in or before the Cretaceous era, and spread over the whole of Australia. The next is the Euronotian. Probably this reached Tasmania from South America, not later than the Miocene epoch ; many of the original inhabitants, particularly on the east coast, probably disappeared before the invaders. Thirdly, a contingent of Papuan forms seized on the Queensland coast, late in the Tertiary, and likewise largely exterminated their predecessors.

Notes on a Snapping Turtle's Nest.—On June 16, 1894, I saw a snapping turtle, *Chelydra serpentina*, in the course of two hours, dig a hole and in it lay twenty-two eggs.

The hole was dug in gravel and was small at the top, but when an inch below the surface of the ground, it widened, and when finished was three inches in diameter and about four inches deep. The digging was done entirely by the hind feet used alternately.

The eggs were crowded in place by the hind feet, as fast as they were laid. Then the hole was filled even with the rest of the ground. The nearest water was a small stream about thirty feet distant.—A.

On some new North American Snakes. NATRIX COMPRESSICAUDA TÆNIATA subsp. nov.—Scales in twenty-one rows ; four series of longitudinal spots above, those of the median pair forming two longitudinal stripes on the greater part of the length ; the laterals forming stripes on the neck only.

Labials $\frac{8}{10}$, oculars 1–3 ; temporals 1–3. Frontal narrow, not widened anteriorly ; parietals rather wide. First row of scales keeled.

Gastrosteges 131; anal 1-1; urosteges 82. The lateral black spots extend as far as the tail. The dorsal stripes are connected by a transverse lighter brown shade for a short distance in advance of the vent. Belly black with a median series of semidiscoid yellow spots; gastrosteges with yellow extremities for the anterior two-thirds of the length of the body. The median neck stripes touch on the nape, and after enclosing a pale space unite on the parietal plates. Muzzle brown, the labials with blackish shades. Lower labials, genials and gulars with yellow spots. Indistinct parietal paired spots. Total length 378 mm.; of tail 98 mm.

Two specimens in my private collection from Volusia, Florida.

In this form the striping which appears on the neck of the form *compressicauda* is extended the entire length. It bears thus a partial resemblance to the *Natrix clarkii,* which is not far removed in affinity from the *N. compressicauda.* The form next described (*N. fasciata pictiventris*) connects the latter with the *N. fasciata.*

The subspecies *tæniata* may be synoptically compared with the typical *compressicauda* as follows:

Scales in 21 rows; four series of longitudinal spots above, those of the median pair forming two longitudinal stripes on the greater part of the length; the laterals forming stripes on the neck only; *N. c. tæniata.*

Scales in 21 rows; numerous dark cross-bands which are resolved into three rows of spots just anterior to the tail, and four longitudinal stripes on the neck; *N. c. compressicauda.*

NATRIX FASCIATA PICTIVENTRIS Cope.—Brown transverse bands numerous, separated by short intervals and extending to the belly throughout the length. Gastrosteges narrowly margined at the base with brown, the margins turning at or before reaching the ends of the gastrosteges and uniting so as to enclose transverse yellowish spots, which may cover a part only or the whole of the gastrostege, but which are always wider than those seen in *N. compressicauda.* Sides of head light brown, generally with a black post-ocular band; top of head black. Scales in 25 rows; in one specimen (No. 19,798) in 27 rows.

No. 5,473 : 25; 8 : 125; 45 : 580 mm.; 120 mm.; (tail injured).

No. 19,999 : 25; 8 : 124; 86 : 550 mm.; 162 mm.

In some specimens (No. 13,729) the transverse bands are very distinct as in young individuals; in Nos. 19,798 and 11,444, they are connected by the same color along the median dorsal line.

This subspecies is restricted to Florida, and it approaches the *N. compressicauda* in the coloration of the belly. The following specimens are contained in the U. S. National Museum.

5,473 1, Palatka, Fla., T. Glover. Type, 10,449 2, Gainesville, Fla., J. Bell; 10,739 1, Clearwater, Fla., S. T. Walker; 11,444 1, Gainesville, Fla., J. Bell; $\left.\begin{matrix}13644\\13693\end{matrix}\right\}$ 2, Georgiana, Fla., G. Wittfield; 13,779 1, Punta Rassa, Fla., C. K. Ward; 19,798 1, W. Florida, Dr. Henshall; 19,999 1, Lake Eustis, Fla., Theo. Holm.

In my private collections are specimens from Volusia, Lake George, Fla. A specimen now living in the reptile house of the Zoological Garden of Philadelphia exhibits the following colors. The borders of the transverse bars, and the markings on the belly are chestnut red, while the ground-color of the latter is cream colored.

SEMINATRIX PYGÆUS Cope, gen. nov.— *Contia pygœa* Cope, *Tropidonotus pygœus* Boulenger. This species has been referred to the water snakes of the genus Tropidonotous (Natrix) by Boulenger (Catal. Snakes Brit. Mus. Ed. II, V. 1). An examination of the penial structure shows that the reference to the Natricinæ is correct. The other characters differ, however, from those of the genus Natrix, so that it appears to be necessary to refer it to a new genus. This I propose to call Seminatrix, and give the following definition. Sulcus spermaticus and hemipenis undivided; no papilla; scales smooth, without keel or pits; anal plate divided.

The only known species *S. pygœa* is found in Florida. According to Dr. Loennberg.[1] its habits are aquatic. While the epidermal scales are smooth, the dermal plates are closely wrinkled and reticulated, a character which I have not observed in any other Natricine and which may be an additional generic character.

ZAMENIS STEJNEGERIANUS sp. nov.—This species and the one following belong to a section of the genus not represented in my "Critical Review" (p. 622), which must be characterized as follows: Superior labials eight; scales in seventeen rows; frontal as wide posteriorly as the superciliary at the same point. To this this might be added, loreal much longer than deep.

In the present species the profile is gently convex, and the rostral plate is slightly prominent. The frontal plate has straight lateral borders and its anterior angles are well removed from the preocular plates. The loreal is twice as long as deep, and its superior posterior corner is cut off as a separate plate on both sides, and on one, a third loreal is cut off below. The eight superior labials are regular, and apparently normal. The parietals are truncate posteriorly, and are bounded by three temporals and two small scales externally. Temporals 2–2–2. Postgenials shorter than pregenials. Gastrosteges 166; anal 1–1; urosteges 102. Length 782 mm.; of tail, 229 mm.

[1] Proceeds. U. S. Natural Museum, 1894 p. 323.

Above and ends of gastrosteges, light brownish-olive; top of head, lips, and inferior surfaces yellow. Skin between scales, black. No. 17,065 U. S. National Museum, Cameron Co., Tex. Dedicated to my friend Dr. L. Stejneger of the U. S. National Museum.

ZAMENIS CONIROSTRIS sp. nov.—The second species of the section of the American species of the genus presents the following characters.

Profile of muzzle much decurved; rostral plate prominent and subconic. Frontal plate with concave lateral borders, and expanded front, in contact with preoculars. A single loreal which is nearly twice as long as deep, and is deeper posteriorly than anteriorly. Parietal plates rounded posteriorly, bordered by three temporals and two or three scales. Temporals 2–2–2. Superior labials normal, regular. Postgenials equal in length to pregenials. Gastrosteges 162; anal 1–1; urosteges 85. Length 758 mm. length of tail 200 mm.

The specimen may have been taken near the period of moult, so that the color is somewhat uncertain. It is now light brown above, and light plumbeous below; the top of the head not lighter than the other superior surfaces. The muzzle is darker in color than the lips and throat. Skin between scales black. No. 1,763 U. S. National Museum, Matamoras, Mex.

This species and the last are founded on a single specimen each, which were obtained in nearly the same region of country. They resemble each other considerably in proportions, size and coloration. The differences are, however, so numerous and important that it is impossible to regard them as belonging to the same species. They differ equally from all others, the nearest approach to the *Z. stejnegerianus* being made by abnormal individuals of the flaviventris form of *Z. constrictor*, which have eight superior labial shields. The very different form of the loreal plate, and its subdivison, in the latter, together with the contrast between the color of the head and the dorsum, will distinguish it.

ZAMENIS LATERALIS FULIGINOSUS Cope.—*Bascanium laterale* Hallow. Cope, Proceeds. U. S. Natl. Mus., 1889, f. 147.

Scales in seventeen longitudinal rows; superior labials eight, the fourth and fifth entering the orbit. Muzzle depressed, narrowed and rather prominent. Frontal plate much narrowed posteriorly, its width equal one-half that of a superciliary plate. Seventh and eighth superior labials about equal, of rather wide parallelogrammic form. Temporals 2–2–2; the last superior large, subquadrate, their posterior borders continuous with that of the parietals. Gastrosteges strongly angulated; tail entering 3·58 times in whole length. Scuta, scutella and dimensions:

No. 15,135 ; 201 ; 1–1 ; ? ; 815 mm. ; tail injured.

No. 15,136 ; 205 ; 1–1 ; 108 ; 665 mm. ; 258 mm.

Color above blackish-brown anteriorly, becoming lighter posteriorly to the end of the tail. The dark color extends on each end of the gastrosteges to the angulation throughout the length, and in the younger specimen, appears as a row of spots on each side of the middle part of the gastrosteges, fading out beyond the middle of the length. Ground color of belly yellow. In the larger specimen the black-brown predominates on the inferior surfaces, yielding gradually to the ground color, which predominates on the inferior surface of the tail. A yellow spot on the preocular ; and in the younger specimen on the postoculars and labial plates. Gular and genial plates yellow spotted in the younger specimen, nearly uniform dark brown in the older. On the anterior part of the body of the younger specimen the lateral scales to the third and fourth row have brown shades, with an obscure trace of cross-banding. On the same specimen near the middle of the body, there are two pale half-cross-bands near together. In the same, the center of each parietal plate is brown.

This subspecies differs widely from the typical form in color characters.

I add here that specimen which strongly resembles this form was sent to the Philadelphia Zoological Garden from Southern Arizona. The belly is light red.

Catal. no.	No. specimens	Locality	Whence obtained
15,135 15,136	1 1	St. Margarita Island, Lower California	U. S. Fish Commission Albatross

—E. D. Cope.

Zoological News, Vermes.—*Distomes.* Dr. H. B. Ward has recently published several papers on these parasites to which attention should be called, since they appear in places where one does not usually look for zoological articles. In the first[1] he records a second American example of the fluke, *Distomum westermannii,* this time from the lungs of a dog, the material being furnished by Prof. D. S. Kellicott, and being that upon which the latter author had already reported.[2] The second of these papers[3] reviews the literature of this

[1] Veterinary Magazine, Vol. II, p. 87, 1895.

[2] Trans. Ohio State Medical Society, 1894.

[3] Medical News, Mar. 2, 1895.

same parasite and emphasizes the dangerous nature of it when present in man. In the East (Japan, Formosa, etc.) it occurs in a large percentage of the population. A third paper[4] records the presence of *Distomum felinum* in the cats sacrificed to science in the University of Nebraska. In this paper, Dr. Ward discusses the value of measurements and concludes that they are of little value; "the topographical relations alone are fixed and hence are the only points on which species may be founded."

Protochordata.—A species of Enteropneustan has been discovered upon the shores of New South Wales. It is described by its finder, J. P. Hill, under the name *Ptychodera australiensis* (Proc. Linn. Soc. N. S. Wales, Nov. 28, 1894).

ENTOMOLOGY.[1]

Distribution of Injurious Insects.—In an interesting paper upon this subject before the Entomological Society of Washington, Mr. L. O. Howard said: "It is reasonable to suppose that in many cases insects will be unable to follow their food-plants to the limits of their possible range, notwithstanding the fact that the geographical distribution of animals and plants is governed by the same general laws of temperature, humidity, exposure, and geological characteristics. The obvious reason for this is, that purely artificial features are introduced in cultivating plants, varieties are propagated which develop resistant powers lacking in the parent stock; seeds, in the case of annuals, are carefully collected and selected, the soil is prepared for their reception, and is artificially fertilized; while with perennials the same general care is taken. It follows, therefore, that the natural range of cultivated species is widely extended in every direction, and in the teeth of the very barriers which naturally would have held them rigidly in check. Plant-feeding insects in general follow the natural distribution of their specific food. Experience has shown that as this natural food becomes a cultivated crop they increase. As the cultivation of the crop is spread along natural lines of distribution, they follow it. When, however, by

[4] Veterinary Magazine, 1895.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

artificial selection, hardy varieties of the crop plant have developed, and the range becomes thus extended along what may be termed unnatural lines, with certain species, at least, and within certain limits with them, their insect enemies will naturally be unable to follow them. The result will be, theoretically, natural selection with the insects trying to catch up with the results of artificial selection with the plants."

An All-purpose Net.—There is no doubt but that a special net for each kind of collecting will give the best results, but while the net becomes better suited to one purpose it becomes at the same time less suited to other purposes. A specialist will adopt a special net, but an ordinary collector will want an all-purpose net even if not quite the best for each insect.

The net we have found to meet best the requirements of an all-purpose net is one consisting of a strong but light brass hoop about a foot in diameter, soldered firmly into the end of a brass or tin ferrule. This ferrule should be about six inches long to serve as a handle when beating, when long handle is removed.

The bag of the net should be of strong but light cloth as a good muslin or swiss. It should be about two feet deep, and taper gradually from the mouth to the bottom where it should be two or three inches wide. This will enable one to easily remove an insect with the cyanide bottle or with the hand, and facilitates the clearing of the net by reversing it.—*Entomologists Post-Card.*

Picobia villosa (Hancock) is *Syringophilus bipectinatus* (Heller).—In the number of April, 1895 of THE AMERICAN NATURALIST (Vol. XXIX, p. 382–384, plate XXII), Mr. Joseph L. Hancock describes and figures as "*a new Trombidian*" a species of *Cheyletinœ* already well known in Europe. His *Picobia villosa* does not differ from *Syringophilus bipectinatus* Heller.

Mr. J. L. Hancock is not acquainted with the modern literature on interesting type. In a communication made, in 1884, before the *Académie des Sciences de Paris*[2], I have shown how this form is common on the birds of all orders. It lives in the quill of the feathers of the wings, and comes out but rarely.

The *Syringophilus bipectinatus* and its variety *major* have been figured by Professor Antonio Berlese, from my preparations, in his great work entitled : *Acari, Myriopoda et Scorpiones Italiani* (fasc. XXXVII, n° g et 10, 2 pl.).

[2] TROUESSART *Sur les Acariens qui vivent dans le tuyau des plumes des Oiseaux*, —(Comptes-Rendus Acad. des Sciences de Paris, XCIX, (1884), p. 1130).

This Acarid has been found in the interior of the quills of the wings (*rémiges et couvertures alaires*) on the domestic hen (*Gallus domesticus*), on the sparrow (*Passer domesticus*), and on a great number of other birds belonging to the genera:—*Syrnium, Eclectus, Pœocephalus, Chalcopsitta, Picus, Fringilla,* (var. *major* on *F. montifringilla*), *Emberiza, Linota, Coccothraustes, Troglodytes, Anthornis, Parus, Orites, Turdus, Hirundo, Caprimulgus, Trogon, Phasianus, Meleagris, Gallinago, Aramus, Strepsilas, Vanellus, Totanus, Tringa, Anthropoïdes, Sterna, Hydrochelidon, Larus, Anas,* etc.

From this list, we see that the species may be considered as universally dispersed and really cosmopolite. If we compare the types of these various origins, we find no other difference than the size.

The form found by Mr. J. L. Hancock upon the flycatcher (*Phœnopepla nitens* Fer.), is absolutely the same that the typical *Syringophilus bipectinatus* from Europe. It cannot be placed in the genus *Picobia* (Haller) which possesses for differential characters:—*Pedes dissimiles; primi et secundi paris tarsus cirro longo, bifido, terminatus; tertii et quarti paris tarsus, unguibus binis recurvis et pectine duplici* (pulvillo) *instructus.*

On the contrary, the type figured by Mr. Hancock has the characters of the genus *Syringophilus:—Pedes omnes similes, unguibus binis recurvis et pectine duplici instructi.* This type is then connected with this last genus.

I must add that, from my observations, the form named "*Syringophilus*" is not adult and represents only the *syringobial and parthenogenetic* form of a species of *Cheyletus* described by Doctor S. A. Poppe (from Vegesack) under the name of *Cheyletus nörneri*[3], which is found also in the quills of the feathers of the birds enumerated previously, feeding on the Sarcoptids (*Analgesinœ*) which live there habitually.

I have lately[4] drawn the attention of naturalists to the habits of these various syringobial forms, and I have shown that the *Cheyletus nörneri* (Poppe), which devoured the *Pterolichi* and *Syringobiœ* which live in the quill, never touches the *Syringophili*, doubtless by virtue of the saying: "*les loups ne se mangent pas entre eux.*"

[3] S. A. Poppe, *Uber parasitische Milben* (Abhandl. Naturw. Ver. Bremen, [1887] X, p. 239, pl. II, fig. 4–5)

[4] E. Trouessart, *Sur le Mimétisme et l'instinct protecteur des Syringobies* (Bulletin de la Société Entomologique de France, 1894, p. CXXXVI).—*id.*, *Sur la Parthénogenise des Sarcoptides plumicoles* (Comptes-Rendus de la Sociéte de Biologie, 26 Mai, 1894:—C.-R. Académie des Sciences, CXVIII, p. 1218).

It is not possible to find any differential sexual character between the two forms disinguished by Mr. Hancock as male and female. The form figured (plate XXII) is the syringobial nymph, and the other the parthenogenetic female.

In the interior of the quill, the *Syringophili* feed, according to the manner of the *Analgesinæ,* on the marrow (or pith) of the feathers. The transformation into adult *Cheyletus* takes place likely out of the quill, which explains why the syringobial form is found, but rarely, in the plumage, outwardly to the feathers, as in the case observed by Mr. Hancock.

As to the *Syringophilus uncinatus* Heller, it is a true *Cheyletus.*

In summary:

1. *Picobia villosa* (Hanock)=*Syringophilus bipectinatus* (Heller).

2. *Syringophilus bipectinatus* is a syringobial form of *Cheyletus nörneri* (Poppe).—Dr. E. L. TROUESSART, Paris, France.

Preparing Orthoptera.—In Special Bulletin No. 2 from the Department of Entomology of the University of Nebraska Prof. Lawrence Bruner gives excellent directions for collecting and preserving Orthoptera. Regarding the process of "stuffing" he says:—"Within the past few years most of the objections that had so frequently been made to the gathering and preservation of orthopterous insects, have practically been removed by the adoption of different and better methods of preparing and preserving these creatures. A few of our specialists only seem to have profited from the discovery that these insects can be handled 'taxidermically,' *i. e.*, be stuffed in a similar manner as we would adopt for birds, reptiles and mammals, and thereby preserved in collections equally well with other forms. The following directions for collecting, cleaning and 'stuffing' orthopterous insects may, therefore, be of much value to those who contemplate making collections of and studing these insects. Instead of throwing the specimens in spirits (alcohol, brandy, whisky, etc.), when captured they should be killed in the 'cyanide' bottle from which they should be removed soon after death, and at once opened, cleaned and stuffed; or they can be transferred to a small tin or other box where they may be kept moist and flexible till arrived at home or in camp. Now take the specimens, one at a time, in the left hand, and with a fine, sharp-pointed scissors open the abdomen by cutting across the middle of the two basal segments on the lower side, then reverse and cut the opening a trifle larger by nearly severing the third segment. After this has been done extract all of the insides (intestines, crop, ovaries, etc.), along with the juices, using a fine pointed forceps for the purpose, wipe out the inside of the insect with a small wad of cotton and it is ready to be 'stuffed' or filled up. When this latter is done the insect may be either pinned into a box prepared for the purpose at once, or it can be wrapped in paper and packed away for future use. To 'stuff' cut some cotton bat (raw cotton) in short pieces and fill up the insect through the opening previously made for cleaning it, using the same or a similar pair of forceps for the purpose, taking care not to fill too full nor to stretch the abdomen beyond its original dimensions. When the filling is completed carefully draw the edges of the several segments together and gently press the sides of abdomen into shape with the fingers. This can all be done, after a little practice, in about four or five minutes time. The advantage in favor of a specimen thus handled are several. It will not decay nor turn dark, the original colors will be retained more nearly perfect, and there is but little danger under ordinarily careful treatment of its being attacked in future by the museum pests mentioned. Specimens when thus prepared by an expert and properly labeled are easily worth three or four times as much for cabinet specimens as those not so cared for. Especially is this true with reference to specimens collected in warm, moist climates where decay is rapid, and where mould is sure to attack specimens that are long in drying."

Recent Literature.—Mr. H. G. Barber of the University of Nebraska publishes an interesting list[5] of Nebraska butterflies. One hundred and thirty-seven species are enumerated.

Mr. W. A. Snow contributes three dipterological papers to the Kansas University Quarterly for January, 1895. Professor S. W. Williston also contributes a paper on Exotic Tabanidæ to the same issue.

Mr. G. C. Davis publishes as Bulletin 116 of the Michigan Agricultural College Experiment Station a 24 page discussion of Insects of the Clover Field.

Prof. Lawrence Bruner discusses in 75 pages of the Nebraska Horticultural Report for 1894 the Insect Enemies of the Apple Trees and its Fruit.

In Bulletin 109 of the New Jersey Station Prof. J. B. Smith discusses cut worms, the sinuate pear-borer, the potato stalk borer and the insecticidal value of bisulphide of carbon. In Bulletin 106 the San José Scale is treated of.

[5] Proc. Nebr. Acad. Sci. IV, pp. 16–22, 1894.

Part IV of the valuable Bibliography of America Economic Entomology has been recently issued by the Department of Agriculture. It includes authors from A to K, and shows the same careful compilation by Dr. Samuel Henshaw as the previous issues of the series.

An important Report upon the Parasitic Hymentoptera of the Island of St. Vincent by Messrs. Riley, Ashmead and Howard has recently been issued by the Linnæan Society (Journal Zoology, XXV, pp. 55–254). The material was collected by Mr. H. H. Smith, and contained six new genera and 299 new species.

EMBRYOLOGY.

Origin of Twins.—Jacques Loeb of the University of Chicago contributes to the fourth part of Roux's new peroidical—Archiv. für Entwickelungsmechanik der Organismen—an illustrated article in which the results of his experiments upon echinoderm eggs are set forth along with a hypothesis of the mechanical origin of double embryos.

He found that when the eggs of the sea-urchin "Arbacia" were put into water less salt than normal the membrane might burst as if from osmotic pressure and part of the egg protoplasm ooze out from the rent. In case this extruded part remained in continuity with the rest of the egg farther development might result in the formation of a double larva.

Many most interesting double and triple larvæ so produced are figured with the abnormal skeletal structures seen in them.

The author then adopts the ideas of Quincke in an attempt to explain the production of double monster in general and in the higher animals in special.

Quincke regarded certain protoplasm movements as similar to those of oil and water when mixing in the presence of soda or of albumen. In such cases more or less violent "extension currents" are produced: currents which Bütschli would assume in the movements of the pseudopodia of an amœba on his hypothesis that protoplasm has a vescicular structure.

Professor Loeb assumes that mechanical currents are normally present in the process of cleavage and that in the abnormal process of double formation there is, for various unknown reasons, an exaggerated, violent stage of the same phenomena. When the vortex currents become violent, watery liquid accumulates between the cleavage cells so that they are separated and henceforth develop separately to form a twin.

It is to be regretted that the excellent observations recorded do not bear more forcibly upon the hypothesis advanced.

PSYCHOLOGY.[1]

Mental Development in the Child and the Race: Methods and Processes. BY JAMES MARK BALDWIN, M.A., PH.D., STUART PROFESSOR OF PSYCHOLOGY IN PRINCETON UNIVERSITY.[2]—Prof. Baldwin's latest book will prove of no less interest to the biologist than to the psychologist. There is a growing feeling that biology, the science of life at large, and psychology, the science of the inner life, since they deal with facts of the same order, must ultimately express those facts in essentially the same conceptions. To biology we must look for the most generalized expression of those conceptions; it will be the duty of the psychologist to apply them in his narrower field and to restate them with such additions and limitations as the facts demand. Yet, just because his field is the narrower, we may expect of him suggestions which will aid the biologist in his work. This is what Prof. Baldwin has undertaken to do. While studying imitation in the infant, he tells us, he was struck by the important part played by it in the development of the individual. This led him to read again "the literature of biological evolution with view to a possible synthesis of the current biological theory of organic adaptation with the doctrine of the infant's development," and this book is the outcome. It is full of original and suggestive material and I think I can do no better than give the readers of the NATURALIST a fairly complete outline of its contents.

The arrangement of the book is open to criticism. The first six chapters deal with certain special problems and are intended to develop inductively the fundamental conceptions of dynamogenesis

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

[2] Macmillan & Co., 1895. Price, 2.60.

and the circular reaction which underlie the entire book. These chapters, although of considerable intrinsic value, are superfluous so far as the main object of the book is concerned, in that their contributions to it might have been much more clearly put and in briefer compass. It is in the last chapter, on Suggestion, that the principal of dynamogenesis is most clearly stated: "The principle of contractility recognized in biology simply states that stimulations to living matter—the protoplasm of the higher vegetable and animal structures—if they take effect at all, tend to bring about movements or contractions in the mass of the organism. This is now also safely established as a phenomenon of consciousness—that every sensation or ingoing process tends to bring about action or outgoing process." (P. 166.) The movements thus produced may simply be repeated, thus forming a habit. But many of them "seem to beget new movements by a kind of adaptation of the organism—movements which are an evident improvement upon those which the organism has formerly accomplished." How is this done? This introduces us to the main problem of the book—that of Accommodation.

The answer is found in the Law of Excess. Of all the stimuli to which the organism is exposed some are advantageous. These heighten vitality and thereby increase the amount of motor reaction. In the case of advantageous stimuli the reaction is expansive, towards the source of stimulation, but the disadvantageous produce contractions, away from the source of stimulation. It is evident that the expansive movements are best fitted to secure the repetition of the stimulus, and the excessive discharge greatly increases this probability. If any one of these movements proves successful, there is a second excess discharge, but the second tends to pass out by the channels of the successful movement. This gives us the nucleus of a habit. The law that advantageous stimuli produce expansive movements and disadvantageous contraction is doubtless due to natural selection. (Pp. 199 et seqq.) The admission or denial of the inheritance of acquired traits would not affect this theory. And, since it represents selective reaction as part of the original endowment of life, and since this selective reaction is the organic analogue of pleasure and pain, we may say "that life began with consciousness, that is, with feelings of pleasure and pain. This position preserves the criterion of mind, making it also the criterion of life, and so assumes an absolute phylogenetic beginning of both life and mind in one." (P. 213.) From the preceding discussion the relation of Habit and Accomodation comes clearly to view. "Habit expresses the tendency of the organism to secure and to retain its vital stimulus," (P. 216) while by Accommodation the organism "learns new adjustments simply by exercising the movements which it already has, its habits, in a heightened or excessive way."

Prof. Baldwin then undertakes to apply these principles to the explation of the phenomena of life, especially of human life. The first problem attacked is the origin of motor attitudes and expressions, which includes the theory of emotion. In the psychophysics of emotion in general the three factors, Dynamogenesis, Habit and Accommodation are clearly traceable. By the first every element of content must have its motor expression, but as no two contents are ever exactly the same, our reactions are constantly being modified by new motor elements. Habit, it is true, tends to diminish the amount of consciousness found in the reaction, but on the other hand, by increasing the total motor disturbance, it increases the consciousness of movement, which is a chief element in all emotion. It is, therefore, a factor in the genesis of emotion. By virtue of Accommodation such of the new elements contributed by Dynamogenesis as are useful to the organism get associated with and modify the old, thus increasing the total content of the emotional state. To this must be added the pleasures and pains of Attention, itself, as later to be shown, a form of motor accommodation. When we come to examine the special forms of emotion we find that the laws of expression formulated by other writers, such as the principles of antagonism, of direct motor discharge and of analogous feeling stimuli are readily explained as varying expressions of the laws above given. But we must note that in the individual the acquisition of emotional expression depends largely upon imitation.

Returning now to the fundamental type of reaction, we find that it involves: Stimulus—increased vitality—excess discharge ("random movements") towards source of stimulation—accidental securing of the beneficial stimulus by some one of these movements, thereby tending to make the same reaction easier—repetition of the process. This is best described as a circular reaction, since it tends to repeat itself, and as its nearest conscious analogue is found in imitation the whole class may be termed imitative. In the simplest form, as above described, it may be termed organic imitation. An examination of the responses to stimulations found in the lower forms of life, both animal and vegetable, shows that reactions of this type are coextensive with life itself. But in the higher forms, in which consciousness has been developed, the reaction assumes new forms. The stimulus produces conscious experience, and its repetition repeats that experience. But the experience may also be repeated in the form of an *idea* without the occurence of the stimulus, and this idea may take the place of the stimulus and produce the reaction. This is termed conscious imitation, and is the germ of voluntary action. Furthermore these ideas, or copies, may be associated with one another, so that any one tends to awaken others and with them their appropriate reactions. Thus all the higher functions originate from and involve the lower. Sometimes, by the principle of lapsed links, the true stimulus may disappear and the movement be produced, to all appearance, by one of the associative antecedents of the stimulus.

Assimilation and Recognition.—The copy image may be so strong as to assimilate to itself the new experiences, their motor discharges uniting in one—this union in motor discharge is the basis of association by contiguity; association by similarity is found "when both of them, by association with a third have come to unite in a common discharge. The energy of the new presentation process finds itself drawn off in the channels of the old one which it resembles; the motor associations, therefore, and with them all the organic and mental elements stirred up by them, come to identify or unite the new content with the old." (309.) Assimilation then is due to the tendency of a new sensory process to be drawn off into preformed motor reactions. Some of these reactions are directly useful. Others constitute a more special kind of motor reaction upon the mental content. This latter is attention. It consists of three factors. First, the grosser muscular strains in brow, scalp, etc.; second, the more special strains of sense accommodation; third, the still more special strains peculiar to the content in question. When a new experience is repeated, not only is it assimilated to the memory of the original experience, but the third factor in attention is facilitated; these two constitute what we call recognition. (P. 314.) Upon the first factor of attention depends the peculiar sense of "warmth" or "ownership;" it is due to the fact that the attention strains constitute a large part of the sense of self. Recognition is an advanced form of adjustment to environment and has been of great phylogenetic significance.

Conception and Thought.—The principles already developed furnish a basis for the evolution of the higher mental processes. Judgment, or the demand for identity, is the conscious representative of the irresistible tendency to act in one way upon a variety of experiences. Belief is the conscious representative of the assimilation of new to old tendencies to action. Conception and perception arise together when new experiences are brought face to face with old memories to whose motor tendencies their own can be but partially assimilated. In so far as assimilation takes place the concept arises; in so far as it does not the respective contents are discriminated as particulars, and this discrimination is the function of perception. By the omission of certain motor reactions peculiar to the several occurences of a common sensory content the latter is *abstracted*. Thus we see that the general or abstract "is not content at all. It is an attitude, an expectation, a motor tendency." (P. 330.) And when we recognize an object as belonging to a class, we mean that this object presents, in addition to the motor reactions peculiar to itself, motor reactions common to it and many other objects.

SYMPATHY is primarily due to imitation.—At times a new presentation is assimilated to memories of past experiences and thus awakens their emotional reactions—at others the sight of the emotional reaction in others provokes a similar reaction directly. To imitation the consciousness of self is also largely due. Its earliest form is found in a discrimination of persons as moving and especially interesting objects whose conduct at first admits of no exact calculation. This is the *projective* stage. The second stage is initiated by imitation of these projects; together with other bodily sensations the sense of effort then emerges and with it comes the vague consciousness of self as a *subject*. In the third stage the subjective elements thus gained are ascribed to the projects and they become *ejects* or persons like the subject. (Pp. 333 et seqq.)

THE ETHICAL FEELING originated in like manner—The child must accommodate himself to his environment, and especially to that part of his environment which we term the authority of others. But, as we have shown, one element of the self owes its origin to this very factor. Thus the intrinsic or habitual self tends to come in conflict with the self of accommodation and imitation. Later, from this external factor, is formed a "moral ideal of a possible, perfect, regular will taken over in me in which the personal and social self—my habits and my social calls—are brought completely into harmony; the sense of obligation in me in each case is a sense of lack of harmony—a sense of actual discrepencies in the various thoughts of self as my actions and tendencies give rise to others." (P. 345.)

The third form of imitation, which we may term plastic imitation, embraces those degenerated forms of reaction, which, having once been conscious, are now become secondarily automatic and subconscious. They fall under two classes; those that represent habitual reactions and those that represent the imitative tendency itself become habitual. The first finds its expression in the community in conservatism; the second in liberalism.

Volition involves desire, deliberation and effort.—Desire consists of "(1) a pictured object suggesting associated experiences which it is not sufficient to realize, and (2) an incipent motor reaction which the pictured object stimulates but does not discharge." (P. 368.) Thus the germs of desire are present whenever a nascent movement is inhibited, but it is only when the representative element is added that it becomes typical desire. As desire arises from inhibited reactions, so does deliberation arise from the competition of reactions by the addition of analogous representative elements. Effort arises upon the resolution of a state of deliberation.

In persistent imitation we have the earliest form of volition. The "copy" is given and provokes a movement which only partially reproduces it. The apprehension of the movement as actually performed now constitutes a momentum prompting its repetition, but the original "copy" still persists, prompting a slightly different movement —out of the competition of these two reactions is formed a third, from these three a fourth, and so on until the movement as performed and the persistent "copy" prompt to the same movement—that is until the movement is successful. The sense of effort is due, as above shown, to the co-ordination or two or more such reactive tendencies. Thus we find in volition "the point of meeting of two principles, Habit and Accommodation, and their common function."

In the highest exhibition of reflective volition there is "no departure in type, however wide a departure it be in meaning and implications for philosophy—from the first organic reactions of organic life. Habit is formed in the face of suggestion through persistent imitation and volition, and Habit, made organic in character, is modified in turn by changed environment, which is reacted to by imitation and volition." (P. 388.) Prof. Baldwin then proceeds to present a mass of special evidence for the doctrines above outlined from the early life of infants, from some experiments made on students, from the intimate relation of attention to voluntary movement, from the phenomena of partial or total aboulia, especially as found in hysteria, idiocy and the various disturbances of speech. This last is of especial interest but is too technical in character to be given in abstract. Then follows a chapter on the Mechanism of Revival and Internal Speech and Song of which the same may be said. It is intended to illustrate the application of the theory to detailed instances.

"ATTENTION is the mental function corresponding to the habitual motor coordination of the processes of heightened or excess discharge." This theory finds a further confirmation in two facts. First, since the excess discharge is the sole means of accommodation in the lower organisms, and attention the only one in consciousness, we must connect in theory the function of excess with that of attention. Second, the excess discharge is also the organic analogue of pleasure and pain; attention, then should be the seat of pleasure and pain. This we find to be the case, especially in the pleasures of emotional and intellectual life. Since attention is a motor phenomenon, and since by the law of Dynamogenesis the more intense sensation has the greater effect, we readily see why an intense sensation tends to attract attention, and why attention tends to increase the intensity of the content attended to. It follows (P. 468) that attention is not a single function—there are as many attentions as there are contents. This fact has escaped notice because in all states of attention there is a certain relatively constant element, viz,: tensions in brow, jaws, skin of head, etc. "The office of attention is that of fixing the content steadily on the sensory side, and at the same time of releasing the associated discharge movements on the motor side. It is a go-between between the copy imitated and the imitation which copies it and is, therefore, *the central and essential fact in all voluntary muscular control.*"

I have gone somewhat at length into the analysis of this book because it seems to me a most important contribution both to biology and psychology. It may be described as an attempt to express all forms of conscious experience, from the lowest to the highest, in terms of their motor concomitants. In a sense the attempt is strictly legitimate. All mental states have motor concomitants, and since motion is the most essential fact in the life of the organism, and moreover, since movements are often more easily studied and measured than their accompanying mental states, it may well be that from a study of movement we may get those architectonic conceptions which all psychologists seek, but which have not as yet been got from introspection. But in the effort one is apt to exaggerate the genetic importance of the motor element, to ignore certain definite laws which introspection reveals, and to rest content with a careless and inadequate analysis of the psychoses which are to be explained. Against a large part of Prof. Baldwin's book these charges may be brought, and I think they rob many of his expositions of all practical value. Yet the book is full of acute observation and insight; one feels upon first reading it that he has here a mass of material of very unequal value, carelessly thrown together, whose exact value will come to view only after careful thought and study. Especially does it seem that the conception of the circular reaction and its genetic importance in the individual will remain a permanent acquisition of psychology.

ANTHROPOLOGY.[1]

Surprising Discovery of Ancient Rope and Netting in Southwestern Florida.—Lieutenant-Colonel C. D. Demford, late of the English army, has found in the recent months, a piece of well-preserved rope, a mass of string woven into the meshes of a net and several artificially shaped wooden billets, from two to three feet deep, in a deposit of soft, black mud, in one of the tide-water sea lagoons near Punta Rasso. These objects were associated with a necklace of shells and a well-preserved wooden dish, evidently of Indian make, and lay at a spot flooded daily by the salt tide, and encircled by one of the narrow ridges of oyster shells, now familiar to students, made by Indians, who feasted on molluscs at the spot. Here, as at other places on the west coast, the shells seemed to have been so arranged upon the low margins of the lagoons as to form small canals and water basins, where canoes could easily pass shoreward, and land on hard bottom when the tides were favorable. As far as I know, no such discovery as this of Lieutenant-Colonel Demford's has come to the notice of students in Florida before, but it remains to be proven, beyond reasonable doubt, that none of the objects, which rested on the shell bottom in the middle of the basin, and completely under the mud, worked their way down in recent times. Nevertheless, experience in digging out the bottom of drained lakes in Switzerland has shown us the effect of mud in preserving perishable objects of human make for long periods of time, and there is no reason why submarine deposits may not restore to us lost details of the past here as well as there. This brilliant and original work in Florida, directing investigation into a new channel, leaves us to wonder why no one thought of it before. The discoverer, while carrying many of the objects found to England, has kindly deposited a series of them at the Museum of Archæology of the University of Pennsylvania, to whose

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

authorities he communicated the discovery more than a month ago, thus enabling Dr. William Pepper to send Mr. Frank Hamilton Cushing to the spot, and to take immediate measures to follow farther an entirely fresh line of research. H. C. MERCER.

SCIENTIFIC NEWS.

Indiana Academy of Science.—The Spring meeting of the Indiana Academy of Science was held at the Wyandotte Cave in Crawford County, May 15–17. The members and friends spent the greater part of two days exploring this great cave. The party made the three trips usually open to visitors. The total distance traveled in the cave was about twenty miles, and the greatest depth reached about 300 feet. This report must be too brief to enter into an elaborate description of the long and winding avenues, the grotesque shapes of the many beautiful stalactites, stalagmites and pillars, the grottoes, the pillared palaces, the large rooms and massive monuments and the numerous channels some of the diminutive kind that made it pretty difficult for some of the party to pass through. It is a fertile field for the geologist. The cave is made in the St. Louis limestone of the Carboniferous. Much gypsum was found as well as the various forms of the limestone ; also magnesium sulphate and occasional layers of flint. In one part yellow ochre is found. The large white masses of Alabaster is especially noticeable in one part.

A few salamanders were found and several blind crayfish obtained from the guides. Many other animals have been found by previous investigators. It was a most enthusiastic meeting and also a very profitable one.—A. J. BIGNEY, *Ass't. Sec.*

The fourth session of the **Hopkins Seaside Laboratory** begins Monday, June 17, 1895. The regular course of instruction continues six weeks, closing July 27. Investigators and students working without instruction may continue their work through the summer. The Laboratory provides for three classes of students. 1. Investigators who are prepared to carry on researches in Morphology or Physiology. 2. Students in the departments of Zoology, Physiology, and Botany in the University, who wish to supplement their work under the favorable conditions of such an institution, and to gain a knowledge of the methods of research in Biology. 3. Students and teachers not members of the University, who desire te pursue biological studies and to become acquainted with the practical methods of laboratory work. For this group of workers regular courses are conducted in Zoology and Botany, accompanied by lectures and by individual instruction at the work table.

The corps of instructors embraces the followiug members of the faculty of Leland Stanford University. Dr. Oliver P. Jenkins, Dr. Charles S. Gilbert, George C. Price, Harold Heath, Charles W. Greene, Walter R. Shaw.

The following courses have been arranged: A course in Zoology, consisting of the structure, physiology, and life histories of typical marine forms. A course in Botany, consisting mainly of a comparative study of the principal groups of fresh water and marine algæ, with collateral work in other groups of plants. Both these courses will include instruction in laboratory methods and in microscopical technique.

More advanced courses in Morphology, Physiology, Embryology, Histology and Botany will be arranged for students who are prepared to enter such courses.

Those students who have had sufficient training to take up some original investigation will be given an opportunity to do so under the direction of an instructor.

The original building contains three general laboratories, a store-room, and seven private rooms for investigators. A new building contains a general lecture and library room, a general laboratory, ten private rooms for investigators, and a dark room for photographic work. The basement is designed for large aquaria. Both buildings are supplied with running water, both salt and fresh. The library and apparatus of the University are made use of in the Laboratory. Each student will be furnished with a good compound microscope. There is a good supply of reagents and supplies for microscopical work. Apparatus for work in experimental physiology is also provided. The Laboratory also possesses a fair supply of collecting apparatus, and two boats.

LOCATION.—Pacific Grove is a seaside resort on the southern shore of Monterey Bay, two miles west of Monterey. It is reached by the Coast Division of the Southern Pacific Railway, and is about four hours distant from San Francisco. The coast line at this point offers every variety of rocky and sandy shores, and the variety and abundance of marine life is exceptionally great. In the immediate vicinity of the Laboratory are exceptionally fine collecting grounds.

EXPENSES.—To investigators prepared to carry on original work the use of the Laboratory and its equipment is tendered free of charge.

Students in the Leland Stanford Junior University, will be charged a fee of fifteen dollars.

The fee for other students is fixed at twenty-five dollars for the term of six weeks.

Pacific Grove, is well supplied with boarding accommodations, with considerable range in price. Cottages and tents, furnished for light housekeeping, can be rented at reasonable rates. For further information address the Directors:

CHARLES H. GILBERT,
OLIVER P. JENKINS.

The Royal Academy of Science, Letters and Fine-Arts of Belgium offers prizes for Memoirs on researches concerning the following subjects: 1. Original investigations on the intervention of phagocytosis in the development of invertebrates. 2. Description of mineral phosphates, sulphates and carbonates found in Belgium, including the locality and formation in which the deposits occur. 3. Original investigations on the peripheral nervous system of Amphioxus, and, especially, the constitution and genesis of the sensory roots. 4. Original investigations on the mechanism of the cicatrization of plants.

The next meeting of the British Association for the Advancement of Science will commence on the 11th of September at Ipswich, under the Presidency of Sir Douglas Galton, F. R. S. The general secretaries are Sir Douglas Galton and A. G. Vernon Harcourt, F. R. S. The Presidents of the Sections are as follows:

Section A, Mathematical and Physical Science, Prof. W. M. Hicks, M. A., D. Sc., F. R. S.; Section B, Chemistry, Prof. R. Meldola, F. R. S., For. Sec. C. S.; Section C, Geology, W. Whitaker, B. A., F. R. S., F. G. S.; Section D, Zoology, Prof. W. A. Herdman, D. Sc., F. R. S.; Section E, Geography, H. J. Mackinder, M. A., F. R. G. S.; Section F, Economic Science and Statistics, L. L. Price, M. A., F. S. S.; Section G, Mechanical Science, Prof. L. F. Vernon Harcourt, M. A., M. Inst. C. E.; Section H, Anthropology, Prof. W. M. Flinders Petrie, D. C. L.; Section I, Physiology. This Section will not meet at Ipswich; papers on Animal Physiology will be read in Section D; Section K, Botany, W. T. Thiselton-Dyer, C. M. G., C. I. E., F. R. S.

Ipswich possesses a fine Museum, founded by Professor Henslow, which contains a very complete collection of Crag Fossils. Geological excursions are being arranged to show the Crag Districts and the Cromer Cliffs. Marine dredging excursions will be made down the Orwell from Ipswich to Harwich. Excursions are also being organized to other places of special interest in the district around Ipswich, including Bury St. Edmund's, Colchester, the Norfolk Broads, Cambridge, Brandon, Wenham, Dunwich, etc. The seaside towns of Norfolk, Suffolk, and Essex are within easy reach.

The undersigned is engaged at present in a compilation of a complete directory of living botanists of all countries, inclusive of botanical gardens, institutes and societies, as also of their papers and the botanical publications issued by them. The undersigned, taking a lively interest in the accurracy of the directory, and in the exact insertion of your Christian and sur name, with full address, etc., etc., solicits, herewith, the favor of your kindly filling up the query sheet and returning it. The Boards of Botanical Gardens and Institutes are requested to send in a list of all the officials employed by them. Botanical Societies will kindly please to state their full name, year of establishment, and periodical publications (papers only partially treating on botanical matters included), and when published (yearly, monthly, etc.). Publishers of periodicals treating of matters relating to botany will greatly oblige the writer by their kindly stating the name, date and subscription price of their papers; at the same time the forwarding of proof-copies is requested.—J. Dorfler, I. and R. Technical Officier to the Botanical Section of I. R. Court Museum of Natural History, (Vienna) Austria, I. Burgring 7.

The collection of Fossil Mammalia made by Prof. E. D. Cope, was recently sold to the American Museum of Natural History of New York. It includes 470 species, of which 402 are types of species first described by Prof. Cope. The species were collected between 1872 and 1895, and were derived from eleven geological horizons.

Two of our paleontologists had the misfortune to break their arms during the winter that has just passed. We refer to Profs. Henry F. Osborn and Angelo Heilprin. Both have nearly recovered.

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THE AMERICAN NATURALIST

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Vol. XXIX. AUGUST, 1895. No. 344

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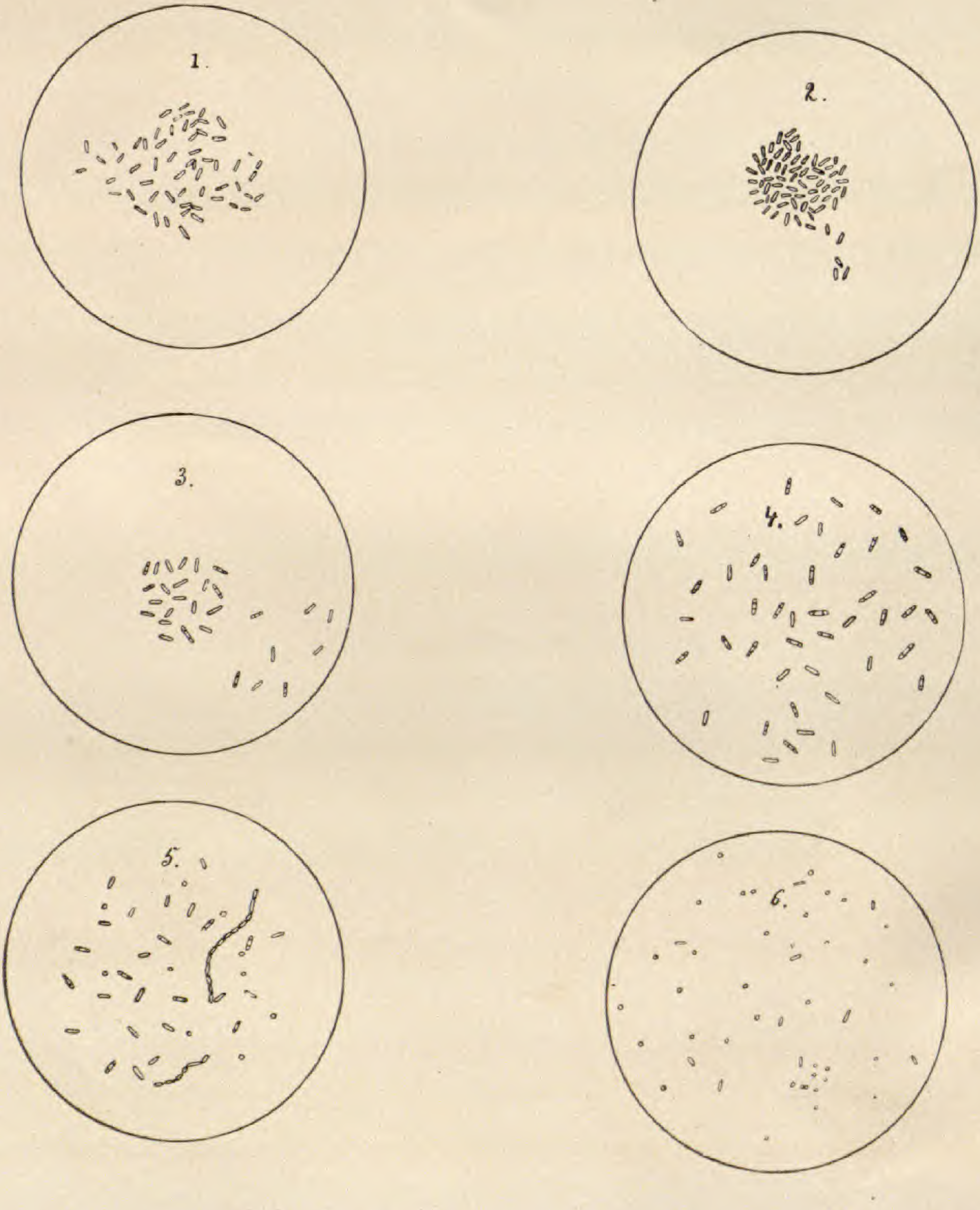
PLATE XXIX.



Bay on Small-Pox.

THE

AMERICAN NATURALIST

Vol. XXIX. August, 1895. 344

INVESTIGATIONS CONCERNING THE ETIOLOGY OF SMALL-POX.[1]

By J. Christian Bay.

[With plate XXIX.]

The etiology of small-pox is one of the most interesting problems in bacteriology, and has been subject of considerable investigation for thirty years and more. A brief historical sketch, illustrating what has hitherto been done in this line should, naturally, precede this preliminary record of my own work the progress of which may be traced in the Iowa Health Bulletin published by the State Board of Health of Iowa under whose authority these investigations were carried out during the past year.

Numerous writers have investigated the small-pox and vaccine lymph, and some have recognized specific micro-organisms, both animal and vegetable, as the primary cause of the disease, or of the specific eruptions.

One of the micro-organisms, heretofore more or less generally recognized as the effective agent is the *Micrococcus vaccinæ* and *variolæ;* Bareggi who, among others, studied these, states[2]

[1] Published in abstracted form in the Medical News, January 26, 1895. Presented to the Iowa State Board of Health, February, 1895, and read before the Des Moines Academy of Sciences.

[2] Sul microbi specifici del vajuolo, del vaccino e della varicella. Gaz. med. Ital. Lomb. Milano (8) VI, 480, 506, 519, 529, 545; with plate.

that the micro-organisms of small-pox and those of vaccine are identical.[3]

In 1868, Chauveau[4] proved that vaccine virus is deprived of its active substance by filtration. Hence, it became more than probable that the contagion was a living organism, and no gaseous or diffusible product. "For when he carefully poured a stratum of water upon a layer of lymph, in tiny tubes, he obtained a diffusion of the dissolved material into the water, but this clear solution could not produce pustules like the insoluble residue."

In the same year, Hallier[5] described micrococci "of a singular appearance from human small-pox, cow-pox and vaccine eruptions, the diameter of these bacteria being $\frac{1}{300}'''$ to $\frac{1}{150}'''$; they exhibited motion except when covering the lymph-particles.

Previous to this, G. Simon[6] found, in human small-pox, round particles which were insoluble in acetic acid. Salisbury[7] also claimed to have demonstrated a specific small-pox organism which he named *Jos variolosa*; it was described as quite polymorphous; its alga-stage was seen in cow-pox eruptions; "fructification" was reached in small-pox eruptions.

Luginbuehl[8] discovered, in sections cleared with acetic acid micrococci which formed colonies at certain places in the skin, near the epidermis, in cases of small-pox eruptions. Beale[9] found "vast multitude of minute particles of living matter or bioplasm" in the small-pox vesicles, but he did not attribute to these the name of *causa morbi*.

Cohn[10] showed the presence of minute cocci in vaccinia and small-pox lymph; when the lymph is fresh, the cocci were moving freely, propagated themselves by division, and, after

[3] Confer Crookshank, Manual, p. 203; Klein, Micro-Organisms and disease, pp. 79–80.

[4] Comptes Rendus LXVI, 289, 317, 1868.

[5] Aerztl. Intelligenzbl. XV, 75; Virchow's Archiv XLII, 309, 1868.

[6] Müller's Archiv, 1846, 185.

[7] Schmidt's Jahrbücher, 1871.

[8] Verhandl. d. phys. med. Ges. in Würzb. IV, 99, 114; 1873, w. pl.

[9] Disease-germs, their nat. and orig., 1872, 148; pl. XVIII, fig. 64.

[10] Virchow's Archiv LV, 229–238, 1872.

16–32 hours of cultivation, aggregated in masses, afterwards in films the formation of which seemed to be the terminal phase of their life-history.[11] Cohn named this organism *Microsphæria vaccinæ* which was a specific coccus and no representative of some stage of development of some other organism. The name was later changed into *Micrococcus vaccinæ* which Cohn, in his system of bacteriology, described in the following way[12]: "Cells ball-shaped, 0.5–0.75 μ. in diameter, or united two and two or more in chains and masses, also forming a zoogloea. In fresh lymph from cow-pox and small-pox as well as in the pustules in confluent variola."

Weigert, a short time before Cohn, found[13] "vessel-shaped, irregular, often ramified formations of 0.1–0.2 mm. in diameter with granulated, well-marked contents which was not affected by acetic acid, sodium and glycerin. He interpreted these formations as lymphatics filled with bacteria. They were found in the neighborhood of small-pox pustules, and at their edges, where also haemorrhagical herds, and arteries with the same contents were observed. Cohn declared that Weigert's granules were identical with his *Microsphæria*.

Thus it was beyond doubt that vaccinia, cow-pox and variola were caused by attacks of bacteria. Burdon-Sanderson also confirmed this view. The history of the cases also show that the disease is caused not only by a *contagium fixum*, but also by a *contagium halituosum*.

Weigert's observations concerning the lymphatics were repeated and confirmed by Klein.[14]

Klebs[15] set forth the statement that the organism (micrococci) in vaccinia and variola exhibit peculiar physiological and morphological properties. The cells are placed four and four together and assume, ontogenetically, no other shape than that

[11] The same aggregations had been observed by Keber.

[12] Beitr. zur Biol. d. Pflanzen, Vol. I, part II, 161.

[13] Ueber Bakterien in der Pockenhaut. Centralbl. f. d. med. Wiss. IX, 606–611, 1871. Ueber pockenaehnl. Eruptionen in innern Organen. Deutsche Zeitschrift f. prakt. Med. I, 367–369, 1874. Anatom. Beitr. z. Lehre von den Pocken, part I, 1874.

[14] Phil. Trans. Lond., 1874; Micro-Organism and disease, 1886, 69.

[15] Arch. f. experiment. Pathol. und Pharm. X, 222, 1879.

of the coccus. The size of the cell diameter was 0.5 μ. This organism received the name *Micrococcus quadrigeminus.* The literature on hand does not elucidate whether this bacterium had, by virtue of its characteristics, any diagnostic value.[16]

In 1883, C. Quist found that vaccine lymph could be artifically propagated in various nutritive media,[17] but such a dilution of the lymph had nothing to do with the bacteria, so far as these experiments went. It is undisputable that Quist propagated the vaccine *virus* along with the dilution of the lymph; the preservation of the virus in glycerin and other media, as done by practitioners, is, therefore, in spite of Pfeiffer's views, no simplification of Quist's method, in as much as propagation and preservation of efficacy (life activity) are not absolutely identical. Small-pox is unquestionably a bacterial disease, and we know that bacteria can live without propagating themselves; the ultimum temperature of propogation is lower than that of life, in both directions from zero.

Pfeiffer[18] found, in 1885, a sprouting fungus which he named *Saccharomyces* seu *Cryptokokkus vaccinæ vaccarum.* This fungus is not very much different from the so-called *Saccharomyces apiculatus,* and is no *Saccharomyces*[19], as it belongs to the group *Torula* in the sense of Pasteur and Hansen. In small-pox lymph, I have occasionally met a *Torula* which corresponds to Hansen's fifth species.[20] Pfeiffer's fungus did not bear endospores, and has no causal relation to small-pox. This *Torula* as well as the saprophytic bacteria, and the animalculæ which Pfeiffer reported from pustules will appear in many other eruptions and ulcerations. It appears that some of Pfeiffer's

[16] Conf. Lœffler, Vorles. ueb. d. gesch. Entwickelung der Lehre von den Bakterien I, 132, 1887.

[17] Finska läk. sällsk. handlingar XXV, 271, 1883. XXV, 341, 1883. Berl. klin. Wochenschr., 1883, 811–813. Hygiea (Stockholm) XLVI, 194, 203, 1884. See also Medical News.

[18] Correspondenzblatt d. allgem. aertzl. Vereins von Thüringen., 1885. No. 3. Sep. 12 pp.

[19] See my paper in THE AMERICAN NATURALIST, XXVII, 685–696, 1893.

[20] See Jœrgensen, Micro-Organisms and Fermentation, 1893, p. 190, and Bay, Amer. Monthly Microscop. Journal, XV, 42; 1894.

drawings[21] as well as Beale's " bioplasts (loc. cit.) indicate serious misinterpretations of the microscopic pictures.

L. Voigt described, in 1885,[22] three different forms of cocci from small-pox pustules. All of them would liquefy gelatine, and one of them was considered the probable carrier of the contagion. No definite results were, however, obtained. There were two cocci, and a diplococcus.

Pohl-Pincus also studied the micrococci found in specific eruptions, and showed their passage through the epidermis of a calf after inoculation.[23]

Hlava[24], Bowen and Garré have succeeded in isolating a streptococcus (*Streptococcus pyogenes*). They considered the united attack by these pyogenic cocci the cause of the disease. Koch and Feiler were, however, of the opinion that although some of the saprophytic micro-organisms found in vaccine lymph are pathogenic, they do not carry the contagion.

Protopopoff[25] succeeded in finding a streptococcus which corresponds, both macro- and microscopically, to the descriptions of the *Streptoccocus pyogenes.* Samples from pure cultures were injected in rabbits, dogs and cats, but without effect. Although this does not imply that this organism cannot affect man, it seems improbable that it could have any causal relation to variola.

Crookshank[26] and Copeman[27] found, in vaccine lymph, great numbers of common saprophytic and of some pathogenic bacteria, but no specific organism.

Rille[28] observed cocci in the vesicles and blood of persons suffering from varicella, but did not apply himself to bacteriological studies of these organisms.

[21] Correspondenzblatt d. allg. aerztl. Vereins von Thüringen, 1887, No. 2, Sep. 12 pp. 2 plates. Monatshefte f. prakt. Dermatologie, VI, 1887, No. 10. Sep. 13 pp. 2 pl. Die Protozoen als Krankheitserreger. Jena, 1890.

[22] Deutsche med. Wochenschrift, XI, 895–897, 1885.

[23] Pohl-Pincus, Untersuch. neb. d. Wirkungsweise der Vaccination, 1882.

[24] Sbornik Lékarsky, II, 96–105, 1887. Cblt. f. Bakt. II, 688, 1887.

[25] Zeitschrift für Heilkunde XI, part 2, 1890. Sep. 7 pp.

[26] Transact. Seventh Internat. Congr. of Hyg. and Dermogr. II, 326, 1892.

[27] *Ibidem*, 319–326.

[28] Wiener klinische Wochenschrift, No. 38–39, 1889.

Probably Sternberg was right in stating[29] that the etiology of small-pox is still undetermined. Still, some of the investigations above cited furnish very interesting points which are of value to those who wish to reinvestigate the matter.

Micrococci of different shape and characters are, however, not the only bacteria which have been observed in small-pox and vaccinia. A few statements point towards the presence of other bacteria, namely, bacilli. Crookshank (loc. cit.) mentions that he has found *Bacillus pyocyaneus*, *B. subtilis*, different *Bacterium*-forms (one yellow), and a bacillus resembling *Bacillus subtilis.* Martin[30] has described a bacillus of vaccine lymph. The ends of this bacillus are round or square, and it may form micrococci (!) which are arranged in chains of five or six cells. The author admits the possibility that both a bacillus and a micrococcus were present.

Coze, Feltz and Baudoin[31] have demonstrated the presence of bacilli in the blood of variola; upon injections of this blood into the veins of a rabbit, the typical symptoms of variola were produced.

In sheep-pox lymph examined by Zimmermann[32] three bacilli were found one of which had almost the same appearance as *Bacillus amylobacter*. A second investigation showed the presence of a short-limbed bacillus; *Micrococcus vaccinæ* (or *variolæ*) occurred in both series of investigations. All of Plaut's plates demonstrate bacilli which he was able to cultivate.

Toussaint's studies which also resulted in a discovery of bacilli are mentioned by Plaut (loc. cit.)

In April, 1894, vaccine "points" were procured from Dr. Hewitt's Vaccine Station at Red Wing, Minn. A watery dilution of the lymph adhering to the "point" contained, when examined by 1160 diam. m. (Bausch and Lomb, Oc. C2, Obj. $\frac{1}{12}$ oil imm.) a few amorphous bodies which assume a yellow color with IIKa, a few round bodies and irregular masses (probably nuclei or fragments of cells), dispersed in a clear fluid. I could distinguish no micrococci or other bacteria, and

[29] Manual of Bacteriology, 1892, 528–529.

[30] Boston Med. and Surg. Journal, CXXIX, 589, 1893.

[31] *Fide* Magnin-Sternberg, Bacteria, 1884; 410, 464.

[32] Plaut, Das organisirte Contagium der Schafpocken, 1882; 22.

no staining revealed any living organisms. Some of the round bodies observed in ten different examinations may have been spores or micrococci, but their nature was not revealed by the microscope.

A series of plate cultures upon " Pasteur gelatine "[33] was then arranged, but there occurred no development. These plates were prepared from 10 parts of gelatine to 90 parts of Pasteur's fluid. So, test-tube cultures in Pasteur's fluid alone, and in bouillon (beef; one pound of meat to one liter of water) rendered alkaline by Cl Na. were made. The points were grasped with a forceps, passed through a flame, and dropped into the medium which had been, previously, submitted to a very thorough fractional sterilization, as by the usual preparation of medium supplies. Great care was exerted in order that no infection from without should take place.

By a temperature of 24°C. the culture fluid would, on the next day after inoculation, become slightly turbid; on the second day the turbidity increased, a thin film being formed on the surface, and on the third day a grayish, highly tenacious film made its appearance. Microscopic investigation showed the presence of *bacilli*. The latter are colorless; they exhibit no motion, are devoid of cilia; their long diameter measures 0.6–1.0 μ and the short diameter .2–.3 μ. During the first and second days, they seem to develop in colonies of 20–200 cells, although, under the cover, many cells appear to be free and isolated.

The zooglœa (surface-film) has, to a great extent, the same appearance as the film-growth of the yeast-like *Mycoderma*, being folded, and of a greasy appearance. It is so tenacious that it resists the weight of the column of the culture medium which was observed as one of the cultures chanced to be inverted. Its connection with the culture vessel is quite intimate. On the fourth days, fragments of the zooglœa began to descend to the bottom, and the macroscopic appearance of the culture remained, after this, unaltered for three weeks and more. During this period, however, the microscopic appearance of the bacillus was gradually much modified.

[33] See Salomonsen, Bacteriological Technology, pp. 460 and 464.

This organism was found, with three exceptions, in 65 cultures from vaccine points hitherto made. Buttersack whose recent investigations will be mentioned in due time ventures the supposition that the specific organism of vaccine was not hitherto detected, because of its index of refraction being identical with that of the medium (lymph). I see no reason for this supposition, and I am prepared to explain Buttersack's theory from my own observations.

This bacillus has, to a great extent, the same appearance as those found by Plaut[34] and Zimmermann in sheep-pox.

Already at the beginning of the development, while the medium is well stored with nutrition, *the bacilli* bear spores. This being the most conspicuous feature of the organism, I named it *Dispora variolæ.* The systematic side of the description is as follows:

Genus: DISPORA.

Dispora: Kern, 1882.

Kern (Botanische Zeitung, 1882, No. 16) founded this genus upon one species which was found in kephir and which was characteristic mainly by having two spores in each cell. The genus belonged to the bacillus-group. Kern's *D. caucasica* has not been rediscovered by later students of the kephir-organisms (Beyerinck, M. Ward, Mix), and the genus-name vanished into *Bacillus* (Crookshank, Manual, 312).

Dispora variolæ.

Syn. The spore stage was described under the following names: *Microsphæria vaccinæ* Cohn, *Micrococcus vaccinæ* and *variolæ* Cohn, *Jos variolosa* Salisbury.

Habitat: In vaccine and small-pox lymph constant. Descr. Bacilli 0.6–1.0 μ by 0.2–0.3 μ. Two spores in each cell, one at each end. Aërobic.

On the sixth days of cultivation, *free* spores begin to make their appearance, both in the fluid and in the zooglœa. They are globular, highly refractive, and may be mistaken for what appeared to me, by a little over 2000 d. m., as vacuoles. The

[34] Loc. cit. Beilage I–IV b; especially II a.

latter are, however, larger, and their shape is oval or rectangular.

The same organism was found also in the lymph of variola confluens kindly furnished by the small-pox hospital in Chicago. Out of forty bouillon-cultures made from this lymph, only two failed to show the presence of the *Dispora*.

To prove that *Dispora variolæ* was not accidentally caught in the cultures from the atmosphere, gelatine-plates (10% gel., 90% beef-bouillon) were exposed to the air at the tables and windows for different periods of time. Among the numerous organisms thus obtained, none presented the characteristics of the above named bacillus

When cultures were examined on the eighth day after inoculation, the cells seemed to be crowded together in separate masses, each cell being surrounded by a rather thick layer of a gelatinous mass, free spores being abundant. As the cultures grew older, the cells gradually became more and more lengthened, forming rows, and on the fourteenth and fifteenth days, the culture presented the appearance shown in fig. 4. The cells were lengthened and formed long, thin threads. Spores were abundant, both in the cells and free. The number of cells was now gradually diminished, and, on the thirtieth day, very few were seen, the number of spores being altogether predominating. When traces of this last stage of development were transferred, with the usual precautions, into new medium, development promptly followed, as above described.

The following method of staining gave good results: A small drop of the culture was placed between two covers and slightly pressed between them. The covers being separated in the usual way were placed, moist side upwards, under a bell glass. When some of the fluid had evaporated, the clean side of the covers were placed three times, for a period of about one-second, in the immediate neighborhood of a flame. When completely dried in the temperature of the room, the covers were placed in alcohol for two or three minutes, and again dried; then they were floated, film-side down, upon aniline blue or aniline violet for 24 hours, washed, dried and mounted in the usual way.

While this organism had the appearance of being a specific bacillus-form, I was not thoroughly convinced thereof until I had made a fractional culture in bouillon which resulted in the development of the one form described. The *Micrococcus vaccinæ* I have never found in vaccine or small-pox lymph.

Regarding the polymorphism of this species I can state that I have observed no such swellings at the middle or ends of the long cells in old cultures as Martin (l. c.) noticed in the bacilli found by him, or as Hansen[35] described for acetic bacteria.

From the figures of *Micrococcus vaccinæ* and *variolæ* which I have seen I am inclined to believe that this organism is not specific, but consists of free spores of *Dispora variolæ*. I also believe that the facts in regard to the spread of small-pox, as well as the observations stated above point towards the conclusion that the spores are the main source through which the disease, itself, as well as vaccinia, are reproduced.

The organisms from small-pox and vaccine lymph are morphologically identical. The physiological difference consists mainly in the attenuation of the form found in vaccine lymph, so far as has been hitherto ascertained.

Buttersack[36] published, a short time ago, an account of certain bodies which occurred, constantly, in vaccine lymph, and which may have some relation to vaccinia. He allowed lymph to dry on covers; having fixed the latter to the slides by means of bees-wax, he inspected the film by immersion and observed a net-work of threads wiih small, refractive, round bodies. Landmann[37] and Dräer[38] interpreted Buttersack's discovery as threads of fibrin and other albuminates. I would assume that B. had seen the "thread-stage" of the organism found by me. Having not yet seen B's illustrations, this is a mere supposition.

The diagnostic value of my discovery is yet uncertain. I hope to be able to report upon the progress of the work, especially concerning inoculations upon animals and the prepara-

[35] Comp. Rend. Laboratoire de Carlsberg III, 265–327, 1894.
[36] Arbeiten a. d. Kais. Gesundheitsamte IX, 96–110, 1894.
[37] Hygienische Rundschau, 1894, 433–34.
[38] Centralblatt f. Bakt. und Parasitenkunde XVI, 561–564, 1894.

tion of vaccine in the laboratory, at some future time, when the work now in progress, has reached completion.

Bacteriological Laboratory, State Board of Health. Des Moines, Iowa, February, 1895.

EXPLANATION OF PLATE XXIX.

Fig. 1. $\frac{1000}{1}$. *Dispora variolæ*, two days old growth in Pasteur's fluid.

Fig. 2. $\frac{1000}{1}$. Same; four days old. Specimen from surface film.

Fig. 3. ca. $\frac{1500}{1}$. Same; eight days old culture in bouillon. A few spore-bearing cells.

Fig. 4. ca. $\frac{1500}{1}$. Same; eleven days old culture in bouillon. Spore-bearing cells numerous.

Fig. 5. $\frac{1000}{1}$. Same; 25 days old bouillon-culture. Some free spores; chains.

Fig. 6. $\frac{600}{1}$. Same; one month old bouillon-culture. Cells almost disappeared; free spores in excessive numbers.

THE AFFINITIES OF THE LEPIDOPTEROUS WING.

BY VERNON L. KELLOGG.

It has long been recognized that the venation of the wings of the Trichoptera and Lepidoptera is of similar general character; and recognized, too, although less popularly, that the genera *Hepialus* and *Micropteryx* display more clearly than do any other lepidopterous forms this general resemblance to the trichopterous venation. Speyer,[1] in 1870, pointed this out in his discussion of the affinities of the Lepidoptera and the Phryganidæ. His too serious consideration of the many mere analogies apparent in any comparison of the groups did much

[1] Speyer, A. Ueber die Genealogie der Schmetterlinge, Stettiner Entomologische Zeitung, pp. 202–223, 1870.

to discredit the real points of worth brought out in his discussion. In the light, however, of the present association of *Hepialus* and *Micropteryx* as a sub-order, the *Jugatæ,* of the *Lepidoptera,* which is recognized as a distinctly more generalized group than the sub-order *Frenatæ,* which includes all other Lepidoptera, this trichopterous character of the jugate venation becomes more conspicuously significant.

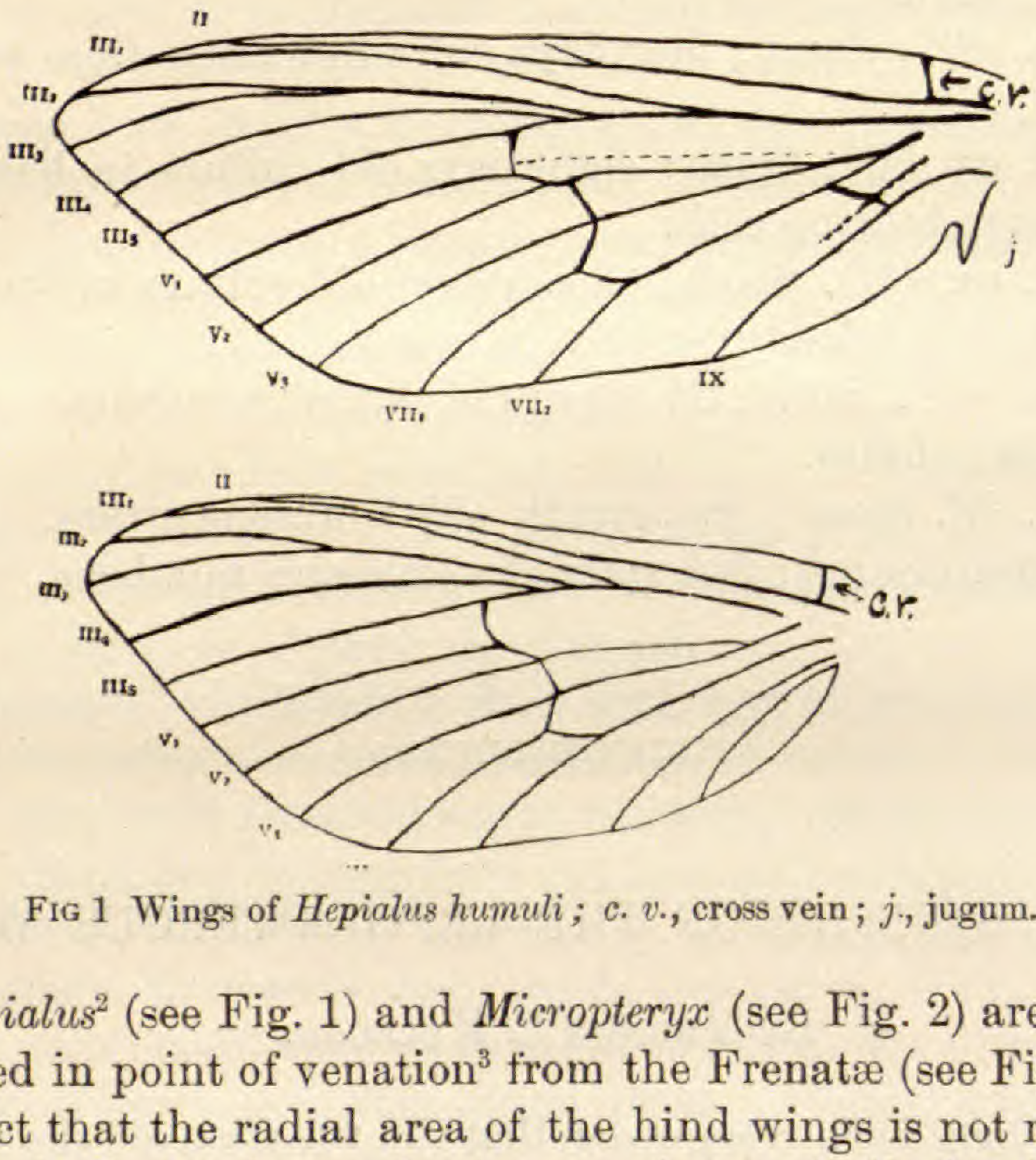


FIG 1 Wings of *Hepialus humuli; c. v.,* cross vein; *j.,* jugum.

Hepialus[2] (see Fig. 1) and *Micropteryx* (see Fig. 2) are distinguished in point of venation[3] from the Frenatæ (see Fig. 3) by the fact that the radial area of the hind wings is not reduced, although the anal area is, thus causing a similarity in venation between the fore and hind wings, radius (III) being five-branched in each. This similarity of the venation of both wings is not to be found among the Frenatæ. The persist-

[2] The venational nomenclature used is that of Redtenbacher (Vergleichende Studien über das Flügelgeäder der Insekten, in Annalen der k. k. naturhistorischen Hofmuseums, Bd. I, 1886, Wien) adopted, with modifications, by Comstock.

[3] The real value of these taxonomic characters presented by the venation of the Lepidoptera can be fully appreciated after a reading of Prof. Comstock's essay on Evolution and Taxonomy; in the Wilder Quarter-Century Book, 1893, Ithaca, N. Y.

ence of the stem of media (V) anywhere among the Lepidoptera is an indication of a generalized condition, as is the persistence of more than two anal veins in the hind wings. At the base of the principal descent lines of moths are found generalized forms, their generalization indicated in their venation by the persistence of media (V) and often by the presence of three anal veins in the hind wings. But the specializing ten-

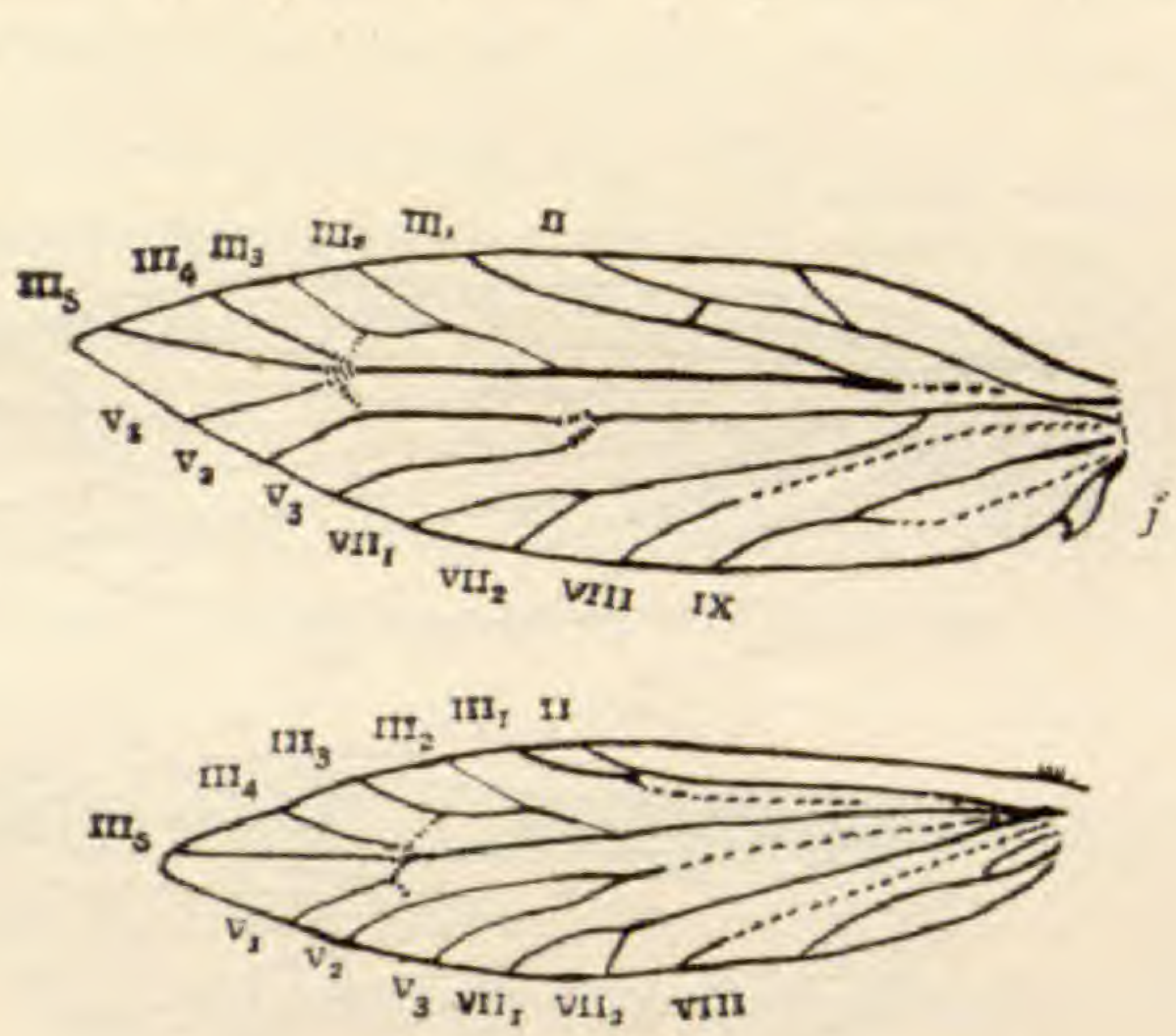


FIG. 2. Wings of *Micropteryx* sp.; *j.* jugum. (After Comstock).

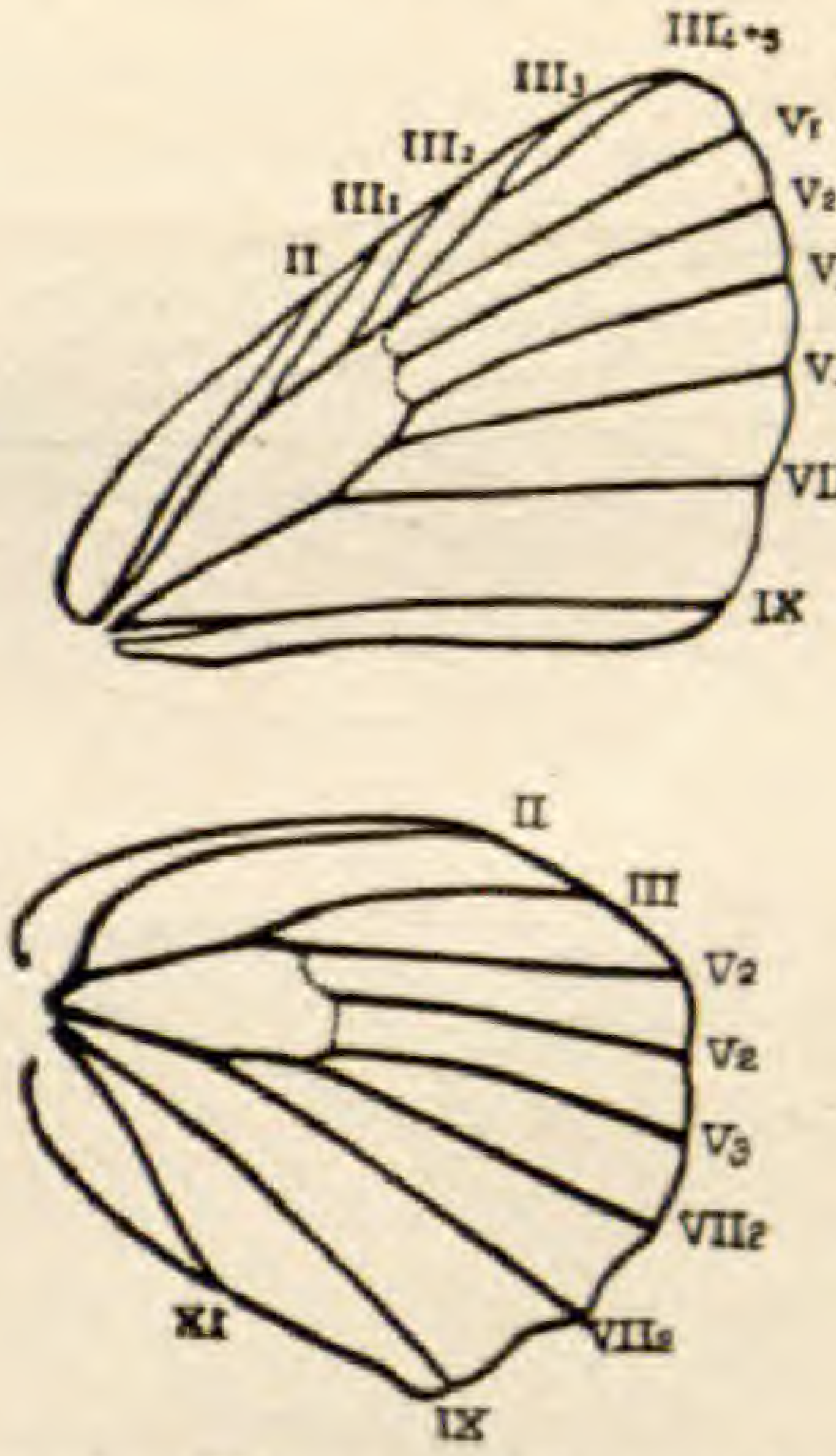


FIG. 3. Wings of *Chrysophanus thoe.* (After Comstock).

dency towards a cephalization of flight, resulting in a change from the racial sub-equality and importance of fore and hind wings to an inequality produced by a reduction of the hind wings has resulted in the loss (coalescence) among all living Lepidoptera, except the genera *Hepialus* and *Micropteryx*, of the branches of radius in the hind wings.

As pointed out by Prof. Comstock, the Jugatæ (*Hepialus* and *Micropteryx*) in this respect stand much nearer the racial lepidopteron than do any of the Frenatæ. The striking resemblance, then, of the jugate venation, standing, as it does, for the most generalized existing condition of lepidopterous venation, to the trichopterous type of venation is significant. By an inspection of the figures, herewith presented, of the venation of *Hepialus* (see Fig. 1) and *Micropteryx* (see Fig. 2) with those of the venation of *Neuronia* sp. (see Fig. 4) and of an undetermined caddice-fly collected by me in Colorado (see Fig. 5), the reality of the correspondence is apparent. In the fore wings of all the simple unbranched sub-costa (II), the 5-branched radius (III_1–III_5), the persisting stem of media (V) coalescing at its base with cubitus (VII), the three branches (four in the Colorado trichopteron) of media (V), and the reduced anal field, are common characters. In the hind wings, the general character of the venational uniformity is only varied by differences which,

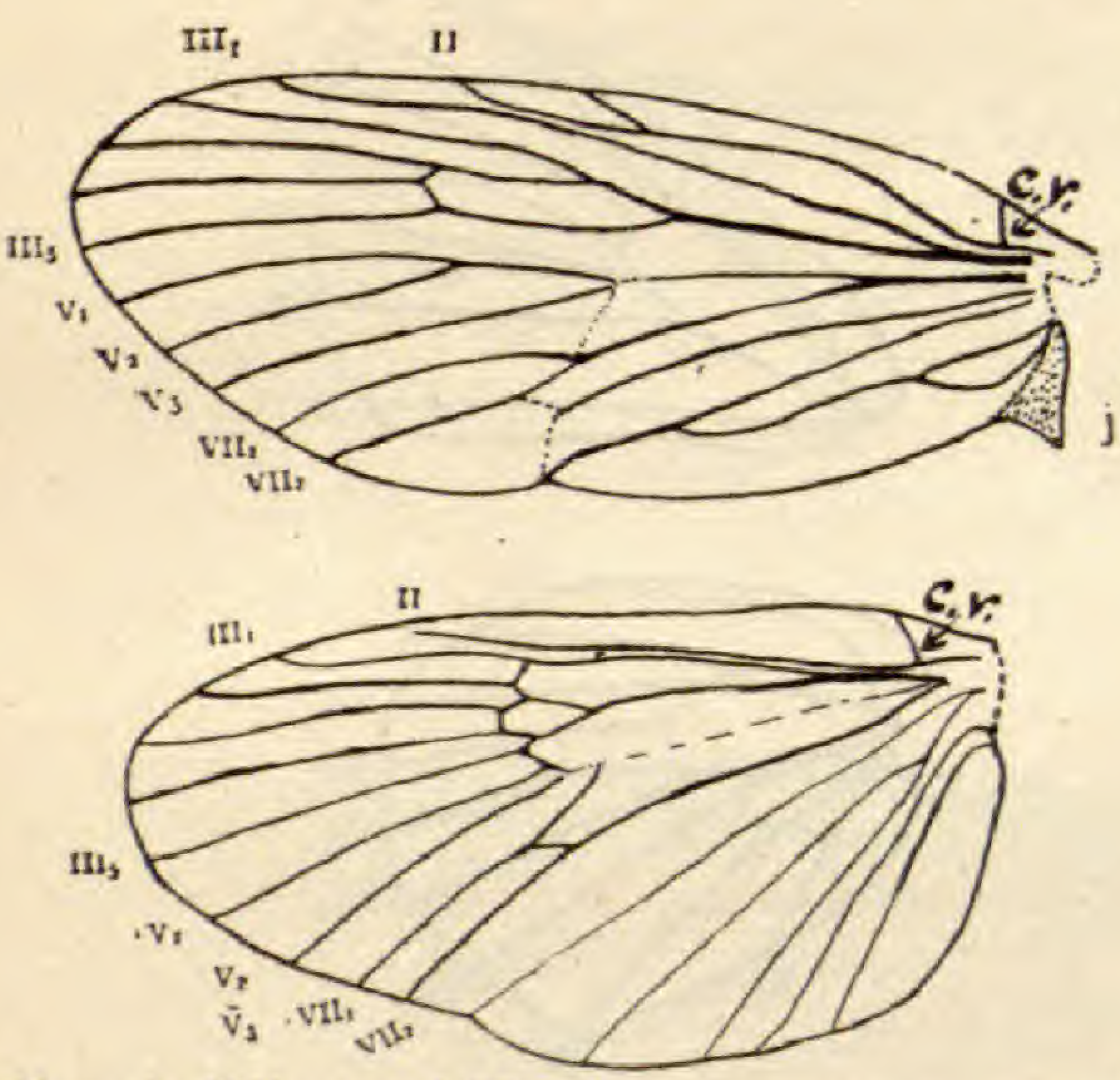


FIG. 4. Wings of *Neuronia*, sp.; *c. v.*, cross vein; *j.* jugum.

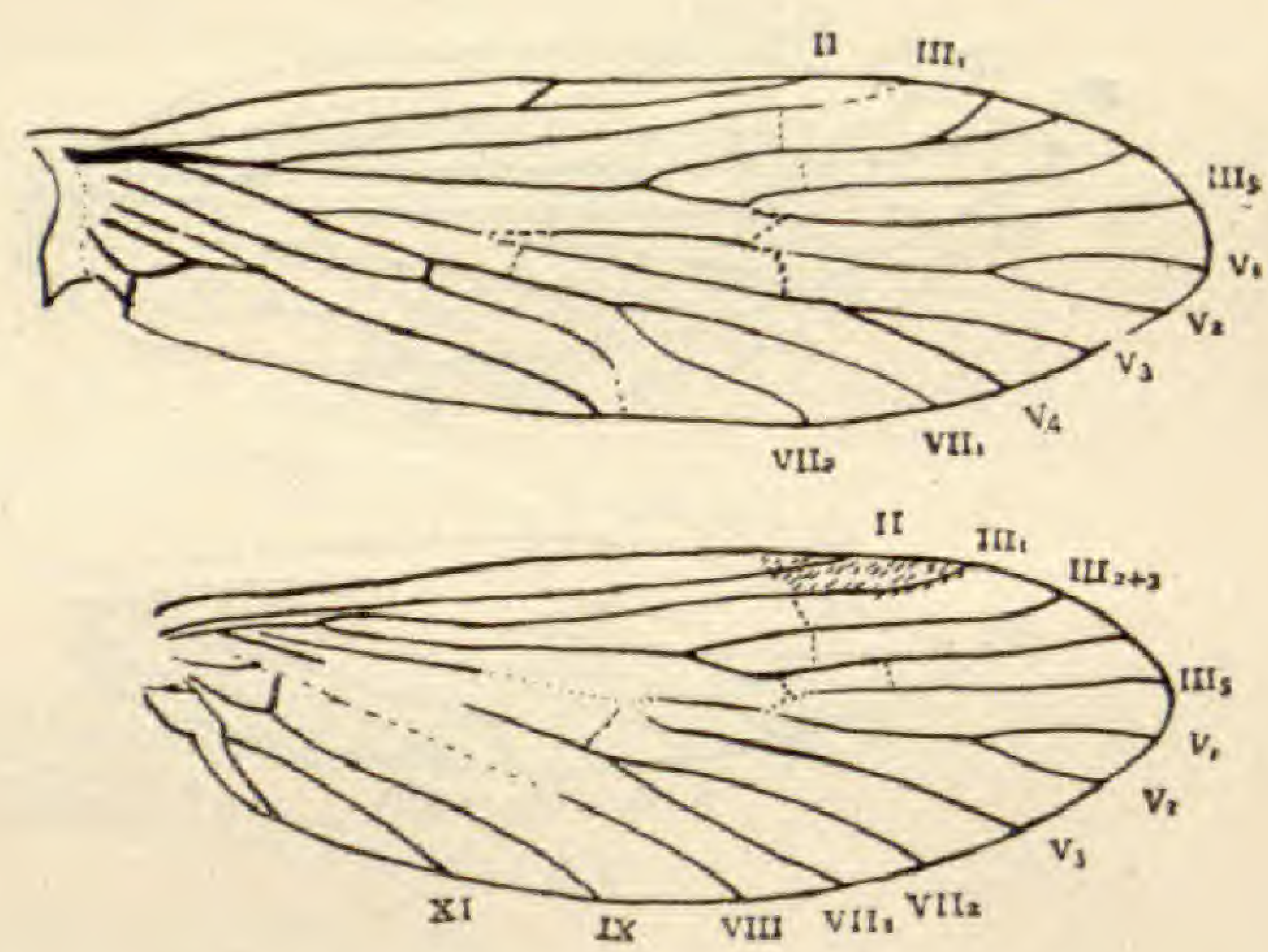


FIG. 5. Wings of undetermined caddice-fly; *j.* jugum.

in themselves, are additional evidences of a community of plan. One of the caddice-flies differs from the other in those correlated characters which have been pointed out by Prof. Comstock as characteristic of the tendency of specialization in the lepidopterous wing, viz., a tendency towards the coalescence (or disappearance) of the radial branches and increasing reduction of the anal area manifested by a loss of anal veins. In the hind wings of the Colorado caddice-fly (see Fig. 5) there are but four radial branches (III_1, $III_{2,3}$, and III_4 and III_5), and the anal veins (VIII, IX, XI, XIII), while two more in number than in *Micropteryx* or *Hepialus*, are less in number than in *Neuronia*.

It is beyond the scope of this paper to attempt any discussion of the lines of specialization exhibited by the wings of the Trichoptera, but it is an obvious and interesting fact that the general characters of these lines are strikingly parallel with those exhibited by the Lepidoptera. A more primitive subequality of the wings, shown among the Lepidoptera only by the Jugatæ, is retained, but there is an obvious tendency towards a narrowing of the wings and consequent loss in number of veins, this loss being first apparent among the anal veins, and radial branches, and the hind wings being the first to be reduced. *Setodes* and other similar forms constitute an exception to this general tendency, something as do the Saturniina among the Lepidoptera, in that a peculiarly expanded anal field is displayed, although the venation of the wing is considerably specialized, the radial branches being largely reduced. The wing and anal area here are not in a primitive condition, but display a peculiar sidewise developed specialization. The tendency towards the disappearance of the base of media (V) is manifest, the stem of the vein in both fore and hind wings of *Mystacides punctatus* and others being represented by a mere fold.

Of interest in the comparison of the trichopterous and jugate wings, is the condition of the cross veins. The primitive neuropterous wings are characterized by the wealth of cross veins; the specialized lepidopterous wings are characterized by the almost total absence of these veins. The Jugatæ show more cross veins than do any of the Frenatæ. The usual trichopterous wings possess more cross veins than the jugate wing, but the manifest tendency is towards their fading out and disappearance. The wings of *Mystacides punctatus*, for example, a highly specialized trichopteron, shows fewer cross veins than do the wings of *Hepialus* or *Micropteryx*. In the hind wings of *Setodes* sp. there are no cross veins and but two or three in the fore wings. In the disappearance of the cross veins those midway between base and apex of wing persist longest; although there is a cross vein between the basal part of subcosta (II) and the costal margin of wing which is very persistent (see *c.*

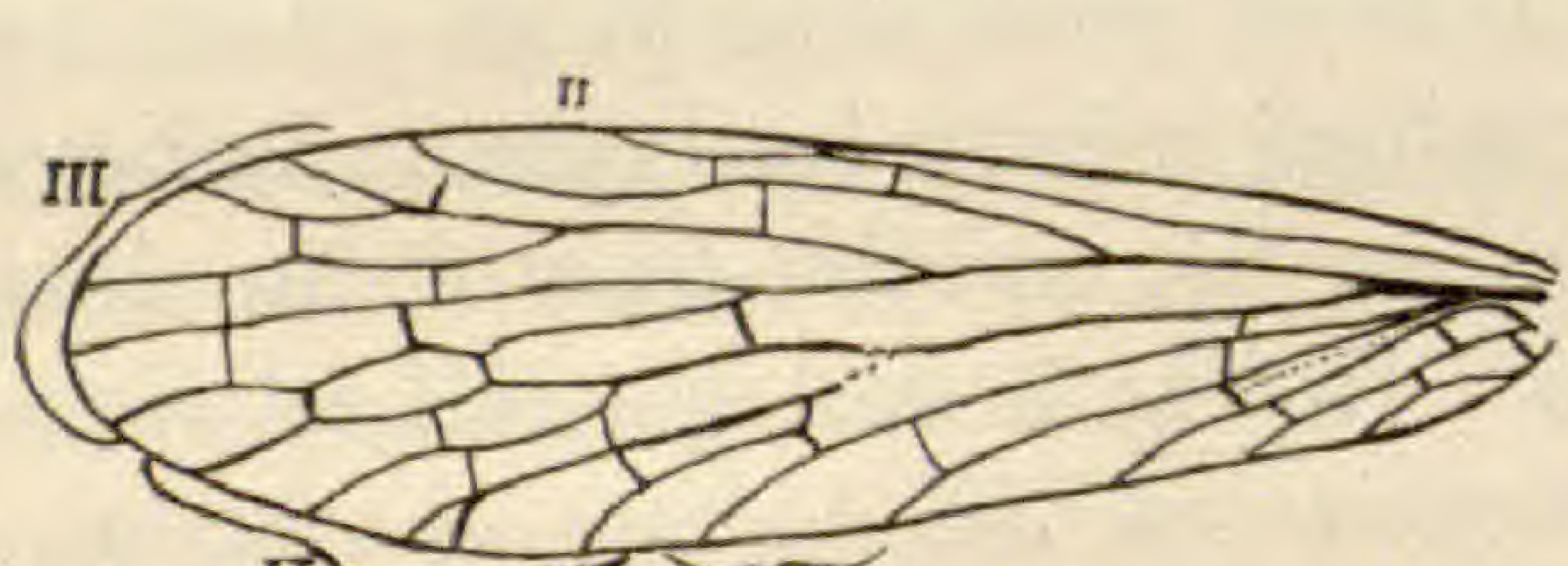


FIG. 6. Fore wing of *Panorpa* sp.

v. in *Hepialus humuli* Fig. 1, and in *Neuronia*, Fig. 4). I present a figure of the venation of the fore wing of *Panorpa* sp. which should be examined in connection with the jugate and trichopterous wings for the noting of this tendency of disappearance of the cross veins, and for the persistence of the mid-wing cross veins. It is worth while, in passing, to note also the general agreement in venational character of the mecopterous wing with the trichopterous and lepidopterous wings. The more generalized character of the *Panorpa* wing is manifest in the point of number of radial and medial branches and in the abundance of cross veins. As I have pointed out elsewhere, this disappearance of cross veins in these three groups proceeds coincidently with the development of the wing-scales, which serve to strengthen the wing-membrane.

Not alone in character of venation but in character of wing-clothing, as pointed out in a previous paper,[4] and in the mode of tying the fore and hind wings of each side together for the sake of sychronity of movement in flight, do the jugate and trichopterous wings show obvious resemblances. The well-known scale-hairs of the Trichoptera are simply the true lepidopterous scale in generalized state. Nor are these trichopterous scales always of so generalized condition as an examination of a limited number of wings might lead one to believe. There are many instances among the caddice-flies of the presence of well developed scales. In Fig. 7 well-specialized scales from the fore wings of two species of *Setodes* are shown at *c* and *d*. I have been specially interested to note in the wing clothing of *Mystacides punctatus* (see *a* and *b*, Fig. 7) in addition to the numerous broad scale hairs, a sprinkling of conspicuous large, flattened, bulbous, white scales, which present externally the peculiar characters of the variously modified scent-scales or androconia of the male butterflies.

The essential structural difference between the Jugatæ and Frenatæ on which the two groups were separated by Prof. Comstock is that displayed by the two methods of uniting the wings of each side during flight. The jugate moths have fore

[4] Author. The Classification of the Lepidoptera, AMERICAN NATURALIST, v. XXIX, no. 339, pp. 248–257, March, 1895.

and hind wings united by a membranous lobe, the jugum, borne at the base of the inner margin of the fore wings. When the wings of *Hepialus* or *Micropteryx* are extended, "the jugum projects back beneath the costal border of the hind wing, which, being overlapped by the more distal portion of the inner margin of the fore wing, is thus held between the two as in a vise." The frenate Lepidoptera have the two wings of each side united by the familiarly known frenulum borne at the base of the costal margin of the hind wings, or by a substitute for a frenulum, an expanded humeral area of the hind wings, by which a considerable overlapping of the wings is produced. The common occurrence of a jugum among caddice-flies (see *j* in Figs. 4 and 5), which is essentially the same structure presented by the jugate moths, has already been referred to by Prof. Comstock as of interesting significance. The jugate method is, however, by no means the only mode of wing union among the Trichoptera. The jugum may exist coincidently with other uniting structures, or it may be entirely wanting, the tying together of the fore and hind wings being accomplished by the overlapping for a considerable space of the hind margin of the fore wing and the costal margin of the hind wing, or by a row of hooks projecting from the costal margin of the hind wing which fasten to a chitinized ridge running along near the hind margin of the fore wing. There seems even to exist the beginnings of the frenate method of wing tying, as displayed in *Hallesus* sp. The wings of this trichopteron present a combination of the jugate and row-of-hooks methods of wing tying, and, in addition, there are present on the base of the costal margin of the hind wing two long strong hairs (see *f*, Fig. 8), the very counterpart of the generalized

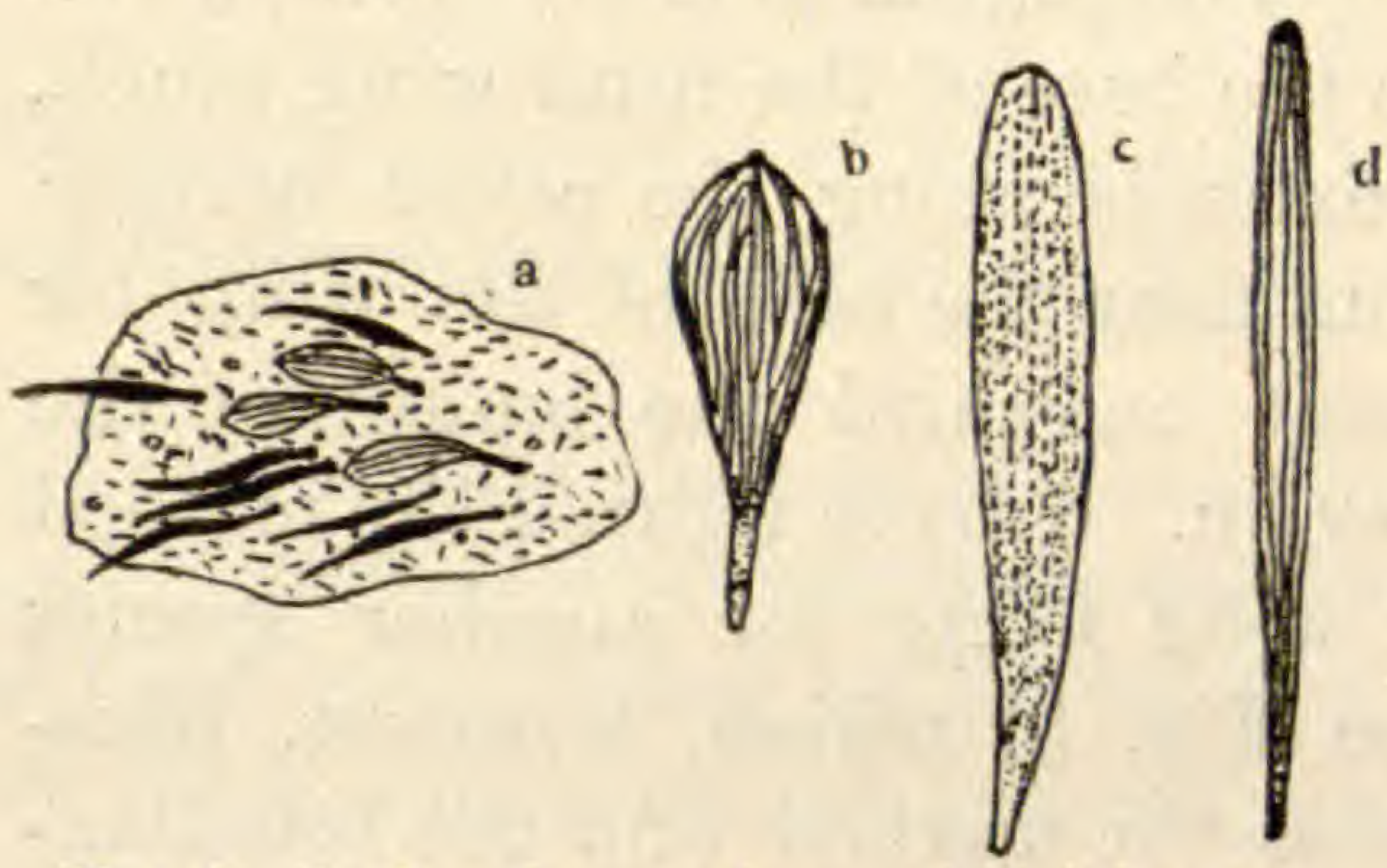


FIG. 7. Scales from wings of Trichoptera; *a*, portion of fore wing of *Mystacides punctatus* showing scale hairs and bulbous, androconia-like scales; *b*, one of the androconia enlarged; *c*, *d*, scales from fore wings of *Setodes*.

frenulum (i. e., frenulum in which the hairs are not united into one single strong spine) of the lepidopterous wing. This trichopterous frenulum is, however, much shorter than the lepidopterous frenulum and does not fit into a frenulum hook on the under surface of the fore wing, but merely rests against the jugum of the fore wing. The jugum is fairly well developed but can hardly overlap the base of the hind wing much. The series of tying hooks extends along the costal margin from near the base of the wing for about one-third the length of the margin. I have figured the method of wing tying for another species (see Fig. 9) which, however, illustrates the method and the functioning structures quite as truly for *Hallesus* sp. In the species figured, the hooks method, combined with the overlapping of the opposed margins of the wings, is the only means of union, the small, jugum-like structure at the base of the fore wing being practically functionless. When the wings are extended a narrow space along the inner margin of the fore wing, roughened on its under surface by many short, strong, sharp-pointed bristles, and with the membrane greatly strengthened and made less yielding by these bristles, is underlain by the costal margin of the hind wing for a distance of more than half the length of the margin. Along the extreme costal border of this underlying space, which is slightly expanded costal-wards, there is a regular series of strong, hooked hairs or bristles, each of which bears on the concave surface of the curved or hooked portion many fine teeth (see *c*, Fig. 9). These toothed hooks are applied to and firmly grasp a strong, roughened, chitinous line or ridge running along the under side of the fore wing. This chitinous line is roughened by the presence of fine ridges for the firmer grasping of the hooks. By the overlapping and hooking there is formed an effective tying together of the two wings.

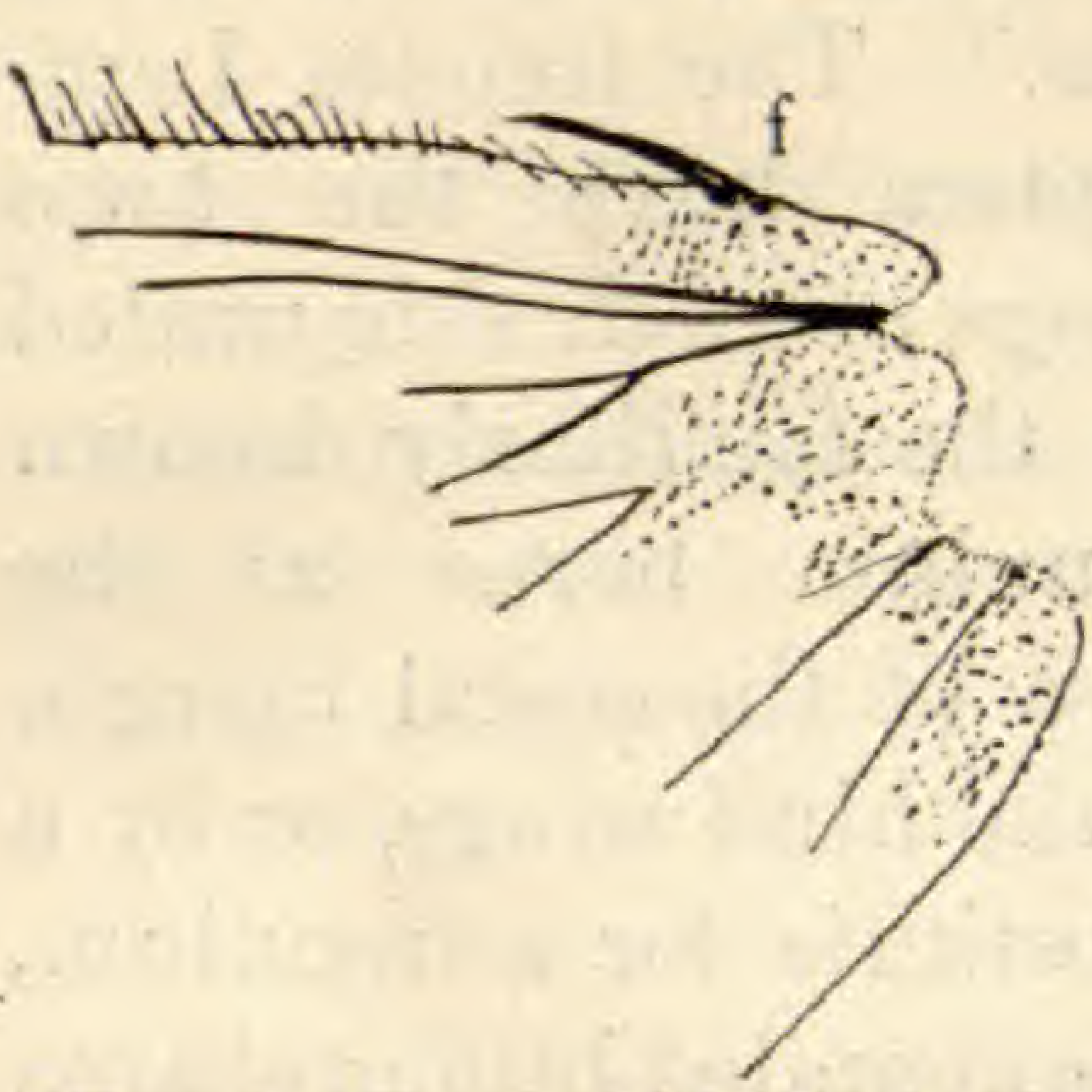


FIG. 8. Base of hind wing of *Hallesus* sp.; *f*, frenulum hairs.

This method of tying by hooks is a common one among the caddice-flies. Often there will be no chitinized ridge (chiefly produced by an extra thickening of one or more of the anal veins) for the hooks to grasp, but one of the anal veins will bear a series of stiff hairs or bristles which interlace with the hooked bristles and project in such a direction that they are effectually grasped by them. In connection with the hooks and slight overlapping of the wing margins, there is usually a well-developed jugum, which makes a firm overlapping connection between the bases of the wings. There are often, too, small bunches of strong, long hairs, or smaller number of still stronger hairs borne on the base of the costal margin of the fore wing, which project forward under the jugum, suggesting, as shown especially in *Hallesus*, the beginnings of the lepidopterous frenulum.

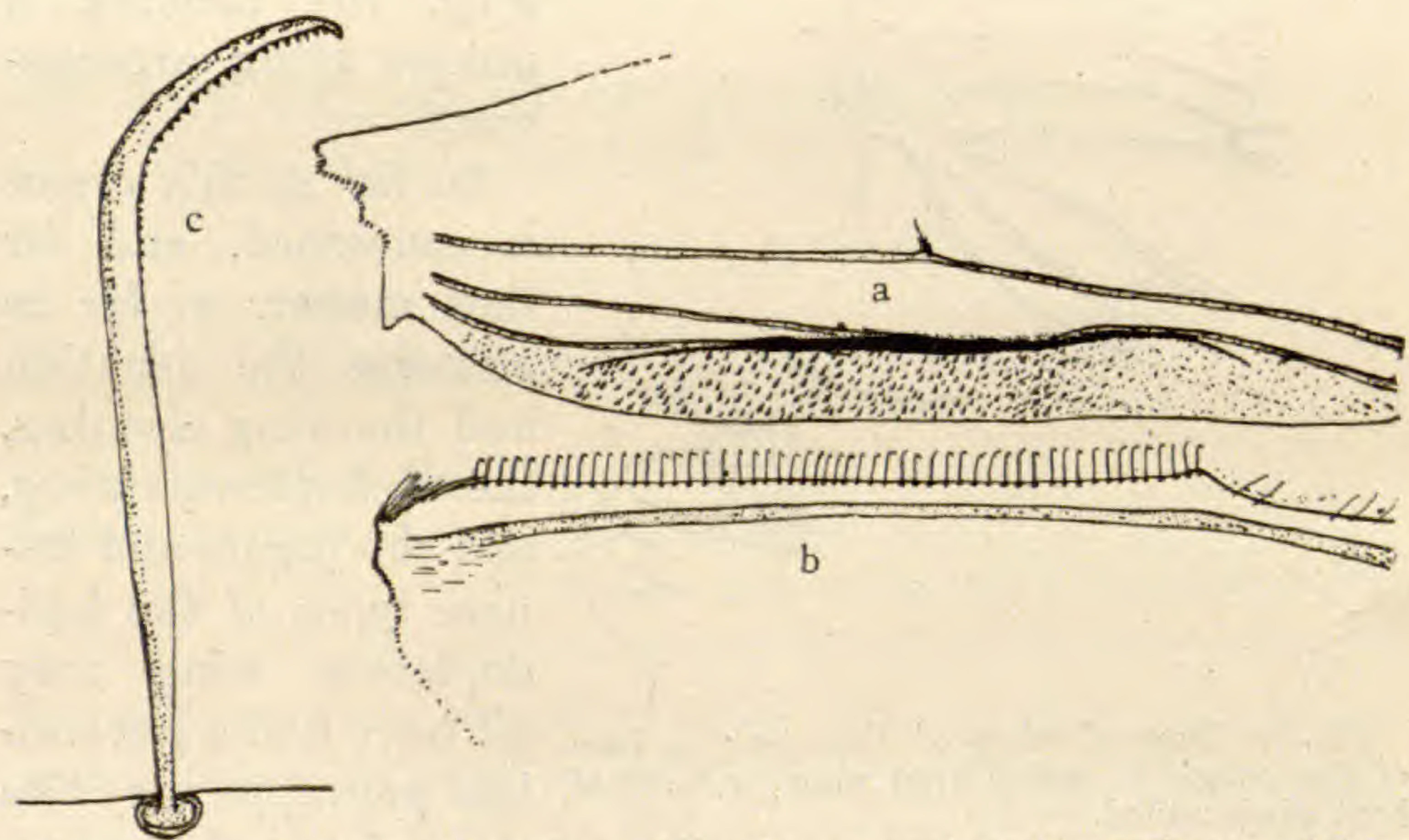


FIG. 9. Portions of wings of a caddice-fly; *a*, anal margin and area of fore wing; *b*, basal half of costal margin and area of hind wing; *c*, hook (enlarged) from costal margin of hind wing.

A most interesting wing tying arrangement is presented by *Panorpa* (see Fig. 10, *a*, *b*, *c*). We have here an arrangement which is strongly suggestive of what that racial type-structure may have been from which, on the one hand, the successfully functioning unaided jugum, and on the other, the perfected frenate arrangement could have been developed. The pretty strongly developed jugum in this mecopterous form bears on its free margin four strong backward projecting bristles, while a basal expansion of the costal margin of the hind wing bears on its free margin four strong backward projecting bristles, while a basal expansion of the costal margin of the hind wing bears two long, strong, slightly diverging bristles, so projecting that one lies above the other. When the wings are expanded the four jugal bristles lie between two bristles of the hind wing (see *c*, Fig. 10), forming a unique tying arrangement.

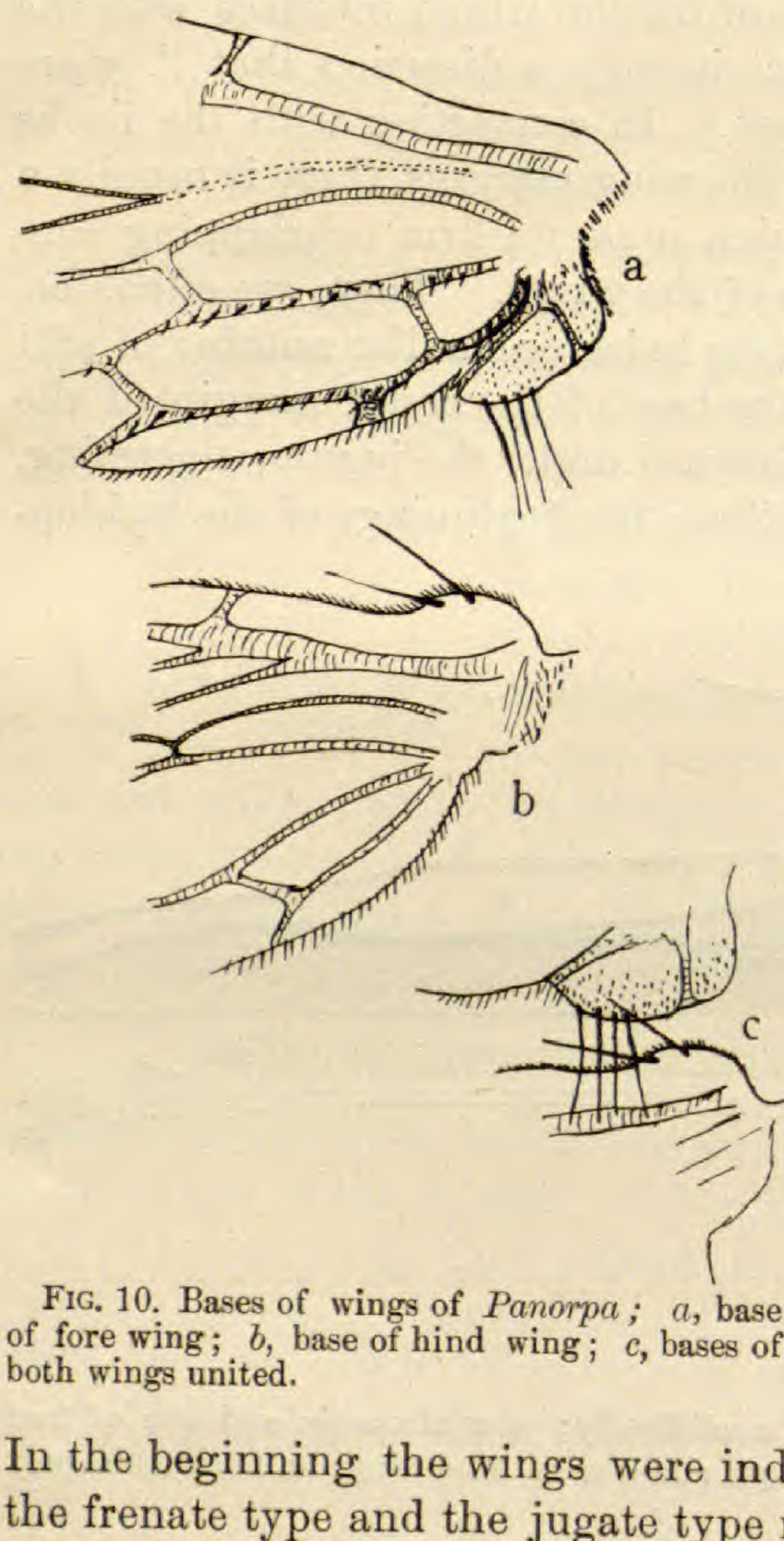


FIG. 10. Bases of wings of *Panorpa*; *a*, base of fore wing; *b*, base of hind wing; *c*, bases of both wings united.

So far as this organ is concerned, and for that matter, so far as concerns the venation and the wing clothing, the trichopterous wing, and the jugate and frenate types of the lepidopterous wing may all have had a generalized prototype very like the mecopterous wing. In the beginning the wings were independent and obviously the frenate type and the jugate type may have arisen, as suggested by Prof. Comstock, as distinct lines from the un-united wing type. But from the known phyletic relations of the Jugatæ and Frenatæ, and from the conditions presented by the trichopterous and mecopterous wings, which I have here attempted to indicate, the evidence, though as yet most ill-digisted, suggests strongly, to my mind, the probability of the origin of the frenate type from an earlier type which was essentially jugate, but which possessed frenulum-like structures of a character to be easily developed, by selection, into the existing highly specialized frenate condition of the wings of the Noctuidæ and others.

In conclusion, I may add that every attempt I have yet made to study, in a comparative way, the morphology of the three insect groups mentioned in this paper, has afforded in each succeeding instance stronger basis for a belief in the close phyletic relationship of the groups, a belief shared with, of course, and already expressed by many others.

Stanford University, Calif.

ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES.

BY DR. THOMAS WILSON.

(*Continued from page 456, Vol. XXIX*).

Appreciating the importance of the discoveries made in France in regard to the proportion of fluorine in animal bones as a test of their fossilization and antiquity, I determined to make a further attempt in the investigation by analysis of the bones, human and mylodon, found by Dr. Dickeson at Natchez, as heretofore described (page 303). To that end, I made application to Dr. Samuel G. Dixon, Curator of the Academy of Natural Sciences of Philadelphia, for specimens of the two bones to be subjected to analysis with a view to the determination of their respective proportions of fluorine. Dr. Dixon kindly presented my application, and it was allowed. In due course I received the fragments from the two respective bones. Professor R. L. Packard was engaged in the laboratory in the U. S. National Museum making a series of mineral and rock analyses, we had, together, become acquainted with Mons. Carnot's methods of analysis by having read and studied them, and he was heartily enlisted in the investigation, therefore was chosen to make the analyses. His report is herewith presented:—

WASHINGTON, D. C., March 20, 1895.

Dr. Thomas Wilson, Curator, Department of Prehistoric Anthropology, Smithsonian Institution.

DEAR SIR: I send you herewith the results of the chemical analyses of the fragments of bones you gave me for examination.

One of the specimens, said to be a portion of the mylodon gave on complete analysis the following composition:

Moisture,	3.94
Organic matter,	25.55
Carbonic acid (CO_2),	3.76
Lime (Ca O),	28.25
Magnesia (MgO),	.06
Manganese (MnO),	.79
Oxide of Iron and Alumina (Fe_2O_3 & Al_2O_3),	7.75
Phosphoric acid (P_2O_5),	26.59
Fluorine (Fl),	.28
Insoluble matter,	1.55
	98.51

From the nature of the case the determinations were made on different pieces of bone, and its composition seems to be tolerably uniform, because duplicate determinations of moisture, carbonic acid and organic matter varied very little.

Arranged to show the combination of the above bases and acids, for which a separate determination of the iron (and alumina) phosphate were made, the result is:—

Moisture,	3.94
Organic matter,	25.55
Calcium carbonate,	8.54
Calcium phosphate,	42.83
Iron (and alumina) phosphate,	12.07

Magnesium phosphate, ...	.13
Calcium fluoride, ...	.57
	93.63

The specimen said to be fragments of the human pelvis consisted of a disk of perhaps an inch in diameter and a quarter of an inch thick, pieces of what appeared to have been another disk similar to the first, and a quantity of coarse powder. That the two were not identical in composition is evident from the difference in the loss on ignition, the solid pieces having given 25.05 and the powder 14.20 per cent.

As the determination of fluorine was a special object in this investigation, I decided to use only the solid pieces of the bone, as this would afford a better means of comparison with the mylodon bone. This was accordingly done, and the following was the result of the partial analysis which was carried out on the same sample in which the fluorine was determined:

Moisture, ...	3.62
Organic matter, ...	21.43
Iron (and alumina) phosphate, . .	13.01
Lime (Ca O), ...	27.94
Phosphoric acid (P_2O_5), ...	20.77
Fluorine, ...	.38 (=.78 Ca F_2)

It was impossible to determine the carbonic acid. The insoluble residue was slight, but was not determined.

Deducting the moisture and organic matter, we should get for the composition of the ash of the mylodon:—

Calcium carbonate, ...	13.14
Calcium phosphate, ...	65.92
Iron (and alumina) phosphate, ...	18.57
Calcium fluoride, ...	.88

We have not sufficient data for making a similar complete calculation in the case of the human bone, but we can give enough of the constituents to find in it, as well as in the mylodon bone, the ratio between the fluorine contained in the bones and the theoretical quantity which an apatite having the same proportion of phosphoric acid would contain, as recommended by M. Carnot in the Ann. des Mines, 1893.

Deducting the moisture and organic matter, therefore, we should have the following partial composition of the ash of the human bone:—

Iron (and alumina) phosphate, ...	17.34
Lime (Ca O), ...	37.25
Total phosphoric acid, ...	27.69
Fl (fluorine), ...	0.51
Or Ca Fl (calcium fluoride), ...	1.03

The analyses are here re-arranged so as to permit of comparison with those tabulated by M. Carnot:—

Ash	Organic matter	Oxide of Iron (and alumina)	Phosphoric acid	Fluorine	Fluorine of apatite	Ratio { Fluorine and Fluorine of Apatite }
Mylodon	22.55	7.75	26.59	0.28	2.37	0.12
Human bone	21.43	6.50	20.77	0.38	1.85	0.20

In the present instance the fluorine was determined by the method recommended by M. Carnot with no essential modifications. This method differs from others mainly in the composition of the precipitate produced. The process, in brief, consists in decomposing the substance mixed with silica (free from fluorine) with concentrated sulphuric acid which has been freed from fluorine by heating with silica, passing the silicon fluoride gas evolved through dry tubes unto a solution of fluoride of potassium, and precipitating the fluo-silicate of potassium so produced with alcohol, which precipitate is collected on a tared filter dried and weighed. The decomposition is effected in a dry flask at a temperature of about 100° C and the current of dry air is passed through the apparatus during the operation, which lasts a couple of hours or more. I examined the precipitates under the microscope in order to be certain of their character, and observed the small isometric forms—combinations of cubes and octahedrons—under which silicofluoride of potassium appears.

The analyses of the human bone and mylodon which you had made formerly and have handed me, show that the specimens differed in several respects from those you furnished me. The composition of the mylodon bone does not vary so very much in its essential constituents from that I have analyzed, but the human bone contained 22.59 per cent. of silica. Deducting that figure from the total, and recalculating, we have:

Loss on ignition, ...	20.15
Lime, ...	33.59
Phosphoric acid, ...	22.57

This makes the proportion of lime about six per cent. greater than in the specimen I analyzed, while the phosphoric acid is only some two per cent. higher. In both cases that latter constituent is present in much smaller proportion than is usually given for phosphoric acid in human bones. (See Fremy, Encyclopedie Chimique T. IX, p. 603, where phosphoric acid is as high as 53 per cent. of the ash or total mineral matter). Moreover, the percentage of ash is higher than is usual in human bones. A list in Watts' Dictionary, article Bone, gives the percentage of ash in such bones as below 70 per cent., ranging from about 50 to 70, while in the present case the ash is about 75 per cent.

I am
Very truly yours,
(Signed) R. L. Packard.

It is always to be remembered throughout this paper, both in the investigations of myself and Dr Packard, as well as in those of Mons. Carnot, that the results are comparative and not absolute. The value of our investigations lies in showing that if the bones of the mylodon and the man were originally deposited together, and were practically the same age, they must have been subjected to substantially the same chemical influences, they would show practically the same analyses, and the comparison between their respective constituents should be substantially the same. Thus is afforded the great desiderata of a means of comparison between the human and the animal bone. As it is known that the mylodon was to a certain extent an ancient animal, if the human bone, when compared with that of the mylodon showed an equal amount of fluorine together with the concomitants of fossilization, it is evidence that they are of the same antiquity.

The relations between the various chemical constituents of the two bones are shown in the following table:

	Mylodon	Man
Fluorine, ...	0.28	0.38
Fluorine calculated for apatite, .	2.37	1.85
Ratio, ...	0.102	0.205
Phosphoric acid, ...	26.59	20.77
Fluorine, ...	0.28	0.38
Ratio, ...	94.96	54.70
Organic matter, ...	25.55	21.43
Oxide of iron and alumina, . . .	7.75	6.50

From these tables the following comparisons may be made: The fluorine in the mylodon was 0.28, in man 0.38, the ratio between the quantity of fluorine in the bone and to that of an apatite having an equal amount of phosphoric acid was, for the mylodon 0.102, for the man 0.205. A reference to the tables on pages 313 and 447 will show that for modern bones, the average as calculated from twelve specimens, is 0.058. By the same table the Quaternary bones were shown to be 0.36. It would appear from a comparison, that the bones of the man and the mylodon subjects of the present analyses are approximately between modern bones and those of the Quaternary period.

In the present cases the phosphoric acid was in the mylodon 26.59 and the man 20.77, while the fluorine was respectively 0.28 and 0.38, making the ratio between them, for the mylodon 94.96, for the man 54.70. Referring to page 455, we will see this test applied to the discoveries of Billancourt. There the two fossil bones were respectively 23.9 and 19.4, while the human bone reached the high average of 168.9. Turning again to the table on page 447, we will see that this ratio was increased in the case of bones known to be modern to 193.1. This, therefore, bears out the contention of the value of this test—it shows two things, (1) that according to the averages made by Mons. Carnot, the bones under present consideration, the man and the mylodon, are substantially of the same antiquity, and (2) by the same comparison their antiquity is about midway between the modern bones and those of the Quaternary geologic epoch.

This investigation will be carried further by making analyses of other bones, some of which will be modern, some of known, and others of supposed antiquity.

CONTRIBUTIONS TO COCCIDOLOGY.—I.

By T. D. A. Cockerell,

ENTOMOLOGIST, NEW MEXICO AGR. EXP. STATION.

The present is the first of a proposed series of papers on Coccidæ (Scale Insects); intended to make known some of the numerous new facts, especially regarding their distribution, which are constantly coming to light. The ever increasing traffic in living plants, which is going on in nearly every part of the world, is leading to the wide dispersal of injurious Coccidæ. No one who has not given particular attention to this matter can realize the serious nature of the situation, from an economic point of view. Not only is the number of harmful Coccidæ in each locality being greatly increased by importations, but, as is well-known, the imported species often show a marked tendency to become more destructive than in their native habitat.

If the naturalist, pure and simple, on reading these lines should say that the matter does not concern him, but the horticulturist, he is begged to remember the bearing of these changes on questions of geographical distribution. If, ignorant of what is going on through man's energy, he proceeds to collect Coccidæ and argue about their distribution, he will arrive at the most extraordinary conclusions, and will, perhaps, be asking for sunken continents to explain phenomena which had no existence twenty-five years ago!

The notes given will be placed under sub-heads indicating the several countries, states or districts. Species marked * are new to the region indicated by the sub-head. This merely means that they are first found there, whether on wild or cultivated plants, out of doors or in hothouses. But native and introduced species will not be placed under the same sub-head if it can be avoided; when we do not know whether a species is native or not, it will be assumed for the present to be so. (N.)=native. (I.)=introduced.

With reference to food plants the following abbreviations will be used: (n. p.)=new food plant; (n. g. p.)=new genus of food plants; (n. o. p.)=new natural order of food plants. Coll. =collected by; com.=communicated by; cp.=compare; used in indicating useful references.

Types of all new species described will become the property of the U. S. National Museum.

Antigua, West Indies.

While we have no positive information to guide us, I believe the following species have been introduced. They were all coll. Mr. Barber, Superintendent of Agriculture of the Leeward Institute (cp. Ins. Life, VI, 50–51.)

Aspidiotus destructor Signoret. On leaves of banana at Clare Hall; also on cocoanut, Jan. 15, 1895.

Aspidiotus personatus Comst. A few on rose leaves, and many on *Ficus* sp. near *benjamina* (cp. Jn. Inst., Jamaica, 1892, 54). This is the fifth *Aspidiotus* found on rose, the others being *A. fiscus*, *A. articulatus*, *A. dictyospermi* var. *jamaicensis*, and *A. perniciosus*.

* *Ceroplastes floridensis* Comst. Several on fern leaves (n. o. p., but cp. supposed *C. vinsoni*, in Timehri, Dec., 1889, p. 309, fig. 3). The fifth *Ceroplastes* found in Antigua.

Lecanium hemisphæricum Targ. A few on fern leaves (cp. Bull. Bot. Dep. Jamaica, 1894, p. 71).

Lecanium oleæ (Bern.). Brown variety. One on fern leaf. (Also found on leaves of a fern in hothouse, Denver, Colo., by Prof. Gillette, the fern in this case being *Platycerium alcicorne*).

TRINIDAD, WEST INDIES.

The first two are certainly, I think, native; the third probably native, the fourth certainly introduced. All were coll. Mr. J. H. Hart in 1895.

**Icerya rosæ* Riley & Howard. Sent in quantity, from the base of a tree of *Amherstia nobilis*, "covered up by small caverns of earth by a species of small ant that no doubt was interested in so doing. The scale was not perceived above ground at all, but on the roots there were plenty of several sizes." (Hart in litt.) This was on Jan. 26.

Vinsonia stellifera (Westw.). On *Stanhopea* (n. g. p.). "Fairly common here but causes little trouble." (Hart in litt.) There appear to be good reasons for believing that this is properly a neotropical species.

Otheria insignis Dougl. In numbers on leaves of lime (n. p.), "quite a pest." (Hart in litt.) (Also found by Professor Townsend on lime and orange in Mexieo, as will be set forth in a report shortly to be issued. The insect is to be dreaded as a pest of *Citrus* fruits in the warmer parts of the U. S.; already it is well known in this country as a greenhouse species (cp. Mr. Lounsbury's paper, lately sent out from the Amherst, Mass., College), and may very easily be transferred thence to out-of-door plants in the South. In Ceylon it has also appeared, and Mr. E. E. Green has found the true ♂—the presumed ♂ of this species, found by Douglas and Lounsbury, being apparently those of *Dactylopius*. It is hard to explain why the true ♂ (with caudal tuft) has not been seen in America, unless it is that the insect reproduces parthenogenetically with us. It may here be remarked that *Ortheria edwardsii* Ashmead, described only from the ♂, is pretty clearly no *Ortheria*.

Chionaspis citri Comst. "Is the pest of our lime trees here." (Hart in litt.) This extremely pernicious species has not yet spread generally through the West Indies, being still unknown, for example, in Jamaica.

COLORADO (I.).

The following species have lately been sent to me from Colorado hothouses by Prof. Gillette. I refrain from giving details as Prof. Gillette will shortly publish the full records in a paper on the Hemiptera of Colorado.

* (1.) In greenhouse at Fort Collins: *Lecanium hesperidum* (L.), *Aspidiotus nerii* (Bouché), *A. dictyospermi* Morg., *A. rapax* Comst.

* (2.) In greenhouse at Denver: *Lecanium oleæ* (Bern.), *L. longulum* Dougl., *L. hemisphæricum* Targ., *L. perforatum* Newst., *Aspidiotus ficus* (Ashm.), *A. dictyospermi* Morg., *Aulacaspis boisduvalii* (Sign.).

(Thus, ten species between the two hothouses! The *A. dictyospermi* is a species originally from Demerara; I found it last year on a palm in Mr. Boyle's hothouse at Santa Fe, New Mexico. *A. rapax* is the *camelliæ* of Signoret, but hardly that of Boisduval, vide Morgan, Ent. Mo. Mag., 1889, p. 351. Since Signoret intended no new species, but only Boisduval's, by his name *camelliæ*, it is apparent that the name proposed by Comstock has a right to stand.)

It may be here added that Prof. Gillette also sent me *Aspidiotus perniciosus* Comst., found on pears purchased (but not raised) in Fort Collins, Colorado.

NEW MEXICO (N.).

Lecaniodiaspis yuccæ Twns. I have lately found several of this species on Little Mountain, Mesilla Valley, living on *Parthenium incanum* (n. o. p.) mixed with *Tachardia cornuta* Ckll.

Coccus confusus Ckll. Mr. A. Holt has found this close to the Agricultural College, on *Opuntia leptocaulis* DC. (n. p,), the plant determined for me by Prof. Wooton. (At Tucson, Arizona, Prof. Toumey finds *C. confusus* on *Opuntia versicolor* Engelm.)

**Dactylopius solani* var. nov. *atriplicis.* On *Atriplex canescens* close to the Agricultural College, Sept., 1894, living on the twigs and branches.

♀. Size of *D. citri;* pale greenish, sparsely mealy, no lateral processes; forming no ovisac, but a cushion of white cottony matter, in which are seen lively young.

Mr. Joseph Bennett, who was a student of the college at the time of the discovery of this insect, prepared specimens of the ♀, and drew up the following description:

"Derm clear transparent. Form oval, slightly obovate. Leg: coxa rather short, about as broad as long; trochanter rather large, about half as long as coxa and two-thirds as broad as long; femur about one and a half times as long as coxa, and about two-thirds as broad as coxa; tibia about as long as femur, and half as thick; tarsus two-fifths as long as tibia and very near as thick, tapering to half as thick, claw very small. Anal ring with six hairs. Antenna 8-jointed; 1 short and thick, 2 about as long as 1, 3 much longer than 2; 4, 5, 6 about equal in length, about one-third as long as 3 and same thickness; 7 a little longer than 6; 8 as long as 3+4. Formula 83 (21) 7 (654). Each joint emits numerous hairs, those on final joint being longest." (J. Bennett.)

♂. Mr. Bennett had the good fortune to find the ♂, of which I noted the following characters:

Very small, about 1 mm. long, dark sage-green or greenish-gray, legs and antennæ brownish; caudal filaments only about as long as abdomen, thick, snow-white from secretion; wings semitransparent milky-white.

The typical *D. solani* lives on the roots of *solanum* underground; and differs from the var. *atriplicis* in lacking the greenish color, and in the second joint of the antennæ being somewhat longer than the third. (The typical *D. solani*, hitherto known only from New Mexico, is to be added to the fauna of Colorado, having been found on roots of *Solanum rostratum* (n. p.) at Fort Collins, coll. C. F. Baker, com. Gillette. Found originally on potatoes grown in the Mesilla Valley, it was not feared as a potato pest, since the potato is not grown as a regular crop. It may, however, prove quite otherwise at

Fort Collins, where, I understand from Prof. Gillette, the potato is one of the leading crops. Yet it is probable that the disturbance of the land in the cultivation of potatoes would prevent the over-abundance of *D. solani.*)

Atriplex canescens has proved a mine of wealth to the coccidologist. The following species are found on it in the Mesilla Valley, n. m.: *Dactylopius solani* var. *artriplicis* Ckll., *Lecaniodiaspis* (*Prosopophora*) *yuccæ* var. *rufescens* (Ckll.), *Ortheria annæ* Ckll., *Mytilaspis albus* var. *concolor* Ckll., *Ceroplastes irregularis* Ckll.

**Ortheria nigrocincta* n. sp. On narrow leaves, apparently of a species of Compositæ, Gila Hot Springs, N. M., July 20, 1894, coll. C. H. T. Townsend. When Prof. Townsend gave me this insect, I supposed it was only *O. annæ*, but a careful comparison reveals the following good distinctive characters:

♀. Length, with ovisac, 4 mm., breadth 2 mm.; ovisac pure chalk-white, firmer than in *annæ*, longitudinally ridged above. Body (dried) coal-black, legs dark brown, antennæ reddish-brown. Sides, between dorsal and lateral lamellæ, broadly black from the exposed body, Anterior dorsal lamellæ broader antero-posteriorly than in *annæ*. Posterior lamellæ much as in *annæ*, free from ovisac, but not so rapidly increasing in length mesad; the innermost one not being greatly longer than the outermost.

Another allied species is *O. sonorensis*, which will be described in Prof. Townsend's report on his recent trip in Mexico. The following table will separate the three:

A. Length with ovisac over 5 mm.
   1. Posterior lamellæ about equal in length; a small portion of hind-dorsum free from secretion, *sonorensis* Ckll.
   2. Posterior lamellæ successively longer mesad, the innermost at least twice as long as the outermost; dorsum covered by secretion, *annæ* Ckll.

B. Length with ovisac under 5 mm., sides of dorsum naked, *nigrocincta* Ckll.

**Chionaspis pinifolii* (Fitch). Last December I found this scale on some pine branches brought from the Organ Mountains. (It is doubtless native on the pines of the Rocky Mountain region. Prof. Gillette has found it at Manitou, Colorado; the specimens from this locality vary, some having the exuviæ very pale yellow, as in examples found by Mr. Petit at Ithaca, N. Y., while others, constituting a mut. nov. *semiaureus*, have the exuviæ bright orange.)

JAMAICA, WEST INDES (I.).

**Ceroplastes ceriferus* (Anders). Mr. W. Harris sends me specimens from Jamaica on burweed, *Triumfetta rhomboidea* Jacq. (n. g. p.). They were found at Cinchona on March 15, 1895. These scales differ a little from typical *ceriferus*, being very white, yet I cannot separate them specifically. The derm has very large oval gland pores, and is obscurely tessellated. The digitules of the claw are very stout, with large knobs; those of the tarsus long, moderately slender, with large knobs. (The only West Indian locality before known for the species is Antigua.)

**Icerya montserratensis* Riley & Howd. There were in the Jamaica museum some fragments of a coccid marked "19 Feb., 1886. No. 740. J. Hart." I brought away a portion of this material when I left Jamaica, as it was evidently something I had never found in the island; and on recently subjecting it to careful examination, I find it to be *I. montserratensis*. It differs from the type of that species in no important respect, though the club of the antennæ is not as long as the three preceding joints together. The antennæ are very large, 11-jointed. The ovisac is long, yellowish-white, strongly grooved. Mr. Hart, now of Trinidad, formerly lived in Jamaica, and presumably found these specimens there. It is curious that I never met with the species, if it has been introduced into the island.

NEW YORK STATE (N.).

Aspidiotus ancylus Putnam (cp. Comstock, 2d Cornell Rep., p. 59). Dr. Lintner sent me some of this from Albany, found several years ago on black currant (n. p.) in his garden.

Lecanium ribis Fitch. Dr. Lintner sent me specimens found in June, 1885 by Hon. G. W. Clinton, in Albany Rural Cemetery, on *Ostrya* (n. g. p.) and *Carpinus* (n. g. p.). Comparison of these with examples from *Ribes* showed no valid distinction. This species may be readily known by its small size (long. 3, lat. 2, alt. 2¼ mm., looking a little like *L. hemisphæricum*), red-brown color; derm with large gland-pits, frequently in pairs; antennæ 6-jointed, 3 as long or longer than 4+5+6. The digitules of the claw are remarkably stout, but very little expanded at their ends.

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General Notes.

MINERALOGY.[1]

New Edition of Groth's Physical Crystallography.—The concluding part of the third edition of this classic work[2] has recently appeared, the entire book having been so largely rewritten as to be essentially new. The necessity of this shows what remarkable advances have been made in the science during the past few years. The new work is divided into three parts, treating respectively physical, geometrical, and applied crystallography. Unlike earlier editions, the development of the optics of crystals is not made to depend on Fresnel's theory of the elasticity of the ether, but the optical characters are derived by the purely geometrical methods of Fletcher. Some features of this treatment have been already referred to in these notes. This treatment of the subject, which is certainly the more logical and may prove to be easier of comprehension by the student, involves a considerable change in the nomenclature of optical directions.

The sections treating the electrical properties of crystals and the influence of mechanical forces on crystals, as would be expected, contain a vast amount of new material. In the closing section of this part,

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Physikalische Krystallographie und Einleitung in die krystallographische Kenntniss der wichtigeren Substanzen von P. Groth. 3d Ed. pp. 783, 3 colored plates. Engelmann, Leipzig, 1894.

Bravais's space lattice theory of molecular structure is treated comprehensively, with addition of some of the modifications which have been made to it by Sohñche, Federow and Schönflies. Professor Groth states in his preface, that "the edifice of crystal knowledge is one of the best founded in theory of any in the entire realm of physics."

The second part of the work, that treating the geometrical properties of crystals, bears but slight resemblance to the corresponding portion of the former editions. Instead of the primary classification of Naumann into six crystal systems with their partial forms, which is in general use, the differentiation of Gadolin into thirty-two classes of forms which represent all possible kinds of crystal symmetry, is adopted. This classification does away with hemihedral, hemimorphic and tetartohedral divisions, which cause so much difficulty in teaching, and is logically and scientifically superior to the classification in use. Professor Groth thinks that the simplification of the nomenclature which this classification makes possible, will make the subject easier for the student, but it seems to us that the additional conceptions of symmetry (centre of symmetry, and 1, 2, 3, 4 and 6 *zählige* axes of symmetry) which are used will more than outweigh these advantages in simplicity, except for students who have what the Germans call *raümliche Vorstellungsgabe* highly developed. Of the thirty-two classes of forms, three have now no known representative, but when it is remembered that since 1887 representatives have been discovered for six classes which before lacked examples, the probability is great that examples will soon be found of all classes. The crystal systems are retained as a sub-classification to indicate relationships, and a seventh system—the *trigonal system*—is added to include those classes which have a 3-*zählige* axis of symmetry (rhombohedral, pyramidal, trapezohedral, etc., making in all seven classes). The word cubic is adopted for the isometric system. Another important change lies in the arrangement. The class of least symmetry is considered first, and the others in the order of increasing symmetry.

The subject of the calculation and drawing of crystals, which in the former editions of the work was scattered under the different systems in the geometrical portion, is here brought together and expanded to over 60 pages in the beginning of part III. It is followed by a description of the methods of crystal measurement, in which is contained what will be to many, new descriptions of recently devised apparatus. Such is a modification by Klein and Fuess of the Federow universal attachment to the microscope stage.

The appearance of this edition of Professor Groth's work marks an epoch in the history of crystallography, and there can hardly be a doubt that all the essential features of his treatment will soon be introduced at least in all advanced courses in the science. Crystallographers will look forward with anticipation to the appearance of the great work on chemical crystallography on which Professor Groth is now engaged.

Tables of the Thirty-two Classes of Crystal Forms.—In 1892 Groth[3] issued a table giving the stereographic projection to indicate the most general form of each of Gadolin's classes of crystal forms, together with the position of the crystallographic axes and the axes and planes of symmetry of the class. These differ from those of his later published text-book only in that the trigonal crystal system is not introduced in the secondary classification. This table has the great advantage of bringing all the projections together on a single plate so that mutual relations may be made out. Wülfing[4] has very recently issued a series of seven plates with explanatory text which give not alone the stereographic projections to illustrate the kind of symmetry of each class, but also sketches to indicate the character of all the kinds of crystal forms which can possibly occur with that kind of symmetry. They constitute an introduction to or a synopsis of the subject of geometrical crystallography, much as it is treated by Groth, and will be of service in making the subject clear to a beginner, particularly one who cannot easily bring his mind to the condition of picturing geometrical forms. Wülfing has, however, unfortunately adhered to the old arrangement, and treats the classes of highest symmetry first; and, moreover, has not utilized the abbreviated nomenclature adopted by Groth. This and the different numeration of the classes which the old arrangement involves, will introduce confusion, and are the serious mistakes of the little book. In his preface Wülfing recalls an interesting passage in Goethe, which brings out so well the difference between the position now held by the science of crystallography and that which it occupied at the time the words were written (they were first printed in 1829) that I am inclined to introduce it here. Goethe wrote referring to the science of crystallography as follows:

[3] Uebersichtstabelle der 32 Abtheilungen der Krystallformen mit Erlaüterungen, Beispielen, und graphischer Darstellung nach Gadolin zusammengestellt von P. Groth. Engelmann, Leipzig, 1892, 1 Mark.

[4] Tabellarische Uebersicht der einfachen Formen der 32 krystallographischen Symmetriegruppen zusammengestellt und gezeichnet von Dr. E. A. Wülfing. Koch, Stuttgart, 1895.

"Sie ist nicht productiv, sie ist nur sie selbst und hat keine Folgen...... ....Da sie eigentlich nirgends añwendbar ist, so hat sie sich in dem hohen grade in sich selbst ausgebildet. Sie giebt dem Geist eine gewisse beschrañkte Befriedigung und ist in ihren Einzelheiten so mannigfaltig, dass man sie unerschöpflich neñnen kañ, deswegen sie auch vorzügliche Meñschen so eñtschieden und lañge au sich festhält.—Etwas Mönchisch-Hagestolzenartiges hat die Krystallographie und ist daher sich selbst genug. Von praktischer Lebeñseinwirkung ist sie nicht; deññ die köstlichsten Erzeugñisse ihres Gebiets, die krystallinischen Edelsteine, müssen erst zugeschliffen werden, ehe wir unsere Frauen damit schmücken können."

Wülfing remarks "Can it not be doubtful if the sentence of Goethe's' 'crystallography has something of the bachelor monk about it and is hence sufficient unto itself; does not belong to a standpoint of the science already far behind us."

WM. H. HOBBS.

PETROGRAPHY.[1]

An Example of Rock Differentiation.—The Highwood Mountains of Montana have afforded Weed and Pirrson[2] an interesting study in rock differentiation. The mountains comprise a group of hills composed of cores of massive granular rocks surrounded by acid and basic lava flows and beds of tuff, which are cut by hundreds of dykes radiating from the cores as centers. One of these hills, isolated from the others is known as Square Butte, whose laccolitic origin can be plainly shown. The Butte is composed entirely of igneous rocks. Its center is a core of white syenite, and around this as a concentric envelope is a dark basic rock called by the authors shonkinite. Near the top of the Butte the surrounding envelope has been eroded off exposing the white rock, so that from a distance the latter appears to be capping the former. The black rock consists of biotite in large plates and augite crystals, in the irregular spaces between which are found orthoclase, olivine, a little albite and small quantities of nepheline, cancrinte and the usual accessory minerals. An analysis of the rock gave:

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

[2] Bull. Geol. Soc. Amer., Vol. 6, p 389.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	P_2O_5	Cl	Total
46.73	.78	10.05	3.53	8.20	.28	9.68	13.22	1.81	3.76	1.24	1.51	.18	=100.97

The rock is thus a granular plutonic rock consisting essentially of augite and orthoclase. It is closely related to augite-syenite, bearing the same relation to it as vogesite does to hornblende-syenite.

The white rock associated with the shonkinite is a sodalite-syenite, containing as its bisilicate component only amphibole. Its composition is given as follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	P_2O_5	Cl	Total
56.45	.29	20.08	1.31	4.39	.09	.63	2.14	5.61	7.13	1.77	.13	.43	=100.45

The basic rock is richer in iron, magnesia and lime than the acid one; since the two rocks pass into each other by a rapid but continuous gradation, they are believed to be of the same age and to be the complementary differentiated portions of the same magma. The differentiation in this case could not have been due to a process of crystallization, in which the first crystallized minerals were accumulated in the peripheral portions of the cooling magma, since the other iron-bearing components of the shonkinite and of the syenite are so radically different. The differentiation must have occurred in the magma while still molten.

The Serpentines of the Central Alps.—Three years ago Weinschenck[3] gave a preliminary account of the serpentines of the East Central Alps and their contact effects, showing that the former were originally pyroxene eruptives. In a recent paper he returns to the subject,[4] and in a well illustrated article gives in detail the reasons for his former conclusions. He finds upon the examination of a large suite of specimens that the original rock was an olivine-antigorite aggregate, which he names stubachite, from its most important locality. The antigorite is believed to be an original component and not an alteration product of the olivine, as it is found intergrown with perfectly fresh grains of the latter mineral. The grate structure ("Gitterstructur") of many serpentines is ascribed to such intergrowths, and not to the alteration of pyroxene along its cleavage planes. The original stubachite was a medium grained holocrystalline, allotriomorphic rock of intrusive igneous origin, which has not suffered much alteration since its exposure by erosion.

[3] American Naturalist, 1892, p. 767.

[4] Abhand. d. k. bayer. Ak. d. Wis II, Cl. XVIII, Bd. p. 653.

Becke[5] calls attention to the frequency with which a pyroxenic origin has been ascribed to serpentines of the Alps because of the lack in them of the mesh structure, and questions the safety of this conclusion when based on such scanty premises. He mentions the existence of a serpentine in the stubachthal in the Central Alps, in the freshest portions of which olivine and picotite can be seen in large quantities, and in other portions diopside and olivine. In many specimens the olivine has been crushed into a mosaic, the finer grains of which have been altered into serpentine, clinochlor, antigorite and what is probably colorless pyroxene. The mesh structure is found in the weathered portion of the antigorite-serpentine. It is thought by the author to be due to weathering subsequent to the production of the antigorite.

The central mass of the east central Alps consists of granite and gneiss,[6] of which the former is intrusive in the latter, although both have essentially the same mineralogical composition, and the former is schistose on its periphery. The granite contains zoisite, epidote, orthite, chlorite, calcite, etc., all of which are regarded as original, since the other primary components of the rock from which they may be assumed to have come are perfectly fresh. The origin of these minerals is ascribed to the cooling of the magma under the influence of mountain-making processes—a condition of crystallization which the author designates as piezocrystallization. The hydrated components of the rock are supposed to have been formed with the aid of magma moisture under the influence of pressure. This theory is believed to account for the granulation and other pressure phenomena noted in the granite, as well as for its composition.

Dynamic Metamorphism.—In connection with his work on the rocks of the Verrucano in the Alps, Milch[7] makes a study of dynamic metamorphism and suggests a number of terms to be used in the descriptions of metamorphic rocks. Allothimorphic fragments are those with the composition and forms of the original grains. Authimorphic fragments have the forms of the grains changed but their composition unchanged. Allothimorphic pseudomorphs have the original forms but a composition different from that of the original grains, and authimorphic pseudomorphs have both forms and composition changed, but with the latter dependent upon the original composition. Finally eleutheromorphic new products are those entirely independent of the

[5] Minn. u. Petrog. Mitth., XIV, 1894, p. 271.

[6] Ib., p. 717.

[7] Neues Jahrb. f. Min., etc., IX, p. 101.

original substances both in form and composition. Of the authimorphic fragments two classes are noted, first, the authiclastic, those that have been unable to adapt themselves to the altered conditions and, consequently, which have been fractured, and, second, the kamptomorphic, embracing those fragments that have been able to adapt themselves to changed conditions, and so have yielded to these and have bent, or have assumed abnormal optical properties, such as undulous extinctions. With these terms the author describes some of the rocks studied and states that in many instances no traces of clastic structure remain in them, although they must be regarded as regionally metamorphosed fragmentals. Regional metamorphism, he declares, may be brought about by pressure alone, or by dislocation—pressure with movement (dynamic metamorphism). The former may act slowly, deforming the minerals in rocks, while the latter acts rapidly, shattering them. The latter process usually forms rocks like the mica-schists, with a fine grain, and the former coarse grained ones like the gneisses. Of course, the action of water, which is the agent of transportation of the new substances added during metamorphism, may come into play in each case. The Verrucano rocks exhibit the effects of both kinds of regional metamorphism. The article contains a great many suggestions of interest to students of metamorphism.

Miscellaneous.—The conglomerates and albite schists of Hoosac Mountain, Mass., referred[8] to some time ago in these notes, have been described by Wolff[9] in some detail in his report on the geology of Hoosac Mountain. The conglomerates form gneisses which grade upward into the albite schists. Amphibolites also are described, whose origin is from a basic intrusive rock. A large number of photographs of hand specimens and thin sections of the rocks described accompany the paper.

Van Hise[10] in the report by Irving and himself on the Penokee iron district, gives a number of descriptions of sedimentary and volcanic rocks, illustrated by a large number of plates of thin sections. The rocks discussed include greenstone conglomerates, crystalline schists, intrusive greenstones, slates, quartzites, limestones, etc.

Ries[11] finds that one of the crystalline schists of the series of foliated rocks forming the greater portion of Westchester Co., N. Y., is a

[8] American Naturalist, 1892, p. 768.

[9] Min. XXIII, U. S. Geol. Survey, p. 41.

[10] Mon. XIX, U. S. Geol. Survey.

[11] Trans. N. Y. Acad. Sci., Vol. XIV, p. 80.

plagioclase-augen-gneiss which the author calls a schistose granite-diorite. Its constituents are quartz, plagioclase, biotite, hornblende and orthoclase as its principal components, with garnet, sphene, zircon, apatite, muscovite and microcline as the accessories. The quartz is penetrated by rutile needles. Nearly all the rock's constituents show evidence of dynamic fracturing.

GEOLOGY AND PALEONTOLOGY.

Dawson on the Oscillations of the Behring Sea Region.—Among the recent contributions to a knowledge of the coasts of Behring Sea are the notes made by G. M. Dawson during an extended cruise in that region. His paper is supplementary to that of Dall's relating to the American shores and islands of Behring Seas, and gives, generally speaking, the general physographic features of the land to which the attention of the earlier writer was not directed. We quote the following extracts from his general remarks.

"Behring Sea is a dependency of the North Pacific, marked off from it by a bordering chain of islands like those which outline Okhotsk Sea and the sea of Japan. It differs from these two seas by reason of its connection to the north with the Arctic Ocean, and in the fact that while the whole eastern part of its extent is comparatively shallow, the profounder depths of the north Pacific (in continuation of the Tuscarora deep) are continued into its western part. The Aleutian Islands, regarded as a line of demarkation between the main ocean and Behring Sea, are analagous to the Kurile islands with Kamtschatka, and to the islands of Japan. As to the Commander Islands, though these appear to lie in the continuation of the arc formed by the Aleutians, they are separated by a wide and, so far as known, very deep stretch of ocean from the last of these islands, and it is wholly probable that they may represent an altogether independent local elevation analogous to that to which Saint Matthew and its adjacent islands are due.

"The western part of Behring Sea has as yet been very imperfectly explored with the deep-sea lead, but the following general facts may be gathered from the existing charts: The entire chain of the Aleutian Islands is bordered at no great distance to the south by abyssal depths of the Pacific. The whole western portion of the chain likewise slopes rapidly down on the northern side into very deep water, exceeding 1,000 fathoms as far to the eastward as Unimak Island; but from the vicinity of Unimak pass (longitude 165° west) the depths to the north of the islands are consistantly less than 100 fathoms. Beginning near the Unimak pass, the edge of the hundred-fathom bank runs northwestward, passing to the west of the Pribilovs and Saint Matthew Island and meeting the Asiatic coast in the vicinity of Cape Navarin, in about north latitude 60°. Thus all parts of Behring Sea to the north and east of this line, together with Behring Straits and much of the Arctic Ocean beyond, must be considered physiographically as belonging to the continental plateau region and as distinct from that of the ocean basin proper, and there is every reason to suppose that it has in later geologic times more than once and perhaps during prolonged periods existed as a wide terrestrial plain connecting North America with Asia.

"In all probability this portion of the continental plateau is a feature much more ancient than the mountain range of which the outstanding parts now form the Aleutian Islands. This range, though to some extent due to uplift, as for instance in the case of Attu Island, is chiefly built up of volcanic material. Its eastern part, in the Alaskan peninsula and as far as the Unimak pass, must be regarded as having been built upon the edge of the old continental plateau. Its western part, though certainly the continuation of the same line of volcanism, runs off the edge of the plateau and rises distinctly from the ocean-bed.

"The available evidence goes to show that the submarine plateau of the eastern part of Behring Sea, together with much of the flat land of western Alaska, was covered by a shallow sea during at least the later part of the Miocene period, while the most recent period at which this plateau stood out as land is probably that at which, according to facts previously noted, the Mammoth reached the Pribilof Islands and Unalaska Island across it.

"Evidence has recently been obtained of an important factor in regard to late changes of climate in this region, in the observations of Mr. I. C. Russel, which show that the great mountain range of the Saint Elias Alps must have been entirely formed in Pliocene or post-Pliocene times. The crumpling and upheaval of the beds which now form this range must have relieved a notable and accumulating tangential pressure of the earth's crust, the result of which it is yet difficult to trace; but that it must have brought about extensive changes of level throughout the region over which this pressure was exerted seems certain, and I am inclined to suppose that it may have had much to do with the great later Pliocene uplift and subsequent depression to which the British Columbian region appears to have been subjected.

"One of the most remarkable features connected with the Behring Sea region is the entire absence of any traces of general glaciation. Statements to the effect that Alaska, as a whole, showed no such traces were early made by Dall and concurred in by Whitney. The result of my later investigations in British Columbia and along the adjacent coasts have been to show that such original statements were altogether too wide; that a great Cordilleran glacier did exist in the western part of the continent, but that it formed no part of any hypothetical polar ice-cap, and that large portions of northwest America lay beyond its borders.

"Statements made by Mr. John Muir, in which he not only attributed every physical feature noted by him in Behring Sea to the action of glaciation, but even expressed the opinion that Behring Sea and Strait represented a hollow produced by glaciation, remained altogether unsupported. It might be unnecessary even to refer to them but for the fact that they relate to a region for which data on this subject from other sources are so small. No traces have been found of general glaciation by land-ice in the region surrounding Behring Sea, while the absence of erratics above the actual sea-line show that it was never submerged for any length of time below ice-encumbered waters.

"The facts, moreover, connect themselves with similar ones relating to the northern parts of Siberia in a manner which will be at once obvious to any student of the glacial period." (Bull. Geol. Soc. Am. Vol. 5, 1894.)

Green Pond Conglomerate.—In Darton's paper on the outlying series of Paleozoic rocks which occupy a narrow belt extending from the Archean highlands of New Jersey into Orange Co., New York occurs the following description of the Green Pond Conglomerate.

"The greatest development of this formation is in New Jersey, where it is continuous over a wide area, and gives rise to a number of prominent ridges. In New York there are three small outlying areas: Pine Hill, northeast of Monroe, and two small ridges west of Cornwall station. Throughout its course it consists of coarse, red conglomerates below, and buff and reddish quartzites above, and the characteristics of these members are uniform throughout. The conglomerates consist of quartz pebbles from one-half to two inches in diameter in greater part, in a hard, sandy, quartzitic matrix of dull red color. The proportion of pebbles to matrix is usually large, but there is local variation in this regard. The pebbles are mainly well rounded, but some subangular ones occur. They are mostly all of quartz, and white or pinkish in color. No quartzite pebbles were observed. In this characteristic the Green Pond Conglomerate differs greatly from the Skunnemunk conglomerate, but otherwise they are very similar. The thickness of the Green Pond conglomerate varies. In New York there are not over 60 feet, but in New Jersey it will probably be found to average about 150 feet in its greatest development in Green Pond and Copperas Mountains. Owing to its extreme hardness and massiveness, it give rise to high, rocky ridges with precipitous slopes in greater part. Green Pond, Copperas, Kanouse and Bowling Green Mountains are the most prominent of these, and they occupy an area of considerable size in New Jersey. South of the south end of Green Pond Mountain west of Dover there are outliers of conglomerates and sandstones probably of this age, which are described by book in the 'Geology of New Jersey' 1868.

"In the vicinity of Cornwall Station the conglomerate lies on Hudson shales; Pine Hill, on Cambrian limestone, at least in part; in Kanouse Mountain, on slates possibly of Hudson age, northward, and on Cambrian limestone southward; in Green Pond, Copperas and Bowling Green Mountains it lies directly on the crystalline rocks. The contact with the crystalline rocks is exposed along the upper part of the eastern slopes of Copperas Mountain, and the surface is a relatively level one. Small enclosed areas of the crystallines are bared by erosion of the conglomerate along the two anticlinals south of Newfoundland, and I find that gneiss extends to within half a mile of the depot in the western flexure. Along the axis of the eastern flexure, gneiss extends to and under Green Pond and down the gorge of the outlet of the pond to the end of Copperas Mountain. Along these anticlinals no actual contacts were found, but from many exposures in its vicinity the relative eveness of the floor was clearly apparent. In the Bowling Green Mountain the conglomerate is wrapped around the northern end of a ridge of gneiss, but its contact relations were not observed.

"The age of the Green Pond conglomerate and quartzite is approximately the same as Shawangunk grit and Oneida conglomerate, and probably they also represent all or a portion of the Medina. They are, at any rate, the representatives of the great arenaceous sedimentation at the beginning of the Upper Silurian. The evidence of their position is mainly their intimate relation to the Helderberg limestone throughout and the fact that they overlie the Hudson shales in New York and probably also in New Jersey. Throughout their course in New Jersey and in New York the upper quartzites grade into the Longwood red shales, and these into the Helderberg limestone, constituting a series which overlaps the Archean, the Cambrian limestone and the Hudson shales. This stratigraphic relation, as well as precise lithologic similarity, served to correlate the Pine Hill and Cornwall Station areas with those of the Green Pond region in New Jersey. The superposition on the Hudson shale is unquestionable in the Cornwall region, where the Green Pond, Longwood, Helderberg and other series present the full sequence. In New Jersey there are shales underlying the conglomerate along the east side of Kanouse Mountain near its northern end, but it is not as yet demonstrated that they are Hudson in age.

"The estimate of the total thickness by Merrill of 600 feet in the Newfoundland region is considerably too great. I find that the 500 foot cliff south of the station, on which his estimate is based, contains nearly 100 feet of crystalline rocks at its base, but probably a considerable portion of the original thickness of sandstone was removed from its summit. The formation appears to attain its greatest thickness at this locality, for the average amount is considerably less elsewhere.

"The name Green Pond Mountain conglomerate or series has been applied to the formation by Cook, Smock and others, and, although originally always used to include the Skunnemunk conglomerate, it is, I believe, an appropriate name, with proper restriction, for the Upper Silurian member. The "mountain" may be omitted to advantage, as Green Pond is a typical locality. It is not proposed at present to separate the quartzite under a distinctive name." (Bull. Geol. Soc. Am., Vol. 5, 1894.)

Notes on the Osteology of Zeuglodon cetoides.—Last November Mr. Charles Schuchert of the U. S. National Museum obtained for that institution portions of the skeletons of two Zeuglodons. These have since been "developed" and the bones thus brought to light promise to add some points of interest to our knowledge of this interesting form.

The lower jaw, like that figured by Müller, contained six molariform teeth, showing that the number of premolars plus molars should be given as five to six, and not limited to five, as in Nicholson and Lydekker's Manual of Palæontology. The jugals, although slender, are much heavier than in the toothed whales, and the hyoid was apparently like that of a Sirenian, the basihyal being rather broad and flattened, the ceratohyal, long, curved, expanded at its distal end, and articulating directly with the basihyal and not through the interposition of a long cartilage. The first four cervicals are very curiously interlocked; the atlas gives off a process from its ventral surface which curves back to almost touch the axis; the spinous process of the axis overlies the atlas in front, and extends backwards until it nearly touches the spinous process of the fourth cervical, that of the third cervical being abortive. The fourth cervical sends down a long parapophysis. The dorsal vertebræ are apparently fourteen in number, and none appear to have been lost. The last three ribs have no tubercle and unite with the middle of the centrum by a large head; the 10th and 11th ribs have a small tubercle although articulating with the body of the vertebra; the fifth rib is remarkable for its great upward curvature; the second to seventh ribs are much swollen towards the distal extremities.

The scapula is thoroughly cetacean in shape, as well as in the length of the acromial and coracoidal processes. The humerus is, as figured by Müller, heavy at its proximal end and tapering rapidly towards the distal extremity; the radius and ulna are so articulated with one another and with the humerus, as to permit flexion and extension only; the olecranal process is large, wide and flat; the distal ends of radius and ulna are rough and their epiphyses may have been entirely cartilaginous; two or three small bones of irregular form are very likely carpals, and if so they too were largely cartilaginous. No traces of hind limbs have as yet come to light.

The regular articular posterior extremity of the first sternal segment has led Professor Cope to suggest that the animal was in the habit of rearing the front part of its body out of water, and this suggestion derives additional weight from the shape of the articular faces of the dorsals; they indicate that not only was there movement in the dorsal region from side to side, but up and down, and show that the intervertebral cartilages were very thick. Many of the lumbo-caudals have the faces slightly approximated dorsally, indicating considerable vertical movement in this region. The change from the short centra of the dorsals to the extremely elongate centra of the lumbo-caudals is very abrupt and the vertebral column doubtless terminated with equal abruptness, since vertebræ a long way from the head are very massive. A curious feature is the prominence of the anterior zygapophyses in the lumbo-caudal region, since the spinous process are from 8 to 12 inches apart. Above all one is struck with the small size of the head and thorax when compared with the posterior region of the body, and it would seem that the head must have had a busy time in order to capture sufficient food to sustain the huge tail.—F. A. LUCAS.

BOTANY.[1]

Decades of North American Lichens.—Botanists have lately received the 16th, 17th and 18th decades of this interesting distribution by Clara E. Cummings, T. A Williams and A. B. Seymour. An examination of the specimens shows them to be most satisfactory. The species included are the following: 151. *Ramalina lævigata* Fr. (Tex.); 152. *R. pollinarella* Nyl. (So. Dak.); 153. *Evernia vulpina* (L.) Ach. (Calif.); 154. *Theloschistes villosa* (Ach.) Wainio, (L. Calif.); 155. *Parmelia borreri* Turn. (So. Dak.); 156. *Umbilicaria hyperborea* Hoffm. (N. H.); 157. *U. phæa* Tuck. (Calif.); 158. *Sticta aurata* (Sm.) Ach. (So. Car.); 159. *S. anthraspis* Ach. (Calif.); 160. *Peltigera aphthosa* (L.) Hoffm. (Me.); 161. *Pannaria lanuginosa* (Ach.) Koerb. (Iowa); 162. *Collema pulposum* (Bernh.) Nyl. (Iowa); 163. *Leptogium pulchellum* (Ach.) Nyl. (Iowa); 164. *Placodium murorum* (Hoffm.) DC., (Mass.); 165a. *P. cerinum* (Hedw.) Naeg. & Hepp. (Ohio); 165b. *P. cerinum* (Hedw.) Naeg. & Hepp. (Iowa); 166. *Lecanora muralis* (Schreb) Schaer., a. *saxicola* Schaer. (Iowa); 167. *Lecanora varia* (Ehrh.) Nyl. d. *symmicta* Ach. (Me.); 168. *Rinodina oreina* (Ach.) Mass. (So. Dak.); 169. *R. sophodes* (Ach.) Nyl., e. *exigua* Fr. (So. Dak.); 170. *Pertusaria velata* (Turn.) Nyl. (Iowa); 171. *Biatora suffusa* Fr. (Iowa); 172. *Buellia oidalea* Tuck. (Calif.); 173. *Opegrapha varia* (Pers.) Fr. (So. Dak.); 174. *Graphis afzelii* Ach. (La.); 175. *G. scripta* (L.) Ach., var. *serpentaria* Ach. (So. Dak.); 176. *Arthonia dispersa* (Schrad.) Nyl. (Nebr.); 177a. *A. lecideella* Nyl. (Mass.); 177b. *A. lecideella* Nyl. (Iowa); 178. *A. radiata* (Pers.) Th. Fr. (Iowa); 179. *Calicium quercinum* Pers. (Ohio); 180. *Pyrenula subprostans* (Nyl.) Tuck. (No. Car.).

CHARLES E. BESSEY.

North American species of Polygonum.—Mr. John K. Small has done a good work in bringing out his monograph of this interesting genus, which is issued as one of the Memoirs from the Department of Botany of Columbia College. All told there are according to this paper, seventy species, and in discussing these, the synonymy is fully and carefully worked out. The descriptions are full, and leave little to be desired. The omission of all reference to type specimens, and specimens examined from different localities and herbaria is to be

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

regretted, especially as this might have been done very easily. This monograph will be of much service to students of these widely distributed plants.

Notes.—Two valuable papers on embryology have recently appeared in the *Botanical Gazette*, viz. "The embryo-sac of *Aster novæ-angliæ*" by Charles J. Chamberlain and "Contributions to the embryology of the Ranunculaceæ," by David M. Mottier. Part III of Murray's "Phycological Memoirs" appeared in April (London, Dulau & Co.). It contains papers on *Pachytheca*, calcareous pebbles formed by Algæ, Diatoms (list), *Macrocystis* and *Postelsia*, and a Comparison of the Arctic and Antarctic Marine Floras. Baillon's Histoire des Plantes has nearly completed its thirteenth volume, the last part being a monograph of the Palmaceæ. The illustrations are, as usual, of high excellence, and the general treatment is quite like that in preceding parts. Botanists will not be likely, however, to accept his substitution of *Rotang* L., Fl. Zeyl. (1747) for *Calamus* L., Sp. Pl. (1753). We notice, also, that the author doubts the validity of Sereno Watson's genus *Erythea*, suggesting its identity with either *Brahea* or *Copernica*. From a notice of the London Catalogue of British Plants, in the June number of the *Journal of Botany*, we learn with pleasure that our usually conservative brethren across the water have adopted some of the "radical" views of certain American botanists. The editor of the the *Journal* says "certain necessary alterations in nomenclature have been made" and then gives without a word of dissent the following:

Nuphar Sm., now *Nymphæa* L.

Nymphæa L., now *Castalia* Salisb.

Corydalis Ventenat, Choix des Plantes, xix (1803), now *Neckera* Scopoli, Introd. 313 (1777).

Capsella Medic. Pflanzeng. i. 85 (1792), now *Bursa* Weber, in Wigg. Prim. Fl. Holsat. 47 (1780).

Lepigonum Wahlberg, Fl. Gothob. 45 (1820), now *Buda* Adanson, Fam. des Plantes, ii. 507 (1763).

Mertensia Roth, Catalect. i. 34 (1797), now *Pneumaria* Hill, Veg. Syst. vii. 40 (1764).

Calystegia Brown, Prodr. 483 (1810), now *Volvulus* Medic, in Staatsw. Vorles. Churpf. Phys. Oek. Ges. i. 202 (1791).

Leersia Solander, ex Swartz, Prod. Ind. Occ. 21 (1788), *Homalocenchrus* Mieg, ex Haller, Stirp. Helv. ii. 201 (1768).

VEGETABLE PHYSIOLOGY.[1]

Woronin on Sclerotinia.—Dr. Woronin who was formerly associated with De Bary and whose beautiful studies of the life history of the smut fungus, *Tuburcinia trientalis* at once placed him among the very foremost investigators in a difficult field, continues to unravel interesting life histories of the pleomorphic fungi. Some years ago he published valuable researches on the Sclerotinia diseases of Vaccinium berries, and now distributes an important paper on the Sclerotinia disease of the bird cherry and of mountain ash. This paper (Die Sclerotinienkrankheit der gemeinen Traubenkirsche und der Eberesche, *Sclerotinia padi* und *Sclerotinia aucupariae*) is a quarto of 27 pages illustrated by five superb lithographic plates. It is printed in *Mém. de l'Acad. imp. de St. Petersbourg,* VIII, sé., Class Physico-Mathematique, Vol. II, No. 1. *S. padi* attacks and kills young leaves, fruit and stems of *Prunus padus,* on which the grayish, pulverulent conidia soon appear. On the host plant these conidia cause a distinct almond-like odor similar to that of the flowers, but no such odor could be detected when the fungus was grown on artificial media. Growing on the mountain ash the conidia of *S. aucupariae* cause an odor resembling that of the flowers of that tree. The apothecia of *S. padi* appear in the spring on the fallen, mummified fruits. Paraphyses and asci are always borne by distinct hyphae, the ascogeneous hyphae being stronger and thicker. The ascospores have two envelopes, an outer delicate one which is cast off in water and subsequently becomes gelatinous to complete disappearance, and an inner, colorless, thick-walled true membrane. When germinated in pure water the ascospores soon begin to form chains of small round spermatia-like sporidia, and the conidia behave in the same way. Ascospores sown in nutrient media or on the host send out strong germ tubes, but conidia or ascospores taken from nutrient media and put into pure water stop the production of hyphae and begin to form the above mentioned sporidia. In nutrient media an abundant conidial fructification was developed from ascospores in 3–4 days, and this was exactly like that observed in nature. Direct experiment with ascospores showed that the leaves are infected as they emerge from the bud, the stems being browned and killed by a secondary infection, just as peach twigs are destroyed by Monilia fructigena, only in case of the

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

peach the stem infection takes place apparently only through the blossoms or fruits, and here apparently only through the leaves. The striking similarity may be seen by comparing Woronin's Fig. 23, Table II, with *Journal of Mycology,* Vol. VII, Plate V, figs. 1, 2 and 3. The germ tubes bore directly through the epidermal cells of the host or penetrate at the junction of two or more cells. In no case were they found entering through stomata, although most of the infections were through the underside of the leaf. On culture media long chains of conidia develop before any septa appear. Finally the ripe conidia are separated by delicate spindle-form or diamond-shaped disjunctors consisting of two minute cones of cellulose joined at their bases and having their apices connected with the two adjacent spores. Neighboring ascospores and conidia as well as germ tubes often fuse, and this is very striking in case of the infection of the incipient fruit through the stigma. For this purpose a half dozen conidia may fuse into a sort of colony or association giving rise to a single, very robust hypha which grows down the style after the manner of a pollen tube and finally infects the ovary. Fusions of spores and of hyphae are common enough in fungi, but fusion for so manifest and important an end is certainly noteworthy. The elongated penetrating hypha usually remains unbranched until the ovary is reached. In 3–4 days from the time of placing the spores on the stigma the germ tube has reached and entered the micropyle, and a day or two later the nucellus is invaded. No further development of the fungus takes place unless the flower has been fertilized by a pollen tube. In that case there is a movement of nutrient substances into the ovary, and on these the fungus makes a luxuriant growth. First the nucellus is occupied, then the integuments are invaded, and finally the pericarp, following which the young fruit browns externally and shrivels, and, if the air is moist enough, conidia appear on its surface. During early stages of germination 4–10 problematic bodies resembling nuclei appeared pretty constantly in each germ tube and then disappeared. The fungus on mountain ash is smaller than *S. padi,* but is otherwise very similar. The paper closes with 5 pages on relationships among Sclerotinia.—ERWIN F. SMITH.

Demonstration of Photosyntax by Bacteria.—In *Verhandelingen d. Koninklijke Akad. van Wetenschappen te Amsterdam* (2 Sectie, Deel III, No. 11) Professor Th. W. Engelmann summarizes in a brief paper (Die Erscheinungsweise der Sauerstoffausscheidung chromophyllhaltiger Zellen im Licht bei Anwendung der Bacterienmethode) what is known on this subject, and illustrates it very satisfactorily by a well executed chromolithographic table. The value of this method rests on the fact that aerobic motile bacteria cease to move as soon as oxygen is withdrawn, and again become motile when a trace of it is added. This method of showing the photosyntax of chlorophyll-bearing cells is very delicate and exceedingly simple. A round green algal spore is placed on a slide in the center of a drop of water containing some aerobic actively motile bacterium and imprisoned by an ordinary cover glass cemented to the slide air tight by vaseline. If this preparation is now examined immediately, the bacteria will be found uniformly distributed through the drop and actively motile. They pay no attention to the green spore because they find sufficient oxygen everywhere. If the slide is now placed in the dark the movement of the bacteria gradually ceases with the exhaustion of the oxygen, and in this condition also the bacteria pay no attention to the algal cell. If, however, such a slide be left exposed to the light, the bacteria begin in a minute or two to swarm around the green spore and continue to do so as long as it is exposed to the light. Under these conditions there is a zone close to the spore and about as wide as the diameter of the latter, crowded with actively motile bacteria, a much wider zone in which there are only a few organisms swimming about, and a remoter zone of uniformly distributed non-motile bacteria. If now the mirror of the microscope be shaded so as to let barely enough light through for seeing, all self motion ceases and the bacteria which have crowded into a narrrow zone around the green spore begin to be distributed through the liquid uniformly by molecular movements. When bright light is flashed in again, active movement begins immediately, centering around the spore, and the two zones are reproduced, but if only a moderate amount of light is let in, only a small amount of oxygen is given off, only a few bacteria become motile, and these crowd back the rest forming a narrow clear zone of motile organisms, bounded by a crowded quiet zone, bounded in turn by a clear quiet zone, outside of which the bacteria are evenly divided. If a little more light be let in the number of motile organisms around the green spore increases, the inner clear zone widens, and finally with full light we have immediately the first condition, viz., a dense swarming mass of organisms around the algal cell, next a wide zone having in it only occasional rods, all of which are motile, and farther away a uniform distribution of organisms, which are non-motile because they have not felt the influence of the oxygen given off by the green spore. The algal cell of course gets from the bacteria CO_2 in return for the oxygen. Beautiful results can be obtained with threads of Cladophora, Spirogyra and other algæ, and

Spirogyra with the hay bacillus may be used to show that it is not the colorless protoplasm, nucleus, cell sap, or cell wall, but only the chromophyll bodies that give off oxygen. Light thrown on a chlorophyll band of Spirogyra causes the bacteria to swarm to it, while light thrown on any other part of the cell causes no crowding or movement of the bacteria. Light thrown on a chlorophyll band, after being passed through an alcoholic solution of chlorophyll derived from Spirogyra, caused no crowding or movement of the bacteria, while light passed through red glass, although less intense, caused an active swarming of the bacteria around the illuminated part of the band. The same method may be used to show whether red and variously colored cells contain chlorophyll, and whether the chlorophyll-bearing protoplasm of a cell is living or dead. The author obtained some of his results with undetermined bacteria from the surface of slightly foul water, but fresh cultures of Bacillus subtilis also gave good results. Organisms which make only a small demand on free oxygen, such as Vibrio lineola and Spirillum tenue give somewhat different results. In this case the motile organisms crowd around the algal spore or thread only when it is under the influence of feeble light. When bright light is let in, too much oxygen is given off, and a space is cleared around the green cell which widens or narrows in proportion to the varying of the light. With waning vigor of the chlorophyll the same results are obtained in bright light as with vigorous cells in feeble light, i. e., a crowding of the bacteria close up to the algal cell. The appended bibliography includes 61 titles, beginning with the year 1881, when Engelmann first published on this subject.—ERWIN F. SMITH.

Detection of Glukase by Auxanographic Methods.—Beyerinck has devised a neat method for showing that the enzym, glukase, first changes cooked starch into dextrine and subsequently into glucose. Over ½ the bottom of a Petri dish or similar receptacle, which part we will designate A, he pours a nutrient gelatine (10 per cent. gelatine ; ½ per cent. soluble starch ; ¼ per cent. asparagin ; $\frac{1}{20}$ per cent. potassium phosphate) infected with Saccharomyces ellipsoideus or any other maltose yeast which is able to take nitrogen from asparagin, but will not react on dextrine. Into the other ½ of the dish, which we will designate B, he pours a nutrient gelatine infected with the same yeast and of identical composition except that the soluble starch is left out. Of course, no growth occurs in either part, because neither contains any carbohydrate on which this yeast can feed. A small area on A is now strewn with glukase powder and at some distance the same powder is strewn on a part of B. Wherever the glukase powder falls on A, dextrine is formed out of the soluble starch, and from this, under the influence of the same enzym, glucose is produced. The latter is food for the yeast and growth begins at once, but as glucose is not diffusible through the gelatine, and as dextrine is not food, the growth of the yeast is sharply limited to the spot covered by the enzym, which is but slightly diffusible and is itself not food for the yeast. On B there is at first no growth even where the glukase falls, but after a time some of the dextrine produced on A escapes from the enzym spot and, being diffusible, passes through the gelatine without influenceing the imprisoned yeast cells until the glukase spot on B is reached. Here the fresh enzym immediately converts the dextrine into glucose, as shown by the production of an S. ellipsoideus auxanogram, the yeast spot corresponding in shape not to the area strewn with the enzym, but to so much of it as has been entered by the diffusion curve of the dextrine. This method was employed to determine what seeds contain glukase and to locate it in particular parts. The yeast is much more sensitive to minute quantities of glukase than chemical tests or polarized light. Glukase occurs in ungerminated maize principally in the horny part of the endosperm. It also occurs in abundance in the endosperm of sorghum and millet seeds, and is present in the seeds of about a dozen families of monocotyledons, i. e., in those having a mealy endosperm. Most seeds which are free from endosperm, or in which the endosperm is fleshy or horny, do not contain it. It does not occur in ungerminated wheat, rye or barley. Fresh starch grains outside the plant are attacked by glukase just as little as by diastase. Inuline also remains unchanged. The product of the action of glukase on maltose is glucose pure and simple. Dextrine is less readily converted into glucose than is maltose, and soluble starch is still less readily converted. These notes are from the third part of a long paper, Ueber Nachweis und Verbreitung der Glukase, das Enzym der Maltose, in *Centrb. f. Bakt. u. Par., Allg.*, I, 6, 7-8, and 9-10.—ERWIN F. SMITH.

ZOOLOGY.

The Characters of the Enchytræid Genus Distichopus.—In the absence of any information regarding the internal structure of the *Distichopus silvestris* of Leidy, European students of the Oligochæta have rightly treated this species cautiously, there being no data to indicate its position in the system. That Beddard, in his recent Monograph has seemed uncertain even of the Enchytræid nature of the form, has led me to make a brief statement of its anatomical characters.

Setæ, as stated by Leidy, are restricted to the ventral series of bundles. That these are truly the ventral bundles is shown by the position of the nepridial openings at the same level, and the relation of the bundles to the lateral line. There appears to be no glandular replacements of the dorsal setæ. The complete, typical seta bundle consists of two pairs, an outer of larger and an inner of smaller setæ, disposed symmetrically. Such bundles were rarely present in the material examined, and were confined to the ante-clitellar region. In some specimens they were entirely absent. Behind the clitellum, four, or even three, setæ were seldom found, two being the rule, and on a variable number of the posterior segments only one. Often some of the segments were without setæ. This irregularity in distribution, the frequent absence of setæ on a somite, and the fact that the posterior pairs were usually the outer or larger setæ, indicate a retardation in the successive production of new pairs of setæ, and a consequent tendency toward a reduction of the number in the bundle.

In form, the setæ are peculiar, being very stout, swollen in the middle, blunt-pointed and slightly curved externally and hooked internally.

A cephalic pore is present between the prostomium and peristomial ring; but no dorsal pores were observed, though this is not conclusive evidence of their absence.

The inter-segmental septa, from the second to the sixth inclusive, are very thick and muscular, and the last three of these, namely, iv-v, v-vi, and vi-vii, bear prominent septal glands on their anterior faces. The bundles of ductules from these glands open as usual on the surface of a prominent dorsal pharyngeal pad, which was the usual structure.

The testis papillæ are united into a transverse ridge of simple columnar cells. The alimentary canal presents no marked enlargements, constrictions or saccular outgrowths. Its musculature is unusually powerful, and the two sets of fibres cross in a trellis-like arrangement, which is complicated at the septa.

The pepto-nephridia (salivary glands) are a pair of branched tubular structures in somite v, and are similar to those of several species of Fridericia with which they have been compared.

The ante-septal portion of the nephridia is small, and consists mainly of the funnel; the post-septal is large, with a prominent dorsal lobe, and a slender ventral portion, from which the terminal duct arises. The intra-cellular canal is very tortuous, and in part seems to form a plexus such as has been described for other Enchytræidæ by Bolsius. Nuclei are prominent, but cell divisions in the granular protoplasmic mass, not apparent. No spermatheca have been found.

The essential sexual organs occupy the usual positions. The funnel of the vas deferens is rather small, with an oblique, ventrally directed mouth. Its duct is slender, closely coiled entirely within the twelfth somite, and about five or six times the length of the funnel. It terminates in a copulatory apparatus exactly like that of the Fridericia examined, that is, the duct perforates the muscular sheath of the spherical prostate gland, which is composed of radiating pyramidal cells, and opens immediately dorsal to the mouth of the gland into a tabular invagination of the body wall (atrium), which can be everted to serve as a penis. The oviducts have the usual form and position.

Peritoneal corpuscles are of two kinds, the smaller ones being about half the diameter of the nuclei of the large ones, elliptical and refringent.

The supra-œsophageal ganglion is truncate or slightly concave posteriorly and varies in relative length.

The dorsal blood vessel arises from the sinus in somites xiii and xiv and hence is post-clitellian. There is an internal chain of valve cells, not, however, very greatly developed. The only other peculiarity of the vascular system is in the structure of the endothelium bounding the peri-enteric blood sinus, which requires further study.

The above is an abstract of a detailed account which was prepared with appropriate figures last winter, but which has been withheld in the hope that an acquisition of fresh material would permit the elucidation of several doubtful points.

The material on which this account was based consisted of several rather poorly preserved specimens found among the collections left by the late Dr. Joseph Leidy at the University of Pennsylvania.

The several points referred to above about which I am still in doubt are the character of the spermathecæ, if present, the presence or absence of dorsal pores, the minute structure of the nephridia, and the number of species, there being indications of the existence of two. Furthur studies of the variations and distribution of the setæ are also desirable.

Michaelsen, in his synopsis, has placed Distichopus next to Fridericia, but apparently without any intention of suggesting relationship. That such a relationship exists, and that Distichopus finds its closest ally in Fridericia, is perfectly evident from the above account. The form of the setæ is easily derived from the straight, internally hooked type of Friedericia, while their arrangement in the bundles is even more characteristically of the Friderician plan. The post-clitellar origin of the dorsal vessel, the colorless blood, the two kinds peritoneal corpuscles, the large size and branched arrangement (as in some species of Fridericia) of the salivary glands, the simple alimentary canal, the character of the male ducts and of the nephridia are all characters which these two genera possess in common. On the other hand, Distichopus is clearly separated Fridericia by the abortion of the dorsal setæ bundles, and perhaps by the absence of dorsal pores.

The absence of dorsal setæ is not to be regarded as allying Distichopus with Anachaeta.—J. PERCY MOORE.

New Mollusca from the Pacific.—While the *Albatross* was engaged in making soundings between the coast of California and the Hawaiian Islands in 1891–92, some dredgings were made on the archibenthal plateau about the islands in water from 300 to 400 fathoms deep, from which a small collection of molluscs and brachiopods was made. This material is now reported upon by Mr. W. H. Dall. It proves to be most interesting, and wholly new, not a single species heretofore described, either from the deep sea or from the Hawaiian Archipelago, being found among the dredgings. A new subgenus of Pleurotomidæ, the hitherto unknown and very interesting soft parts of a species of Euciroa, regarded as belonging to the Verticordiidæ, but now necessarily raised to family rank, and several new Brachiopods, are described. To these are added a few new species from the northwest American coast.

The Hawaiian collection is distributed as follows: Gasteropoda 11, Scaphoda 2, Pelecypoda 4. The northwest American species have been described before, but are now figured with a few additional notes, and 13 new species added to the list. (Proceeds. U. S. Natl. Mus. xvii, 1895.)

Taylor on Box Tortoises.—In a classification of the Box Tortoises of the United States, Mr. W. E. Taylor adopts the species recognized by Baur, and adds one new one, *Terrapene baurii.* The author agrees also with Baur as to the important position in the taxonomy of Terrapene of the modification of the zygomatic arch, and gives seven figures, showing that the quadratojugal is well developed in primitive forms of the genus, rudimentary in intermediant forms, and absent in *T. ornata*, the most specialized species.

In regard to distribution, the author has compiled the following facts: *T. major* is a Gulf species, and ranges from the mouth of the Rio Grande to Florida, possibly including southern Georgia. *T. baurii* belongs to the peninsula of Florida, possibly including southern Georgia. *T. carolina* is found in northeastern United States, extending from the St. Lawrence and Great Lakes south to the Carolinas and Tennessee, and west to the Mississippi River in Kentucky and to eastern Illinois. Concerning *T. mexicana* the data are insufficient to outline its range. *T. triunguis* occupies the swampy districts of the Lower Mississippi and bordering territory. *T. ornata* belongs to the plains and tablelands east of the Rocky Mts. from the Rio Grande north to the Yellowstone River. (Proc. U. S. Natl. Mus. Vol. XVII, 1895).

Although these box tortoises are similar in external appearance, they cannot be referred to a single genus owing to the extraordinary differences in the characters of the zygomatic arch which Baur has shown to be present. They furnish an illustration of a case where the generic characters are more conspicuous than the specific. Using the table furnished by Mr. Taylor, we will have the following:

I. Three digits to the hind foot.

Zygomatic arch complete,	*Pariemys*, g. n.
Zygomatic arch incomplete,	*Onychotria* Gray.

II. Four digits to the hind foot.

Zygomatic arch complete,	*Toxapsis* g. n.
Zygomatic arch incomplete,	*Terrapene* Merr.

The only species of Pariemys is *P. baurii* Taylor. Of Onychotria there are two species, *O. triunguis* and *O. mexicana*. Of Toxaspis but one species is known, viz., *T. major;* while there are two of Terrapene, viz., *T. carolina* and *T. ornata.*—E. D. COPE.

The Genera of Xantusiidæ.—The interesting additions to this family of lizards made by Stejneger and Van Denburgh exhibit a large range of variation in scutellation of the head. It appears to me that neither of the species added by these gentlemen can be properly referred to Xantusia, and I would distinguish them as the types of two genera. The genera of Xantusiidæ appear to me to be five, distinguished as follows:

I. One frontal and frontonasal plates.

Superciliary scales, none ; pupil round, *Lepidophyma* Dum.
Superciliary scales present ; pupil erect, *Xantusia* Bd.

II. One frontal and two frontonasal plates, pupil erect.

An interoccipital plate ; frontoparietals in contact ; superciliaries, *Zablepsis* Cope.
No interoccipital ; frontoparietals widely separated ; superciliaries, *Cricosaura* Pet.

III. Two frontals and one frontonasal ; pupil erect.

No interoccipital ; frontoparietals in contact ; superciliaries, *Amœbopsis* Cope.

Each genus includes but one species except Xantusia, which has two. The type of Zablepsis is the *Xantusia henshavii* Stejneger, and the type of Amœbopsis is *X. gilbertii* Van Denburgh. The former is from Southern, the latter from Lower California.—E. D. Cope.

Occurrence of the Siberian Lemning-Vole (Lagurus) in the United States.—In describing a new vole (*Arvicola pallidus*) from Dakota, in 1888,[1] I referred it to the subgenus *Chilotus* of Baird, with which it agrees in the number of triangles in the molar teeth. Two years later, when studying a collection of voles from Idaho, I found that *pallidus* and its near ally *pauperrimus*, differed from *Chilotus* in important cranial and external characters, and the teeth, while agreeing in the number of triangles, differed materially in other respects. They were, therefore, removed from *Chilotus*,[2] but a new subgenus was not erected for them because it was believed that they would be found to fit into some of the numerous named groups of Eurasian voles of which no specimens were then available for comparison. Through the courtesy of Mr. Gerrit S. Miller, Jr., I now have before me a skin and skull of the Siberian *Lagurus lagurus* (Pallas) [=*Eremiomys lagurus* Auct.[3]], collected at Gurjew on the north shore of the Caspian Sea, and recently received by him from

[1] American Naturalist, August, 1888, 702–705.

[2] N. Am. Fauna, No. 5, August, 1891, 64–65.

[3] The generic name, *Lagurus*, of Gloger (1841), antedates *Eremiomys* Poliokoff (1881) by forty years. For an article on Gloger's names see Thomas, in Annals and Magazine Nat. Hist., Ser. 6, Vol. XV, 1895, pp. 189–193.

the St. Petersburg Museum. At first glance I was impressed by the strong resemblance of this animal to our members of the *pallidus* group; and a detailed comparison of the skulls, teeth, and external characters of the two serves only to confirm this view. They agree in the small flattened skull with squarish, depressed braincase and short nasals; the pattern of the molar teeth (not only the number and relations of the triangles, but also the distant spacing of the loops posteriorly and the appearance of immaturity of the posterior molar in both jaws); the structure of the hinder part of the palate; the short wooly hind feet; the short tail; and even the softness of the polage and pale coloration. In Mr. Miller's specimen the audital bullæ and occipital region are broken off, but on comparing these parts in the Amercian members of the *pallidus* group with Buchner's figures of *Eremiomys* [=*Lagurus*] *lagurus*[4], they are found to be essentially identical. The posterior part of the braincase is not only flattened, depressed and very broad, but the audital and mastoid bullæ are unusually large and the latter project decidedly behind the plane of the occiput. From the close agreement in the above mentioned essential characters, and the absence of important differences, I unhesitatingly refer the American *Microtines* described under the names *Arvicola curtatus, pauperrimus* and *pallidus,* to the Eurasian *Lagurus.* The principal differences are that *L. lagurus* has the tail even shorter than our species, and the ear decidedly smaller. There is also a more or less clearly defined dark streak down the middle of the back that is not present in the American forms.

Lagurus is commonly accorded full generic rank, but I am unable to appreciate more than subgeneric weight in the characters that distinguish it from *Microtus.* Why it has been called a lemning instead of a vole I am not able to understand.

It is gratifying to add another group to the *Microtines* of Circumpolar distribution and at the same time lesson the number restricted to a single continent. *Lagurus* is a Boreal group, finding its southern limit in the Transition Zone.—C. HART MERRIAM.

The Introitus Vaginæ of certain Muridæ.—A series of observations made by Mr. G. I. Miller, during the winter and spring months of 1890 and 1891, prove conclusively that in many of the smaller American Muridæ and also in the European *Mus sylvaticus, Evotomys glareolus* and *Microtus agrestis* the vaginal orifice, during pregnancy, lactation and the period of sexual inactivity, is tightly

[4] Przewalski's Reise nach Central-Asien, Säugethiere, liefr. 3, 1889, pl. XIII.

closed by a membrane which resembles a hymen. That this structure is not homologous with the hymen the author has discovered by a histological examination. A series of sections shows conclusively that the vaginal orifice is closed, not, as Lataste states, by the mere approximation of the walls, but by a mass of epidermal cells which is absolutely continuous across the vaginal region. This peculiar epithelial growth does not contain the same histological elements, nor does it occupy the same position as the hymen.

The use of the structure is to protect the vagina from particles of dust, dirt and sand, and probably originated, according to the author, as the result of the action of foreign substances in the vaginal orifice, since mechanical irritation of epithelial tissue causes cell proliferation. This tendency to cell growth in a definite region once established, the protection afforded by it, although incomplete, might offer sufficient opportunity for the operation of natural selection, whereby the definite and useful structure now present could be perfected. (Proceeds. Boston Nat. Hist. Soc., XXVI, 1895).

Zoological News.—A note published by M. A. T. Rochebrune calls attention to a mollusc with toxic properties. This mollusk is *Spondylus americanus*, found by M. Diguet in Lower California. It emits an odor of sulphurretted hydrogen, strong enough to disgust even a famished creature, so it is never prayed upon for food. M. de Rochebrune has isolated the toxic principle by the Stass method, and has obtained an unctuous olive-green extract with an acrid odor and bitter taste, which produces a burning sensation, and which burns with a vivid yellow flame. .001 gr. kills a frog in 12 minutes, after first producing paralysis. .003 gr. kills a guinea pig in 25 minutes. Chemical reactions indicate that in *Spondylus americanus* there is elaborated a product allied to ptomaines and leucomaines, very similar to muscarine, the toxic product of the mushroom, *Amanita muscaria*, and which M. Rochebrune calls Spondylotoxine. (Revue Scientifique, June, 1895).

The South American Characinidæ collected by C. F. Hart, and presented to Cornell University, comprises 167 species of which seven are new, four of them belonging to the genus Tetragonopterus. The material has been identified by A. B. Ulrey. (Am. N. Y. Acad. Sci. 1895).

A collection of birds made in the Philippine Islands by the Menage Expedition for the Minnesota Academy of Natural Sciences includes 36 new species. These are described by Messrs. Bourns and Worcester (1804) in the first volume of Occasional Papers issued by that institution. Two hundred and twenty-six species are noted as already described, but from localities not previously known. Of these 73 were were found in the Calamianes Islands—all of them identical with species found in Palawan.

M. A. Pettit, having had an opportunity of examining the suprarenal capsules of two adult Ornithorhyncus (*O. paradoxus*) makes the following statements in regard to them. In size and general appearance the suprarenal capsules of Ornithorhyncus resemble those of mammals, while their position, within the posterior extremity of the kidney, is an Avian character. (Bull. Soc. Zool. de France, T. XIX, 1894).

ENTOMOLOGY.[1]

A new Tettix.—In a series of specimens of Tettigidæ received from Mr. J. C. Warren of Palouse, Washington, I find a new form, see Fig. 1, nearly allied to *Tettix granulatus* but having certain recognizable differences as here described.

Tettix incurvatus sp. nov. Resembling *Tettix granulatus* nearly but differing as follows: Average length shorter, more robust, pronotum faintly bulging and deeper over the thorax, lateral angles more pronounced, median carina of pronotum distinctly elevated reaching the maximal height over the shoulders, a small swollen space here intercepting the base leaves the carina just in front sharply compressed, convexly sloping to the front, with a depression on each side—this is barely indicated in *T. granulatus.* Dorsal front and lateral front margin of pronotum encroaching on the head. Face broader, cheeks more swollen. Surface of pronotum densely granulated interpersed with fewer coarse granulations. Color dark brownish fuscous tending to black. In the male the wings slightly over reach the pronotum from ½ to 1 mm.; in the female this condition varies, the wings slightly over reaching the pronotum in some cases, in other individuals the reverse is true. Specimens of *T. granulatus* from Indiana, Illinois and

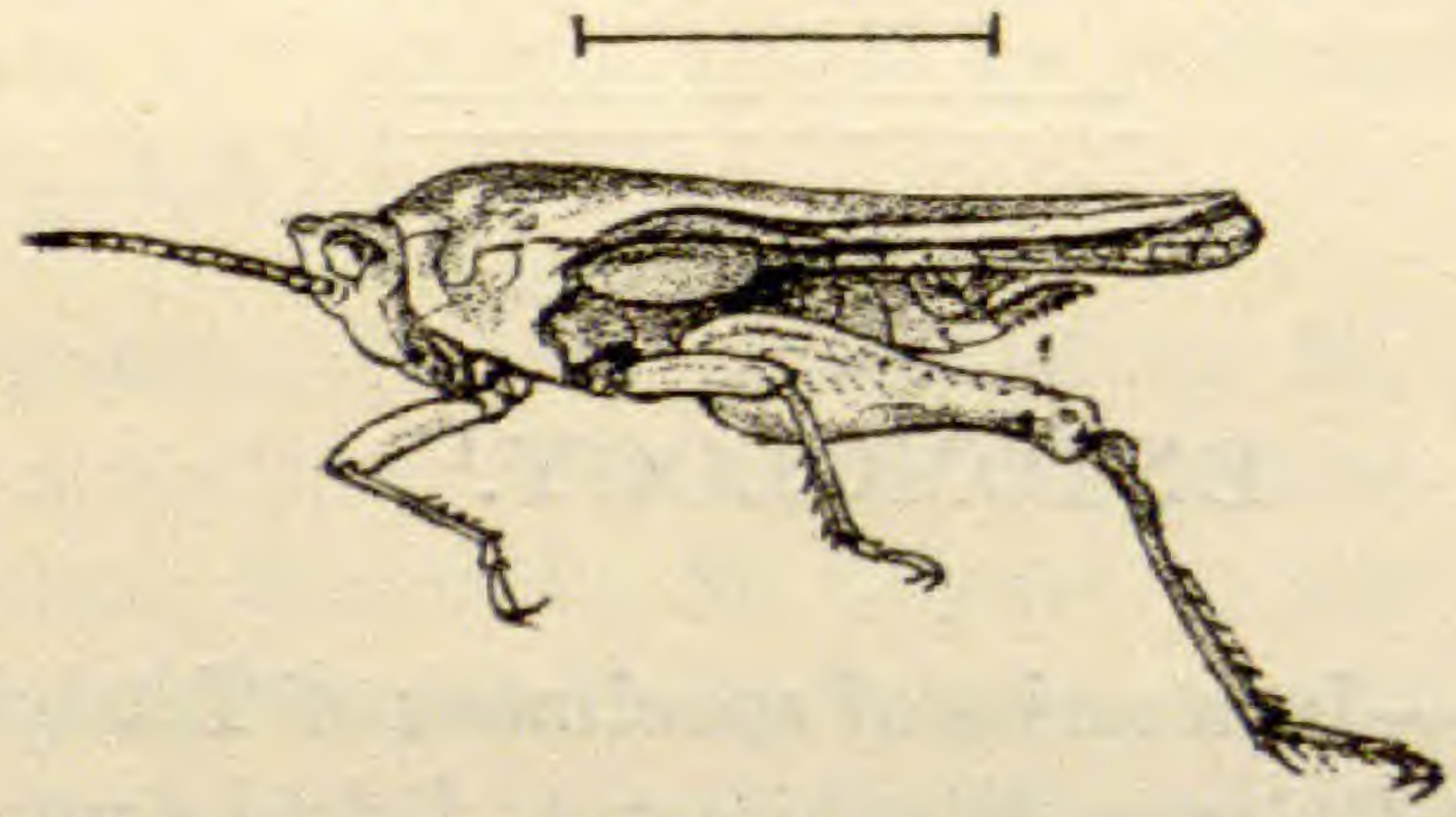
[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

Massachusetts, in my collection are almost uniformly slender, the pronotum nearly straight toward the front, and the median carina very slightly raised. A series of these examples brought together with the foregoing for comparison are easily separable.

MEASUREMENTS IN MM.

Length.	Pronotum.	Hind Femora.
♀ 14–15	13–13½	6½–7
♂ 11–12	10–10½	5¼–6

This small locust abounds in openings among pines near the Palouse River, sometimes occurring on moss or white clover. Described from 12 males and 16 females from Palouse, Washington, (collected by J. C. Warren), in the authors collection.



Explanation of Fig. 1. Side view of *Tettix incurvatus* Hancock, enlarged, original, the line above shows natual size.—J. L. HANCOCK.

On the Early Stages of some Carabidæ and Chrysomelidæ. —The descriptions of the larvæ of the species which follow should be compared by the student with those of *Chlœnius laticollis* and *C. leucoscelis* as given by Schaupp[1] and with Dugès'[2] figure and account of *Leptinotarsa lineata.* The details of some of the mouth-parts of the larva of *Cychrus elevatus* are introduced to show the peculiar armature of the mandible.

CYCHRUS ELEVATUS Fabr.

Larva found under a log (in cell, ready for pupation) April 23rd. Color above nearly black, beneath almost white, form robust rather resembling that of some Silphids. Pupated April 25th,pupa of an ordinary Carabidous form and without special marks though the deeply emarginate labrum and expanded tips of the palpi indicated its identity before the beetle was disclosed on the 10th of May. The figures of the mouth

[1] Bull. Brooklyn Ento. Soc., III, 17, 26.

[2] Ann. Soc. Ent. Belg., XXVIII, 1.

parts of the larva are introduced for comparison with those of other Carabids. The mandibles are long and curved, with a very strong tooth near the base, this tooth being pectinate on the inner margin and provided on the side with many short bristles. Still nearer the base of the mandible than the tooth is a bunch of long slender hairs. The maxillæ have only the basal joint left in my preparation—this is heavy and very spiny, bearing near its inner tip a bristle-tipped tubercle. The mentum is broader at tip, the palpi with bristly basal and naked second joint.

CHLÆNIUS SERICEUS Forst.

Larva of a greenish-black color with bronzed luster, head reddish, feet testaceous becoming piceous in the vicinity of the claws.

Form elongate, slightly convex above, more flattened beneath, tapering to both ends but more distinctly posteriorly. The ninth abdominal segment bears two processes or filaments about equal in length to the rest of the insect.

Head narrowed behind the eyes and slightly constricted into a neck; anterior to and between the eyes the upper surface is concave and with two very distinct longitudinal impressed lines. Beneath the surface is convex but with a distinct longitudinal groove and a large anterior triangular impressed space, the middle of which is slightly elevated. The upper and lower surfaces are both very finely granulate, the former with some distinct rugæ and punctures in addition. Hairs are visible only under a strong lens and are few in number.

Ocelli six, about a raised spot back of the antennæ.

Antennæ four-jointed, bristly, the first joint long, the second shorter, third a little longer than the second and bent near the tip. The fourth is scarcely half as long as the third and fusiform in shape.

Mandibles long, curved, armed below the middle with a strong tooth which is directed inwards and downwards; still nearer the base is a small bunch of hairs which lie against each other so closely as to simulate a spine and can only be resolved into components by the use of a high-power objective. This little bunch is, without doubt, the homologue of the large brush found in the larva of *Cychrus elevatus*.

Maxillæ with long stout basal joint bearing a few long spines and numerous more delicate hairs; inner lobe two-jointed, the basal joint the longer and stouter. Palpus four-jointed, first joint short and thick, second more slender and about twice as long, third about equal in length to the second, but more slender, fourth very small. Besides the palpus and inner lobe, the maxilla bears on its basal joint, just near the base of the lobe, a small bristle-tipped appendix of a single joint.

Mentum broader than long, quite bristly, the anterior margin produced at middle and emarginate at sides, the process bearing two long bristles which are approximated at tip and give the appearance of a single long stout spine. Palpi with large basal, shorter second and extremely minute third joint, the basal one alone somewhat feebly spinous.

Prothorax narrower anteriorly, about one-fourth broader than long, lateral and basal marginal lines distinct, anterior margin somewhat broadly depressed, angles rounded; an impressed median line is found, on each side, of which, is a less well-defined slightly oblique channel, deeply punctate at bottom. The whole disk is irregularly punctured, with intervening smooth spaces, the most evident of which are on each side of the above-described lateral grooves.

Meso- and metathorax, taken together, shorter than the prothorax, the impressions similar but broader and less well-defined, the discal punctures with a tendency to coalesce and form transverse rugæ.

Abdomen of nine true segments, slowly tapering, the margins of the first eight paler and apparently somewhat membranous in structure, the ninth bearing a long tubular anal segment and two processes which latter about equal the rest of the body in length and are black with a broad sub-basal orange band. These processes are rather thickly finely bristled and under high power the dark portions give a segmented appearance due probably to the surface being roughened by transverse ridges or scales.

Legs of an ordinary carabidous form—the figure shows a posterior member.

Pupa 10·5 mm. in length, the thorax narrow, with many dorsal bristles, the sides of the abdominal segments somewhat produced as shown in the figure.

The larvæ described were taken in July at Bayfield, Wis., under pieces of wood near ponds. They are hard to rear and only a small proportion could be brought to maturity. If the figures given by Schaupp[3] are correct, the larva of my species differs greatly from his in the immense length of the caudal setæ.

DORYPHORA (Mycocoryna) LINEOLATA Stäl.

Living larvæ cream-colored, pronotum with a yellowish tinge, head of a very light amber, legs black. The mandibles are dark, the tip of the antennæ and a frontal spot in the shape of a broad inverted V are black, as are also the front and hind margins of the pronotum. There is a

[3] Tom. cit. Pl. (I), fig. B.

line of more or less confluent black spots along each side of the body from the base of the pronotum to the penultimate abdominal segment which is dusky over the most of its surface, while the terminal segment is shining and of a deep brown (or occasionally castaneous) color. A black dorsal line extends from near the middle of the metanotum on to the seventh abdominal segment and all the abdominal sutures are edged with black. A more or less interrupted line of brown dots and dashes extends from side to side of each of the first seven abdominal segments and in some cases a similar one occupies the same position on the meso- and metanotum, though they may be reduced to a lateral dot. Form heavy and thick-set much as in the larva of the common *D. decem-lineata;* the prothorax is broader and higher than the mesothorax, the abdomen broadest near the middle. The figure I give is of a specimen in the quiescent state immediately preceding pupation, as all were full grown when mailed to me and changed soon after reception. Length, measured on the chord of the curve 7 mm.

Labrum transverse, rounded in front and rather deep emarginate, the bottom of the margination round. The surface is bristled as shown in the figure.

Ocelli six in number and in two species; the first series, of four, is placed just behind the antenna, the other, of two, immediately beneath that organ.

Antennæ extremely small, short and thick, joints rapidly reducing in thickness.

Mandibles strong, heavy, curved, much flattened, five-toothed at the extremity. Two views are given to show the appearance under different aspects.

Maxillæ about equal to or a little shorter than the mandibles, the inner lobe short and heavy, beset with many spines around the edge. Palpi four-jointed, the first joint very large, the second narrower and shorter, the third again longer, the fourth about equal to the third in length and conical in shape, the tip truncate and beset with very small spines. The bristles on the first, second and third joints are few in number but very stout.

Mentum with the anterior angles turned inward and partially embracing the ligula which is slightly emarginate in front and bears short two-jointed palpi and several spines as figured. In this figure the mentum is drawn under pressure and the angles are everted from their ordinary flexed position.

Legs stout and rather short with a moderate number of strong spines as shown.

The pupa is very robust in form and about 7 mm. in length, the disk of the prothorax bears numerous short bristles, while the sides and dorsum of the abdomen are armed in the same way. The terminal segment bears a short, strong horny spine at apex. The eggs were too much damaged when received to admit of careful description, but were yellow in color and deposited in elongate masses, each egg attached by one end to the leaf of the food-plant, Eggs and full-grown larvæ were sent me by Professor Theo. D. A. Cockerell who collected them at San Augustine Ranch on the east side of the Organ Mountains of New Mexico in August.

State University of Iowa. H. F. WICKHAM.
May 27th, 1895.

EXPLANATION OF PLATE.

Fig. 1. *Cychrus elevatus* Fabr.

Fig. 2. *Chlœnius sericeus* Forst.

Fig. 3. *Doryphora* (*Mycocoryna*) *lineolata* Stäl. All the dissections are lettered alike, ant., antennæ, l. leg, lb., labrum, md., mandible, mt., mentum, mx., maxilla.

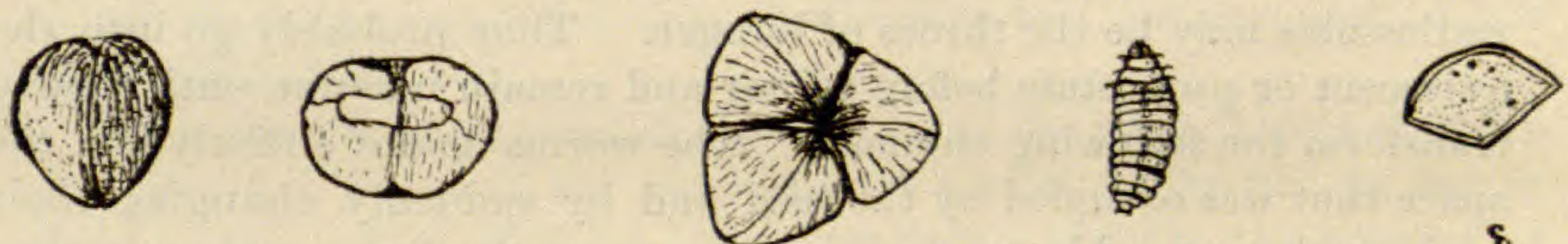
Cecidomyia atriplicis [Towsend, Am. Nat., Nov., 1893, gall only] n. sp.— ♀ about 4 mm. long, general color grey ; abdomen blackish above, slightly reddish at sides, presenting, especially towards base, scattered silvery hairs. Ovipositor not exserted. Thorax above leaden-grey, with two distinct longitudinal grooves. Legs and antennæ grey. Eyes black, joining above, almost covering head. Halteres with the stem grey and the knob dull white. Base of occiput with the fringe of hairs. Antennæ with the whorls of hair obscure, 13-jointed, 3rd joint much longer than 4th, but hardly so long as 4–5, which are equal. Joints 4 to 11 decreasing gradually in length ; 12 and 13 very small, looking like one deeply-constricted joint. Wings greyish-white, hardly at all translucent, veins grey, costal vein black, ending abruptly at junction with first longitudinal. Cross nervure slightly oblique, situated almost at base of wing. The anterior fork of the third longitudinal is very obscure, and there is a wing-fold stimulating a third longitudinal, so that the wing seems to have four longitudinal veins, all simple.

Pupa-shell reddish-brown, with the covering of the wings concolorous or rather paler.

Hab. Bred, May 9, 1895, from galls on *Atriplex canescens* collected on College Farm, Las Cruçes, N. M. The galls are red on one side.

I am glad to have an opportunity of describing this species, since Prof. Townsend had already named it in connection with the galls.—T. D. A. Cockerell, N. M. Agr. Exp. Sta.

Mexican Jumping Beans.—Occasionally one sees what are known as Mexican Jumping Beans, or Broncho Beans, exposed for sale in curiosity stores, or displayed as objects of interest in drug-stores, or other merchantile establishments. They are usually shown upon some smooth surface, as glass, the face of a mirror, or on the bottom of a smooth box. These beans are able to execute short leaps forward, or even turn over by a side-wise movement. If a dozen are placed in a box, so active are they, that some will be in motion most of the time. They are interesting objects both to grown people and children. Children will watch them by the hour and be amused. They appeal strongly to the sense of the marvelous in older people, who seek a cause for everything, as there is no apparent explanation of these erratic movements. All the risk of dispelling the charm that gives attractiveness to the mysterious, the following explanation of the phenomenon is given.



a b c d e

These animated curiosities are the product of the plant belonging to the Spurge Family (Euphorbiaceæ) known to botanists as *Sebastiania bilocularis.* To this same family belongs the Castor Oil Bean. Therefore it would not seem inappropriate to apply the name *bean* to these saltatorial seeds, though they bear no resemblance in shape to beans belonging to the Pulse Family.

The pods of plants belonging to the Spurge family are usually three lobed, as shown in cut C, and when ripe split up into three triangular valves with a rounded back as shown in cuts *a*, dorsal view, *b* face view, and *e* cross section. Each valve contains a single seed. It is to this tripartite form of the pod that the name Jumping Bean is applied. The plant they are obtained from has quite a wide geographical range, but the saltatorial seeds are found only in a limited area in *Sonora*, Mexico. Some of the seeds do not possess jumping powers and the active ones have to be selected. They are gathered by boys and find ready sale to travelers and dealers in curiosities. These diminutive " Bronchos " are

PLATE XXX.

H.F.W.

Wickham on Coleoptera.

advertised to continue their antics for about nine months. This is approximately correct. If some of them are put in a box and examined the following season their movements will have ceased. Small holes will be found in the seeds as though something had gnawed out. In the bottom of the box small moths will be found. If the beans are opened while still active in each one will be found a worm or larva snugly tucked away in the interior. One of these larva is shown in cut *c* natural size. The worm is pale yellowish with a brown head, which has a triangular darker patch in the middle, and black mouth parts. There are eight true legs, six anterior and a single pair posterior and four pairs of false feet, pale pink at the ends. There is a pale brownish stripe down the back. Our specimens were examined November 1st. The seed was entirely eaten, the pod only remaining, cut *e* shows a cross section of one of the beans, the dotted portion was eaten. The worm was plump and fat, evidently having relished the oily seed, a taste we can hardly appreciate if the oil of these seeds has the some flavor and properties as Castor Oil. If these larvæ remain active until next summer they will have to live a long time on their accumulated fat, as their food supply was exhausted November 1st. Possibly their restlessness may be the throes of hunger. They probably go into the quiescent or *pupa* state before winter and remain inactive until time to transform the following summer. The worms do not entirely fill the space that was occupied by the seed and by suddenly changing their position they are able to give movements to the light seed pods they occupy. If the seeds are disturbed the worms become quiet for a time. This is an inborn instinct for self-preservation, like that of feigning death, so common among insects.

These worms in due time change to the *pupa* state and finally emerge as small *moths* belonging to the order *Lepidoptera*, Family *Tortricidæ*, which embraces the *Codling Moth* and a host of other small moths many of which are more or less injurious. This species is known to entomologists as *Graptolitha sebastianæ* Riley.

We presume the moths lay their eggs in the young growing pods, as their is no evidence in the mature pods of the method of entrance. The eggs hatch and the young worms feed upon the developing seed and finally spend the winter in the cavity thus formed. They finally change to the quiescent stage and in due time transform to moths gnaw out and are ready to lay eggs again, thus completing the cycle of life. That which appears marvelous often becomes common place when viewed by the light of some natural cause. But the life history of this insect regardlesss of the movements it causes in seeds is interesting, illustrating as it does the wonderful provision made by host plants to entertain and preserve the parasites that infest them.—F. L. HARVEY, Orono, Maine.

EMBRYOLOGY.[1]

Half Embryos versus Whole Embryos.—In a brief contribution to the Anatomische Anzeiger Dr. T. H. Morgan makes an important advance toward the comprehension of the much vexed question as to what may arise from part of an egg, a part or a whole embryo.

Roux claimed that when one of the first two cells of a cleaving frog's egg was killed by a hot needle, the other cell formed only half an embryo. Hertwig, however, in repeating these experiments obtained whole embryos of small size. Then Born showed that when a frog's egg is fixed upside down, the contents rotate and become differently arranged. Finally O. Schultze has shown that if the egg is fixed upside down in the two-celled stage, it will form two embryos, each of half the normal size.

With these facts in mind Morgan repeated the experiments of Roux and Hertwig to see if the contradictory results might not be due to their having overlooked an important factor, namely, the *position* of the cells.

The results obtained are that when most of the 155 eggs were fixed upside down, six half embryos and two whole embryos were reared, eight in all. Of these, the six half embryos came from the few eggs that were fixed in the normal position, that is, with the black part of the egg uppermost. The two perfect, but half sized embryos, came from the large number of eggs fixed upside down, or with the white side uppermost.

In another set of experiments subsequently undertaken, five half embryos were formed from 92 eggs kept in the normal position. In another case from 125 eggs fixed upside down seven whole embryos and three half embryos were obtained.

It seems that in all the eggs tried, half embryos resulted when the egg was fixed in the normal position and one of the first two cells killed. On the other hand, in most cases tried, small whole embryos were

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

formed when the egg was fixed upside down and one of the first two cells killed; in some cases, however, half embryos were formed even under these conditions.

The advance made lies in recognizing that results obtained are not final till all the conditions of the experiment are considered, and that the state of the egg determines the development of half or whole forms irrespective of theories of post-generation or qualitative-division.

The Mouse's Egg.—Dr. J. Sobotta, of Berlin, contributes to the May number of the Archiv für Mikroskopische Anatomie a fully illustrated account of his researches on the fertilization and cleavage of the mouse's egg.

His work has been extended over five years and has involved the death of 750 mice yielding 1459 eggs, only 57 of which were degenerate or not fertilized.

While still warm the ovaries, oviducts and part of the uterus were killed in mixtures of corrosive sublimate and picrosulphuric acid or, to even better advantage, in osmic acid mixtures. The entire organs were cut into serial sections about 10 microns thick, and fixed and stained by special methods given in detail in the paper, to which the reader is referred for a full account of the technique employed.

The author discovered that in the mouse there is besides the period of heat occurring just after parturition, as in many mammals, a second period twenty-one days later. At this time the young are weaned, and by permitting fertilization at this second period only the young are saved for future experiments, whereas they perish if the mother becomes again pregnant at the first period. The ages of the embryos obtained were most accurately determined by reckoning from this second period of heat, at which time the male was admitted.

Ovulation takes place at the first period whether copulation is effected or not. Between the periods of heat copulation is prevented by the fact that the walls of the vagina are grown together.

The process of copulation lasts but one minute and is difficult to observe even in the most tame of the white mice that the author had, as it takes place in the night towards morning, and the animals are then shy. In this process the uterus becomes very greatly distended with sperm containing clusters of sperms and also some isolated sperms, all moving in the liquid. The vagina is distended by a large mass of a homogeneous secretion of the seminal vesicle of the male.

Twenty to thirty hours after copulation the vaginal plug softens and falls out; before this the uterus has become small again and the sperms are dead, as they live but a few hours.

It appears that only a few single sperms enter the oviducts to meet the eggs, since when a sperm was found entering an egg no others could be discovered anywhere near.

When the egg bursts out of a Graafian follicle in the ovary, it is accompanied by a large mass of cells of the discus proligerus that may continue to surround it till after fertilization. It is probable that some of the liquid in the capsule enveloping the ovary and mouth of the oviduct passes into the oviduct with the egg, for the egg is found in a part of the tube distended with liquid.

The egg of the mouse is exceedingly small, only 59 microns in diameter, and is again remarkable amongst Mammalian eggs in having a very thin, flexible zona, only 1½ microns thick.

The polar bodies are exceptionally large, as much as 16 microns through. One is formed while the egg is still in the ovary, it may divide into two, but this was seldom seen. In fact in nine-tenths of the eggs observed only one polar body was formed. Without any other apparent difference some eggs give rise to two and some to one. Since the size and character of the spindle seen in the formation of the single polar body is the same as that seen in the second one when two are formed, it is inferred that most of the eggs omit the formation of the first polar body. In forming the polar body the egg nucleus changes into an achromatic spindle, of probably only 12 threads, lying tangentially near the surface of the egg and bearing probably 12, at the most 14 or 15 rod-shaped chromosomes. There is no sign of radiations in the protoplasm nor of the existence of a centrosome. This spindle then turns into a radial position and the chromosomes divide into two groups of each apparently 12 rounded chromosomes that move toward the ends of the spindle. One group enters the large polar body that is pinched off about it. When there is but one polar body (and is the second if there be two) there are marked thickenings of the achromatic threads to form conspicuous rounded bodies lying in the position of an equatorial plate.

When the polar body is formed the remaining nucleus of the egg forms a dense mass of chromatin about the same size as the male pronucleus. This is formed from the head of a sperm that enters the egg and becomes a spindle-shaped, dense mass lying tangentially near the surface. A centrosome is now seen lying near the male pronucleus. Both pronuclei enlarge and exhibit remarkably large nucleoli or dense spherules of chromatin; there is but one of these in the male while there may be several in the female. Finally all differences between the two nuclei disappear, they lie side by side and each contains a long, much bent strand of chromatin apparently without a free end.

The union of the pronuclei is a summation of separate chromatin bodies that pass from each nucleus to the equator of a spindle; the nuclear membranes disappear and the chromatin breaks up finally into V-shaped loops, apparently 12 in each nucleus; between the nuclei a centrosome is seen surrounded by sharp radiating lines, while there are also radiations in the protoplasm about the nuclei; two centrosomes are next found at the ends of a small spindle lying between the two sets of chromatin loops; these loops then collect at the equator of the spindle that enlarges to form the first cleavage spindle; these chromatin loops are entirely different in size and form from the chromatin bodies seen in the formation of the polar body and appear to be not more than twenty-four in number.

The first cleavage results in the formation of two entirely equal cells. The nucleus of each receives some of the above chromatin loops; the author supposes they split so that each cell receives 24 chromosomes, but this is not evident from his figures and seems rather an inference from a general idea supported by his belief that the adult tissues of the mouse apparently show 24, and the spermocytes as well as the maturing egg 12 chromosomes.

The subsequent cleavage taking place as the egg passes toward the uterus is at first unequal in that one of the cells enlarges and divides into two; there are then three cells, one large, a pair of smaller. The larger then divides into two smaller than the first formed pair. The first formed then divide so that there are now six; then the others divide and the egg is made up of eight all essentially alike. The egg has 16 cells about 72 hours and comes into the uterus about 80 hours after coitus.

If the eggs are not fertilized, either from the lack of copulation or from the fact that not enough sperm enters the oviduct to fertilize all the eggs, they degenerate without cleaving.

Interesting cases of polyspermy were seen to result from a second copulation; if when the vaginal plug is fallen out a second male be admitted, the usual changes in the uterus take place. In one case when the second copulation occurred 18 hours after the first, a sperm was found in an egg having two normal pronuclei, and in another a small pronucleus in addition to the two normal ones. In another case of copulation 24 to 36 hours after the first, where the eggs had divided into two cells, two sperms were found in one cell of one egg and a large nucleus (apparently a male pronucleus) in a cell of another egg, in addition to the normal nucleus of the cell.

PSYCHOLOGY.[1]

The Problem of Instinct.—The works of Prof. Lloyd and of Prof. Baldwin, which I have recently reviewed in these pages, deal more at length with this problem, but it seems worth while to add an account of a very interesting article which Louis Weber published in the January number of the "Revue de Metaphysique et de Morale," pp. 27–59.

The word instinct may be taken in three quite distinct senses. In the first sense it is practically equivalent to animal mind or intelligence; in the second it denotes certain types of conduct, adapted to an end, constant throughout the individuals of a given species or race, and although constant, not dependent upon consciousness for their performance; in the third it denotes simply unconscious adaptation to an end—the instinctive act may be conscious but in that consciousness there must be no representation of the end to which it tends. The first is too vague, the second is arbitrary in that it involves the assumption of a precision that does not exist, the third is preferable to either of the others, for it embraces phenomena of widely different character and recognizes instinct as a phenomenon co-extensive with mentality. The facts accumulated by investigators in this field have been of little value to science for lack of approved methods of research and the theories based upon them stand in need of critical revision.

The difficulties of getting exact information upon these points are great. Unlike physical phenomena, mental phenomena are not objects of direct perception but must be inferred from external signs. In the process of inference many errors creep in, springing, in part, from theological or philosophical prejudices, and in part from our natural tendency to read our own experiences into the minds of the lower animals. Among the most misleading of the anthropocentric conceptions to which this tendency gives rise, is that of the scale of intelligence, in which the human mind has the first place, every other type of mind having its appropriate niche below it. "Thus, the conceptions of relative value, of degree, and of hierarchy are intruded into the study of phenomena which from their very nature cannot be brought under any scheme of classification based upon the notions of less or more."

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

Their points of difference are essentially qualitative and cannot be estimated as quantities or magnitudes.

One convenient method of avoiding such illegitimate interpretations is found in the careful study of the physiological conditions of consciousness. We are justified in assuming that sense organs of the same character mediate sensations of the same kind, and if we find any wide difference in the structure of the organs we must be cautious in our interpretations. It is probable, for example, that the conscious states mediated by the composite eye of the insect cannot be translated into any terms drawn from our visual consciousness. It follows, then, that to the bee or the fish, the hive and the water is not at all like that which we understand by those words. And the same is true even of that most general condition of all perception—space. It is probable that few animals have what we know as space, yet all probably have some analogue which bears tó their total consciousness the relation that space bears to ours.

Similar inferences may be drawn with reference to common or bodily sensation. As it depends upon bodily structure we can scarcely suppose that the body of an insect yields a sensation-total to its possessor at all like that which our body yields us, and since emotions depend upon variations in the composition of this bodily sensation, we cannot assume that the ant, when he attacks or runs away from his enemy, experiences what we call fear or courage. Yet he experiences analogous emotions.

A careful description of the phenomena of organization and life from the biological or external point of view must, therefore, precede any attempt at an interpretation of their psychological significance, and, as the former has never been done, the attempts made at the latter are of little value. Especially must we discard the current antithesis between "human" and "animal" psychology. As there is no structure common to all "animals," so, too, is there no mind common to all animals. If we are to draw antitheses at all, it would be better to speak of the "insect mind," the "vertebrate mind," since the gulf between the human mind and that of other vertebrates is probably not as great as that between the mind of vertebrates and that of insects. We must, in other words, study morphological types of mind, just as we study similar types of body.

While the method above outlined has not been followed, and the nature of the sensibility of the lower animals has, in consequence, never been thoroughly understood, their acts have been very carefully studied. Unfortunately, the inquiry has been prosecuted from the more complex to the more simple instead of in the reverse direction, and consequently we find the characteristics of the more complex types ascribed to the acts of animals in general. These traits are finality, or conduciveness to an end, uniformity, and automatic fatality. These, therefore, have been grouped together and termed instinctive, in the narrower sense of the word.

At this point philosophy stepped in and brought the problem into its present shape. The first of the three traits, conduciveness to an end, seems to show an affinity to intelligence; the other two, uniformity and automatic fatality, would put instinct in the same category with mechanisms. And the efforts at explanation proposed show the difficulty of reconciling these conceptions. Thus Hegel terms it an unconscious activity tending towards an end; Schopenhauer, the universal will not yet become clearly self-conscious; Hartmann, instinct is the Unconscious. Montaigne identifies it with intelligent reason, while Descartes claims that it has no mental existence whatever. The most interesting of these theories, however, are those which not only recognize the existence of mental elements in the instinctive act, but endeavor to determine their character. All agree in interpreting them, after the analogy of our own innate and habitual acts, as involving desires, appetites, a vague sense of discomfort, without clear consciousness of the end or volition to realize it, followed, when the end is gained, by subsidence of desire and a sense of comfort, repose, equilibrium. No detailed criticism of this interpretation is necessary; it is enough to say that it rests upon our own experience alone and must not be regarded as more than probably correct.

The above theories deal with the nature of instinct. When we turn to its mode of functioning, we find that the explanations proposed largely depend upon the theories formed of its nature. The only one that need engage our attention at present is that which explains instinct by the analogy of habit. Its functioning, then, depends upon the existence of certain preformed tendencies to act, ingrained in the nervous system of the animal; the start is given by appetite, blind impulse, the painful feeling that drives an organism to movement in conjunction with the external impressions which fire the mental mechanism. Thus, the instinctive act arises as the joint product of nervous organization and environment.

It is evident that this theory stands in need of some account of the manner in which the nervous organization has been got. The explanations proposed fall under three captions: those that ascribe the origin of instinct to more simple phenomena, explicable upon purely mechanical principles; those that admit a mental source; and those that admit both. According to the first, instinct depends upon habit; according to the second, upon selection; according to the third, upon both. The common point of departure of all these theories is found in the generalization of habit and memory and their union in the conception of heredity. Habit is not limited to the individual but its results are inherited by descendants.

As the type of the mechanical theories, we may take that of Spencer. Instincts are due to complications of reflexes, and this complication is simply an illustration of the most general law of evolution, which involves progressive increase in heterogenity and complexity of correspondence. But this is merely a statement of a fact and not an explanation of it. We wish to know the reason why, and the method in which this complication takes place.

The mental theories fall into two classes. The one, represented by that of Lewes, regards the instinct as a degraded form of intelligent act. This doctrine is discredited by the fact that it would require the parallel assumption that the nervous system of the lower animals is degraded from a more complex form capable of manifesting the higher forms of intelligence. The second class, represented by that of Fouillée, merely translates into mental terms Spencer's mechanical notions. Mind stuff takes the place of Force, but the details are essentially the same, and again the question arises, how and why can combinations of mind stuff bring about the new creations which we see?

None of these theories afford any true explanation of the phenomena. They bring to view the points of resemblance and difference between the instinct, the reflex and the voluntary act, but they do no more.

But the most interesting of the questions that arise in connection with instinct is that of its mode of development. For the solution of this problem we are indebted to Darwin, who has shown that it is due to variation and selection. Yet it should be noted that this does not reduce the development of instinct to a purely mechanical process, which was Spencer's error. The variations are not physical so much as mental, nor are they absolutely predetermined. The conditions that make them possible must be given, such as antecedent and concomitant mental states, but this does not determine their occurrence, since they may or may not occur. If they occur, the organism adapts itself to its environment and survives; if not, it does not adapt itself and becomes extinct. This introduces the last question to be considered, that is, what is the character of these mental variations that underlie the development of instinct?

In the human being we recognize as instinctive the impulsive acts, which fail to present any distinctively voluntary character. Some appear to spring from an unconscious or involuntary tendency, others exist as elements of which the actor has no knowledge, others seem to result from some innate predisposition. To this class a large majority of all our acts belong. When we come to examine it more closely we find that the class contains two groups: the one includes those acts which contain no new element, but are mere repetitions of former acts. These are our habits, innate predispositions, ordinary operations of intelligence, *a priori* intuitions of sense, *a priori* forms of the understanding, etc. All such processes have somewhat in common with instinct, and in common speech the word is often used of them. The other group, while closely akin to these, differs from them in that it contains a new element. Yet they have little in common with the clear volitions and deliberations with which we associate the notion of a new discovery. Few discoveries have, in fact, been so originated. They have rather been the results of a blind impulse, a feeling after the novel, which we can see throughout the animal world, and which has little in common with deliberate will. "Thus, when one says that the human mind has been shaped and enriched by discovery (*invention*), one means that all the modes in which its activity develops are not primary data, of extrinsic origin, but productions of that very activity. Discovery is then neither reason, liberty, religious faith nor conscience; it is not because we are reasonable, free, religious or moral, that we have so progressed and distanced the lower animals, but because we have discovered or created reason, liberty, religion and morality. Why? We do not know, and never shall know. How? It is for sociology and psychology to give us partial answers. Discovery is not an entity. Its concept resolves itself into that of the possibility of real action and of active mental change, and it simply indicates the point at which becoming takes the place of repetition."

The power of discovery is not peculiar to the human race. It requires no high degree of consciousness or power of reflection. It is a blind impulse, found in all animals and the new elements gained by it are concreted and amalgamated by habit and memory into what we see and call instincts.

Thus far, Weber. The affinity between his thought and that of Baldwin is evident; the two classes into which Weber divides the more vague acts, *habitudes* and *invention* are clearly equivalent to Baldwin's Habit and Accommodation. But Weber contents himself with a simple *nescio* at the very point upon which Baldwin has done the best work, that is, How is Accommodation possible?

ANTHROPOLOGY.

Notes taken upon an Exploration of the Lehigh and Susquehanna Valleys for the University of Pennsylvania, in the Summer of 1892.—A careful examination of the Susquehanna region showed that there were no caves available for exploration on the river side, between Pittston and Harrisburg. Many of the caverns reported as light, dry and spacious, were rifts, not large enough to stand in, or did not exist at all. The rocky ravines of the tributaries of the Lehigh in Monroe County were equally unproductive, and though there, and along the Susquehanna, the sandstone was not adapted to the formation of caverns, there seemed at first no reason why preprecipitous cliffs should not have exposed rock shelters, such as characterize the sandstone region of the upper Ohio.

A day was lost at the rock shelter in a steep hillside near Stemlersville, Monroe County, Pa., about 6 ft. long, 8 ft. wide, and 5 ft. high, though tradition said that Indians had made the place and lived in it. Forty years ago, a man, having walled it in, had used it as a sheep pen. Nevertheless, it appeared that beyond a chance night's lodging for the passing tramp, it had probably never served as a shelter for humanity, and when we had removed a large fragment of rock on its floor and dug down two feet without finding any trace of charcoal below the surface, we abandoned the place.

It took half a day to find Girty's Cave in the sandstone cliffs along the Susquehanna, above Klemson's Island, said to have been the hiding place of Simon Girty, the ferocious Indian renegade of the last century. It was the one and only cave on that river, following the east branch from Wyoming to Harrisburg, after the shelter on the bluff, under the Shekillemy Hotel at Sunbury, had been blasted away by a railroad. Mr. McCalvey, of Girty's Notch, had to go with us to the cave, and to find it climed up a series of perpendicular ledges, said to be inhabited by rattlesnakes, overhanging the "river road." Evidently he had forgotten the site himself, for it took half an hour's search to discover it closed by a fallen rock. The evil reputation which Girty's name had given the place in the last century had been increased by events in recent years, and our guide, descending the cliff, told the horrible story of the decomposed body of a murderer long concealed in the hole, and which he had helped to find a few years before. The cramped inaccessible rift, only large enough for entrance on hands and knees, could have been no fit shelter for man, and even if animals had chosen it for a den it had no more interest for archæology than the so-called "Indian Cave," on a mountain top near Hunlock's Creek, on the right bank of the Susquehanna in Luzerne County, Pa. There two spacious caverns were reported, but the man who led us over the bramble-covered rocks, haunted by rattlesnakes, could only find one. This was a damp, drafty fissure between large, loose blocks of sandstone. Perfect specimens of Indian earthenware have been found hidden in the crevices of rifts like this, and we hoped to have found a hidden pot, but the place was too far from water and too difficult of access to have presumably served as a primitive habitation, and we were not surprised to find no underground relic of man's occupancy when we dug down into the black mold of its floor.

A century of weather and original rough usage seems to have played such havoc with the pottery of the Pennsylvania Indians that scarcely anything is left but small sherds. If it had not been for the habit of the white man's predecessor of placing pots in small caves and rock rifts for safe keeping, we should have few earthern specimens left perfect enough to show what the old forms were. Scarce as Indian graves are in the east Apalachian region of Pennsylvania those containing perfect pots are still scarcer. As a great rarity, the Wilkesbarre Historical Society shows an almost complete pot, found by John Kern in an Indian grave on the Susquehanna River at Plymouth, near by, and another unearthed on the neighboring Kingston Flats, by Millard P. Murray; but one of their best specimens is that found on a ledge in a cave near Tunkhannock, by Asa Dana, in 1858. Mr. A. F. Berlin, of Allentown, informs us that another perfect pot was found recently, as if hidden by an Indian in precolonial times, on the shelf of a sandstone rift on Indian Mountain, near Kresgyville, Carbon County, Pa., by Alfred Keppler.—H. C. Mercer.

SCIENTIFIC NEWS.

Professor Thomas Henry Huxley died at Eastbourne near London, June 30th. Professor Huxley was born in 1825 at Ealing, Middlesex, England. He was educated at Ealing School, of which his father was one of the teachers. At the age of seventeen he entered the Charing Cross Medical School, and after three years of severe study he graduated with the degree of Batchelor of Medicine, taking high honors in physiology. He entered the navy as an assistant surgeon in 1846, and was appointed to H. M. S. Rattlesnake, Captain Stanley, which sailed the same year on an exploring expedition in the South Pacific and Torres Straits. He collected a great number of specimens and wrote several admirable papers, which he sent home, and which were published after his return in 1850 on the Philosophical Transactions of the Royal Society. His theories excited much interest among that scientific body, and he was in 1851 elected a fellow, which, when conferred on so young a man, was a tribute to talent and learning.

He resigned his navy appointment in 1853, and succeeded Professor Forbes in the chair of natural history in the government School of Mines. Besides this he was connected with other institutions as instructor and lecturer. From 1863 to 1869 he was Hunterian professor in the Royal College of Surgeons and served twice as Fullerian professor of physiology to the Royal Institution. His time was constantly devoted to researches in science, particularly zoology, to advance which he contributed as much as any other contemporaneous investigator. He was a warm friend of Professor Tyndall, and travelled with him over the Alps in early life. The friendship formed in early life continued until death.

The name of Professor Huxley came prominently before the public in 1870 in connection with the London School Board, to which he was elected in that year. In the deliberations of the Board he was especially prominent as the fierce opponent of denominational education, and was particularly conspicuous by his fiery fulminations against the doctrines of the Roman Catholic Church. He retired from the Board in 1872. In the same year he was elected Lord Rector of the University of Aberdeen, and was installed in 1874. On the death of Frank Buckland, in January, 1881, he succeeded that indefatigable naturalist as Inspector General of Fisheries, a position which he filled with his accustomed energy, ability and zeal.

His essays and memoirs were principally contributed to the Journals and Transactions of the Royal, the Geological, the Linnæan and the Zoological Societies. He is the author of "Oceanic Hydrozoa" and "Man's Place in Nature," 1863; "Lectures on Comparative Anatomy," 1864; "Lessons in Elementary Physiology," 1866; "An Introduction to the Classification of Animals," 1869; "Lay Sermons, Addresses and Reviews," 1870; "Manual of the Anatomy of Vertebrated Animals," 1871, and later of a Manual of the Anatomy of the Invertebrata; and "Critiques and Addresses," 1873.

On the death of Mr. Spottiswoode in 1884, Professor Huxley was elected President of the Royal Society.

Professor Huxley was a skillful taxonomist, and on the whole the best that England has ever produced. His conclusions in this direction have in many instances met with general acceptance, and there was never any difficulty in understanding exactly what he intended to present. His mind was clear, and his method of presentation equally so. He elucidated every subject which he investigated.

The same clearness and logic were apparent in his treatment of philosophical questions. He was one of that class whose reflective powers were equal to those of observation. While exposing obscurities and inconsistencies in popular beliefs, he showed his superior self control and intellectual honesty in that he did not make assertions as to matters on which the evidence is insufficient. Hence in theology, while declaring himself a free-thinker, he did not deny the possibility that some popular beliefs might be true. For this attitude of mind he proposed the term "agnostic," a word which expresses the ignorance of the honest thinker with regard to questions, which lack of sufficient evidence renders at present insoluble. His care not to overstep the boundaries of knowledge in any direction was admirable, for thus he left the door open to progress in all directions.

An authorized edition of the works of Huxley, in nine volumes, is now in course of publication. In this edition his essays are collected under various heads, each of which gives its title to a volume. The fourth volume is entitled "Science and Hebrew Tradition," and has a preface written for it by the author, in which he gives his statement of what is the object of the essays and what he supposes they establish:—

"It is becoming, if it has not become, impossible for men of clear intellect and adequate instruction to believe, and it has ceased or is ceasing to be possible for such men honestly to say they believe, that the universe came into being in the fashion described in the first chapter of Genesis; or to accept as a literal truth the story of the making of woman, with the account of the catastrophe which followed hard upon it, in the second chapter; or to admit that the earth was repeopled with terrestrial inhabitants by migration from Armenia or Kurdistan, little more than four thousand years ago, which is implied in the eighth chapter."

Dr. Lewis Janes, President of the Ethical Society of Brooklyn, with the assistance of Miss Sarah J. Farmer, of Eliot, Maine, called a conference of evolutionists to meet at the place mentioned. Eliot, Maine, is situated near the N. bank of the Piscataquay river, and is surrounded by white pine forest and cultivated land. The following is the program of exercises.

Saturday, July 6, 1895, 3 p. m.—Welcome to Greenacre, Miss Sarah J. Farmer; opening address, Professor Edward D. Cope, Ph. D., of the University of Pennsylvania, "The Present Problems of Organic Evolution"; 8 p. m.—Paper from Herbert Spencer, London, England, "Social Evolution and Social Duty;" to be followed by a symposium of letters and brief addresses; Monday, July 8th, 3 p. m.—Mr. Henry Wood, Boston, Mass., "Industrial Evolution;" 8 p. m.—Mr. Benjamin F. Underwood, Editor *Philosophical Journal*, Chicago, Ill., "How Evolution Reconciles Opposing Views of Ethics and Philosophy," letters and brief addresses; Tuesday, July 9th, 3 p. m.—Professor Edward S. Morse, of the *Peabody Institute*, Salem, Mass., "Natural Selection and Crime;" 8 p. m.—Dr. Martin L. Holbrook, Editor *Journal of Hygiene*, New York, "Evolution's Hopeful Promise for Human Health;" Wednesday, July 10th, 3 p. m.—Rev. Edward P. Powell, Clinton, New York, "Evolution of Individuality;" 8 p. m.—Miss Mary Proctor, New York, "Other Worlds than Ours," (with stereopticon illustrations); Thursday, July 11th, 3 p. m.—Rev. James T. Bixby, Ph. D., Yonkers, N. Y., "Evolution of the God-Idea;" 8 p. m. —Dr. Lewis G. Janes, President Brooklyn Ethical Association, "Evolution of Morals;" Friday, July 12th, 3 p. m.—Mr. Henry Hoyt Moore, of the Outlook, N. Y., "Utopias; Social Ideals Tested by Evolutionary Principles;" 8 p. m.—Rev. Jno. C. Kimball, Hartford, Conn., "The World's coming better Social State;" Saturday, July 13th, 3 p. m.—Professor Jno. Fiske, LL. D., Cambridge, Mass., "The Cosmic Roots of Love and Self Sacrifice;" 8 p. m.—Professor Jno. Fiske, LL. D., "The Everlasting reality of Religion."

The Kansas University will have five scientific expeditions in the field this summer. One under the direction of Professor Dyche will go to Greenland to collect natural history specimens. Professor Williston will have charge of the second to collect Tertiary fossils in Kansas and Wyoming. Professor Snow will explore the southwestern States for entomological specimens; while the fifth, under Professor Haworth, will thoroughly overhaul the Cenozoic beds of Kansas.

The Third International Congress of Physiologists will be held at Bern, Switzerland, September 9 to 13th, 1895. Titles of communications may be sent to Frederic S. Lee, Secretary American Physiological Society, Columbia College, New York City.

Walker Prizes in Natural History.

By the provisions of the will of the late Dr. William Johnson Walker two prizes are annually offered by the Boston Society on Natural History for the best memoirs written in the English language on subjects proposed by a committee appointed by the Council.

For the best memoir presented a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the committee.

For the next best memoir, a prize not exceeding fifty dollars may be awarded.

Prizes will not be awarded unless the memoirs presented are of adequate merit.

The competition for these prizes is not restricted, but is open to all.

1. In all cases the memoirs are to be based on a considerable body of original and unpublished work, accompanied by a general review of the literature of the subject.

2. Anything in the memoir which shall furnish proof of the identity of the author shall be considered as debarring the essay from competition.

3. Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before April 1st of the year for which the prize is offered.

Subjects for 1896:—

(1) A study of an area of schistose or foliated rocks in the eastern United States.

(2) A study of the development of river valleys in some considerable area of folded or faulted Appalachian structure in Pennsylvania, Virginia, or Tennessee.

(3) An experimental study of the effects of close-fertilization in the case of some plant of short cycle.

(4) Contributions to our knowledge of the general morphology or the general physiology of any animal, except man.

Subjects for 1897:—

(1) A study of glacial, fluviatile, or lacustrine phenomena associated with the closing stages of the glacial period.

(2) Original investigations in regard to the chalazal impregnation of any North American species of Angiosperms.

(3) An experimental investigation in cytology.

(4) A contribution to our knowledge of the morphology of the Bacteria.

SAMUEL HENSHAW,

Secretary.

Boston Society of Natural History,
Boston, Mass., U. S. A.

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THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

Vol. XXIX. SEPTEMBER, 1895. No. 345

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PHILADELPHIA, U. S. A.
THE EDWARDS & DOCKER CO.,
518 AND 520 MINOR STREET.

Entered at the Philadelphia Post Office as second-class matter.

THE
AMERICAN NATURALIST

VOL. XXIX. September, 1895. 345

THE PRESENT STANDING OF THE FLORIDA MANATEE, TRICHECHUS LATIROSTRIS (HARLAN) IN THE INDIAN RIVER WATERS.

BY OUTRAM BANGS.

The last two generations have witnessed such a destruction of animal life in this country that it is appalling to look ahead and see what the future has in store for us. Our larger animals and birds are going with such rapidity, and the wilder parts of the country to which they have been driven are being cleared and settled so fast, that the end of many species, still common in places, is already plainly in sight.

Man is, of course, the real cause, in almost every case, of the extermination of a species, although often the end comes by some natural calamity, as, for example, the tragic end of the Great Auk.

When a species has become, through the persecution of man, reduced to a mere remnant that persists either from the inaccessible nature of the country to which it has taken refuge. or from the wariness the few surviving individuals have developed, it takes but a small change in its surroundings to wipe it forever from the face of the earth.

The winter of 1894–95 has been a most disasterous one and has shown us on how slight a change in temperature the life or death of a whole species depends. Two such winters in succession would in all probability exterminate the blue-bird, the snow-bird and many others that winter in the Carolinian Zone. These birds went into the winter in their full numbers and strength, and yet this summer they are so rare that I have not seen a single blue-bird in the Plymouth Co. Mass. country, where usually they are one of the common breeding birds. Think what a proportionate reduction in numbers must mean then to a species already on the verge of extinction.

The cold in Florida of the last winter was unprecedented and the mortality among the fish in the shallow water was such as I never thought to witness. The birds suffered very much, but as far as I could tell few died as far south as where I was, Oak Lodge on the East Peninsular opposite Micco. Here, at five o'clock, on the morning of February 12th, the thermometer registered 20° Far., and on the next morning at the same hour, only 23°. It was a strange experience to walk over the frozen sand and see every little puddle covered with ice, on a trail overhung by the sub-tropical vegetation of a Florida hammock with a north wind blowing in my face that chilled me to the bones. The cold of these two days and nights was intense.

On February 19th, Mr. Walter L. Gibson came across the river to tell me he had found two manatee that had been killed by the " freeze," and the next day I went over to take possession of them. They were both found where they had floated ashore on the bank of the Sebastian River, one about four and the other two miles from its confluence with the Indian river. I found to my great regret that both were too far gone to hope to save the skins and the only thing to be done was to save the skeletons which we began to macerate out at once. One was an old female of very large size, measuring from the end of the nose to the end of the tail 11 ft., 4 in. The other, a young male, measuring from the end of the nose to the end of the tail 6 ft., 4 in.[1] Both skeletons are now in the collection of E. A. and O. Bangs, Boston, Mass.

[1] The Florida Manatee grows but little larger than this female. The two largest I ever heard of were two caught in the St. Lucie River, by Mr. August Park of Sebastian, Florida. One in August, 1880, that measured 13 ft., 7 in. long, and one in June of the same year, that measured 12 ft. long and estimated at two thousand pounds weight.

These Manatee were two of the survivors of the herd of eight, which had, for the past year, been living in the St. Lucie and Sebastian Rivers and that part of the Indian River which is between these two. For two years the Manatee has been protected by a State Law and this herd had come together in consequence and probably consisted of most of the Manatee of this region that, freed from persecution, had collected into a herd as was their wont in old times when the rivers were theirs.

Mr. Gibson told me that often he has stood on the railroad bridge that spans the Sebastian, and seen this herd pass under him and counted them over and over again and knew every individual in it. After the first "freeze" of last winter, in December, three of the Manatee were found ashore, dead, in different places and no live ones were seen. Whether any of this herd pulled through both "freezes" is impossible to say but five out of the eight are accounted for and it seems likely that more died than were found, as a great part of their range was not covered and their carcasses might easily have escaped detection even in places that were visited. It does not take long for a dead body to disappear in Florida and the Manatee as they lay half under water would soon have been disposed of, the crabs doing the business below the surface and the turkey buzzards above.

The Manatee is extremely sensitive to a change in the temperature of the water. This was noticed by Mr. Conklin to be the case with the one that was kept alive in the Zoological Park in New York and Mr. C. J. Maynard told me that he knew of three large Manatee that were killed in the "freeze" of 1886 and washed up near Palm Beach. The 1886 "freeze" was very mild compared with those of last winter. In 1886 the mangroves hardly suffered at all, while last winter, 1894 and 1895, nearly every tree along the whole stretch of the Indian River was killed to the ground.

In both "freezes" last winter the cold came without any warning and the change of temperature was so sudden that the only chance for the Manatee to escape certain death lay in their being able to reach deep water before they were overcome by the cold.

The region from the Sebastian to the St. Lucie has, for a number of years, been the only part of the Indian River where the Manatee were seen. Here, besides the herd of eight, now reduced to three at the very outside, there were some solitary scattering individuals, how many it is impossible to say, as the Manatee has become very shy, but it is safe to assume that the scattering ones fared no better than did the herd, and that the reduction in numbers from the cold of last winter was very great.

There are still, however, a few Manatee alive in the Sebastian River. In a letter I lately received from Mr. Gibson he told me that in the end of March he surprised several Manatee lying close together on a mud flat, high up the Sebastian River. As soon as they heard him they made a rush for deep water, throwing the mud and water fifteen feet high in the violence of their flight.

I made many careful inquiries among the people who live along the river and would be in the way of knowing of the Manatee and its diminution of numbers of late years, but got surprisingly little information of any value except from Mr. Gibson, to whom I have so often referred, and Mr. Fritz Ulrich, a German of more than ordinary intelligence, who has spent the last fifteen years dreaming his life away among the birds and animals of the Indian River. They were all his friends. The panthers knew his voice and answered him from the wilderness, and the owls came from their hiding places and flew about him to his call and the little lizards fed from his hand. But it is all gone now and there only remains of the great life of the river a small terrified remnant, and in its stead the railroad train hurries along the west bank and hideous towns and more hideous hotels and cottages have sprung up everywhere among the pines. It is now eight years since Mr. Ulrich saw a living Manatee, but when he first came to the river fifteen years ago they were still common and he often saw them from the door of his little house at The Narrows passing up and down the river and occasionally he saw them at play when they would roll up, one behind the other, like the coils of a great sea serpent.

The spring and summer of 1894 were so dry that the salt water went nearly to the head of the fresh water streams and killed out the "Manatee grass,"[2] of which the Manatee are especially fond and the poor brutes had to fall back on the leaves of the mangroves, a food not much to their liking, which they reach by laboriously dragging their huge bodies half out of water. Mr. Gibson spent a great part of that summer up the Sebastian where he was catching paraquets, and on several occasions he saw the herd of eight feeding in this manner.

The Manatee is an animal of the highest economic value and one that the Indian River, with its fresh water tributaries, seems able to support in large numbers and it would be more than mere sentiment to regret its disappearance should it become a thing of the past. But there is still a chance for it. There are some Manatee alive now in the Sebastian River and these have passed through the cold of a winter such as no living man in Florida has known before; they are protected by law, and the netting[3] has been stopped; and in spite of the small annual increase, the female bringing forth but one calf a year, it should slowly come up again to something like its old numbers.

[2] I regret that I am unable to give a more definite name to this plant, never having seen it myself, but it was described to me as a tender ribbon-like grass, the blades of which are about half an inch wide and four or five feet long. It grows with the ends of the blades and the blossoms resting on the water, and is found only in a few of the fresh water streams of southeast Florida,

[3] For a full account of this most successful method of destroying the Manatee, see an article in Forest and Stream, XIII, 1880, pp. 1005, 1006, by Mr. J. Francis Le Baron.

OF A NEW CLASSIFICATION OF THE LEPIDOPTERA.

BY A. S. PACKARD.

(*Continued from page 647*).

Remarks on the Family Hepialidæ.—This group is assigned by Comstock, from the venation alone, to a position at the bottom of the Lepidopterous scale, even below the Micropterygidæ. By Chapman it is more correctly placed above the latter group. He even places it above the Nepticulidæ, Adelidæ and Tischeria.

Since receiving and studying Chapman's paper, it has become very plain to me that Hepialus and its allies are simply colossal Tineoids, and that Speyer was right in 1870 in suggesting that the Hepialidæ stand very near to the Tineids.[1]

These views arrived at independently by these authors are confirmed by the trunk characters, and also by the larval characters, as pointed out by Dyar,[2] and which I have been able to confirm by an examination of the freshly hatched larva of *Hepialus mustelinus*, and fully grown larvæ of the Australian *Oncopera intricata* Walk., as well as *Hepialus humuli* and *H. hectus* of Europe.

In 1863 I pointed out[3] the similarity in the head and thorax of *Hepialus* (Stenopis) *argenteomaculatus* to those of the neurop-

[1] In his suggestive paper (Ent. Zeit. Stettin, 1870), Speyer refers to the similarity of the venation of Hepialidæ and Cossidæ and remarks that they resemble the Trichoptera no less than the Micropterygidæ, though the Hepialidæ exhibit other close analogies to the Trichoptera. He adds that the middle cell of the wing in the Phryganeidæ is not fundamentally different from that of the Hepialidæ, Cossidæ, and Micropteryx, also the hind wings of Pychidæ. On p. 221 he associates the Zygænidæ with the Cossinæ, Cochliopodidæ, Heterogynidæ, Psychidæ and Hepialidæ, and remarks that all these families are isolated among the Macros; the Cochliopodidæ and Zygænidæ alike in the pupa state by the delicate integument and the partially loose sheaths, the groups standing nearest to the Tineidæ with complete maxillary palpi, forming the oldest branch of the lepidopterous stem, and having been developed earlier than the Macros.

[2] A classification of Lepidopterous larvæ. Annals N. Y. Acad. Sci. viii, 1894, p. 196.

terous Polystœchotes, and mentioned the elongated thorax of Hepialus, especially "the unnatural length of the metathorax, accompanying which is the enlarged pair of wings, a character essentially neuropterous." Reference was also made to the metascutum which is divided into two halves, being separated widely by the very large triangular scutellum. I also drew attention to the transverse venule or spur of the costal vein, and to the great irregularity in the arrangement of the branches of the median nervure, also to the elongated abdomen, and, finally, I remarked, "The Hepiali are the lowest subfamily of the Bombyces." But in those days I did not fully perceive the taxonomic value of these generalized characters, which have so well been proved by Chapman from imaginal and pupal characters, and by Comstock from the venation, to be such as to place the Hepialidæ at or near the base of the Tineoid series. Chapman, unaware of the existence of mine and of Speyer's paper, says: "The metathoracic structure of Hepialus came as a very unexpected confirmation of the idea that of the Tortricoid group, it was the nearest to the lower Adelids, and despite its specialization was near the line by which Tortrix was derived from some Adelid form." (P. 113.)

I will now refer to some characters of the Hepialidæ which further show that they are colossal Tineoids, and should be placed very near the base, though still presenting in their boring larval habits, and in the reduced maxillary and labial palpi, the entire absence of a haustellum and of mandibles, that the family (at least Hepialus and Stenopis) have undergone a considerable degree of modification, compared with the Micropterygidæ.

Beginning with the larva, that of the Australian *Oncopera intricata*, when compared with the larva of the colossal Tineid *Maroga unipunctaria* of South Australia, is the same in structure, though less specialized in the colors of the tubercles and in the sculpturing of the head, but it has the same shape of the body, the same arrangement of the 1-haired tubercles, though the setæ are smaller and shorter; and the same complete circles of crochets on all the abdominal legs.

[3] On synthetic types in insects, Boston Jour. of Nat. Hist., 1863, pp. 590–603.

In the freshly hatched larva of *Hepialus mustelinus* 1.3 mm. in length, the head is no wider than the prothoracic segment, whose dorsal plate is well developed. The mouthparts are quite large, especially the spinneret, while the hairs which are acute at the end, are in this stage as long as the body is broad. The abdominal legs appear to have at this stage only ten crochets, or at least very few.

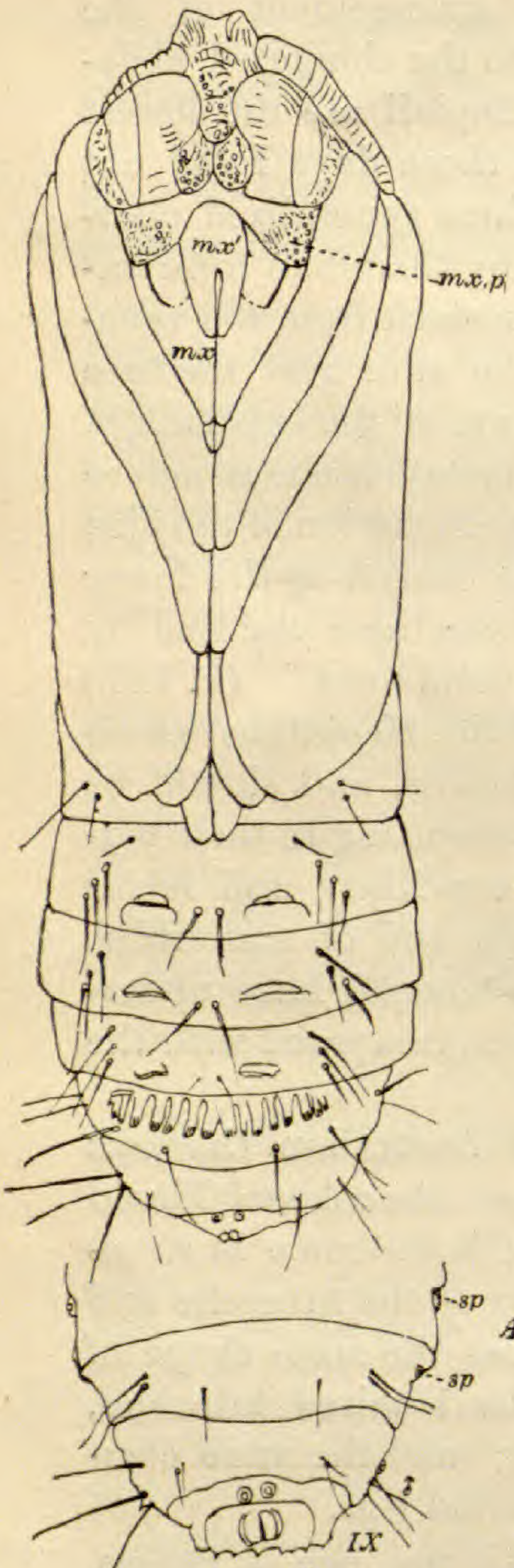


FIG. 7.

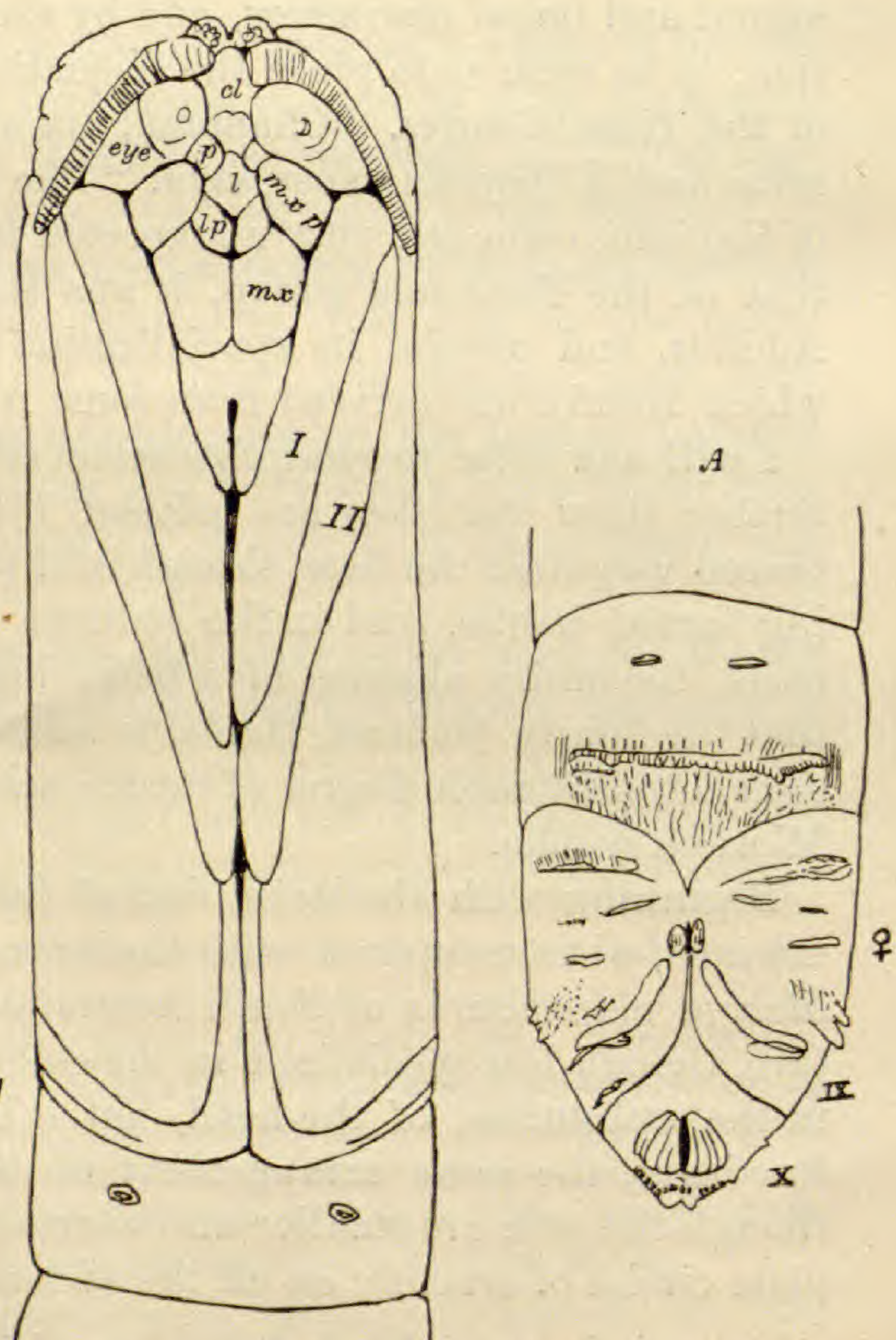


FIG. 8.

The pupa of Hepialus is said by Chapman to differ from that of Tortrix " in having the third abdominal segment free, but in a peculiar and modified manner," etc. He does not refer to the mouthparts. I have not seen the pupa of Hepialus, but have examined the pupa of the Australian *Oncopera intricata* (Fig. 7), and of the Mexican *Phassus triangularis* H. Edw., both of which present some remarkable generalized features. In the former genus, the labial palpi are visible, the entire piece is very wide at the base and is divided at the middle into the two pupal cases. Between it and the deeply lobed labrum is a piece, unless the two lobes are the paraclypeal pieces, of the nature of which I am uncertain. It is the homologue of the eye-collar, and if so, are the two lateral portions the maxillary palpi? The maxillæ themselves (*mx.*) are well developed, but at their base are divided by an impressed line, representing a portion which I am unable to name. The three pairs of feet (I, II, III) are easily identified. The outer division of the eye is large; and the cocoon-breaker consisting of two solid thick ridges on the vertex adapted for breaking out of its cell in the tree it inhabits, is marked. Abdominal segments 3–7 are free in ♂, and on 3 to 6 is a row of spines at each end; on segments 7 and 8 there are four transverse rows of stout spines, and on 9 two rows of small spines. There is no cremaster. On the under side of segment 8 is a row of about 15 stout spines. Vestiges of three pairs of abdominal legs are distinct. The pupa is provided on the abdomen segments with a few long setæ.

The pupa of Phassus (Fig. 8) is remarkable. The larva bores into a very hard tree, according to the late Mr. Henry Edwards, who kindly gave me a specimen of the pupa. The head is remarkably adapted for its life in a cell, being broad, obliquely truncated, the small antennæ being protected by the flaring sides of the head, which is very solid, with numerous rugosities and small tubercles. The region about the mouth is remarkable. The clypeus and labrum are very narrow, the eye transversely elongated, with an impressed line in the middle. The eye-collar (*mx. p*) is distinctly separated from the maxillæ (*mx*).

The two pieces (*l p*) at the base of the maxillæ may possibly prove to be the labial palpi, if so, is the piece marked *l* the labium? The two paraclypeal pieces or tubercles (*p.*) appear to be the homologue of those in the Psychidæ.

The pupæ of this family are very extraordinary, but it will be seen that they are Pupæ incompletæ, and prove that the

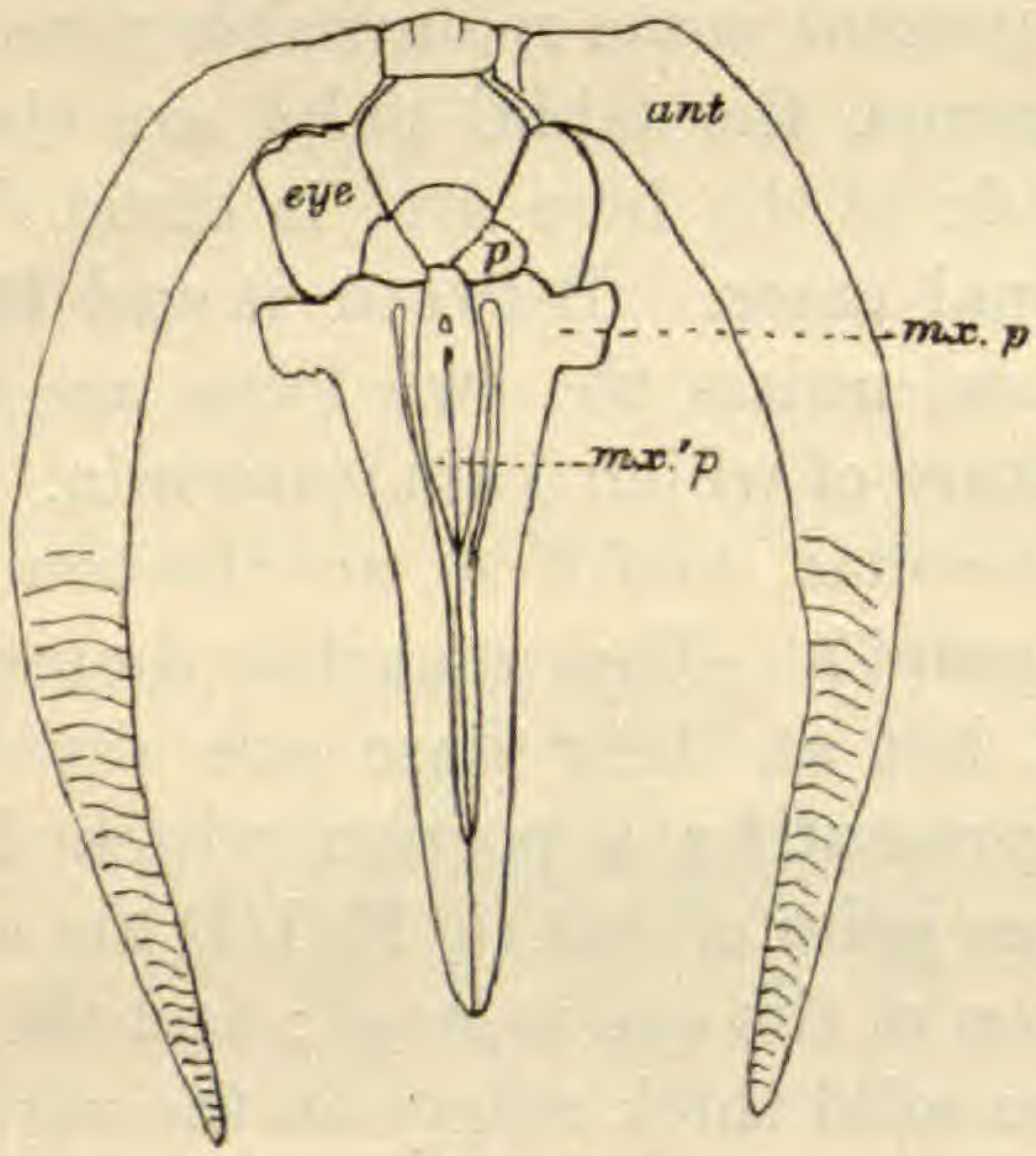


FIG. 9.

family should stand much above the Micropterygidæ, rather than below them, so far as regards pupal characters.

Fig. 9 shows the front of the head and maxillæ of the Cossid, *Prionoxystus robiniæ*, which is more Tortricid than Hepialid; *pc*, paraclypeal piece; *mx. p*, maxillary palpi; *l*, labial palpi; *mx*, maxillæ.

The very primitive, generalized shape of the thorax of the Hepialidæ is noteworthy. In *Hepialus mustelinus* the collar or prothorax is very much reduced; while in *H. tacomæ* it is very long and generalized, as in Sthenopis and the Australian *Abantiades argenteus.* The mesoscutum is considerably shorter than in *H. tacomæ.* In the latter species the metascutum is entirely divided by the large scutellum, while in *H. mustelinus* it is only partly divided, the apex of the scutellum passing a little beyond the middle of the scutum.

It is thus quite evident that Sthenopis is an earlier form than *H. tacomæ*, and that the latter is more generalized, having undergone less modification than *H. mustelinus.*

The genus Hepialus occurs in Australia, and that continent appears to be the original home of the family. In *Abantiades argenteus* the antennæ are tripectinate, and the labial palpi are very large; in *Hectomanes fusca* the antennæ are bi-pectinated but the labial palpi are much reduced, being scarcely visible; while *Oncopera intricata* is remarkably modified; though the antennæ are simple, the eyes are very large, nearly meeting on the front, while the 3-jointed labial palpi are remarkably long and slender, extending upwards, and the hind legs have a remarkable broad, flattened, curved pencil of hairs.

It thus appears that in the Australian continent this interesting family, which may be a survival of Jurassic times and coeval with the marsupials, has branched out along several lines of specialization, the most degenerate form being Hepialus which has survived also in Europe and in North America, especially on the Pacific Coast. On the whole, however,

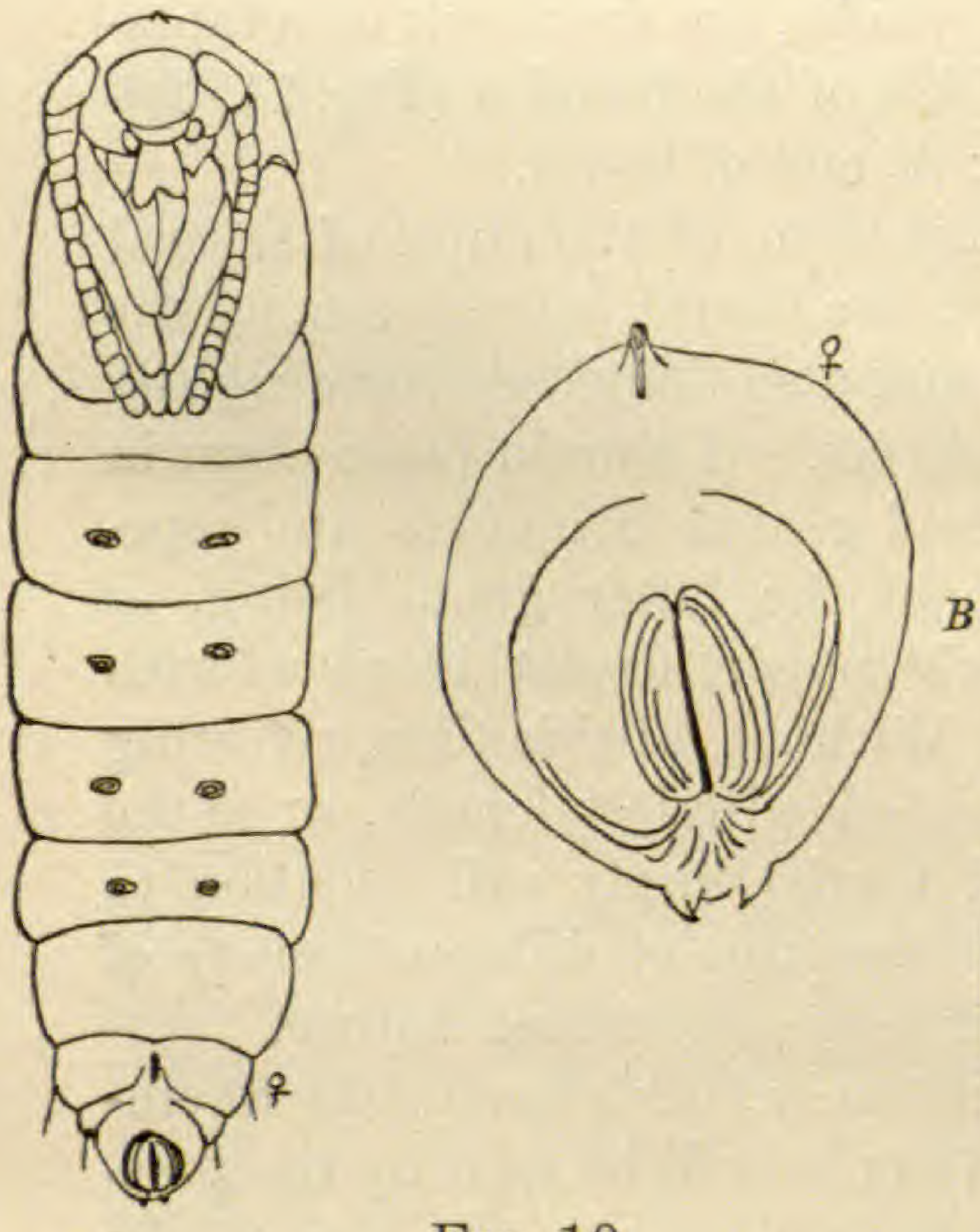


FIG. 10.

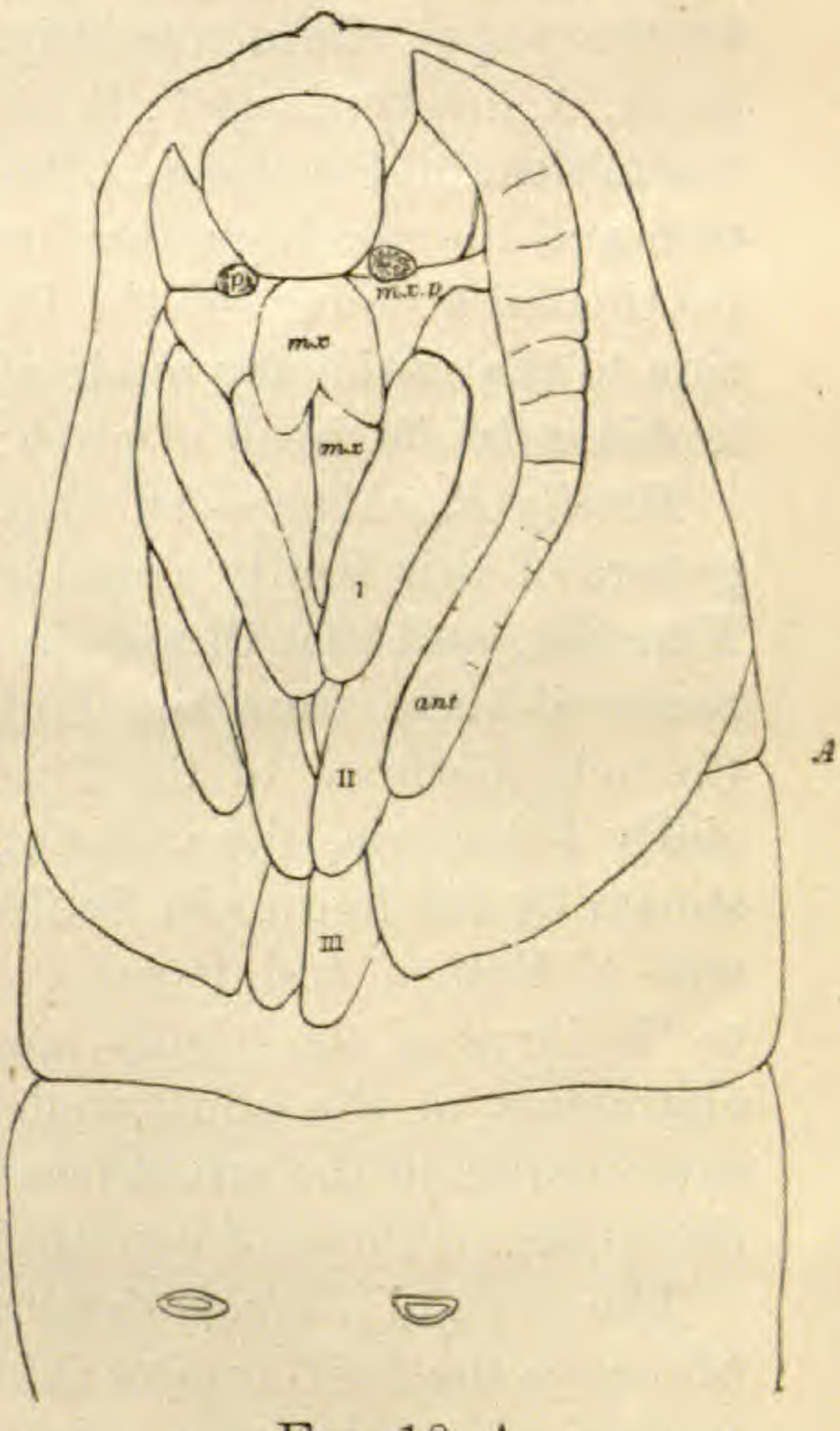


FIG. 10 A.

as we have seen, it is not so generalized a group as the Micropterygidæ, a group common to Europe and North America.

Its relations to the Cossidæ, including the Zeuzerinæ, remain still to be elaborated; they are rather close, yet the Tortricoid affinities are very apparent, and need further examination. The pupa of *Zeuzera pyrina* is of the same character as in Prionoxystus, but the maxillary palpi are larger, the lateral palpi more reduced, while the cell-breaker is very long, being much more developed.

Family Talæporidæ.—This group, comprising the genera Solenobia and Talæporia, have evidently either directly descended from the case-bearing Tineidæ or the two families have had a common origin. They form a side branch by themselves and are evidently the immediate ancestors of the Psychidæ. The imagines have no maxillary palpi, and the tongue is wanting, whilst the females are wingless. They are tineid Bombyces. In the pupal characters (Fig. 10, *Talæporia pseudobombycella*, pupa, A, head enlarged; B, end of body) the group very closely resembles the Psychidæ. Perhaps the slight changes in venation and the much greater breadth of the wings, as well as the pectinated antennæ of the Psychidæ, are the result of adaptation to the stationary mode of life of the females (Fig. 11, *Solenobia walshella*, head of pupa; A, end of body).

Family Psychidæ.—An examination of the pupæ of several genera of this family, convinces me that it belongs among the Tineoids, and that Chapman and also Comstock have rightly removed them from the Bombyces. I should place them in the neighborhood of the Tineoid genera Solenobia and especially Talæporia, the venation of the latter genus being, as shown by the figures in Spuler's[4] paper, almost identical with that of Fumea and Psyche. Without, at this time, referring to the larva of the highly modified wingless female, or to the characters of the adult male, I will simply call attention to some points in the structure of the pupa of different genera of the group, which indicate their very generalized nature.

The pupa of *Thyridopteryx ephemeræformis* has a close resemblance to that of *Oncopera intricata*, as will be seen by the presence of a large median piece or area between the base of the maxillary palpi. In *Œceticus abbotii* (Fig 12) the maxillary palpi are separated by the second maxillary (labial) palpi; the former (*mx p*) is subdivided into an inner and an outer small lobe in another European Psyche; also in *Platœceticus gloverii*. In the Psychidæ the paraclypeal pieces or tubercles, as we

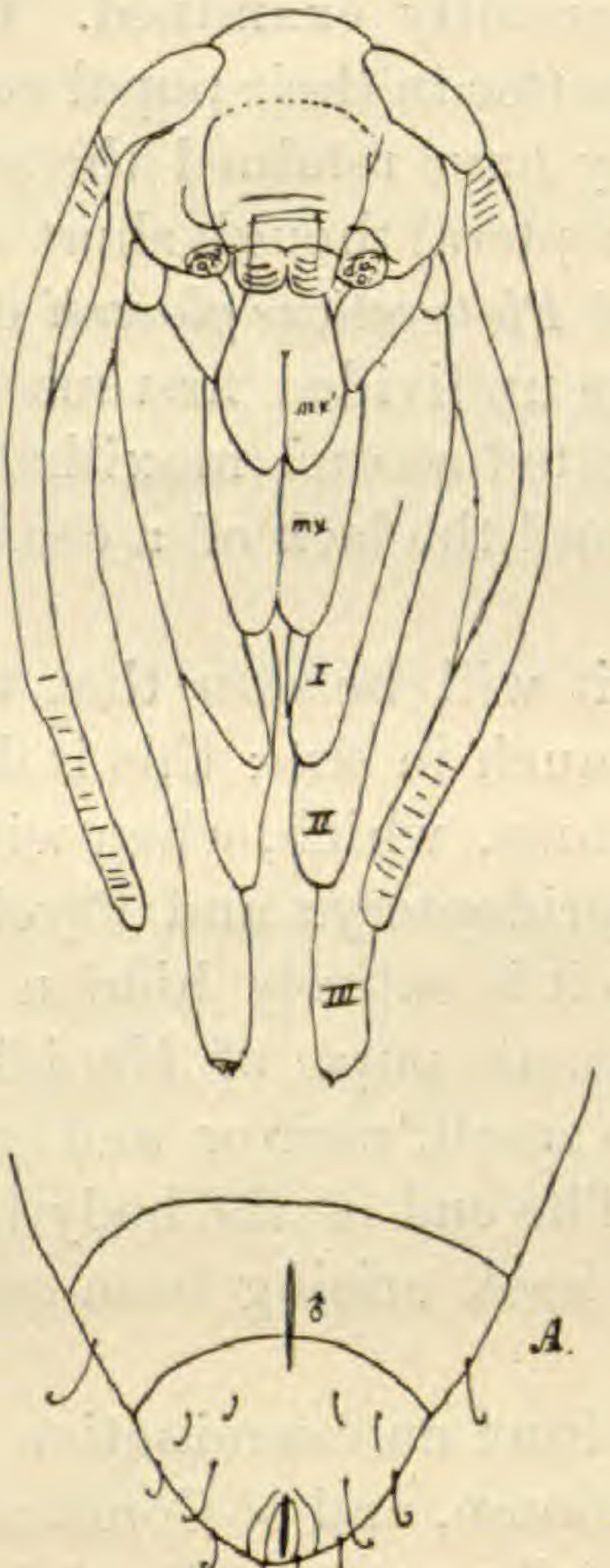


FIG. 11.

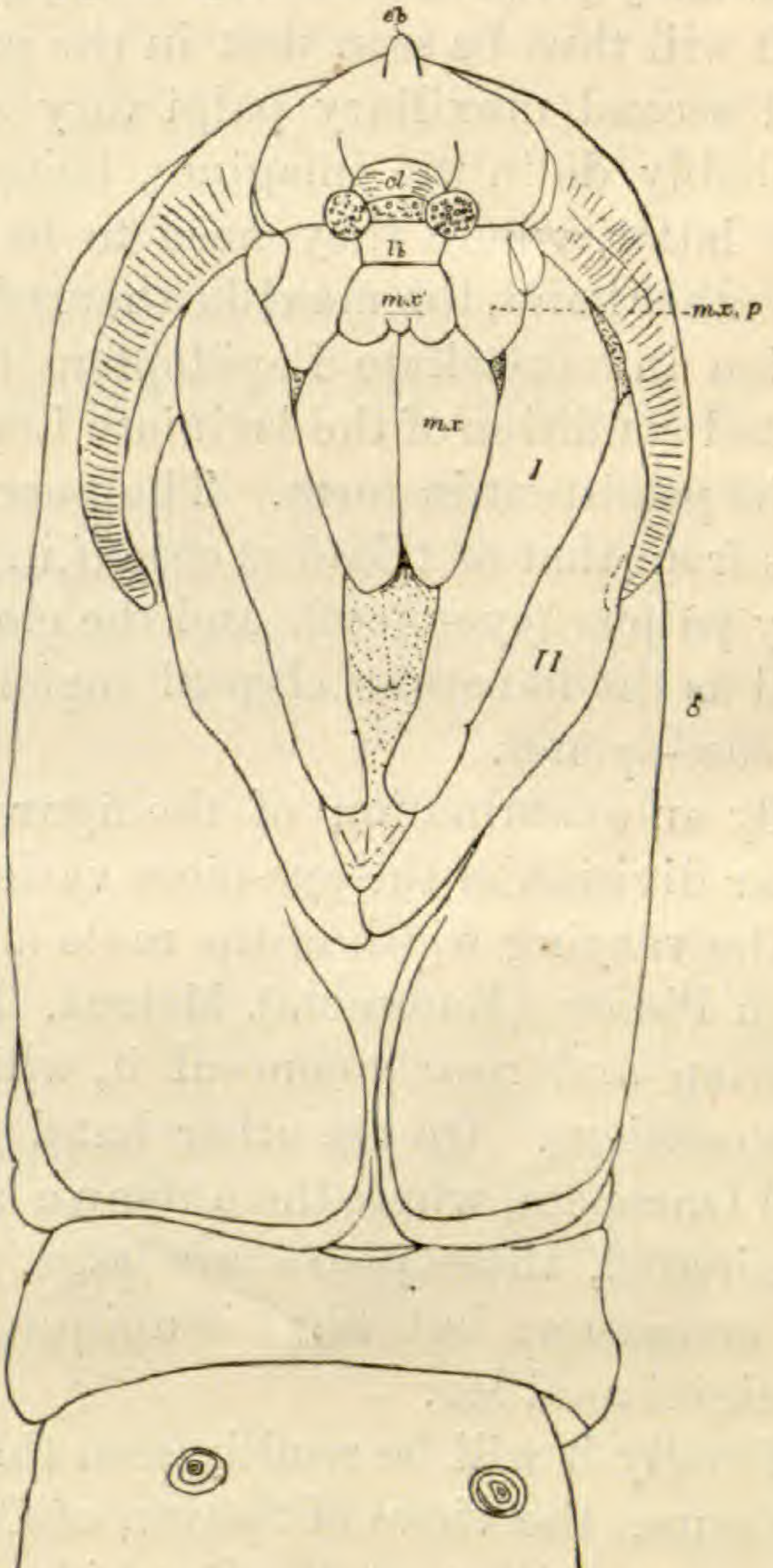


FIG. 12.

might call them, are always present. They are convex and very rugose. The labium or second maxillary piece in the Australian *Eumetopa ignobilis* is of the same shape and sculpturing as in *Psyche graminella*, but the large round rugose pieces on each side, or first maxillary palpi, are single, not divided into two parts, unless the irregularly trapezoidal pieces between the maxillary palpi and the eye-piece be the homologue of the outer portion.

In the Australian *Metura elongata* the short reduced labial palpi are much as in *Psyche graminella*, but are more deeply divided; the two divisions or lobes I am inclined to consider as the second maxillary (labial) palpi. In this genus the first maxillary palpi are also as in *Psyche graminella*.

It will thus be seen that in the pupa of this family the first and second maxillary palpi vary very much in form, as they probably do in the imagines, being more or less atrophied in the latter, where they need to be carefully examined. On the other hand, the maxillæ themselves (for in their pupal condition in haustellate Lepidoptera they have retained the separated condition of the laciniate Lepidoptera) though short are quite persistent in form. The pupa of *Platœceticus gloverii* differs from that of *Œceticus abbotii* in the undivided first maxillary palpus (eye-piece), and the elongated second maxillæ, as well as the narrower clypeal region, and the lack of a cocoon or case-opener.

By an examination of the figures it will be seen that the outer division of the eye-piece varies much in size; this is due to the varying width of the male antennæ, which, when wide, as in Pinara (Entometa), Metrua, Thyridopteryx and Psyche, overlap and nearly conceal it, while it is entirely hidden in Platœceticus. On the other hand in male pupæ of Hepialus and Oncopera, where the antennæ are small, narrow and not pectinated, these pieces are large. The end of the body has no cremaster, but what is unique, a hook arising from each vestigial anal leg.

Finally it will be readily seen that from an examination of the pupæ, the views of Speyer, of Chapman, and of Comstock, as to the position of the Psychidæ is fully confirmed, while I should go a little further and place them still nearer the Hepialidæ. They are, however, still more modified than this last named group, since the females are wingless and limbless. It is very plain that they are an offshoot from the Tineoids, and especially from the Talæporidæ which have no tongue and whose females are wingless and sackbearers.

Remarks on the Cochliopodidæ.—Chapman removes this group from the Bombyces from a study of their larval and pupal characters. We should, after studying the pupæ of five or six genera, agree with his suggestion that this and the family Megalopygidæ (Lagoidæ) should be removed from the Bombyces and placed near the Tineoids, from which they have undoubtedly descended. That the line of descent, however, was directly from the Eriocephalidæ seems to us a matter of doubt. The larvæ of the Cochliopodids present some notable differences from that of Eriocephala, whose so-called "eight pairs of abdominal legs" appear to be merely spine-bearing tubercles. Although the head of Eriocephala is partially retractile, this adaptation may have no phylogenetic significance.

Figure 13 represents the front of the head of *Parasa chloris*, showing the maxillary palpi and a lateral process connected with it, which I have not seen in any other pupæ, and may be internal. I have also observed it in the cast pupal skin of *Tortricidia testacea.* The maxillæ are either shorter or no longer than the large labial palpi. The paraclypeal tubercles are well developed in this group.

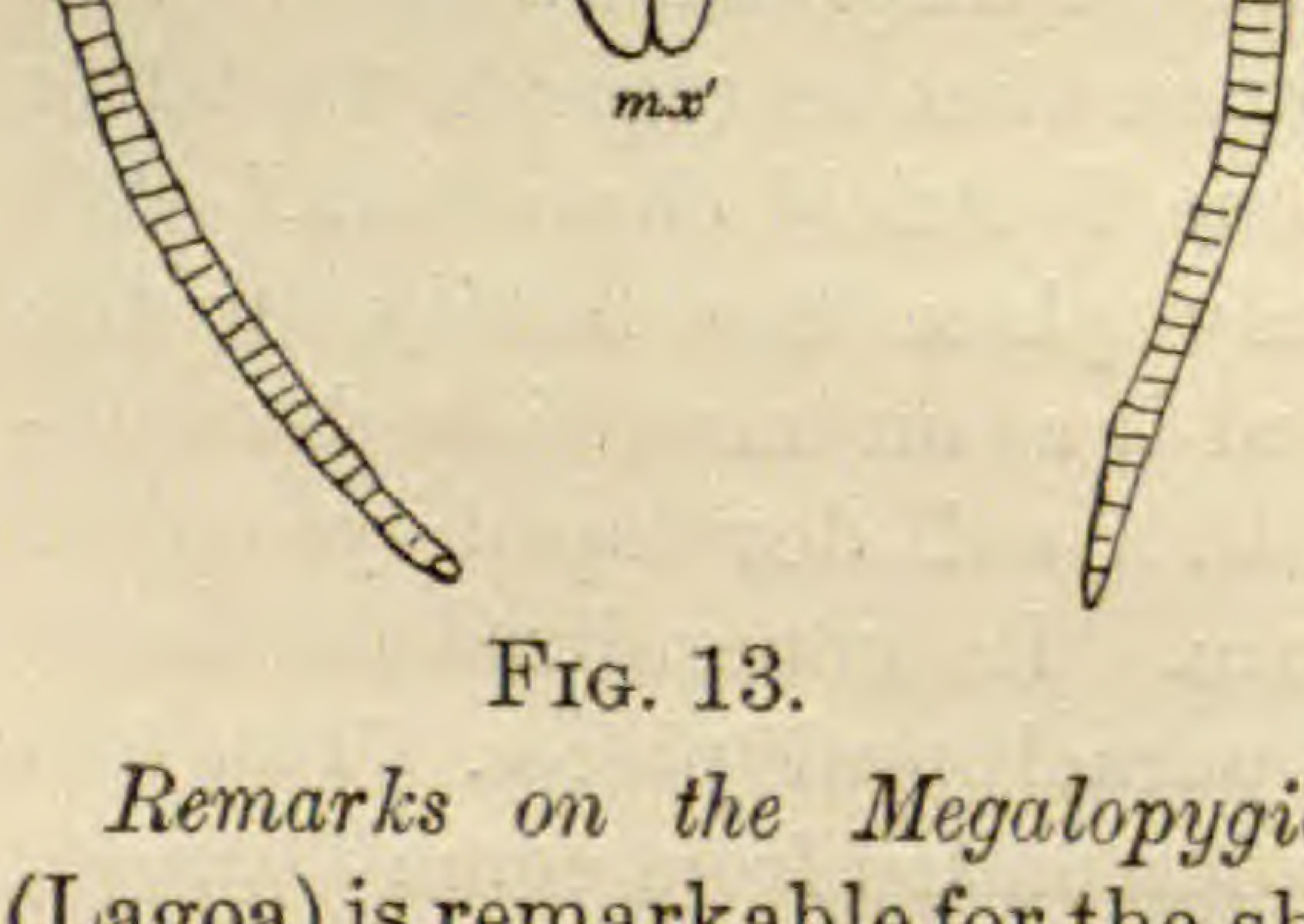


FIG. 13.

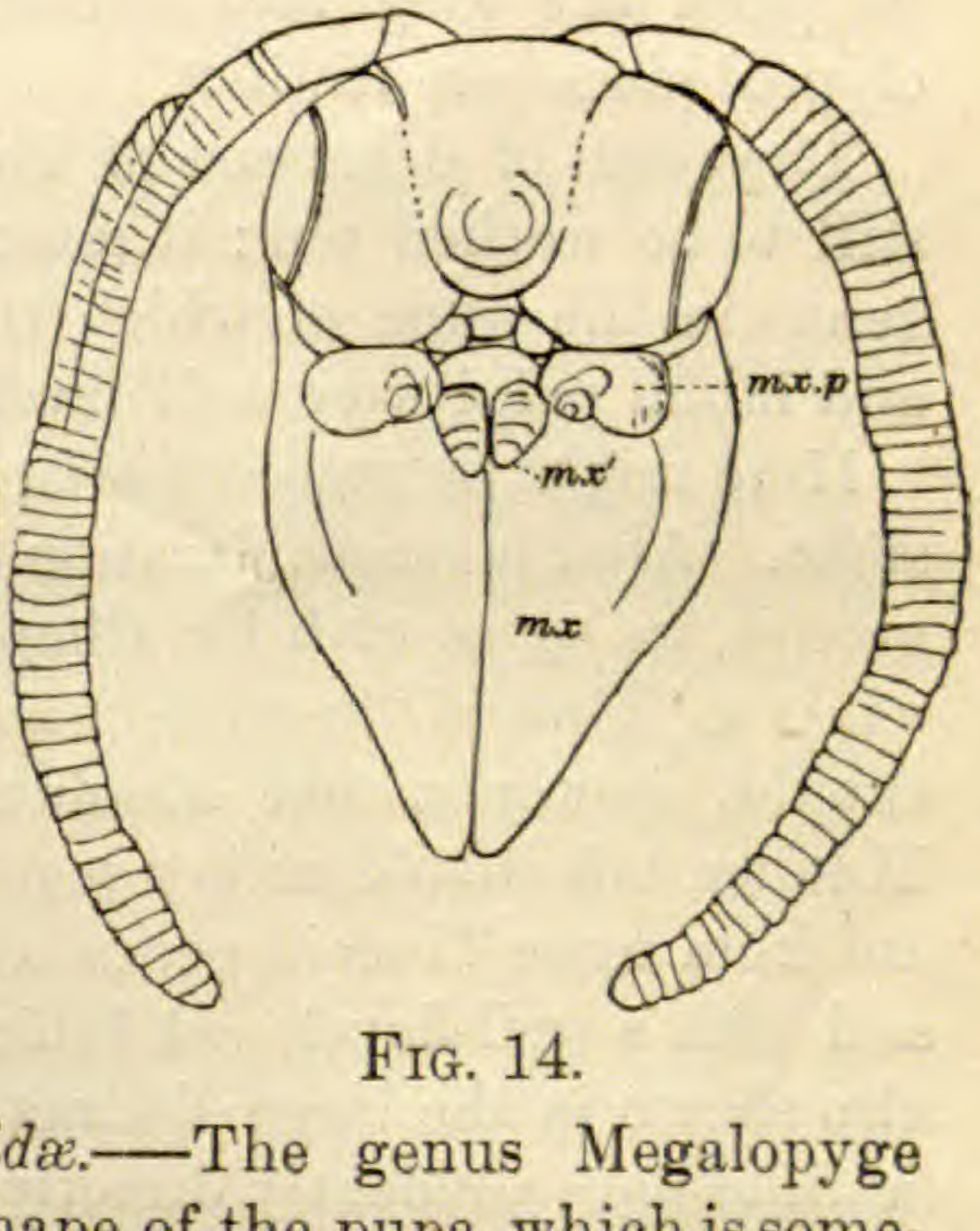


FIG. 14.

Remarks on the Megalopygidæ.——The genus Megalopyge (Lagoa) is remarkable for the shape of the pupa, which is somewhat as in Cochliopodidæ, confirming the view that the two families are allied, though still presenting some notable differences in larval characters. Figure 14 represents the pupal features as seen in the front of the head of a Megalopyge from

Florida (probably *M. crispata* or *opercularis*). The maxillæ seem to be aborted; on each side of the 2d maxillary (labial) palpi under the eye, are the 1st maxillary palpi, whose structure needs farther examination.

The last division of Lepidoptera (*Pupae obtectæ* of Chapman) mostly comprises the specialized broad-winged modern or macropterous forms, though including many of the specialized Tineina.

The next series of families begins with the *Tortricidæ*, from which may have descended the Cossidæ. As will be seen by comparing the pupa of *Tortrix rileyana* with that of the Cossidæ (fig. 9, head and mouth parts of the pupa of *Prionoxystus robiniæ*) Dr. Chapman's opinion that Cossus has "no characters at any stage to distinguish it from Tortrices," is well sustained. The pupal characters of *Zeuzera pyrina* also show that it belongs to the same family as Cossus and its allies. In the Cossidæ there is no separate pupal maxillary palpi, the lateral flap (*mx. p.*) not being separate. The labium and its palpi are long and narrow, as in Tortrix. The paraclypeal pieces are distinct.

The point of departure of Tortrididæ from the Tineina has still to be worked out; it must have been some generalized genus in the pupa of which the eye-collar (maxillary palpi) and labial palpi were well developed.

Here might be placed the two families Thyrididæ and Sesiidæ. After a reconsideration of the transformations of these groups, we agree with Dr. Chapman that as regards the latter "it is a 'Tineoid' in spite of some Tortricid characters." We should, however, not absolutely place the family in the Tineina, but should rather regard it as an immediate descendant from some Tineoid genus with a well developed eye-collar and with a well developed labium. Its generalized nature is also shown in the large distinct paraclypeal pieces. The two families have evidently directly descended from some Tineoid, but they have become much modified and specialized, especially in the venation, and form a side branch of the Tineoid series with absolutely no relation to the Sphingidæ, near which they are usually placed. We have been unable to obtain the pupa of Thyris for examination.

Family Zygænidæ.—Another group supposed by Spuler[4] (venation) and also Chapman (pupa) to be closely related to the Tineoids is the Zygænidæ, from which I should separate the Syntomidæ. The pupa of Zygæna is said by Dr. Chapman to possess "ill-developed eye-collars (maxillary palpi)," and the dehiscence is typically incomplete. I have been unable in the specimen kindly given me by Dr. Chapman to detect the ill-developed eye-collar, but the cast pupa skins examined are not well preserved, and these pieces may be detected in living or alcoholic specimens. Comstock places the Zygænina high up remote from the Tineina, but at present I am disposed to regard the Syntomidæ as a distinct group with a different origin, and more nearly related to the Arctiidæ. I fully agree with Chapman that Zygæna is near the Tineina; and I agree with Comstock that Triprocis and Pyromorpha have "a remarkably generalized condition of wing-structure."

The true Zygænidæ form a side branch or somewhat parallel group. I should regard Ino (Triprocis) as a more generalized genus than Zygæna. Judging by the venation, Harrisina has undergone a little more modification than Ino. Pyromorpha also seems rather more primitive than Zygæna. I see no reason for regarding Pyromorpha as the type of a distinct family.

I have only the pupæ of *Harrisina americana* and of Zygæna to examine, but judging by this scanty material, that of Harrisina seems to be the more generalized form, that of Zygæna the more specialized. As Zygæna does not occur in America, but is Eurasian, it is possible that in its generalized Zygænid fauna America, as in other groups of animals, has lagged behind Europe, Zygæna with its numerous species being a more advanced or specialized type brought into existence by more favorable conditions.

Origin of the Lithosiidæ.—It seems to me that the group of forms usually referred to the Lithosiidæ but which are nearest to the Tineina, is that represented by Enæmia (Eustixia, Mieza), Oeta and Tantura (Penthetria) as the imagines of these

[4] Zur Phylogenie und Ontogenie des Flügelgeaders der Schmetterlinge. Zeits. wissens. Zoologie, 1892.

genera, whether we consider the shape of the head and body, antennæ and legs, or the venation and shape of the wings, are the nearest to the Tineidæ and appear to form a family of Tineoid moths. Indeed Enæmia is now referred to the Tineina of the family Hyponomeutidæ, and possibly the Lithosiidæ originated from this family or from a group standing between them and the Prodoxidæ.

The pupæ have the long narrow head and eyes of Tineina. The eye-collar is wanting, but vestiges of the labial palpi are present, and also vestiges of the paraclypeal pieces. Judging by the venation, Enæmia is the more generalized, and Tantura the more modified genus. The pupa of *Oeta aurea* (fig. 15) in the head characters is rather more generalized than that of Tantura, the labial palpi being a little larger and the base of the maxilla more flaring, as if forming rudimentary eye-collars or palpi, but the abdomen and its end is much more specialized than in Tantura, as it is long, slender, conical, and ends in a well developed cremaster provided with curved setæ adapting it for retaining its hold in its slight cocoon. In general appearance and markings it is like a Geometrid pupa, having black longitudinal stripes. In the pupa of Tantura the shape of the abdomen is more generalized, there being no cremaster, but hooked setæ enabling it to retain its hold within its beautiful loose, basket-like cocoon.

It is probable that these genera descended from some broad-winged Tineid and possibly from the same stem-form as the Prodoxidæ, as the venation is somewhat similar. Hyponomeuta and especially Argyresthia appear to be later, more specialized forms. This group (Enæmia, Oeta, and Tantura) almost directly intergrades, judging from the venation, with the Lithosiidæ, Byssophaga, Cisthene, and Crocota, connecting them with Lithosia; though the larvæ of the latter are much more specialized and arctiiform. Hence the line of descent from the generalized Tineina to Enæmia, Oeta, Tantura, to the Lithosiidæ, and from them to the Arctiidæ, is more or less direct. It is interesting to note the gradual widening of the wings, especially the fore-wings, as we pass from Lithosia to Arctia, also to notice the gradual change in the larval and pupal characters, those of the Arctian pupæ being slightly less primitive than in the more generalized Lithosiidæ. It is also interesting to note that in ascending from the Tineoid pre-

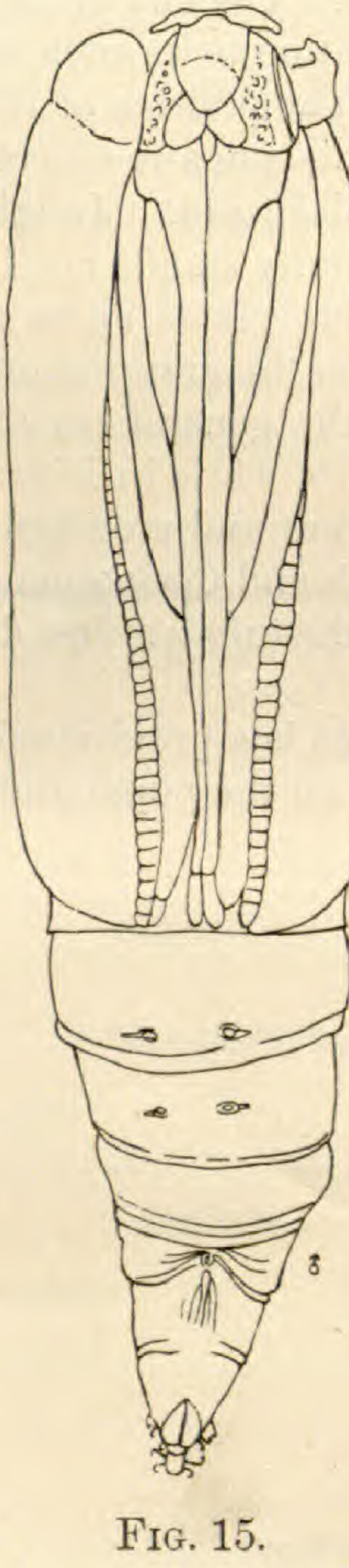


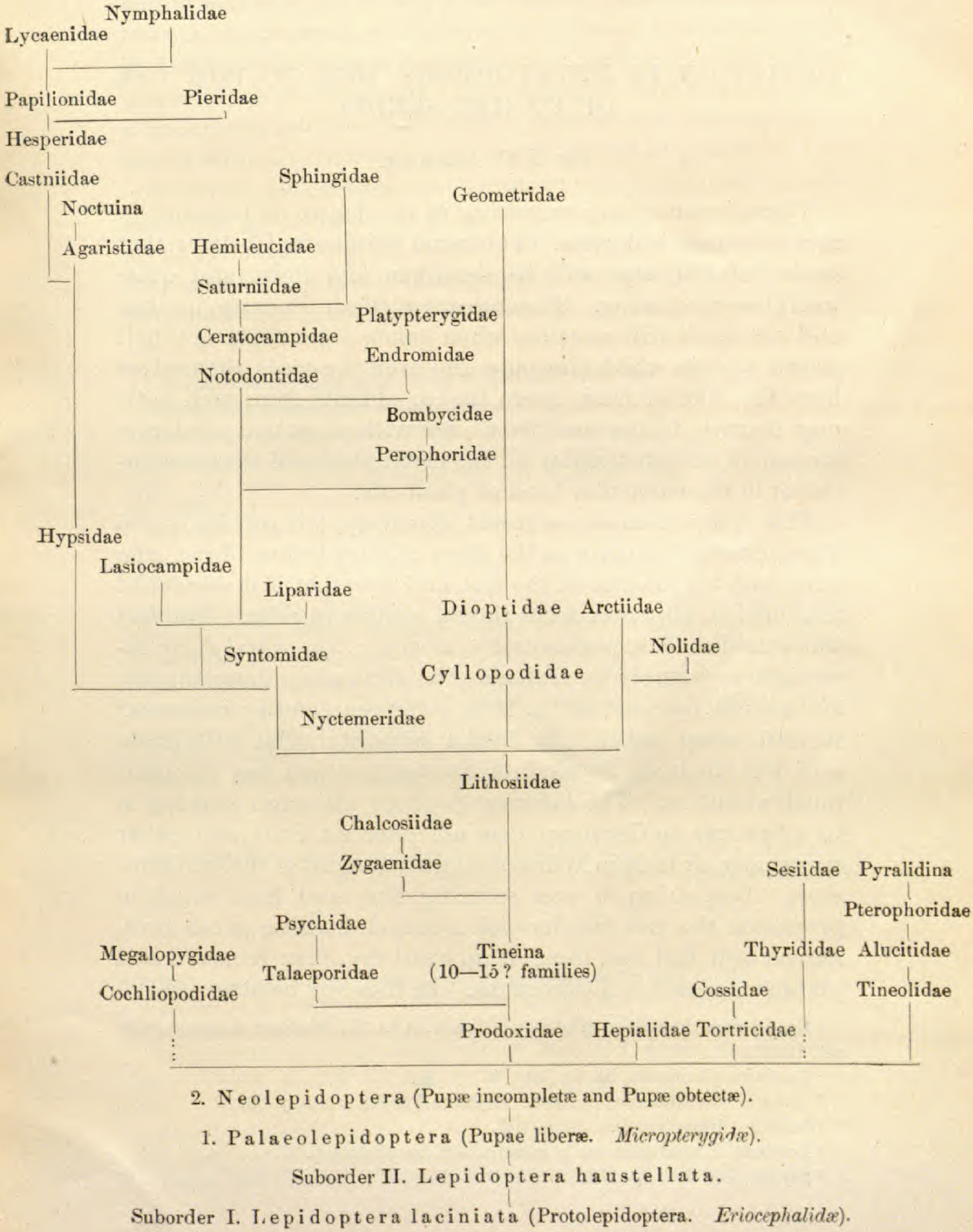
FIG. 15.

cursors of the Lithosiidæ to the members of the latter family, we pass from incomplete to complete pupæ showing that the division into pupæ incompletæ and obtectæ may be at times artificial.

Family Nolidæ.—The structure of the pupa of Nola (*N. ovilla*), besides its larval and adult characters, convinces me that the genus is the type of a distinct family, and forming a line of descent somewhat parallel with and near to the Lithosiidæ. The pupa has the labial palpi well developed, and the paraclypeal pieces large. The end of the abdomen is rounded and unarmed, in adaptation to its enclosure in a dense cocoon.

Family Syntomidæ.—The position of the Syntomidæ is difficult to determine. The pupa is obtected, though it has in Scepsis retained the labial palpi. Judging by the larval and pupal characters the family stands much nearer the Arctiidæ than the Zygænidæ, but yet is more generalized than the former. In the venation the group stands near the Arctians, i. e., the venation of the generalized *Ctenucha* approximates that of *Epicallia virginalis*, while in Didasys and Syntomis the venation is more aberrant and modified; so also in the long tufted larvæ of Syntomis and Cosmosoma, compared with that of Ctenucha, in which the tufts are less developed and specialized.

On the following page is a provisional genealogical tree of the order, based mainly on the pupal and imaginal characters.



Nymphalidae
Lycaenidae
Papilionidae
Pieridae
Hesperidae
Castniidae
Sphingidae
Geometridae
Noctuina
Agaristidae
Hemileucidae
Saturniidae
Platypterygidae
Ceratocampidae
Endromidae
Notodontidae
Bombycidae
Perophoridae
Hypsidae
Lasiocampidae
Liparidae
Dioptidae
Arctiidae
Nolidae
Syntomidae
Cyllopodidae
Nyctemeridae
Lithosiidae
Chalcosiidae
Zygaenidae
Sesiidae
Pyralidina
Pterophoridae
Psychidae
Megalopygidae
Tineina
(10—15? families)
Thyrididae
Alucitidae
Talaeporidae
Cochliopodidae
Cossidae
Tineolidae
Prodoxidae
Hepialidae
Tortricidae
2. Neolepidoptera (Pupæ incompletæ and Pupæ obtectæ).
1. Palaeolepidoptera (Pupae liberæ. *Micropterygidæ*).
Suborder II. Lepidoptera haustellata.
Suborder I. Lepidoptera laciniata (Protolepidoptera. *Eriocephalidæ*).

DEVIATION IN DEVELOPMENT DUE TO THE USE OF UNRIPE SEEDS.[1]

By J. C. Arthur.

There is something surprising in the degree of immaturity at which seeds will grow. The usual opinion is, I believe, that seeds not fully ripe will be shrunken and light, and quite worthless for sowing. To some extent there is truth in this, and yet seeds will vegetate when taken from fruit not half grown, and in which the pulp and even the seeds themselves have the color of fresh, green leaves. Plants from such seeds may flourish, bloom and fruit, and with a certain moderate amount of deviation, show all the usual phases of existence incident to the particular kind of plant life.

This is by no means a recent discovery, but was known to Theophrastus,[2] as early as the third century before Christ, who expressed his surprise at the fact, and says that it is wonderful that unripe, imperfect seeds should be able to grow. The fact was established experimentally, however, by several early investigators, notably by Duhamel,[3] in 1760, using flowering ash and walnut, by Senebier,[4] in 1800, using peas, and by Lefebure,[5] in 1801, using radish. In 1822 a successful trial with green seed was made by Seyffer,[6] of Stuttgart, which has attracted much attention. The Japanese Sophora, although growing to be a fine tree in Germany, does not often set fruit, and never ripens any, at least in Würtemberg, on account of the cool summers. Despairing of ever securing ripe seed from which to propagate the tree, Seyffer took a branch bearing green fruit, not yet half full size, hung it up until dry, then removed and planted the seed in a cold frame. In this way he obtained 500

[1] Read before the section of botany of the A. A. A. S., Madison meeting, August, 1893.

[2] De causis plantarum, lib. iv., cap. 4.

[3] Duhamel du Monceau, Des semis et plantation des arbres, p. 83.

[4] Senebier, Phys. végétale, iii, p. 377.

[5] Lefebure, Expériences sur la germination des plantes, p. 27.

[6] Seyffer, Isis, 1838, p. 113.

young plants, many of which still were to be seen as handsome trees in the grounds of the forestry school at Hohenheim, and in the vicinity, sixteen years afterward, when the paper from which we quoted was read. The economic importance of such a procedure, and its applicability to numerous contingencies, has brought the incident much well merited attention.

It would be possible to cite many other instances[7] of the successful germination of green seed, but it is unnecessary, for all doubt regarding the viability of such seed was set at rest long ago in the very exhaustive treatise upon the subject by Ferdinand Cohn, entitled, "Symbola ad seminis physiologiam," 1847, in which he not only reviewed the previous history, but

[7] Waitz, with morning glory (Convolvulus Nil) Bot Zeit, 1835, p. 5.

Kunze, with wheat. Bot. Zeit., 1835, p. 5.

Kurr, with rye (?), ten-weeks-stock. Bot Zeit., xviii (1835), p. 4.

Seyffer, with peas, kidney beans (Phaseolus vulgaris), English beans (Vicia Faba), soja beans, lentils, laburnum, Sophora Japonica. Bot. Zeit., 1836, p. 84; Isis, 1838, p. 5.

Treviranus, with turnips and peas. Physiologie der Gewächse, ii (1838), p. 576.

Göppert, with rye. Bot. Zeit., v (1847), p. 386.

Cohn, with beans (Phaseolus vulgaris), lupines, radish, shepherd's purse, corn, sorghum, datura, apple, cucumber, canna, evening primrose, princes' feather (Amarantus caudatus), morning glory, (Ipomœa purpurea), Salvia verbascifolia, pinks, squirting cucumber (Momordica Elaterium), bladder senna (Colutea arborescens), marshmallow (Althæa officinalis), castor bean. Symbola ad seminis physiologiam, 1847; Flora, xxxii (1849), p. 481.

Lucanus, with rye. Landw. Vers.-St., iv (1860), p. 262.

Siegert, with wheat. Landw. Vers.-St, vi (1863), p. 134.

Nowacke, with wheat. Untersuchungen über das Reifen des Getreides, 1869, p. 37.

Nobbe, with spruce (Picea vulgaris). Tharander forstl. Jahrbuch, xxiv (1874), p. 203; Landw. Vers.-St, xvii (1876), p. 277; Handbuch der Samenkunde, 1876; p. 338.

Sagot, with wheat (?). Arch. des. Sci. Phys. et Nat, 1876; Just's Bot. Jahresb., iv, p. 1243.

Tautphöus, with rye. Ueber die Keimung der Samen, 1876, p. 23

Wollny, with winter rye. Forsch. Geb. Agrik.-Phys., ix (1886), p. 294.

Sturtevant, with maize. Rep., N. Y. Exper. Sta, ii (1883), p. 39.

Goff, with tomatoes, peas, turnips, lettuce. Rep. N. Y. Exper. Sta., ii (1883), p. 205; iii (1884), pp. 199, 211, 224, 232; iv (1885), pp. 130, 182; v (1886), p. 174, 197.

Atwell, with morning glory (Ipomœa purpurea). Bot. Gaz., xv (1890), p. 46; Bot. Centr.. xlvi (1891), p. 162.

Bailey, with tomato. Bull. Cornell Exper. Station, No. 45. 1892, p. 207.

also himself grew plants of more than a score of widely diverse species from seed in various stages of immaturity.

At the very beginning of the agitation of the subject, a curious misusage in terminology arose, which at one time led to considerable controversy, but which gradually disappeared with the better elucidation of the subject. The confusion was in regard to the application of the terms viability, or power of germination, and maturity, or ripeness. The implied reasoning of most writers, especially the earlier ones, seems to have been this: The object of maturity is to render the seed capable of becoming an independent plant through germination, therefore a seed must be mature before it can germinate, *per contra*, the seed that germinates has already reached maturity.

In Gærtner's monumental work on seeds and fruits, published in 1790, is the statement[8] that seeds are ripe as soon as they can germinate, although from their color, weight and size, they may not appear so. Senebier,[9] in the year 1800, held that seeds must be ripe in order to grow, and yet at the same time says that he has seen green tender peas, taken from equally green pods, germinate. The same confusion of ideas is shown in the defense which Keith made when DeCandolle[10] pointed out that it was an error to place maturity of the seed as one of the conditions for germination, as Keith[11] had done in his work on vegetable physiology, published in 1816. Keith[12] says: "The seed that will germinate is, physiologically speaking,

[8] "Semen maturum, ut docet, non ex colore suo saturato, nec ex sua in aqua subsidentia, neque etiam ex duritie sua satis tuto cognoscitur; sed certior maturitatis nota ex ipso trahenda est nucleo; quippe que, si ex gelatinosa sensim factus sit solidiusculus, si testæ suæ cavitatem repleat exactissime, atque si intra se ipsum nullum prorsus contineat spatium vacuum, indubitatissimum præbit seminis maturi signum quia ita conformatum, germinando aptum est, quæcunque etiam fuerit reliqua ejus conditio." Gærtner, De fructibus et seminibus plantarum, ii (1790), I, p. cxii.

[9] "Les graines doivent être mûres pour germer; pour l'ordinaire elles ne germent pas quand on les a cuillies avant leur maturite; j'ai pourtant vu germer des pois verts and tendres otes de leurs siliques vertes and molles." Senebier, l. c. iii, p. 377.

[10] Phys. Veg., ii (1832), p 662.

[11] Keith, System of vegetable physiology, ii (1816), p. 3.

[12] Phil. Mag., viii (1836), p. 492.

ripe; that is, its fluids have been so elaborated in the process of its maturation, and its solids so vitalized in the assimilation of due aliment as to be now fully and profitably susceptible of the action of the combined stimuli of the soil and atmosphere. Hence I contend, notwithstanding the objection of M. DeCandolle, that the maturity of the seed is rightly and legitimately placed in the list of the conditions of germination." Treviranus[13] held essentially the same views, and expressed himself quite as strongly in his work on vegetable physiology, about the same time. Even Cohn, in his clear and scholarly paper, did not quite set the matter straight. He came to the conclusion,[14] that although the proper ripening of the seed is dependent upon the parent plant, yet when prematurely separated it will still pass through the ripening stage before germinating; there is thus an after-ripening for green seeds, which fits them for continued growth. Although he seemingly held that seeds cannot germinate until they in some way ripen, yet he asserted (and it is a most important deduction, correctly worded) that viability does not usually coincide with maturity, but precedes it.[15]

Since the time of Cohn the terminology adopted has agreed well with the facts. The present usage is presented in Nobbe's large and excellent treatise upon seeds. He says:[16] "The continued life of the embryo is not dependent upon the completion of the storing of reserve material in the seed; the power of germination appears much earlier, even in a stage of development of the seed undoubtedly to be designated as 'unripe.'

[13] "Zum keimen gehort, dass der Same reif sei; das heisst, das der Embryo in dem Grade entwickelt sei, dass er von der Mutterpflanze getrennt, unter Aneignung des Vorrathes nährender Materie im Perisperm oder, in den Samenlappen für sich fortleben kann." Treviranus, l. c., ii, p. 574.

[14] Quum maturatio seminis propria non afficiatur a planta, sumendum videtur, ut etiam processura sit, semine soluto a planta; vel, ut postmaturari possint semina. Cohn, l. c , p. 72.

[15] Facultas germinandi non in idem tempus coincidere solet cum maturitate; hanc illa præcedit Cohn, l. c., p 73.

[16] Die Lebensfähigkeit des Embryo ist an die Vollendung der Reservestoff-Aufspeicherung in Samen nicht gebunden. Die Keimfähigkeit tritt weit früher, schon in einem unzweifelhaft als "unreif" zu bezeichnenden Entwicklungsstadium des Samen ein. Nobbe, Samenkunde, p. 339.

Wiesner[17] has given a concise definition. "The condition," he says, "in which a seed loosens itself from the plant in order to continue its development independently, is designated as maturity." We are, therefore, to regard maturity as applying to the seed as a whole, and viability as applying to the embryo, the physiological processes associated therewith being quite distinct. After-ripening, which takes place when partly grown seed is separated from the parent plant, only leads to partial maturity.

It is an inquiry full of interest as to the minimum development at which a seed will germinate. Goff,[18] in 1884, planted tomato seed in March in boxes in the greenhouse, saved the previous season from fruit still thoroughly green, and obtained only 2 per cent of vegetation. But seed from fruit of full size, and which had begun to lose its green color, although not yet showing any tinge of redness, vegetated 84 per cent, while from fruit with a faint reddish tinge the percentage of vegetation reached 100. In another experiment he found[19] that peas planted in the usual manner in the open ground in April, that had been gathered when in the condition best suited to table use, gave only 3 per cent of vegetation, while those just past this stage of edible maturity gave 9 per cent. But in all probability the conditions of growth at the time were not particularly favorable, as fully ripe seed in the same experiment gave only 54 per cent. of vegetation. In a very carefully conducted experiment with wheat made by Nowacki, selected seed saved from grain when in the milk gave 92 per cent of vegetation, and from grain when turning yellow, as well as when fully ripe, gave 100 per cent., the seed being sown in the open ground (see table III.) Nobbe[20] found that seed of Spruce (*Picea vulgaris* Lk.) gathered on the first and fifteenth of each month from the middle of July to the first of November, and tested in the laboratory in the following January, gave increased

[17] Der Zustand, in welchem ein Same sich von der Pflanze loslöst, um sich selbständig weiterzuentwickeln, wird als Reife bezeichnet. Wiesner, Biologie der Pflanzen, 1889, p. 40.

[18] L. c., iii, p. 224.

[19] L. c., iii, p. 232.

[20] L. c.

percentage of germination according to degree of maturity (see table I). In experiments performed by myself in 1889 to-

I.—Germination of Spruce Seeds at Different Stages of Maturity.

Experiment conducted by Nobbe.

Spruce seed, gathered	July 15,	gave 0 per cent germinations.
Spruce seed, gathered	Aug. 1,	gave 40.8 per cent germinations.
Spruce seed, gathered	Aug. 15,	gave 61.2 per cent germinations.
Spruce seed, gathered	Sept. 1,	gave 75.3 per cent germinations.
Spruce seed, gathered	Sept. 15,	gave 71.6 per cent germinations.
Sprnce seed, gathered	Oct. 1,	gave 84 5 per cent germinations.
Spruce seed, gathered	Nov. 1,	gave 88.2 per cent germinations.

mato seed from green and ripe fruit of the previous season, tested in April in the laboratory, gave 60 per cent germination for the immature seed against 100 per cent for the fully mature. Considerable other data are on record, all going to show that seeds are more certain to germinate the nearer they approach to maturity, or conversely, the more immature the seed, the less number of chances for its germination.

The internal examination of the seed to determine the actual stage of development, in connection with such studies, has been rarely attempted. Seyffert and Cohn agree, however, that with such seeds as peas, beans, lentils, canna and evening primrose, the embryo must be sufficiently formed to be detected with a hand lens, in order that the seed should be capable of growth. If the embryo is watery and unformed, according to these observers, the seed will not germinate.

Probably most of us would at first think, as Cohn[21] did, that "it is a curious circumstance in this connection, that while in the ripening of the seed innumerable stages are run through, passing one into the other without interruption, in germination, which is as it were a function of maturity, no transition exists. For evidently a seed can only either germinate or not

[21] Es zeigt sich hierbei der eigenthümliche Umstand, dass während bei der Reife der Same unzählige, ohne Unterbrechung in einander übergehende Stufen durchläuft, bei der Keimfähigkeit, die gleichsam Function der Reife ist; kein Uebergang existirt. Denn offenbar kann ein Same nur entweder keimen, oder nicht; ein drittes giebt es nicht. Cohn, Flora, xxxii (1849), p. 500.

germinate; there can be no third course." But this is very fallacious reasoning, and is founded upon a misunderstanding of the nature of the seed. In the first place germination is not, even constructively, a function of maturity, as it readily occurs both before and after maturity. From our present standpoint, in whatever way the earlier writers may have viewed the matter, a seed is simply a young plant enclosed in a protective covering derived from the parent plant, and accompanied by surplus nutriment. The resting condition of a seed is purely incidental and designed to aid in distribution and in guarding the plant against injury while very young. From the time of the first cell division in the forming embryo until the new individual becomes established as a free growing plant, there need be no check in the continuous growth, except through untoward conditions, or inherent tendency to provide for such conditions. The germination of seeds inside the fruit of oranges, and gourds, and the ready growth of the mangrove, are familiar instances where the resting period has been practically evaded, and development of the plantlet has been nearly or quite continuous

In the growth of green seed we have a case where an attempt is made to give the plantlet the conditions for continued development without passing through the full protective stage. There is nothing in the nature of things, except the want of skill, to prevent the plantlet being removed from the parent plant at any point in its early development, even before its organs can be detected, and by supplying it with the necessary nutriment, heat and moisture, and protecting it against the inroads of destructive organisms (bacteria, molds, etc.), securing to it by these artificial means the conditions for uninterrupted growth, with the entire omission of the usual resting stage.

With this view of the subject it is easy to explain why green seed generally gives fewer germinations as a rule than mature seed; the more exacting conditions for its growth are not well met. And, further, it is evident that Cohn's aphorism that a seed can only germinate or not germinate is saying that a seed can continue to grow or not continue to grow, and is thus robbed of all its mysticism.

To fully understand the problem before us it will be well to inquire into the meaning of maturity. In the course of normal development of the seed the testa becomes more firm and less permeable, the organic constituents of the cells are transformed into solids or semi-solids, there is a loss of water, growth finally ceases, the organic connection with the parent plant is severed, and the seed is ripe. It remains in an inactive, dormant condition a longer or shorter time and then germinates. Maturity is reached in this metamorphosis when the protecting testa, or pericarp, as the case may be, has become sufficiently solid, and the inner parts sufficiently advanced to permit separation from the parent plant without endangering the life of the embryo.

A most curious thing in connection herewith is the fact that the seed, and sometimes the associated parts of the fruit, will continue to develop under circumstances which put a stop to all growth in the vegetative parts of the plant. If a branch is severed from a tree, all growth in its buds and leaves ceases at once, it wilts, and shortly dies. But the fruits and seeds attached to it continue to develop, and will so continue as long as sufficient moisture remains to transport what food material exists, from the leaves and stem into the fruit and seed. This process is known as after-ripening. So far as I know, it has not been intimately investigated, but I am inclined to think that during this process the embryo continues in actual growth, forming new cells, and elaborating its organs, but that little or no growth takes place in the surrounding parts, although great chemical changes and accumulation of substances do occur.

It was observed by Cohn,[22] who was the first to note such phenomena, that green seeds entirely removed from the fruit and laid in moist earth or sand passed through the various changes of color of normal ripening. If very young, they did not progress far, but if sufficiently grown, although still perfectly green in color, they underwent the intermediate changes, and finally gave every appearance of full, mature seeds. He experimented with the seeds of apple, pear, beans, lupines, Amarantus caudatus, Polygonum tartaricum, Colutea arbor-

[22] Symbola, pp. 67-70; Flora, pp. 508-510.

escens, Kœlreuteria paniculata, and Canna orientalis. An experiment in after-ripening by Lucanus,[23] is very instructive (see table II). He gathered rye in five stages of maturity, ranging from very small kernels, not yet milky, up to fully ripe kernels. Each collection was separated into four lots; in the first the kernels were removed from the heads at once, in the second, they were allowed to remain in the heads, but the

II.—Weight of 1000 Air-Dry Kernels of Rye at Different Stages of Maturity.

Experiment conducted by Lucanus.

	I.	II.	III.	IV.	V.
Weight of 1000 air dry kernels, in grams.	Gathered June 28. Grain very small, soft and green.	Gathered July 3. Grain becoming milky.	Gathered July 10. Juices thick and milky.	Gathered July 18. Grain solid, straw yellow.	Gathered July 26. Fully ripe.
Kernels removed at once...	10430	14655	18366	20294	22230
Left in the separated heads..	10575	14830	18510	20302	22250
Left on cut plant...............	11310	14930	18620	20302	22280
Roots in distilled water...	13790	15440	20220	21070	22325

heads were removed from the stalks; in the third they remained attached to the plant which was cut near the ground, and in the fourth the plants were pulled, the roots washed, and set in distilled water. A thousand air-dry seeds from each lot were finally weighed. In all cases the grain weighed more when permitted to remain in the head than when removed at once, still more when all the stem and leaves were attached, and very much more when the uprooted plant was supplied with water. After-ripening is thus seen to play a very important part in the handling of immature seed.

There is a state of over-maturity of seeds, which has importance in this connection. It is well known that the life of the

[23] L. c.

seed is limited; some seeds will not grow after a few weeks or months, although most seeds are good for from one to several years. In all cases the seed gradually loses its vitality, and sooner or later ceases to live, unless in the mean time given the means for germination.

In view of these facts we can better appreciate the importance of the discovery made by Cohn[24] that there is an optimum for most rapid germination which falls, as a rule, just before obvious maturity, (or possibly at the end of the resting stage, where this is very pronounced, a point not yet investigated), and before and after this optimum the germination is slower.

We are thus led to consider the seed as accumulating energy up to the approximate time of its maturity, and then gradually losing this energy so long as it remains an inactive seed; and that the measure of this energy is the vigor of its germination. There is a wealth of data to substantiate this theory of the life of a seed, but which would be burdensome to further present at this time.

Turning now to a more detailed consideration of the deviations from normal development in plants from immature seed, the weakness of the seedlings will be one feature to first attract the attention of the investigator. In a number of trials with green seed of tomatoes, made at various times since 1889, I have found[25] that the young plants are under size; the stems being shorter and cotyledons smaller. They have less strength, and in consequence many perish in the vain attempt to lift the covering of soil. Some are unable to extricate the cotyledons from the ruptured testa, and often perish from this cause, even after having reached the light. If the seeds are germinated between folds of moist cloth or bibulous paper, such miscarriage will show even more clearly. Similar effects were observed by Cohn, in the use of canna seed. He says:[26] "All plants ob-

[24] Ich selbst habe bei Canna, Œnothera, Lupinen und anderen ein mittleres Stadium im Reifungsprocesse beobachtet, in dem die Samen sich am schnellsten entwickelten; von da aufwärts und abwärts die reifen und die weniger ausgebildeten schienen mir langsamer zu keimen. Cohn, Flora, xxxii, p. 504.

[25] The data are recorded in the manuscript records of the Indiana Experiment Station, and have not yet been published.

[26] Dagegen waren alle aus den jüngsten Samen gezogenen Pflänchen hinfällig und schwächlich und gediehen kaum über das erste Blatt. Flora, xxxii, p. 501.

tained from the youngest seeds were slender and weak,a nd scarcely progressed beyond the first leaf." Goff,[27] who has made experiments with immature tomato and other seeds at intervals from 1884 to the present time, early noted this characteristic of the seedlings.

The rate of germination is in general slower for immature than for mature seeds. This has been observed by Seyffert, Göppert, Cohn, Toutphöus and others, but this depends upon many internal and external conditions affecting the seed, and it is, therefore, not inconsistent with our theory of the process to find that some observers (Duhamel, Senebier) have noted an increased rate of germination for immature seeds. In an experiment by the writer (manuscript record No. 82) in 1890, tomato plants (24) from the seed of ripe fruit planted in a cold frame, came through the soil in an average of 12 days, plants (5) from seed of half-ripe fruit in 12.2 days, and plants (13) from seed of green fruit in 14.2 days. Other trials with tomato, as well as with peas, wheat, and other kinds, made in the laboratory, using folded cloth, have also given tardy germinations for unripe seeds. Nowacki[28] removed seeds from the heads of wheat when in the milk stage, when turning yellow, and when fully ripe, and sowed carefully selected kernels in the garden (see table III). The rate of germination, judging by the time of appearance of the plants above ground, was much slower for the immature seed, the number on the eleventh day after sowing, being respectively 12, 19, 25.

III.—Wheat from Unripe Seed.

Experiment conducted by Nowacki.

Degree of ripeness.	No. seeds.	Germinations.		Stalks.		
		On 11th day.	Total.	Av. No. per plant.	Av. height in cm.	Product of No. by Ht.
In the milk	50	12	45	4.6	128	589
Turned yellow...	50	19	50	5.4	125	675
Fully ripe.........	50	25	50	5.9	121	714

[27] L. c., iii, p. 225; iv, p. 182.

[28] L. c.

Owing to their weakened condition the plants from immature seed are less able to withstand unfavorable conditions than those from ripe seed, the difference being more marked the younger the seeds. In my own attempts to grow very green tomato seeds in the green-house, fully eighty-five per cent of the plants that had unfolded the cotyledons, perished before reaching the third leaf. Wollny[29] observed a great loss of plants from immature seed of winter rye, taking into account the number of plants growing in the fall and in the following spring, while the plants from ripe seed under the same conditions experienced no loss whatever (see table IV).

IV.—Winter Rye from Ripe and Unripe Seed.

Experiment conducted by Wollny.

Degrees of ripeness.	Number planted.	Growing in fall.	Growing in spring.	Wintered per cent.
Very green..................	100	97	40	41
In the milk..................	100	96	88	91
Pale yellow..................	100	100	100	100
Fully ripe..................	100	100	100	100

[29] L. c.

(*To be continued.*)

THE EFFECT OF FEMALE SUFFRAGE ON POSTERITY.

By James Weir, Jr.

The greatest, best, and highest law of Higher Civilization is that which declares that men should strive to benefit not himself alone, but his posterity.

I. The Origin of the Matriarchate.

In the very beginning woman was, by function, a mother; by virtue of her surroundings, a house-wife. Man was then, as now, the active, dominant factor in those affairs outside the immediate pale of the fireside. Life was collective; "communal was the habitation, and communal the wives with the children; the men pursued the same prey, and devoured it together after the manner of wolves; all felt, all thought, all acted in concert." Primitive men were like their Simian ancestors which never paired, and which roamed through the forests in bands and troops. This collectivism is plainly noticeable in certain races of primitive folks which are yet in existence, notably the Autocthons of the Aleutian Islands. Huddled together in their communal *Kachims*, naked, without thought of immodesty, men, women and children share the same fire and eat from the same pot. They recognize no immorality in the fact of the father cohabiting with his daughter—one of them naively remarking to Langsdorf, who reproached him for having committed this crime: "Why not? the otters do it!" Later in life the men and women mate; but even then there is no sanctity in the marriage tie, for the Aleutian will freely offer his wife to the stranger within his gates, and will consider it an insult if he refuses to enjoy her company. "As with many savages and half-civilized people, the man who would not offer his guest the hospitality of the conjugal couch, or the company of his best-looking daughter, would be considered an ill-bred person."

This laxity in sexual relations was, at first, common to all races of primitive men, but, after a time, there arose certain influences which modified, to a certain extent, this free and indiscriminate intercourse. Frequent wars must have occurred between hostile tribes of primitive men, during which, some of them (physically or numerically weaker than their opponents) must have been repeatedly vanquished, and many of their females captured, for, in those old days (like those of more recent times, for that matter) the women were the prizes for which the men fought.

Under circumstances like these, the few remaining women must have served as wives for all the men of the tribe; and, in this manner polyandry had its inception. Polyandry gives woman certain privileges which monandry denies, and she is not slow to seize on these prerogatives and to use them in the furtherance of her own welfare. Polyandry, originating from any cause whatsoever, will always end in the establishment of a matriarchate, in which the women are either directly or indirectly at the head of the government. There are several matriarchates still extant in the world, and one of the best known, as well as the most advanced, as far as civilization and culture is concerned, is that of the Nairs, a people of India inhabiting that portion of the country lying between Cape Comorin and Mangalore, and the Ghâts and the Indian Ocean. The Nairs are described as being the handsomest people in the world; the men being tall, sinewy, and extraordinary agile, while the women are slender and graceful with perfectly modeled figures. The Nair girl is carefully chaperoned until she arrives at a marriageable age, say, fourteen or fifteen years, at which time some complaisant individual is selected who goes through the marriage ceremony with her. As soon as the groom ties the *tali* or marriage cord about her neck, he is feasted and is then dismissed; the wife must never again speak to or even look at her husband. Once safely wedded, the girl becomes emancipated, and can receive the attentions of as many men as she may elect, though, I am informed, that it is not considered fashionable, at present, to have more than seven husbands, one for each day of the week. Of no importance, heretofore, after her farcical marriage, the Nair woman at once becomes a power in the councils of the nation; as a matter of course, the higher her lovers the higher her rank becomes and the greater her influence. Here is female suffrage in its primitive form, brought about, it is true, by environment, and not by elective franchise. As far as the children are concerned, the power of the mother is absolute; for they know no father, the maternal uncle standing in his stead. Property, both personal and real, is vested in the woman; she is the mistress and the ruler. "The mother reigns and governs; she has her eldest daughter for prime minister in the household, through whom all orders are transmitted to her little world. Formerly, in grand ceremonials, the reigning prince himself yielded precedence to his eldest daughter, and, of course, recognized still more humbly the priority of his mother, before whom he did not venture to seat himself until she had given him permission. Such was the rule from the palace to the humblest dwelling of a Nair." During the past fifty years, these people have made rapid strides toward civilization, monandry and monogamy taking the place of polyandry and polygamy, and fifty or an hundred years hence, this matriarchate will, in all probability, entirely disappear.

I have demonstrated, I think, clearly and distinctly, that matriarchy or female government, is neither new nor advanced thought, but that it is as old, almost, as the human race; that the "New Woman" was born many thousands of years ago, and that her autotype, in some respects, is to be found to-day in Mangalore. A return to matriarchy at the present time would be distinctly, and emphatically, and essentially retrograde in every particular. The right to vote carries with it the right to hold office, and, if women are granted the privilege of suffrage, they must be given the right to govern. Now let us see if we can not find a reason for this atavistic desire (matriarchy) in the physical and psychical histories of its foremost advocates. I will discuss this question in Part II of this paper.

II. THE VIRAGINT.

There are two kinds of genius; the first is progressive genius, which always enunciates new and original matter of material benefit to the human race and which is consequently healthy; the second is retrogressive genius, which is imitative and which always enunciates dead and obsolete matter long since abandoned and thrown aside as being utterly useless. The doctrines of communism and of nihilism are the products of retrogressive genius and are clearly atavistic, inasmuch as they are a reversion to the mental habitudes of our savage ancestors. The doctrines of the matriarchate are likewise degenerate beliefs, and if held by any civilized being of to-day, are in evidence of psychic atavism. Atavism invariably attacks the weak; and individuals of a neurasthenic type are more frequently its victims than are any other class of people. Especially is this true in the case of those who suffer from psychical atavism. The woman of to-day, who believes in and inculcates the doctrines of matriarchy, doctrines which have been, as far as the civilized world is concerned, thrown aside and abandoned these many hundred years, is as much the victim of psychic atavism as was Alice Mitchell who slew Freda Ward in Memphis several years ago, and who was justly declared a viragint by the court that tried her. Without entering into the truthfulness or falseness of the theory advanced by me some time ago (vide *N. Y. Medical Record*, September, 1893: "Effemination and Viraginity") in regard to the primal cause of psychic hermaphroditism, which I attributed and do still attribute to psychic atavism, I think that I am perfectly safe in asserting that every woman who has been at all prominent in advancing the cause of equal rights in its entirety, has either given evidences of masculo-feminity (viraginity), or has shown, conclusively, that she was the victim of psycho-sexual aberrancy. Moreover, the histories of every viragint of any note in the history of the world, show that they were either physically or psychically degenerate, or both. Jeanne d'Arc was the victim of hystero-epilepsy, while Catharine the Great was a dipsomaniac and a creature of unbounded and inordinate sensuality. Massalina, the depraved wife of Claudius, a woman of masculine type whose very form embodied and shadowed forth the regnant idea of her mind—absolute and utter rulership—was a woman of such gross carnality that her lecherous conduct shocked even the depraved courtiers of her lewd and salacious court. The side-lights of history, as Douglas Campbell has so cleverly pointed out in his "Puritan in Holland, England and America," declares that there is every reason to believe that the Virgin Queen, Elizabeth of England, was not such a pure and unspotted virgin as her admirers make her out to be. Sir Robert Cecil says of her that "she was more man than woman," while history shows conclusively that she was a pronounced viragint, with a slight tendency toward megalomania. In a recent letter to me, Mr. Geo. H. Yeaman, ex-Minister to Denmard, writes as follows: "Whether it be the relation of cause and effect, or only what logicians call a "mere coincidence," the fact remains that in Rome, Russia, France and England, political corruption, cruelty of government, sexual immorality —nay, downright, impudent, open, boastful indecency—have culminated, for the most part, in the eras of the influence of viragints on government, or over governors."

Viraginity has many phases. We see a mild form of it in the tom-boy who abandons her dolls and female companions for the marbles and masculine sports of her boy acquaintances. In the loud-talking, long-stepping, slang-using young woman we see another form, while the square-shouldered, stolid, cold, unemotional, unfeminine android (for she has the normal human form, without the normal human *psychos*) is yet another. The most aggravated form of viraginity is that known as homo-sexuality; with this form, however, this paper has nothing to do. Another form of viraginity is technically known as gynandry, and may be defined as follows: A victim of gynandry not only has the feelings and desires of a man, but also the skeletal form, features, voice, etc., so that the individual approaches the opposite sex anthropologically, and in more than a psycho-sexual way (*Krafft-Ebing*). As it is probable that this form of viraginity is sometimes acquired to a certain extent, and that too, very quickly, when a woman is placed among the proper surroundings, I shall give the case of Sarolta, Countess V., one of the most remarkable instances of gynandry on record. If this woman, when a child, had been treated as a girl, she would, in all probability, have gone through life as a woman, for she was born a female in every sense of the word. At a very early age, however, her father, who was an exceedingly eccentric nobleman, dressed her in boy's clothing, called her Sandor, and taught her boyish games and sports.

"Sarolta-Sandor remained under her father's influence till her twelfth year, and then came under the care of her maternal grandmother, in Dresden, by whom, when the masculine play became too obvious, she was placed in an institute and made to wear female attire. At thirteen, she had a love relation with an English girl, to whom she represented herself as a boy, and ran away with her. She was finally returned to her mother, who could do nothing with her, and was forced to allow her to resume the name of Sandor and to put on boy's clothes. She accompanied her father on long journeys, always as a young gentleman; she became a *roué*, frequenting brothels and *cafés* and often becoming intoxicated. All of her sports were masculine; so were her tastes and so were her desires. She had many love affairs with women, always skillfully hiding the fact that she herself was a woman. She even carried her masquerade so far as to enter into matrimony with the daughter of a distinguished official and to live with her for some time before the imposition was discovered. The woman whom Sandor married is described as being "a girl of incredible simplicity and innocence;" in sooth, she must have been! Notwithstanding this woman's passion for those of her own sex, she distinctly states that in her thirteenth year she experienced normal sexual desire. Her environments, however, had been those of a male instead of a female, consequently her psychical weakness, occasioned by degeneration inherited from an eccentric father, turned her into the gulph of viraginity, from which she at last emerged, a victim of complete gynandry. I have given this instance more prominence than it really deserves, simply because I wish to call attention to the fact that environment is one of the great factors in evolutionary development.

Many women of to-day, who are in favor of female suffrage, are influenced by a single idea; they have some great reform in view, such as the establishment of universal temperance, or the elevation of social morals. Suffrage in its entirety, that suffrage which will give them a share in the government, is not desired by them; they do not belong to the class of viragints, unsexed individuals, whose main object is the establishment of a matriarchate. Woman is a creature of the emotions, of impulses, of sentiment, and of feeling; in her the logical faculty is subordinate. She is influenced by the object immediately in view, and does not hesitate to form a judgment which is based on no other grounds save those of intuition. Logical men look beyond the immediate effects of an action and predicate its results on posterity. The precepts and recepts which form the concept of equal rights also embody an eject which, though conjectural, is yet capable of clear demonstration, and which declares that the final effect of female suffrage on posterity would be exceedingly harmful.

We have shown, in Part II of this paper, that the pronounced advocates and chief promoters of equal rights are probably viragints—individuals who plainly show that they are psychically abnormal; furthermore, we have seen that the abnormality is occasioned by degeneration, either acquired or inherent, in the individual. Now let us see, if the right of female suffrage were allowed, what effect it would produce on the present environment of the woman of to-day, and, if any, what effect this changed environment would have on the psychical habitudes of the woman of the future. This portion of the subject will be discussed in Part III of this paper.

III. THE DECADENCE.

It is conceded that man completed his cycle of physical development many thousands of years ago. Since his evolution from his pithecoid ancestor, the forces of nature have been at work evolving man's psychical being. Now, man's psychical being is intimately connected with, and dependent on, his physical being, therefore, it follows that degeneration of his physical organism will, necessarily, engender psychical degeneration also. Hence, if I can prove that woman, by leading a life in which her present environments are changed, produces physical degeneration, it will naturally follow that psychical degeneration will also accrue; and, as one of the invariable results of degeneration is atavism, both physical and psychical, the phenomenon of a social revolution, in which the present form of government will be overthrown and matriarchy established in its stead, will be, not a possibility of the future, but a probability. That the leaders of this movement in favor of equal rights look for such a result, I have not the slightest doubt; for, not many days ago, Susan B. Anthony stood beside the chair of a circuit judge in one of our court-houses, and, before taking her seat, remarked that there were those in her audience who doubtless thought "that she was guilty of presumption and usurpation," but that there would come a day when they would no longer think so. Statistics show clearly and conclusively that there is an alarming increase of suicide and insanity among women, and I attribute this wholly to the already changed environment of our women. As the matter stands, they have already too much liberty. The restraining influences, which formerly made woman peculiarly a housewife, have been, in a measure, removed, and woman mixes freely with the world. Any new duty added to woman as a member of society would modify her environment to some extent and call for increased activity. When a duty like suffrage is added, the change in her environment must, necessarily, be marked and radical, with great demands for increased activity. The right of suffrage would, unquestionably, very materially change the environment of woman at the present time, and would entail new and additional desires and emotions which would be other and most exhausting draughts on her nervous organism.

The effects of degeneration are slow in making their appearance, yet they are exceedingly certain. The longer woman lived amid surroundings calling for increased nervous expenditure, the greater would be the effects of the accruing degeneration on her posterity. "Periods of moral decadence in the life of a people are always contemporaneous with times of effeminancy, sensuality and luxury. These conditions can only be conceived as occuring with increased demands on the nervous system, which must meet these requirements. As a result of increase of nervousness, there is increase of sensuality, and, since this leads to excess among the masses, it undermines the foundations of society—the morality and purity of family life" (Krafft-Ebing). The inherited psychical habitudes handed down through hundreds and thousands of years would prevent the immediate destruction of that ethical purity for which woman is noted, and in the posession of which she stands so far above man. I do not think that this ethical purity would be lost in a day or a year, or a hundred years for that matter; yet, there would come a time when the morality of to-day would be utterly lost, and society would sink into some such state of existence as we now find *en evidence* among the Nairs. In support of this proposition I have only to instance the doctrines promulgated by some of the most advanced advocates of equal rights. The "free love" of some advanced women, I take it, is but the free choice doctrine in vogue among the Nairs and kindred races of people.

John Noyes, of the Oneida Community, where equal rights were observed, preached the same doctrines. It is true that these people are degenerate individuals, psychical atavists; yet, they faithfully foreshadow in their own persons that which would be common to all men and women at some time in the future, if equal rights were allowed and carried out in their entirety.

This is an era of luxury, and it is an universally acknowledged fact that luxury is one of the prime factors in the production of degeneration. We see forms and phases of degeneration thickly scattered throughout all circles of society, in the plays which we see performed in our theatres, and in the books and papers published daily throughout the land. The greater portion of the *clientele* of the alienist is made up of women who are suffering with neurotic troubles, generally, of a psychopathic nature. The number of viragints, gynandrists, androgynes, and other female psycho-sexual aberrants is very large indeed.

It is folly to deny the fact that the right of female suffrage will make no change in the environment of woman. The New Woman glories in the fact that the era which she hopes to inaugurate will introduce her into a new world. Not satisfied with the liberty she now enjoys, and which is proving to be exceedingly harmful to her in more ways than one, she longs for more freedom, a broader field of action. If nature provided men and women with inexhaustible supplies of nervous energy, they might set aside physical laws and burn the candle at both ends without any fear of its being burned up. Nature furnishes each individual with just so much nervous force and no more; moreover, she holds every one strictly accountable for every portion of nervous energy which he or she may squander, therefore, it behooves us to build our causeway with exceeding care, otherwise we will leave a chasm which will engulph posterity.

The baneful effects resulting from female suffrage will not be seen to-morrow, or next week, or week after next, or next month, or next year, or a hundred years hence, perhaps. It is not a question of our day and generation; it is a matter of involving posterity. The simple right to vote carries with it no immediate danger, the danger comes afterward; probably many years after the establishment of female suffrage, when woman, owing to her increased degeneration, gives free rein to her atavistic tendencies, and hurries ever backward toward the savage state of her barbarian ancestors. I see, in the establishment of equal rights, the first step toward that abyss of immoral horrors so repugnant to our cultivated ethical tastes—the matriarchate. Sunk as low as this, civilized man will sink still lower—to the communal *Kachims* of the Aleutian Islanders.

EDITOR'S TABLE.

—For reasons not fully set forth, a considerable number of persons at one time adopted the opinion that the coëducation of the sexes possesses advantages over their separate education, and accordingly that system has been introduced into numerous schools of various grades. Consideration of certain facts of nature would, it might be supposed, have suggested that there might be some objections, but it is not the habit of a large class of persons to consider natural facts in the matter of sex. Now that the system has been in operation for many years, it is possible to see more clearly than before, whether the suspicions of the opponents of the system were well-founded or not. We make no account of the opposition of persons who think a college or university education unnecessary for women. Among the best educated men, such a position probably has few supporters.

Experience shows that in classes composed of both sexes, order is more easily maintained ; boys are less disorderly and girls are less silly. The natural instinct for the respect of the other sex works wonders in this, as in other relations of life. Hence many teachers and professors think highly of coëducation. If we consider the interests of the students rather than those of the teachers, however, a different conclusion is indicated. It is well-known that the rate of growth in its later years is widely different in the sexes ; the female becoming mature several years earlier than the male. This fact is the simple explanation of the natural antagonism which exists between the sexes of identical age during their "teens." Neither finds its ideal in the other sex of its age, the young woman especially and naturally finding it in older men who are as mature as herself. In mixed classes she will often excel the boys and take the prizes, a consequence not only of her maturity, but also of her greater sensitiveness to the penalties of failure. That women have, of later years, so often taken leading positions in competitive examinations is not necessarily an evidence of a corresponding superiority of intellectual endowment, but is often the natural result of the inequality of development between herself and her male competitors. We would, in fact, look for such a result as a necessary consequence of the conditions.

The effect of this state of affairs is bad on both sexes. It leads to mistaken conclusions as to the relative capacities of the two, which may lead to disastrous results in after life. It is calculated to produce in a considerable class of boys a distaste for study, and a preference in after years for uneducated women. To this extent it retards rather than aids human progress. It is a fact that, in a number of coëducational schools, the girls largely outnumber the boys, since the latter fail to become interested in their studies, and prefer to leave school and go into business. Whether it induces in girls a contempt for the intellectual furniture of the opposite sex we are not in a position to say, but it has done a great deal towards confirming certain doctrinaires in their a priori belief in the intellectual equality of the sexes.

It is alleged that there are moral reasons why coëducation is better than separate education, and this opinion is well-founded so far as it relates to the mutual benefits of association. But this association need not necessarily be in classes. A model institution would be one in which the classes should be separate, but association at other times easy. Such association could be obtained at meals and on other stated occasions, so as to represent as nearly as possible the family relation.

In universities, the graduate courses should be open equally to both sexes, since those who seek them are mature and stand on an equal footing.

—Experience of the effects of electrical currents on the human body does not sustain the New York method of executing criminals by electric shocks as either effective of humane. We have, so far, failed to find an electrician who can describe the course of an electric current after it enters the human body. Experience has abundantly shown that some men may tolerate currents of much higher voltage than others, so that there is no fixed standard of fatal efficiency. It is not certain that persons apparently killed by such currents are really dead, for there are cases of resuscitation from shocks of a strength which the New York executioners suppose to be fatal. The offer of experts to rescusitate the victims of the electric chair have been declined by the New York authorities. The testimony of some persons who have been resuscitated from apparent death by electricity, is that while all their motor functions were suspended, their consciousness was active. There may then be some truth in the assertion that the real execution under the New York law takes place at the autopsy. We cannot but regard the enterprise of the authors of this law as premature, and as involving a trifling with unknown conditions, which is barbarous. The law should be repealed. As a substitute for this and all other forms of execution, the guillotine has everything in its favor.

Our hopes of the benefits to science to be derived from the Field Museum of Chicago have not been realized. Nearly all of the scientific men who originally obtained positions there, have left it with expressions of dissatisfaction. This was to have been expected as a consequence of the organization which Mr. Field permitted. The most active member of the management was a successful lumber merchant, and the appointee as director was of an equally impossible stamp. Americans sometimes wonder why European Museums of Natural History are so much superior to our own. The answer is that in Europe competent scientific men manage them ; in America they do not, with the sole exception of a museum which is connected with a university (Harvard), and one in New York where exceptional sagacity holds the reins. Chicago begins, in this matter, at the bottom of the ladder, and we will live in hopes. Perhaps Mr. Field himself will some day come to the rescue, and insist that the director of the Museum shall be a scientific man of proved ability, and that the only function of the trustees shall be to see that the investments are good, and that the expenses shall not exceed the income.

THE LAST volume of the reports of the Challenger Expedition has been published, and English biologists are reviewing the work. A late number of our esteemed contemporary "Natural Science," consists mainly of a symposium on the results obtained, and the editors congratulate their countrymen on the successful conduct and completion of the enterprise. We join in their congratulations; for Englishmen may well be proud of their work; and Carpenter as its projector, and Moseley and Murray as its managers, will ever be held in esteem by naturalists the world over. By the way our contemporary in another number shows that there is eruptive matter in some of its editorial substrata. It comes to the surface in some strong language anent of a short communication by Dr. Patton to the NATURALIST. Perhaps the irate editor is not familiar with all the circumstances of the case. Neither are we.

RECENT LITERATURE.

From the Greeks to Darwin.[1]—In a volume of 260 pages Professor Osborn presents the salient points in the history of the growth of the evolution idea in the European mind. Beginning with the Greek philosophers, the author discusses their conceptions and gives a résumé of the legacy of the Greeks to later evolution. Then follows an account of the contributions of the theologians of the Middle Ages, and of the natural philosophers from Bacon to Schelling. Due credit is given both to the speculative evolutionists, of whom Oken is a type, and to the great naturalists of the eighteenth century who laid the real foundations of the modern evolution idea. Several pages are

[1] From the Greeks to Darwin. An Outline of the Development of the Evolution Idea. By Henry Fairfield Osborn. New York, 1894. Macmillan and Co.

devoted to tracing the rise and decline of evolutionary thought in France, from Buffon to Geoffroy St. Hilaire (Isidore), in which attention is called to the opposing views of what may be termed the Buffon-Lamarck adherents and those of the Cuvier-Linnaeus school. The closing chapter is an exposition of the views of Darwin and Wallace and their precursors in the teaching of natural selection.

This review of the history of thought on organic evolution is timely and will interest a large circle of readers. It is judicial in treatment, and although the author is known to have decided opinions on the subject, they do not appear. He reminds us that the early fathers of the Christian church, and conspicuously Augustine, were evolutionists and that Suarez was not, although the contrary has been alleged. He points out the services of Buffon and Erasmus Darwin to thought, and shows the imaginative genius of the former, and the practical sagacity of the latter. In discussing Lamarck, while crediting him with clear-minded sagacity, he shows the superficial character of many of his attempted explanations. Nevertheless he says in closing his review, " We must close by placing Lamarck in the first rank. He was the first naturalist to become profoundly convinced of the great law, and to place it in the form of a system." He shows that Lamarck was the first author to understand the nature of actual phylogeny, and depict it graphically in true form. Of Darwin, the author says, " The long retention of his theory from publication marks the contrast of his caution with the impetuousness of Lamarck." But it must be remembered that the Recherches sur l'Organisation des Corps Vivants was not written until 1802, when Lamarck was no longer young, and had spent his life in study. Further, " He " (Darwin) " sought a hundred facts and observations where his predecessors had sought one ; his notes filled volumes, and he stands out as the first evolutionist who worked upon true Baconian principles. It was this characteristic which, combined with his originality, won the battle for the evolution idea." This is an estimate of Darwin which time will confirm.

The perusal of this book will give a just view of the history of thought on the doctrine of organic evolution, and will enable the reader to determine the respective parts which the contributors to our knowledge have played. The improved means of reaching conclusions which the additions to the store of facts in later periods placed within the reach of later authors, are referred to. The vast increase in our knowledge of facts since Darwin, have thrown so much light on the subject that it is to be hoped that Professor Osborn will at some future time favor us with a volume on the advances made during this period also.

"**The Glacial Nightmare and the Flood.**"[1]—To American geologists, the title of this work is almost a challenge, and might cause it to be ignored, but to every student of superficial geology it is an invaluable book. It is a well-arranged history of the observations and growth of the science of superficial geology. To many of the fathers of this department of science, it is a tardy justice, and impresses a fair reader with the vast array of facts which were collected at an early date, not in Europe alone, but also in America, leaving for the later observers far less new work than our modern writers usually recognize. Another lesson taught demonstrates that the generalized conclusions of the greatest idols of science are by no means established, and often retard progress. The teachings of each succeeding generation replace, to some extent, those of the preceding, until at last reaction sets in and separates the chaff and shows us how much the early scientific geniuses did for their science, though, perhaps, drawn off into erroneous by-ways.

The work fairly sets forth the rise of the doctrine of floods and its abandonment; of the growth and limitation of the iceberg theory; of the origin and culmination of the glacial theory, with Schimper at the head, and originating the term *Ice Age.* Thus far the author's hand is hardly seen in the book. The treatise is of special value in systematically bringing together the facts and views and doing justice to the authors of works, many of which have been overlooked or are not accessible to American geologists.

On the subject of the unity of the glacial period the evidence is fairly stated, but the author marshalls an array of data favoring the unity of the Age in its general aspect, a point upon which American glacialists differ. The difficulties in accepting the astronomical causes of the Ice Age are fairly set forth, and these adverse conclusions will be received by most American geologists. The cause of glacier motions, and the mechanical effects of glaciers are discussed from their physical aspects, and appear very satisfactory to most observers. The facts showing the former extension of glaciers are arranged, and show how the ice-cap theory has given place to continental glaciers. But here the work is directed against the extreme views, giving rise to the title of the book, on the ground of lack of evidence, and challenges the right of

[1] By Sir Henry H. Howarth, K. C. I. E., M. P., F. G. S., etc. 2 vol. pp. 1–920. Sampson, Low, Marston & Company, London.

appealing to transcendental views. Although some American glacialists will here dissent, yet the treatment of the evidence is very fair, and from the facts collected the book cannot be overlooked by any scientific observer.

The work closes with suggestions to explain some difficulties carefully analyzed, wherein the author appeals to "waves of translation," a modification of the old doctrine of catastrophies (as does also Prof. Prestwich in some of his recent contributions). It is surprising that the idea of cataclysms in some form, whether glacial or otherwise, has permeated the views of so many writers, often without their apparent knowledge, who are considered good disciples of uniformitarianism.

In spite of the title, the work is just such a volume of condensation of observations, gathered from the whole world, as is needed for a manual of references, for these are much more prominent than the views of the author, even in the latter part of the book. It, however, shows that there may be two views of great problems. From the work, one is almost surprised to find how much the early geologists in America had done in surface geology, which has been almost forgotten, yet this formed the foundation of even the modern science of superficial geology.

—J. W. S.

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General Notes.

MINERALOGY.[1]

Universal Stage for the Microscope.—Federow has done a great service to mineralogists and petrographers by introducing instruments based on the universal or theodolite principles. His application of these principles to the measurement of crystal angles is the goniometer with two graduated circles, which has already been referred to in these notes. Extending his study to the field of crystallographic-optical measurements, he has devised the universal microscope stage,[2] which increases the usefulness of the microscope by permitting a quite new class of observations to be made. The microscope stage now in use permits of only such motions as always retain the slide in a plane parallel to the initial one. Federow's universal stage allows the slide to be moved into any position whatsoever by two rotations about axes normal alike to one another and to the microscopès axis. He has described and figured two different types of stage, one better adapted to ordinary work and also permitting the slide to be immersed in liquids if desired, while the other has the advantage of greater simplicity and has a convenient arrangement for orienting the slide in its own plane, so that any line (e. g., a twinning trace) may be brought parallel to the immovable axis of the stage. In answer to some inquiries,

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitsch. f. Kryst., xxii, pp. 229–268, pl. 9 (1893).

Professor v. Federow has kindly informed the editor of these notes that he has designed a third and simpler type of stage, specially adapted to petrographical work, which will shortly be described. All these forms can be attached to any of the standard types of petrographical microscopes by screwing to the mechanical stage. They require, however, a special form of slide, which is circular, with a diameter of about 2 *cm.*, and, when in use, this is held in an ebonite holder with circular opening, in which the slide can naturally be given any desired orientation.

Parallel polarized light is used with this stage, and the presence of an axis of the ellipsoid of elasticity in any section is indicated by first bringing the two principal directions of the section parallel to the two axes of the stage and then rotating the slide about each separately. If either of the principal directions is an axis of elasticity, the slide will evidently remain dark when rotated about the axis normal to it, whereas otherwise it will show interference colors. This affords the following scheme for determining the symmetry of a mineral from examination of random sections in a rock slide:

Isometric. Every section is isotropic.

Hexagonal and Tetragonal. Every section has one axis of elasticity.

Orthorhombic. Sections lying in the zones of the three crystallographic axes contain an axis of elasticity.

Monoclinic. Sections belonging to the zone of the axis of symmetry contain an axis of elasticity.

Triclinic. Entire lack of such sections.

Some of Federow's applications of this instrument to the study of the feldspars will be referred to later.

A somewhat different form of stage embodying the same idea, but adapted to the study of the ordinary form of slides, has been since devised by Klein and manufactured by Fuess for attachment to his instruments.[3] Klein[4] has also designed a form of this stage (likewise manufactured by Fuess for his large stand) to be used with convergent as well as parallel polarized light, and this can be used to find the position of the optic axes and measure the optical angle in crystals as well as in sections.

Connection Between Atomic Weight of Contained Metals and Morphological and Optical Properties of Crystals.—The relations found by Tutton to exist between the atomic weights

[3] Groth, Physikal. Kryst., 3d ed., p. 749, figs. 688 and 689 (1895).

[4] Ibiden, p. 750, fig. 691. Cf. also Sitzungsber. d. Akad. d. Wiss., Berlin, 1895, p. 91.

of the contained metals and the crystal characters of the potassium, rubidium, and cæsium double sulphates of formula $R_2M(SO_4)_2 6H_2O$,[5] have been found by Muthmann[6] to hold also for the permanganates. Continuing his studies Tutton[7] has made an equally exhaustive crystallographic study of the normal sulphates of the same alkali metals. The earlier determinations made on these substances seemed to be in conflict with the facts brought out by Tutton in studying the double sulphates, but after most exhaustive and precise observations with specially-devised apparatus, Tutton is able to show that the recorded observations on these salts are incorrect, and that the intermediate position crystallographically of rubidium is established for this series as well as the other. There is shown to be a progression corresponding to the increase of atomic weight of the contained metal as regards the axial ratio, the size of the interfacial angles, and the molecular volume. The differences in the magnitude of the analogous angles, seems, however, to be less, the higher the symmetry, approaching, Tutton suggests the absolute identity requisite to isometric symmetry. The habit of the crystals seems to obey the same law. In a discussion of the relative linear dimensions of the crystal elements of the Bravais-Sohnche space lattice, is communicated a simple method of determining these values which was suggested by Becke. Becke's formulæ are:

$$a_0 = \sqrt[3]{\frac{a^2V}{c}} \qquad b_0 = \sqrt[3]{\frac{V}{ac}} \qquad c_0 = \sqrt[3]{\frac{c^2V}{a}}$$

in which a_0, b_0, and c_0 (X Ψ Z of Muthmann) are the *relative* dimensions of the crystal element in the direction of the correspondingly named crystal axes; a, b, and c are the unity lengths of the crystal axes; and V is the molecular volume. Tutton proposes to call the distances a_0 b_0 c_0 (Muthmann's *topische axen*) *distance ratios of the crystal elements*, and, as they are only relative values, to make one equal to unity as in the case of axial ratios. When these values are determined for the three sulphates, it is found that rubidium occupies the intermediate position. Tutton also finds that these salts follow the Bravais-Sobnche theory in that the planes of cleavage { (010) most perfect and (001) less perfect } are the planes in which the elementary parallelograms of the lattice system are respectively smallest and next smallest.

The optical study consisted in the determination of the principal indices of refraction in prisms prepared with unusual care by the deli-

[5] See these notes.

[6] Zeitsch. f. Kryst., xxii, p. 497.

[7] Jour. Chem. Soc. London, 1894, pp. 628–717.

cate apparatus described by him before the Royal Society, and also in the measurement of the optical angle (in sections prepared accurately normal to a besectrix by means of the same apparatus) in five different wave lengths of light. Here again the intermediate position of rubidium is proven by the values of the indices of refraction along corresponding crystallographic axes. Rubidium sulphate is found to be quite a unique substance optically, having an *extremely* low double refraction (*small differences* between the indices of refraction), but, in general, a large optical angle (*large relative differences* between refractive indices), with high dispersion of the optic axes due to the fact that differences in the magnitude of $2V$ for different wave lengths are large by reason of the extremely small differences between the indices (low double refraction). Similarly the changes in $2V$ caused by rise of temperature are abnormally large. Further, since the index of refraction along crystallographic c increases with rise of temperature faster than those along the other axes, and more in amount than the difference between the indices along c and b at the ordinary temperature, the result is a closing up of the optical angle with a rise of temperature and an opening out in the plane normal to its first position.

The following figures, which are the ratios of the optical elasticities along the crystallographical axes, tell this story:

$$\text{At ordinary temperature } a : b : c = \overset{\mathfrak{c}}{0.9991} : \overset{\mathfrak{a}}{1} : \overset{\mathfrak{b}}{0.9999}$$

$$\text{At } 180°, \quad a : b : c = \overset{\mathfrak{c}}{0.9993} : \overset{\mathfrak{b}}{1} : \overset{\mathfrak{a}}{1.0006}$$

Somewhat similar changes have been found to occur in heating potassium sulphate, but only at higher temperatures. The many results of this elegant and thorough study can not be given in a review of these proportions, and the reader is referred to the original paper.

Boleite and Nautokite from Broken Hill, N. S. W.—Liversidge[8] describes boleite from Broken Hill, N. S. W., in cubic crystals as much as seven millimetres on an edge and modified by both the octahedron and the dodecahedron. The matrix is hematite and quartz. The mineral has heretofore been found only at Boleo in Lower California. From the same locality the same writer describes nautokite, the lower chloride of copper, in fragments of crystals, and beautiful crystals of cerargyrite and cuprite.

New Minerals from Chili.—The late Dr. Dietze,[9] of Tantal, Chili, a few years since studied chemically several new minerals from

[8] Read before the Royal Society of New South Wales, June 6th, 1894. (Separate.)

[9] Zeitsch. f. Kryst., 19, p. 445 (1891).

the salt pampas of that country. Osann[10] has recently studied three of these minerals crystallographically and optically. Some of his results are summarized below:

Darapskite ($Na_2SO_4+H_2O$, Dietze) from Pampa del Toro near Pampa, where it occurs abundantly with blödite. Monoclinic with axial ratio $a:b:c = 1.5258 : 1 : 0.7514$. $\beta = 77°5'$. Habit tabular parallel to the orthopinacoid. The observed forms were (100), (001), (010), (110), ($\bar{1}01$), ($\bar{2}01$), (101), (302), (011), ($\bar{1}11$), (111), and (121). Twins are common according to (100), and are sometimes polysynthetic. H, 2–3, G, 2.203. Easily soluble in water.

Lautarite { $Ca(IO_3)_2$, Dietze } from Calcium Chloride Pampas, also Pampa del Pique III and in Pampa Grove. Monoclinic with axial ratio $a:b:c = 0.6331 : 1 : 0.6462$. $\beta = 73°38'$. The prismatic crystals show the following forms: (110), (120), (010), (001), (011), (101) and ($\bar{1}01$). Cleavage parallel to (011). The crystals vary from colorless to bright wine-yellow, and are difficultly soluble in water. H, 3–4, G, 4.59 (Dietze).

Dietzite. This mineral occurs in the Chloride of Calcium Pampas, and was determined by Dietze to have the formula $7\,Ca\,(IO_3)_2\,8\,Ca\,Cr\,O_4$. It has monoclinic symmetry with axial ratio $a:b:c = 1.3826 : 1 : 0.9515$. $\beta = 73°28'$. Crystals tabular according to 100, possessing the forms: (100), (010), (001), (110), (210), ($\bar{1}01$), ($\bar{2}21$) and ($\bar{2}23$). H, 3–4, G, 3.698. Soluble in hot, but only slightly soluble in cold, water. The mineral is named by Osann in honor of the finder, Dr. Dietze, who perished in a snow storm while on a scientific expedition in the Andes. Lautarite and Dietzite are interesting as being the first salts of iodic acid that have been found in the mineral world.

Miscellaneous.—Rinne[11] determines the symmetry of crystals of metallic aluminium to be probably isometric from a study of quite perfect growth forms. Lacroix[12] describes well crystallized epidote from or near Voheimar, Madagascar, which have developed the base, orthopinacoid, the unit positive orthodome, and also (210), ($\bar{1}02$), (011) and ($\bar{1}11$). He also makes a correction to his earlier paper[13] on the pyromorphite of New Calidonia, adding the form ($11\bar{2}1$) and replacing the described forms ($50\bar{5}4$) and ($10.0.\overline{10}.1$) by the forms ($15.0.\overline{15}.14$) and ($90\bar{9}1$). Ussing,[14] in connection with a mineralogical-petrographical

[10] Ibidem, 23, pp. 584–589, pl. 7 (1894).

[11] Neues Jahrbuch f. Min., etc., 1894, II, pp. 1–2.

[12] Bull. Soc. Franç Min., xvii, pp. 119–120, May, 1894.

[13] Ibidem, pp. 120–121.

[14] Mineralogisk-petrografiske Undersogelser af Gronlandske Nefelinsyeniter og beslaegtede Bjaergarter, by N. V. Ussing, pp. 220, pls. 7, 1894.

investigation of the Greenland nephelene syenites and their associated rocks, describes nepheline altered to cancrinite, sodalite, analcite, hydronephelene, natrolite, and potash mica; also sodalite altered to analcite and natrolite and eudialite altered to katapleite and zircon. Besides numerous varieties of feldspar, augite and hornblende, he describes Ainigmatite and Kölbingite from these rocks. The work is printed in the Danish language.

WM. H. HOBBS.

GEOLOGY AND PALEONTOLOGY.

The Protolenus Fauna.—An important paper based on the collections made by W. D. Matthews, of fossils from the lower part of the Cambrian rocks of New Brunswick in 1892, '93 and '94, was recently communicated to the New York Academy of Sciences by G. F. Matthews. From this article the following abstract has been made of the character of the fauna and the conclusions arrived at from its study.

The fauna described is one of the oldest known. It consists of Foraminifera, Sponges, Molluscs and Crustaceans. All the Foraminifera described are referred to the genera Orbulina and Globigerina; the Sponges include Protospongia and others. The Molluscs are mostly hyalithoid shells of the genera Orthotheca, Hyolithus and Diplotheca. The Crustaceans are chiefly of the two groups, Ostracoda and Trilobita, of which the former are remarkable for the large number of genera and species, as compared with the trilobites; two predominant and characteristic genera are Hipponicharion and Beyrichona. All the trilobites are of genera peculiar to this fauna, except Ellipsocephalus, which, although one of the dominating types, also occurs in the Paradoxides beds of Europe. The most characteristic genus of trilobites is Protolenus, which is abundantly present in the typical beds.

The following are some of the salient characters of the fauna as at present known: *All the trilobites have continuous eye-lobes.* This is decidedly a primitive character, and its value in this respect is shown by the genus Paradoxides of the overlying fauna, which began with small species having such eye-lobes, and culminated in the large forms of the upper Paradoxides beds in which the eye-lobe was considerably shortened.

The important family of Ptychopariidae is absent.

The genus Conocoryphe is absent. This is specially a type of the Lower Paradoxides beds, and under the name of *Conocoryphe trilineata* (*Atops trilineatus*) is claimed as a characteristic fossil of the Olenellus Zone.

The genus Microdiscus is absent. This trilobite is especially characteristic of the Olenellus Zone, and continued to live with Paradoxides.

The genus Olenellus is absent. Hence, although this fauna apparently holds the place where we might naturally expect to find Olenellus, that genus proves to be absent, or, at least, not at all characteristic; and, as so many of its associate genera also are absent, *we cannot regard this fauna as the fauna of Olenellus.*

In this fauna there is a very primitive assemblage of Brachiopods and at least one pelagic mollusc, having a helicoid shell and supposed to be free swimming Heteropod.

The author distinguishes this fauna from that of Olenellus by two marked features; it is more *primitive* and also more *pelagic.* The former is shown by the trilobite forms, and the latter by the following facts: The absence of forms differentiated for shore-conditions; trilobites with fixed outer cheeks are absent; calcareous corals and sponges are rare; thick shelled Brachiopods and Orthidae are rare: no Lamellibranch is known, but Foraminifera are common in some of the beds. (Science, April, 1895.)

Formation of Oolite.—In view of Dr. Rothpletz's recent investigations concerning the lime-secreting fission-algae of the Great Salt Lake, and his own studies of the structure of the Jurassic Pisolite, Mr. Wethered offers the following explanation of the formation of Oolitic granules:

Minute fragments of remains of calcareous organisms, such as corals, polyzoa, foraminifera, crinoids, etc., collected on the floor of the sea. These became nuclei to which the oolite-forming organisms attached themselves, gradually building up a crust. Sometimes this growth was concentric, sometimes at right-angles to the nucleus, or the two combined. When the growth was concentric, other tubules frequently cropped up in other directions and crossed the concentric tubules. At the same time, calcareous material was secreted, and the interstitial spaces between the tubules were filled.

The oolite-forming organisms may be allied to the algae, or they may be even lower in the scale of life. *Girvanella,* identified by the author in the Jurassic Pisolite, the first type of oolite-forming organism discovered, is simply a tubule. (Quart. Journ. Geol. Soc., 1895.)

The Extinction of Saurians.—In regard to the extinction of species, Mr. Charles Morris offers as an explanation of the disappearance of the Cretaceous reptiles, an indirect assault by the placental mammals, viz.: the destruction of the eggs, and possibly of the young, of the reptiles. The author points out that the mammals, equipped with a higher grade of intelligence than their powerful rivals, probably adopted new methods of attack more rapidly than the reptiles acquired means of defense, so that the latter eventually found themselves at a disadvantage in the competition for supremacy. Multitudes of prowling creatures, small and agile, having become aware of usefulness of reptiles' eggs for food, would soon bring about a perceptible diminution of reptilian life. Only the smaller and most prolific forms would continue to exist, or those that developed means of hiding or otherwise protecting their eggs from the assaults of the hungry mammals. (Proceeds. Phila. Acad., 1895.)

The Geology of Cuba.—The following geological history of Cuba is given by Mr. Robert T. Hill. The conclusions are based on stratigraphic and paleontologic data obtained during a personal recognoissance made in 1894.

1. In Pre-Tertiary times, an old land existed, almost as extensive in area as the present Island. Whether this old land was insular, multi-insular, or connected with other Antillean areas on the mainland, I will not speculate. The submarine topography indicates that it was not. Its composition and structure, however, show that it was an area of active vulcanism accompanied by great metamorphism and eruptive flows. If there are preserved in it any traces of Pre-Tertiary sedimentation, they are largely overwhelmed and almost obliterated by the vulcanism, metamorphism and later erosion. Paleozoic, Triassic Jurassic and Cretaceous sediments have been reported by De Castro in localities, but their physical history is unknown.

2. It is also certain that during Tertiary times, embracing the Eocene and Neocene periods, this ancient nuclear land, with all of its geographic outlines, completely subsided beneath sea-level, and that it was covered with limestone sediments, which were originally derived from the sea, not the island itself, for there is no semblance of limestone material in the rocks of the Pre-Tertiary land which could have furnished material for the Tertiary rocks. That this subsidence was profound we may reasonably conclude from the thickness of the older nucleal region, now visibly covered by the limestone beds, which have been horizontally elevated to a height of at least two thousand feet. In other words, the

Pre-Tertiary subsidence may have been at least to an equal depth. During this epoch of Tertiary subsidence, a thousand feet of Tertiary limestone were accumulated over the old nucleal island.

3. After the close of Tertiary times, the Tertiary sediments were greatly warped and folded, concurrently with an emergence of the land from the sea. This movement was orogenic.

4. Following this began the epoch of epeirogenic or regional elevation. During Pleistocene time the island underwent the first of these upward impulses to its present height, with the exception of about six hundred feet represented in still later movement. This older Pleistocene or Yunque elevation raised the main area to a height of at least two thousand feet in its eastern half, and fifteen hundred feet in its western half. How much higher it extended we cannot tell, so great has been the erosion. This elevation was so rapid and general throughout the island that no coastal accumulations are preserved around its perimeter. This elevation likewise developed the present outline of the island almost in its entirety, and perhaps in greater area, which has since been destroyed by erosion.

5. Following this older and greater Post-Tertiary elevation, and intervening between it and the time of the Cuchilla, or five hundred foot level, there was a long period of erosion, cutting down the country to the Cuchilla plain, which was at that time marine base level.

6. Renewed and general elevation of the island commenced in recent times, after the period of rest recorded in the Cuchilla level. The later terraces, sea cliffs, base levels and modern coral reefs and savanna deposits of the south coast were then elevated. It is also evident that in this later period, elevation was intermittent, accompanied by slight pauses. It is difficult to exactly fix the time of this latest elevation. It was certainly very recent, and a considerable period later than the old Yunque elevation. It cannot be older than the late Pliocene, and it may or may not be in progress at present. (Bull. Harvard Mus. Comp. Zool., Vol., XVI, 1895.)

Former Altitude of Greenland.—Recent glacial studies in Greenland was chosen for the subject of the annual address of the Geological Society of America, delivered by the President, T. C. Chamberlin. In his closing remarks, the speaker referred to the former altitude of Greenland as follows:

"There is no ground to question the former elevation of Greenland. Its plateaus, like its valleys, indicate this; but glacialists are especially concerned to know whether the former elevation of Greenland was coincident with its glaciation or not. Aside from the contours of the plateaus and valleys, which seem to indicate a fashioning rather by meteoric agencies than by pronounced glaciation, the driftless area appears to afford the most specific ground for induction. Bearing in mind that this is a small area between the present edge of the ice and sea-level, which would be overridden easily and completely by an advance of the ice-edge of less than five miles, it seems necessary to conclude that at the time of the former greater elevation the climatic agencies of glaciation could not have been what they are now, but for the increased elevation would have caused an extension sufficient to overwhelm the driftless area. If it is safe to conclude that elevation favors glaciation, then it is necessary to conclude that during any period of previous glaciation, there was here no elevation sufficient to cause an advance, unless accompanied by counteracting adverse climatic conditions. The ruggedness of Dalrymple Island bears similar testimony. The general angularity of the coastal mountains of south Greenland throw the weight of their evidence in the same direction. It would appear, therefore, that the former elevation of Greenland was not coincident with conditions favoring glaciation." (Bull. Geol. Soc. Am., Vol. 6, 1895.)

Age of the Sandstones of Crowley's Ridge.—Crowley's Ridge stretches across north-eastern Arkansas from the Missouri line to the Mississippi River at Helena. At numerous localities in this ridge a heavy deposit of cherty gravel is exposed in which are small (and rarely very large) masses of a compact, fine-grained quartzite. The gravel is undoubtedly Plistocene, and, until recently, the sandstones were supposed to be of Paleozoic age. Dr. D. D. Owen referred them to the Potsdam from their lithological character. An investigation by Mr. R. Ellsworth Call, however, results in the discovery that they are indurated sandstones of the same age, and sharing in the common history of the gravels through which they protrude. Dr. Branner has observed similar facts of metamorphosis in Brazil, and these corroborate the view suggested by Mr. Call that the metamorphism is due to weathering.

The facts ascertained by Mr. Call concerning this disputed formation are summed up as follows:

"These rocks are of limited occurrence, covering a few hundred acres all told ; they are found at rather low elevation in the hills, although they sometimes occur as far as the very tops of the highest points in the ridge country ; they have yielded fossils of Lower or Eocene Tertiary age; they have probably resulted from weathering processes; are metamorphic in character, and have no history of dynamic origin or of present or past dynamic change. Their former reference to the palaeozoic is no longer tenable, and they stand as a unique instance of the induration of soft sandstones in the southwest." (Proceeds. Ind. Acad. Sci., Vol. III, 1893–1894.)

Geological News.—The remains of two reptiles are reported from the Triassic of Shasta Co., California, by J. C. Merriam. The larger individual is represented by eight consecutive vertebræ, a few fragments of ribs and both coracoids. These present an assemblage of characters that necessitate the creation of a new genus, *Shastasaurus* with the specific name *pacificus*. The second and smaller individual represents a very different form from that described above, but the material is insufficient for specific characterization. (Am. Journ. Sci., 1895.) The figures and description of Mr. Merriam indicate that the alleged relationship to Ichthyosaurus is very doubtful.

A fossil Liverwort is described by Mr. F. H. Knowlton from the Lower Yellowstone of Montana. The species, which represent the only extinct form from North America, is allied to the genus Preissia, and a new genus, Preissites, has been made for its reception. The fossil was found by Professor Lester Ward, to whom the species is dedicated. (Bull. Torrey Botanical Club, Oct., 1894.)

Mr. R. T. Hill records the occurrence of Radiolarian earth at Baracoa in the island of Cuba. The strata are vertical and over 500 feet in thickness. The rock is chalky in appearance, with occasional thin separation-layers of gray-blue clay, and some flint-like siliceous nodules: sponge-like spicules and echinoid fragments are found in it, but no diatoms. It appears to lie below certain yellow beds identified as Miocene, (Bull. Mus. Comp. Zool., Harvard, 1895.)

Records of well-borings in Iowa show the presence of numerous buried drainage channels. A comparison of the data indicates that in pre-glacial time the land surface of the State stood at an elevatlon considerably above that now obtaining. Throughout the driftless area there is evidence that the region, after being reduced to a base level of erosion, has been elevated, and is now being reduced to a second base level. (Proceeds. Iowa Acad. Sci., Vol. II, 1895.)

Captain F. W. Hutton publishes a classification of the genera of the Dinornithidæ, based on the characters of the axial skeleton, and, in the absence of illustrations, gives keys to assist in distinguishing the genera. (Trans. New Zealand Inst., 1894.)

BOTANY.[1]

Summer-School Botany in the Mountains.—It may be of interest to teachers of botany in schools and colleges to know what has been found possible to accomplish in a short course in the Colorado Summer School of Science, Philosophy and Languages the present year. The school was held in the city of Colorado Springs at the foot of Pike's Peak, within easy reach of the vegetation of the plains, the cañons, foot-hills, and the strictly alpine regions. The numerous brooks and mountain streams supplied an abundance of aquatic forms, while the damp cañons furnished all kinds of fungous growths. Lichens, mosses and ferns were found in abundance, so that every section of the vegetable kingdom was well represented. Good rooms for lecture and laboratory work were set aside in the High-School building. The following outline was followed, with slight variation:

THE STRUCTURE OF PLANTS.

I. (*a*)—Cells. Protoplasm. Nucleus. The formation of new cells. Chlorophyll. Starch. Crystals.

II. (*b*)—Tissues. Rudimentary tissues. Permanent tissues.

III. (*c*)—The Plant Skeleton. Epidermis. The Fleshy Tissues.

IV. (*d*)—The Plant-Body. Homologies and Analogies. Transformation of parts.

THE PHYSIOLOGY OF PLANTS.

V. (*a*)—Water in the plant as a whole; in the protoplasm; in the cell walls. Source of water; movement of water; evaporation of water. Plant food; the compounds used; how obtained; how transported in the plant. Starch-making (carbon-assimilation); other assimilations.

VI. (*b*)—Growth. Effects of Heat and Light on Plants. The sensibilities of plants. The movements of plants.

CLASSIFICATION AND DISTRIBUTION OF PLANTS.

VII. General laws of classification. Relationship. Distribution of plants in space and time.

THE LOWER WATER-PLANTS.

VIII. (*a*)—The simplest plants (Class 1, *Schizophyceæ*), Water Slimes, Nostocs, and Bacteria.

IX. (*b*)—The Green Algæ (Class 2, *Chlorophyceæ*), Green Slimes, Pond-scums, Green-felts, Confervas, and their near relatives.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

X. (*c*)—The Brown Algæ (Class 3, *Phæophyceæ*), Simple Fruit-tangles (Class 4, *Coleochæteæ*), Red Seaweeds (Class 7, *Rhodophyceæ*) and Stoneworts (Class 8, *Charophyceæ*).

THE DEGENERATED PLANTS.

XI. (*a*)—The Sac-Fungi (Class 5, *Ascomycetes*) Mildews, Truffles, Cup-fungi, Black Fungi, Rusts and Smuts.

XII. (*b*)—The Higher Fungi (Class 6, *Basidiomycetes*), Puff-balls, Earth-stars, Bird's-nest Fungi, Mushrooms, Toadstools and Pore-fungi.

THE MOSSWORTS.

XIII. The Liverworts (Class 9, *Hepaticæ*) and the Mosses (Class 10, *Musci*). The undifferentiated plant-body; the Shoot with Stem and Leaves; Reproduction; Alternation of Generations.

THE FERNWORTS.

XIV. (*a*)—The Ferns (Class 11, *Filicinæ*). The prothallium; antherids and archegones; fertilization; growth of the embryo; the leafy plant; spore-cases and spores; germination of the spores. Alternation of generations. Classification of ferns.

XV. (*b*)—The Joint-rushes (Class 12, *Equisetinæ*). Comparison with ferns. The plant-body; spore-cases and spores. Extinct joint-rushes. The Lycopods (Class 13, *Lycopodiaceæ*). Comparisons with ferns and joint-rushes. The plant-body; spore-cases and spores. Extinct lycopods.

THE NAKED-SEEDED PLANTS (Class 14, *Gymnospermæ*).

XVI. Cycads, present and past; Conifers (pines, spruces, firs, etc.), structure of the flowers, fertilization, cones and seeds. Relationship of gymnosperms to lycopods.

THE COVERED-SEEDED PLANTS (Class 15, *Angiospermæ*).

XVII. (*a*)—The Flower (stamens, pistils, flower-leaves); fertilization; fruits; seeds.

XVIII. (*b*)—The lower group (Monocotyledons); water-plantains; lillies; aroids: palms; grasses; irises; orchids.

XVIII. (*c*)—The higher group (Dicotyledons).

XIX. (1)—Flowers with separate petals. Buttercups, mustards, pinks, mallows, geraniums, grapes, maples, roses, beans, myrtles, melons, cactuses and umbelworts.

XX. (2)—Flowers with united petals. Primroses, heaths, olives, gentians, phloxes, morning glories, figworts, mints, honeysuckles, bellworts and sunflowers.

The work was divided into an elementary and an advanced course, the former for those who took up the study of botany for the first time, and the latter for those who had already made some progress in the study. The attendance was large, considerably exceeding one hundred, and was composed almost entirely of teachers of maturer years, in all departments of school work, from the kindergarten to the high-school and academy.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.[1]

Fischer on Bacteria.—Under the title Untersuchungen ueber Bakterien, Dr. Albert Fischer contributes an important paper to a recent number of Pringsheim's *Jahrbücher fur wissenschaftliche Botanik* (Bd. 27, H. 1, pp. 163, T. 5, Berlin, 1895). This paper consists of four parts: (1) New observations on the plasmolysis of bacteria; (2) The physiology of the flagella and of the movement; (3) The morphology of the flagella; (4) Classification. Of the five plates illustrating flagella, four are lithographic, and one is a collotype. The author appears to have made out pretty clearly for a good many forms that the contents of the bacterial cell is plasmolyzed even by a slight concentration of culture media such as takes place on the cover glass in drying or in the transfer of the organisms from a weaker to a more concentrated culture medium. This plasmolysis can be avoided by diluting the fluid very plentifully with water before making cover glass preparations from it. Only a very slight amount of sodium chloride is necessary to produce plasmolysis of a cover glass preparation, especially at the edge of the drop, viz.: 0.01 to 0.05 per cent. The occurrence of this phenomenon can be observed in a hanging drop as it dries. Plasmolysis disappears when watery stains are used, but is beautifully preserved by alcoholic stains, Ziehl's carbol fuchsin, or Delafield's haematoxylin. Many false conclusions have been drawn from such plasmolyzed bacteria. Here belong De Toni and Trevisan's genera *Pasteurella* and *Dicoccia*; the staining phenomena of the cholera vibrio, described by Rahmer; the bamboo-like joints sometimes seen in the anthrax bacillus; the polar bodies in the typhoid bacillus; the various granular structures in the tubercle bacillus, etc. The unstained, empty places

[1]This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

in plasmolyzed bacteria have often been mistaken for spores. In weak salt solutions the phenomena of plasmolysis disappears in an hour or two; in strong solutions it disappears much sooner. This disappearance of plasmolysis and the reappearance of motility bear no relation to each other, but depend upon entirely different causes. To obtain good plasmolyzed cover-glass preparations that will fix and stain in that condition, the author recommends putting a trace of bacteria into a drop of a weak salt solution (0.25 to 0.50 per cent NaCl or 0.5 to 1.0 per cent KNO_3) and then carefully spreading out the drop so that it will dry in 3 to 10 minutes. The bacterial cell consists of a membrane, a protoplast in the form of a wall covering, and of cell sap, and has, consequently, the same structure as any other plant cell. Cell nuclei are still to be sought; a "centralkörper" is never present, when there seems to be one it is a misinterpretation due to the contracted protoplast, as in case of Bütschli's observations on *Spirillum undula*. In weak salt solutions which cause distinct plasmolysis (2.5 per cent KNO_3; 1.25 per cent NaCl, etc.) motile bacteria continue to move, often for hours. In stronger solutions (5–10 per cent KNO_3, etc.), the movement ceases in a few minutes owing to the benumbing of the flagella, which, however, are never drawn back into the body of the bacillus, being in this respect quite like the motile organs of the Flagellata and unlike pseudopodia. In salt solutions which do not inhibit growth, but are strong enough to produce rigidity of the flagella, these organs continue to be produced. The same is true when 0.1 per cent carbolic acid or picric acid is added. Motility reappears when these inhibitory substances are removed. As in the flagella of the Flagellata the cilia of the Infusoria, and the lashes of ciliated epithelium the movement of the flagella in the bacteria is not independent of the protoplast, but nevertheless continues when the latter is disturbed by plasmolysis. Apparently, as in case of crushed infusoria a small fragment of the protoplast remaining attached to the base of the flagellum is sufficient to continue the movement. Rigidity of the flagella can be brought about in various ways—lack of oxygen, acid reactions, too much salt, mal nutrition, or the addition of poisons. On removal of these injurious influences the motility returns. In case on non-motile cultures of the hay bacillus the addition of ½ per cent asparagin sufficed to induce motility quickly. In the making of cover-glass preparations various changes may take place in the flagella, they may be thrown off, or inrolled, or become swollen so as to be unstainable and unrecognizable. The inrolled flagella never unroll. They often appear as little foamy heaps of rings around the bacteria (typhoid bacillus, hay bacillus, etc.) When the bacillus dies the flagella loose their power of swelling. The flagella often remain till the last, i. e., after the membrane and contents of the bacillus has disappeared. This ready swelling which is always at right angles to the long axis, makes the flagella in stained preparations always thicker than natural. The sprouting of the flagella from the body of the cell and their subsequent increase to full length consumes sufficient time so that its phases can be fixed and studied. In *Spirillum undula* it takes place before completed cell-division and from that end of the cell previously destitute of flagella. Continued cultivation in strong salt solutions, e. g. 4 to 5 per cent NH_4Cl, prevents motility, but does not interfere with the formation of the flagella. By movements of neighboring bacilli the flagella are often twisted into strands which are sometimes very large.

In *Bacillus subtilis* the spore is generally found in non-flagellate rods forming the pellicle, rarely in free swiming flagellate rods. The flagella of bacteria are not drawn back into the cell during spore formation. Involution forms of *Bacillus subtilis* bear no flagella, but in the involution forms of some other bacteria they are not thrown off. All motile bacteria possess flagella, and these are the sole organs of movement. Flagella are polar or diffuse according as they are restricted to one end of the cell or occur on any part of it. Polar flagella vary in number from one to several, and this number is characteristic for different species, except when the cells are dividing polar flagella are always at one end. The flagella of the bacteria are neither threads of protoplasm which can be thrust out and drawn back, nor dead appendages of the membrane moved by the protoplast. The substance of the flagellum possesses a life of its own, and the power of swelling and self-contractility. With the protoplast, of which they are a part, the flagella appear to be only loosely connected, yet the little protoplasmic remnant which in plasmolysis often remains attached to the base of the flagellum, and sometimes connects it with the shrunken protoplast is certainly to be regarded as a sign of such morphological union. In connection with the physiological diagnosis of the bacteria a morphological basis for classification is to be sought, and this the author thinks he has found for the rod-shaped bacteria in the number and position of the flagella and the shape of the spore-bearing cells. The author's classification is probably a step in the right direction, and will certainly lead to renewed efforts to determine the number and position of the flagella on a great variety of microörganisms, but, in the present state of our ignorance, it cannot be considered anything more than tentative. It ought not to be adopted until it has been tried thoroughly to see whether it has in it the elements of permanency. It is novel to say the least to find numerous genera established on purely theoretical grounds with no known forms to put into them. In Dr. Fischer's classification the bacteria are divided into two orders: The Haplobacteriaceæ, or single celled bacteria, and the Trichobacteriaceæ, or thread-form bacteria (*Cladothrix*, etc.). The former multiply by slight elongation and cross-septation, the cells separating or remaining attached in small numbers. The latter consist of long cells, branched or unbranched, which finally break up into conidia or motile segments. The Haplobacteriaceæ consist of Coccaceæ, Bacillaceæ, and Spirillaceæ. The author's classification of the more difficult group is as follows:

FAMILY BACILLACEÆ.

Vegetative body one-celled, straight, with a distinct longitudinal axis, varying from short ellipsoidal to elongated rod form. Division always at right angles to the longitudinal axis; motile or non-motile; occuring singly or in chains; bearing endospores or arthrospores.

1. SUB-FAMILY BACILLEI.

Non-motile, destitute of flagella.

(a) With endospores.

(1). Bacillus (Cohn).	Spore-bearing rods cylindrical.
(2). Paracloster (nov. gen.)*	Spore-bearing rods fusiform.
(3). Paraplectrum (nov. gen.)*	Spore-bearing rods clavate.

(b. Without endospores, with arthrospores).

(4). Arthrobacter (De Bary).*

2. SUB-FAMILY BACTRINEI.

Motile, with a single polar flagellum.

(1). Bactrinium (nov. gen.)	Spore-bearing rods cylindrical.
(2). Clostrinium (nov. gen.)*	Spore-bearing rods fusiform.
(3). Plectrinium (nov. gen.)* ?	Spore-bearing rods clavate.
(4). Arthrobactrinium(nov. gen.)*	With arthrospores.
(5). Chromatium.	Red sulphur bacteria.

3. SUB-FAMILY BACTRILLEI.

Motile rods with a tuft of polar flagella.

(1). Bactrillum (nov. gen.)	Spore-bearing rods cylindrical.
(2). Clostrillum (nov. gen.)*	Spore-bearing rods fusiform.

(3). Plectrillum (nov. gen.)* Spore-bearing rods clavate.
(4). Arthrobactrillum (nov. gen.)* With arthrospores.

SUB-FAMILY BACTRIDEI.

Motile, with diffuse flagella.
(1). Bactridium (nov. gen.) Spore-bearing rods cylindrical.
(2). Clostridium (Prazm. *pro. parte.*) Spore-bearing rods fusiform.
(3). Plectridium (nov. gen.) Spore-bearing rods clavate.
(4). Diplectridium (nov. gen.) Spore-bearing rods dumb-bell shape.
(5). Arthrobactridium (nov. gen.)* With arthrospores.

According to the author, 8 or nearly one-half of these so-called genera are founded on purely theoretical considerations, while there is some doubt as to whether there are any known species to go into two others. These pseudogenera are here indicated by asterisks.

—ERWIN F. SMITH.

The Mushroom Gardens of South American Ants.—Ever since the appearance of that wonderfully interesting book, The Naturalist in Nicaragua, it has seemed probable that the leaf-cutting ants do actually grow fungi for food, and use the countless thousands of leaf fragments which they drag into their nests for the same purpose that a gardener uses dung. Belt ascertained that the leaves were never used for food, found the fungus in every nest, observed the solicitude of the ants when it was disturbed, and in various particulars carried his inquiry as far as it was possible to do by simple observation. It remained for Alfred Möller, a young German, the nephew of Dr. Fritz Müller, and the pupil of Dr. Oscar Brefeld, not only to confirm Belt's surmise by close observation and exact experiment, but also to add greatly to our knowledge of the habits of these curious little gardeners and of the nature of the fungi they cultivate. These observations and experiments are embodied in Die Pilzgärten einiger südamerikanischer Ameisen (pp. VI, 127, Figs. 4, Pl. VII), which forms the 6th part of Professor Schimper's *Botanischen Mittheilungen aus den Tropen*, Jena, 1893. Möller's observations were made at Blumenau, Brazil, where he remained two years. The journey was made under the auspices of the Royal Academy of Sciences, of Berlin, whose wisdom in making this expenditure of a few thousand marks has certainly been more than justified by the outcome. During the course of the investigation several hundred ant nests were examined, these ants belonging to three genera, viz.: Atta (4 sp.); Apterostigma (3 sp.), and Cyphomyrmex (2 sp.) All are zealous cultivators and eaters of fungi, but the ants of each genus grow a different sort, one kind only, and stubbornly refuse to eat any other, preferring to starve. More curious still, under the zealous attention of these little gardeners a special form of the fungus has been developed in much the same way that human selection has developed choice cabbages and cauliflowers out of what were originally quite ordinary sorts. This form of the fungus consists of groups of swollen hyphæ-ends, called Kohlrabi tufts. The greater part of the book deals with the fungous gardens of species of the genus Atta. The garden occupies the center of each nest as a loose, sponge-like mass, consisting of leaf-fragments held together by fungous threads. These gardens are often of large size, but between them and the walls of the nest there is always an open space. In the sponge-like cavities of these gardens the ants live, place their eggs, and rear their young. Often the eggs and sometimes the larvæ are overgrown and fastened together by the fungus, so that many as a hundred eggs may be seized and carried away by a single ant without inconvenience. The well known care that ants bestow on their progeny makes it certain that this placing the eggs in groups and allowing them to be bound together by the fungus is not simply accidental. When the nest is broken open and its contents scattered, or when the colony migrates, every tiny fragment of the fungous garden is gathered up and removed as carefully, and with as much solicitude as are the young. These fragments are rapidly and skillfully built into a new garden in the old nest or in some other place. Leaves are cut from a great many sorts of plants and often in such quantities as to entirely defoliate them, but are never eaten even to prevent starvation. Their sole food is the fungus which they cultivate, even fruits and starchy foods being used exclusively as a substratum for growing this much-beloved fungus. The leaf fragments brought into the nest are bitten and trimmed into smaller pieces and these are squeezed and kneeded into tiny pellets which are then carefully patted into the walls of the garden, and are overgrown by the fungus in a few hours. Exhausted fragments are thrown out and fresh pellets put in wherever needed by the fungus. Old worn-out masses of mycelium are also thrown out of the nest. Upon a special class of the colony, distinguished from the leaf cutters by their smaller size, devolves the task of weeding the garden and keeping it pruned within bounds. When neglected for a single day, i. e., by the removal of most or all of the ants, innumerable fungous threads shoot out into the air in every direction, and the well-kept garden soon becomes an unmanagable and uninhabitable thicket. When only a few ants are left in such a nest they work desparately, night and day, to keep it in order, but seem to know that something is wrong, and are finally driven out by the too luxuriant growth of their own culture plant, being compelled to seize their young and flee for very life in a comical way. Most remarkable of all, especially to one who has busied himself much with trying to make and keep pure cultures of various fungi, is the ability of these ants to keep their gardens free from bacteria and all sorts of intruding fungi. Cultures made from various parts of a great many gardens showed conclusively that in an overwhelming proportion of cases these gardens are pure cultures of a single fungus. Unquestionably the ants must be constantly busy with the destruction and removal of intruding organisms. The Kohlrabi, or specially developed bunches of swollen hyphæ ends, occur as minute glistening rounded specks on all parts of the garden and are eagerly devoured by the ants. Unswollen, long mycelial threads push out into the air from all parts of the garden as soon as the ants are removed, and finally bear two kinds of conidial fruits, but nothing of the sort occurs while the ants are in undisturbed possession, and it is pretty certain that they must keep these undesirable shoots in check by constant biting, although this was not observed. The two kinds of conidial fruits were also obtained from artificial cultures under special conditions. In rare cases (only 4 were observed) the fungous garden pushes up through the top of the nest and fruits in the open air, this form of fructification being a large, flecked, wine-red, Amanita-like Agaricus, named by the author *Rozites gongylophora*, and never found except on the ant nests, rooted in the fungous garden. Pure cultures in great numbers and numerous microscopic observations proved beyond reasonable doubt that the swollen hyphæ, and the various kinds of fructification belong to one and the same fungus, and establish for the first time the existence of true conidia in the Agaricineæ. The ants of the other two genera, while equally diligent cultivators of fungi, build much smaller nests and are not leaf cutters, but use fragments of wood, dung, etc., as a substratum for their gardens. The fungi cultivated by them are believed to be hymenomycetous, but each genus has a different species. The different species of these ants vary in ability as gardeners. The facts set forth in this book were derived from prolonged examination of the ants in the open and in captivity, and by hundreds of patient and painstaking cultures and microscopic studies, and appear to be worthy of full credence. Mr. Möller's persistent and painstaking method of work is especially commendable to those over-ambitious young men who are content to look into the microscope one day and publish the next.

NOTE. Since this was written Mr. W. T. Swingle has discovered that our own *Atta tardigrada* has the same habits as its South American relatives, Several fungous gardens have been taken from nests near Washington, and the writer has seen beautiful Kohlrobi tufts growing on the dung of leaf-eating insects. ERWIN F. SMITH.

ZOOLOGY.

Irish Fresh-Water Sponges.—In a recent number of the *Irish Naturalist* (Vol. iv, pp. 122–131), Dr. R. Hanitsch enumerates six species of Spongillidæ from Ireland, the " British fauna " containing but four species. Three of these occur in Ireland, the other three sponges, all from the west coast of the latter country, being also North American species. Dr. Hanitsch would not solve this interesting distributional problem by supposing a former extension of the sponges over the whole northern hemisphere; he believes that their gemmules could readily have been carried across the Atlantic by winds, ocean currents, or birds. In some remarks on the European distribution of the Spongillidæ, Dr. Hanitsch notices their extreme rarity in southern Europe. Only one species is known from the Iberian peninsula (N. Portugal), two from the Italian, while none at all have been found in the Balkan. (Natural Science, July, 1895.)

Reproduction of the Edible Crab.—Through the observations of Mr. Gregg Wilson, some new facts have been brought to light concerning reproduction in the edible crab (*Cancer pagurus*) of the Northumberland coast, England. Crabs that have recently cast their shells have pale ovaries that show no development of ova to the naked eye. Hard crabs have brilliant orange or scarlet ovaries, with ova distinctly visible. Both lots are taken in the catch from October to February. Spawning seems to take place only every second year of the crab's life. At no time were ova undergoing segmentation found within the crab, so that the old idea that fertilization is internal must be abandoned. Milt is undoubtedly passed by the male crab into the body of the female, but it does not affect the roe before extrusion. It is received in flask-shaped *receptacula seminis*, that open off the oviducts quite near the genital apertures. They are well-valved and seem to retain the motionless spermatozoa for long periods. Spawning was noticed to take place during November, December and January. The author is inclined to think that there is a migration connected with either the spawning act or the hatching out of the ova. The mature female crab is usually 6½ inches in size, while males, are mature when much smaller. (Proceeds. Roy. Soc., Edinburgh, Vol. XX).

The Odonata of Lower California.—Various collections of Dragon-flies from Baja California have been acquired from time to time by the California Academy of Sciences, and these form the basis for a memoir recently published by Dr. Philip P. Calvert. The total number of specimens examined is 2600, representing 40 species, of which 6 are new. Of these species, 9 are distributed over a considerable part of temperate America; 18 are neotropical, and 18 nearctic in distribution, while 3 of the species described as new are, according to present knowledge, restricted to Lower California. One of the objects of the paper is to determine the amount of variation in structural details, especially in the venation of the wings, assumed to be of generic character. These variations are to be found under the respective species.

Three page plates, containing 123 figures, accompany the descriptions of the species. (Proceeds. Cal. Acad. Sci. (2) IV).

Baur on the Temporal Part of the Skull,[1] and on the Morphology of the Skull in the Mosasauridae.[2]—In the first paper Dr. Baur reviews the work which he has done in the difficult analysis of the temporal region of the reptilian skull, in former years, and what has been done since by other authors. His results may be summed up as follows. The question relates principally to the determination of the three elements that connect the quadrate bone with the skull superiorly and anteriorly. These have usually, says Baur, been termed the squamosal, supratemporal, and quadratojugal. He adopts this nomenclature for the first and third, but wishes to replace the second by "prosquamosal" of Owen. This is because the name supratemporal was used previously for a different element peculiar to the Teleostomous fishes. The present reviewer has called the three bones in question, the paroccipital, supratemporal, and zygomatic, after earlier authors. Baur maintains that the element which he, with some other authors calls the squamosal, is not homologous with the paroccipital of the tortoises and Ichthyosaurs, as I have supposed. He agrees with those au-

[1] Remarkungen ueber Die Osteologie der Schläfengegend der höheren Wirbelthiere. Anatomischer Anzeiger, X, 1894, p. 316.

[2] The American Journal of Morphology 1894, p. 1.

thors who think that the paroccipital of the Squamata, Crocodilia, etc., is fused with, and undistinguishable, in the adult skull, from the exoccipital. As proof that this is the case, he cites the opinion of various authors, and especially that of Hallmann, who, he alleges, demonstrated this to be the fact in 1837. On this essential point it may be remarked, first, that most of the authors cited have simply supposed this to be the case without making any attempt to demonstrate it. Second, although I have repeatedly examined crania of lizards from the first appearance of ossification, I have never observed a distinct center in the position of the paroccipital of tortoises and which Hallmann and others regard as the representative of that bone; nor have I observed it in the Crocodilia. W. H. Parker has not seen it, nor does Baur say he has done so. After having announced his discovery of it in Sphenodon, he afterwards changed his mind and concluded that he had been misled by appearances. Until the presence of such an element in the Squamata is demonstrated, I must continue to regard the element called by Baur in that order, the squamosal, as the paroccipital. In the Mosasauroids the element has more nearly the position of the paroccipital of tortoises than in any other of the Squamata. I may say that I have not been able to see Hallmann's memoir, and that I am entirely open to conviction when the evidence shall be produced, though I suspect that it will not be forthcoming.

In stating his disagreement with my conclusion on this point, the author does not make it clear that he has come to agree with me in two points on which we formerly differed. Thus he now agrees with my view of 1871, that the single postorbital bar of the Lacertilia is homologous with the superior bar of Sphenodon, and not the inferior, as he has recently maintained, though he at one time agreed with me. He also agrees that the suspensorium of the quadrate of the Ophidia is the paroccipital (squamosal Baur), and not the supratemporal (prosquamosal Baur); an opinion in which I have been alone hitherto.

If the element which I have identified with the paroccipital in the Squamata, is not that element, it is not thereby proven that it is identical with the squamosal of the Mammalia. Moreover it cannot be homologous with the element in the Ichthyosauria, Cotylosauria and Stegocephalia with which Baur identifies it, since it is a brain-case bone, while the latter is a temporal roof-bone, a fundamental difference. For this reason I have called the latter the supramastoid. (See my paper on the Transactions of the American Philosophical Society, 1892, p. 11).

The student who desires to become acquainted with the opinions of authors on the points involved, cannot do better than consult Dr. Baur's paper. His references to the literature are full, and his method in this respect is a model worthy of imitation.

Having seen that Dr. Baur now agrees with me that the bone which supports the quadrate in the Ophidia is not the supratemporal (prosquamosal) I will take up his older, but above last-mentioned paper on the Pythonomorpha. Like Owen, Marsh and Dollo, he does not perceive that this group is essentially distinct from the Lacertilia, and concludes with them that I have erred in alleging it to present affinities to the Ophidia. He places it in the order Lacertilia and in close proximity to the Varanidæ as did Cuvier.

In order to determine this matter, it is necessary to know, in the first place, what the characters are that distinguish snakes from lizards. The superficial characters given by systematic writers generally as distinguishing the Lacertilia and Ophidia, are quite insufficient for that purpose. Johannes Müller[1] first placed the distinction on a sound basis by showing that in the Ophidia the frontal and parietal bones descend to the basicranial axis as in no other vertebrates, thus closing the brain case in front, while in the Lacertilia this does not occur, and as the ali- and orbitosphenoid bones are rudimental or wanting, the brain case is without osseous wall in front. Some lizards present a distinct approximation to the Ophidian type in the strong decurvature of the parietal bones at the sides: these are the Annulati and the Annielloidea. These groups display a similar approximation in the continuous sutural union of the occipital and parietal elements, a condition universal in Ophidia, and rare in Lacertilia.

I have pointed out[2] another distinction between the two divisions, viz., that the supratemporal ("squamosal," "prosquamosal") is present in the Lacertilia and absent in the Ophidia. As it is, however, absent in the Annielloidea and Amphisbænia, I have not included it in the definition of the former suborder. This definition has not been adopted by those authors who erroneously regard the suspensorium of the quadrate bone in the Ophidia as identical with the supratemporal of the lizards, but my view has now received the assent of various anatomists, as e. g., Prof. Baur.

A third distinction is that the quadrate bone is supported by the paroccipital in the snakes, and the exoccipital in the lizards. Baur

[1] In Tiedmann u Treviranus Zeitschrift f, Phisiologie, IV, 233.

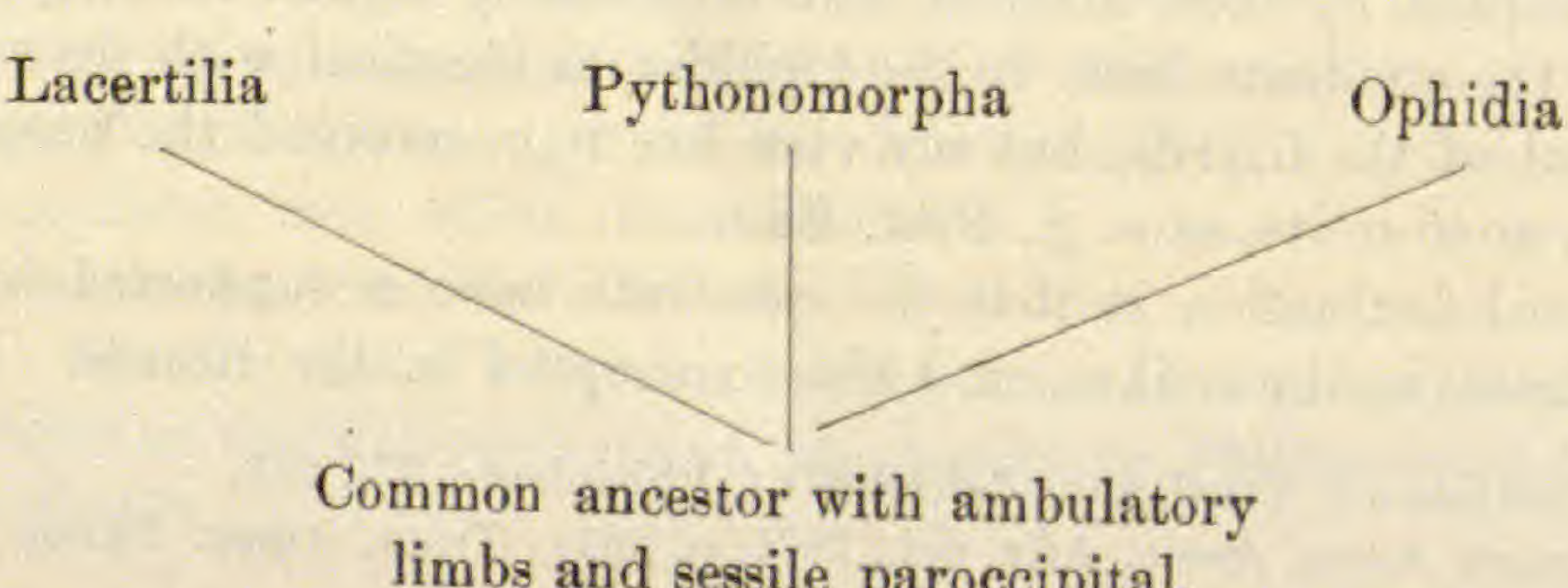
[2] Proceeds. Amer. Assoc. Adv. Sci., 1871, p. 221; Trans. Amer. Philos. Soc., xiv, 1869, p. 29.

and some others do not, however, agree that the suspensorium in the snakes is the paroccipital, but call it squamosal and other names. I was led to identify it with the former element of the Testudinata, etc., by a consideration of its structure in the Pythonomorpha,[3] where it is much more largely developed than in the Lacertilia, and where it supports the quadrate bone as in the Ophidia. The accompanying figures make this more clear. The paroccipital bone is received deeply between the exoccipital and the petrosal in the Pythonomorpha in the same manner as in the Tortricine snakes ; a structure which does not occur in the Lacertilia. This structure is somewhat masked in some genera of Pythonomorpha by the extension of the exoccipital over the paroccipital as a thin lamina on the posterior side ; in that case its true relation to the petrosal can be seen on the anterior side. In the Lacertilia the quadrate merely touches the paroccipital bone, whose distal end has a *convex* surface (Figs. 1, 1a), but it articulates with the exoccipital bone. This it never does in the Ophidia and Pythonomorpha. This is a fundamental difference between Lacertilia and Pythonomorpha to be added to those which I have already given.

For this reason, and in view of the various important differences from the Varani, it is necessary to believe that the Pythonomorpha form a line distinct from the Lacertilia, and that their resemblances to the Varani are the result of a parallel evolution rather than an indication of near affinity.

The failure of Cuvier, Owen, Dollo, Baur and Marsh to perceive this fact is due to their want of information as to what the differences between the Ophidia and Lacertilia really are.

From this point of view the Ophidia and Pythonomorpha must be traced to some type in which the paroccipital bone is less remote from the brain case than is seen in the Lacertilia, where it has become a mere rudiment. Such a phylogeny could be expressed as follows. An investigation of ths Dolichosauria of the Cretaceous might yield interesting results.



[3] L. c., and the Cretaceous Vertebrata of the West, U. S. Geol. Surv. Terrs, Vol. II, 1875.

PLATE XXXI.

Suspensoria of Reptilia Squamata.

The characters of the three suborders of the Squamata are then as follows:

Quadrate bone articulating with exoccipital; paroccipital external to bones of brain case; parietal bones not closing the brain case in front; generally an epipterygoid and sternum; teeth with dentinal roots; phalanges with condyles; *Lacertilia.*

Quadrate bone articulating with paroccipital, which is embraced by bones of brain case; parietal bones not closing brain case in front; epipterygoid and sternum present; teeth with osseous roots; phalanges truncate; *Pythonomorpha.*

Quadrate bone articulating with paroccipital; parietal and frontal bones closing brain case in front; no epipterygoid or sternum; teeth rootless; no phalanges; *Ophidia.*

I cannot agree with Boulenger that the Chamæleontidæ represent a division of equal rank with these three, as most of the characters may be found in one Lacertilian or another, and the group is in many ways related to the Agamidæ of the Pachygloss division. For me it represents a superfamily for which the name Rhiptoglossa is available.—E. D. COPE.

EXPLANATION OF PLATE.

Views of suspensoria of quadrate bone of Squamata. 1. *Varanus griseus* from above; *b*, from below and forwards. 2. *Mosasaurus dekayi* from above; *b*, from below. 3. *Ilysia scytale* from above; *b*, from below. S O, supraoccipital; E O, exoccipital; PaO, paroccipital; Pe, petrosal; P, parietal; B O, basioccipital; Sp, sphenoid. The dotted surfaces represent the articular surface for the quadrate.

A New Xantusia.—A specimen sent me by Dr. J. J. Rivers of Berkeley, Cal., taken at Tejon Pass California, indicates a new and handsome species of Xantusia. It is allied to the *Zablepsis henshavii* of Stjeneger (see last number of the NATURALIST where the genera of Xantusiidae are defined), but differs in generic characters. It has longer limbs and a longer tail than in either of the Xantusiæ known. The hind leg extended forwards, reaches the shoulder, and the tail is twice the length of the body. There is but one row of superciliary scales, and there is but one frontoparietal on each side. Seven superior labials, not separated by scales from orbit. Four inferior labials, the fourth separated from the third by the large third infralabial, which reaches the lip border. Fourteen to sixteen longitudinal rows on the belly. Ten femoral pores. Color above light reddish-brown, marked with two or three rows of large maron spots. Head above maron, the plates pate bordered. Inferior surfaces pale reddish-yellow. Dength 124 mm.; of head and body, 51 mm.

This species is nearer to the *X. vigilis* than to the *X. riversiana*, but differs greatly in its proportions, and in numerous details of scutellation and in coloration. It is nearer to the *Zablepsis henshavii* Stjen., but besides the generic characters, that species has a shorter hind leg, a continuous series of lower labials, and a different coloration.—E. D. COPE.

Bats of Queen Charlotte Islands, British Columbia.—During the past two or three years several small collections of bats, numbering in all 12 specimens, have been sent me from the Queen Charlotte Islands. They were obtained at a place called Massett, at the north end of Graham Island, by the Rev. J. H. Keen, and were transmitted through the courtesy of Mr. James Fletcher, of Ottawa. All of these bats belong to the genus *Vespertilio*. They represent three very distinct specific or superspecific types, namely *V. subulatus*, *V. lucifugus* and *V. nitidus*. In each case the specimens differ in color from the typical form, being decidedly blackish instead of brownish. The ears, feet and membranes, are nearly black, and the color of the fur is very dark.

The Queen Charlotte Islands representative of *V. lucifugus* differs further from the typical form (from the eastern United States) in having decidedly larger feet and in the form of the ear conch, which is less emarginate posteriorily. It may be worthy of subspecific recognition.

The representative of the big-eared *V. subulatus* is so different from the eastern animal that I am forced to describe it as new, and in so doing it gives me pleasure to associate with it the name of its collector, the Rev. J. H. Keen. It may be known by the following description :

Vespertilio subulatus keenii subsp. nov.—Type from Massett, Queen Charlotte Islands, B. C.

Type No. 72922 ♀ ad. U. S. National Museum, Department of Agriculture Collection. Collected by Rev. J. H. Keen, in summer of 1894.

General characters.—Similar to *V. subulatus*, but with shorter, narrower wings, and larger ears; color blackish instead of brownish. Ears, feet, and membranes black except the under surfaces of the wing bones, leg bones, and tail vertebræ, which parts are flesh colored. Fur, blackish, slightly washed with brownish. Ears very long: laid forward they project 3 mm. beyond the nose. Tragus long, slender, and slightly arcuate. Wings attached to feet near base of toes.

Measurements (from alcoholic type (♀ ad.) in good condition).—Total length, 82 mm.; head and body, 42; tail, 41; head, 17.5; ear from inner basal angle, 16; tragus from inner attachment, 8; humerus; 23; forearm, 35.5; thumb, 7; third finger, 57; fifth finger, 46; tibia, 17; foot, 8. C. HART MERRIAM.

Migrations of the Lemming.—A valuable account of "*Myodes lemmus*, its Habits and Migrations in Norway," has been published by Prof. R. Collett, of Christiania. The nature and habits of the lemming are described, and their suicidal migrations discussed on a basis of the author's personal knowledge of the lemming. The migrations seem to be due to over-population. During certain years an abnormal fecundity takes place among these creatures, and the consequences of this multiplication is given by the author as follows :

"The enormous multitudes require increased space, and the individuals, which, under normal conditions, have each an excessively large tract at their disposal, cannot, on account of their disposition, bear the unaccustomed proximity of the numerous neighbors. Involuntarily the individuals are pressed out to the sides until the edge of the mountain is reached. In a short time they enjoy themselves there, and the old individuals willingly breed in the upper region of the forests, when, at other times, they are entirely wanting. New swarms, however, follow on; they could not return, but the journey proceeds onwards down the sides of the mountains, and when they once reach the valleys they meet with localities which are quite foreign to them. They then continue blindly on, endeavoring to find a home corresponding to that they left, but which they never regain. The migratory individuals proceed helplessly on to certain death. The writer thinks it probable that the wandering instinct developed in migratory years is of distinct service to the species in reducing surplus population.

The Brain of Microcephalic Idiots.—A paper embodying the results of a thorough examination of the brains and skulls of two typical microcephals, by Prof. D. J. Cunningham and Dr. Telford-Smith, has just been published in the Transactions of the Royal Dublin Society. The authors accept the view arrived at by Sir George Humphrey, from the examination of microcephalic and macrocephalic skulls, viz.: "There is nothing in the specimens to suggest that the deficiency in the development of the skull was the leading feature in the deformity, and that the smallness of the bony cerebral envelop exerted a com-pressing or dwarfing influence on the brain, or anything to give encouragement to the practice lately adopted in some instances of removal of a part of the bony case, with the idea of affording more space and freedom for the growth of the brain. In these, as in other cases of man and the lower animals, the brain-growth is the determining factor, and the skull grows upon and accommodates itself to the brain, whether the latter be large or small." (Nature, 1895.)

Zoological News, Birds—During the recent visit of Messrs. Brewster and Chapman to the island of Trinidad, the observations of Mr. Chapman on the song habit of the Rachette Hummingbird (*Pygmornis longuemareus*) were confirmed by the discovery of a locality to which the birds evidently came to sing. This resort was frequented also by *Phaethornis guyi* for the same purpose. The latter, while singing, spreads the tail feathers to the fullest extent, pointing them forward over the back until the tips of the long central feathers nearly touch the back of the head. The effect is most striking, the birds suggesting diminutive turkey-cocks. All the specimens killed at these haunts were males. (The Auk, XII, 1895).

The family name of Macropterygidæ is proposed for the Tree-Swifts of Malaysia, by Mr. F. A. Lucas, instead of Dendrochelidonidae, which is preoccupied. To the differential characters described in a previous paper, the author adds the following three important ones:

	Micropodidae.	*Macropterygidae.*
Hypsotarsus,	simply grooved,	with an tendinal foramen.
Shoulder-muscles,	strictly Cypseline,	Passerine.
Deep Plantars,	strictly Cypseline,	characteristic.

The author states that the differences between the Macropterygidae and other Swifts are as great as those existing between any two families of Passerines with which he is acquainted. (The Auk, Vol. XII, 1895).

ENTOMOLOGY.[1]

Chordeumidæ or Craspedosomatidæ ?—This family of Diplopoda has been classified by different authors under the Iulidæ, Poly-

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

desmidæ and Lysiopetalidæ,[2] but if we acknowledge its distinctness a choice is still necessary between the names mentioned in the heading.

The weight of more recent usage is clearly on the side of "*Chordeumidæ*," indeed this name seems to have been almost exclusively employed since it was taken up by Latzel in his great work on the Austrian Myriapoda (1884), after having been entirely disregarded since its publication by C. L. Koch (1847).[3] The alternative is thus between ten years of usage or five years of priority.[4] For those of us who may have used "*Chordeumidæ*" on the supposition that Latzel must have had some good reason for neglecting an earlier name, it may save the trouble of reference to a comparatively rare book to state that in Gray's arrangement "Fam. 2 *Craspedosomidæ*" includes the four genera Craspedosoma Leach, Cylindrosoma Gray, Reasia Gray, and Cambala Gray, in the order named. Evidently the author did not base his family on characters now recognized as important, but no more did Koch, who included in "*Chordeumidæ*" Campodes and Callipus, members respectively of the Iulidæ and Lysiopetalidæ.

It would seem that there was less warrant for Latzel's course from the fact that Humbert and Saussure had recognized and described[5] the family "*Craspedosomidæ*," though still including the Lysiopetalidæ as one of two tribes or sub-families ; indeed, it is entirely possible that the preference for "*Chordeumidæ*" was merely on the ground of brevity. There is, at least, ample justification for such a supposition in the fact that Latzel had previously changed the names of the families Pauropodidæ and Eurypauropodidæ, alleging as a reason the similarity of the former with the ordinal name Pauropoda, and the "horrible difficulty of pronunciation" of the latter. Priority aside, these reasons seem hardly sufficient to justify such family names as "*Pauropoda agilia*" and "*Pauropoda tardigrada*," which Latzel offers as substitutes. But even if the improvement had been more marked there must still

[2] Iulidæ : Leach, Berlese.

Polydesmidæ; Newport, Gervais, Porat, Meinert.

Lysiopetalidæ : Wood, Cope, Harger, Ryder, Packard.

[3] System der Myriapoden, pp. 49 and 119.

[4] The family "Craspedosomadæ" was published by J. E. Gray in the article on Myriapoda by T. Rymer Jones, in Todd's Cyc. Anat. and Physiol., III, p. 546 (1842). The author of the article specifically states that the arrangement of the Myriapoda there proposed was the work of Gray, published from his manuscripts and with his consent. Hence there is no apparent reason for citing the authority of Jones as Latzel and others have done.

[5] Rev. et. mag. d. Zool. 2d series, XXI, p. 153 (1869).

Mission Scient. au Mexique, Zool. VI, 2, p. 56 (1872).

be grave doubts of the advisability of changing family names whenever more brief or euphonious substitutes are offered. True, the winding polysyllables seem a useless infliction, and doubtless frighten many short-breathed people away from scientific study; but if there had been no dodging on "*Craspedosomatidaœ*," it might have stood as a warning which should have saved us such names as Paradoxosomatidæ, Archispirostreptus, and Pseudonannolenidæ. These are longer than the pre-Linnean descriptions, and may further endanger the popularity of the binomial system, already threatened in other ways.

Let us hope that before the nomenclatorial agitation entirely subsides, we may have a rule limiting scientific names to reasonable length. Their authors might then have the time and strength to make a serviceable description, possibly a plate! If this suggestion is not received favorably by the "cloth" it will be quite easy to secure enough "lay" votes to pass it by large majority. —O. F. COOK.

On the Generic Names Strigamia, Linotænia and Scolioplanes.—The genus *Strigamia*, was proposed by Gray, in 1842, in the article by T. Rymer Jones, in Todd's Cyclopædia, as cited in the preceding note. The description is as follows:

"Gen. H. Strigamia (*Geophilus*). Eyes none, antennæ 14-jointed, moniliform, rather elongate. Body linear, depressed. Feet, fifty pairs or more."

It is significant that *Strigamia* stands as the fourth genus of the Scolopendridæ, the other three being Lithobius, Scolopendra and Cryptops. The most natural inference from the above quotation is that Gray for some reason preferred *Strigamia* to Geophilus. This seems to have been Latzel's idea, for he places *Strigamia* Gray, as a doubtful synonym under Geophilus. Whatever may have been the intention of Gray, however, there would seem to be an insurmountable obstacle to the use of his name, in the fact that he published no species under it, the case not being parallel with that of Fontaria. Neither is there any mention of a species of *Strigamia* in what purport to be complete lists of the Chilopoda of the British Museum. Indeed, in the list of 1856, in the preparation of which Gray himself assisted, *Strigamia* appears only as a synonym of Geophilus! It should have rested quietly there, but names were too scarce, and so *Strigamia* was again brought out by Wood, in 1865, and applied to *Geophilus* Newport, not Leach. The type of Geophilus Leach, is *carpophagus*, but this species had been sequestrated by Newport and put into a new genus, *Arthronomalus*, leaving *Geophilus* as the name of another genus whose type was *acuminatus*, Leach. Thus Wood's proposition was to assign to *Strigamia* a type species *acuminatus*, and Latzel is in error in citing *Strigamia* Wood, as a synonym of Geophilus. If we allow that aborted names and synonyms can be thus resuscitated, *Strigamia* Wood, must have stood as a valid genus had it not been for the fact that C. L. Koch had in 1847 established the genus Linotænia on *Geophilus crassipes*. C. L. Koch, a congener of *acuminatus*, so that *Strigamia* Wood is a synonym of Linotænia C. L. Koch.

Neglecting the claims of Linotænia, Bergsoe and Meinert, in 1866, described *Scolioplanes* on *Geophilus maritimus* Leach, also congeneric with *acuminatus* and *crassipes*. The only ground on which *Scolioplanes* could be considered valid is that Linotænia as described by Koch was not a natural group, but this criticism would destroy a large majority of the older genera. It may be that the establishment of *Scolioplanes* was wise at the time, for the identities and relationships of even the European Geophilidæ were uncertain. At present, however, the European authors seem to be agreed that *acuminatus*, *crassipes* and *maritimus* are members of one genus, and while this view is held it would seem that the genus must stand as Linotænia C. L. Koch, with *Scolioplanes* Bergsoe, and Meinert as synonym.

Still another complication has been introduced by Sseliwanoff.[6] He uses *Scolioplanes* Bergsoe and Meinert, but recognizes *Strigamia* Gray as distinct, describing it at length and giving figures of *Strigamia parviceps* Wood, from California, also placing *Strigamia* Wood as a synonym of *Strigamia* Gray. To judge by the descriptions and diagrams of Meinert, Latzel and Daday, the European species as represented by *crassipes* are to be distinguished from *parviceps* by apparently good generic characters. That the American forms which have been referred to *Strigamia*, *Scolioplanes* and *Linotænia* are all congeneric is improbable, but Sseliwanoff has assumed the responsibility of separating *parviceps* and its allies from Linotænia (*Scolioplanes*), and his distinctions should not be ignored, even if *Strigamia* is no longer available as a generic name.

Dissections of *Strigamia bothriopus* Wood, *S. chionophila* Wood, and *S. parviceps* Wood, show that the mouth-parts of all three are very much alike, and that they differ from Linotænia in having the labial sternum divided, and the labial palpus two-jointed, the basal joint with a process, as in Sseliwanoff's figure of *parviceps*. Hence it seems probable that the other American species are more likely to be related to a genus

[6] Geophilidæ museja imperatorskoi Akademii Nauk, p. 12 (1881). T. I., figs. 1–8.

founded on *parviceps* than to the European genus Linotænia.

It is proposed, then, to end, if possible, the confusion which has long attended the use of these generic names by the following arrangement of synonomy:

Genus Geophilus Leach (1814), type *carpophagus* Leach.

Syn. *Strigamia* Gray (1842), no type.

Syn. *Arthronomalus* Newp. (1844), type *longicornis* (Leach).

Genus Linotænia C. L. Koch (1847), type *crassipes* (C. L. Koch).

Syn. *Strigamia* Wood (1865), type *acuminatus* (Leach).

Syn. *Scolioplanes* B. & M. (1866), type *maritimus* (Leach).

Genus Tomotænia nom. nov.

Syn. *Strigamia* Ssel. (1881), type *parviceps* (Wood).

The genus Linotænia is distributed over Europe and Northern Asia. The species are: *acuminatus* (Leach), *crassipes* C. L. Koch, *maritimus* (Leach), *pusillus* Ssel., *sacolinensis* (Meinert), *sibiricus* (Ssel.), *sulcatus* Ssle.

The genus Tomotænia, including species which must be provisionally referred to it, is distributed over temperate North America. The genera of Chilopoda, however, do not appear to be confined by continents, so that a further modification of generic lines and distribution is to be expected. The species which, pending further investigation, should be referred to Tomotænia are: *bidens* (Wood), *bothriopus* (Wood), *branneri* (Bollman), *chionophila* (Wood), *exsul* (Meinert), *fulva* (Sager), *lævipes* (Wood), *longicornis* (Meinert), *maculaticeps* (Wood), *parviceps* (Wood), *robustus* (Meinert), *rubra* (Bollman), *walheri* Wood.

—O. F. Cook.

Picobia Villosa (Hancock).—A response to Mr. E. L. Trouessart. In the April number of The American Naturalist, p. 382–384, I described and figured "a new trombidian" under the above name. In a more recent issue of the same magazine, July, p. 682–684, Dr. E. L. Trouessart, of Paris, takes exception to the species claiming it to be a form of Cheyletinæ, already well known in Europe, not differing from *Syringophilus bipectinatus* Heller. This writer has contributed some valuable articles upon the Acarina with which I was perfectly conversant at the time, notwithstanding he says I was "not acquainted with the modern literature on this interesting type." Thinking it necessary to mention only those papers which bore a classical relation to the species described, these were omitted. In adopting the genus Picobia, I was not alone, for there are others who dissent from the classification Mr. Trouessart lays down, notable among these being Newman,[7] who

[7] Treatise on Parasitic Diseases, p. 235, 1892.

maintains, that "the cheyletinæ, parasites of birds, comprise the genus Cheyletus, Harporhynchus, and Picobia; and in regard to Heller's genus, Syringophilus, the same writer says, p. 236, "for these Acarina he (A. Heller) created the genus Syringophilus which evidently enters into the genus Picobia, and he has described two species in it which ought to be named *Picobia bipectinata* and *P. uncinata*." The various immature stages and the unsettled condition of this group of Acarina, together with an almost total absence of American literature has made it an unusually difficult field for students taking up this line of work. However this may be, we are thankful for the timely discussion, or I may say criticism, raised by Mr. Trouessart on my species, and the expression of his views upon a subject which he is conceded to be an eminent authority. If the form *Picobia villosa* from the black flycatcher is what he claims namely: The same as the European species above mentioned, we are pleased to have the matter straightened, also the point emphasized of the caution necessary in presenting as new, immature stages of these Acarina, sometimes so very different from the adult, and with shades of individual differences, even from localities as widely separated as Europe and America. —DR. J. L. HANCOCK.

Chicago.

EMBRYOLOGY.[1]

Conjugation in an American Crayfish.—The following observations upon the breeding habits of *Cambarus affinis* show how much difference there is between the American crayfish and the European form, Astacus, and serve to clear up some important structures of hitherto unknown use.

Some specimens brought from Washington, D. C., in November, 1894, immediately united in pairs when put into a shallow vessel of water. The same specimens and also others received in February paired during February, March and April. About a dozen cases were carefully observed with the following results:

In captivity the entire process of conjugation lasts from two to ten hours and may be repeated by either animal with some other.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

When a male is put into a vessel with a female he seems ere long to become aware of the presence of the female and does not act as he does when males only are present. The female generally retreats and may even resist the attacks of the male, but generally this is not done with much vigor, and very soon after being seized by the male the female passes into a state of passivity, resembling death. The male advances eagerly to the female and grasps her with his large claws, sometimes gently. When the female struggles to escape, the male holds very firmly by one of his claws that grasps a claw, or an antenna, or any projecting part of the head region of the female, and eventually succeeds in turning her upon her back; if there is no struggle, the same result is also accomplished more directly and methodically. The male now seizes all the claws of the female in his two large claws, three in each on each side and holds them firmly as seen in Figs. 1 and 2. He

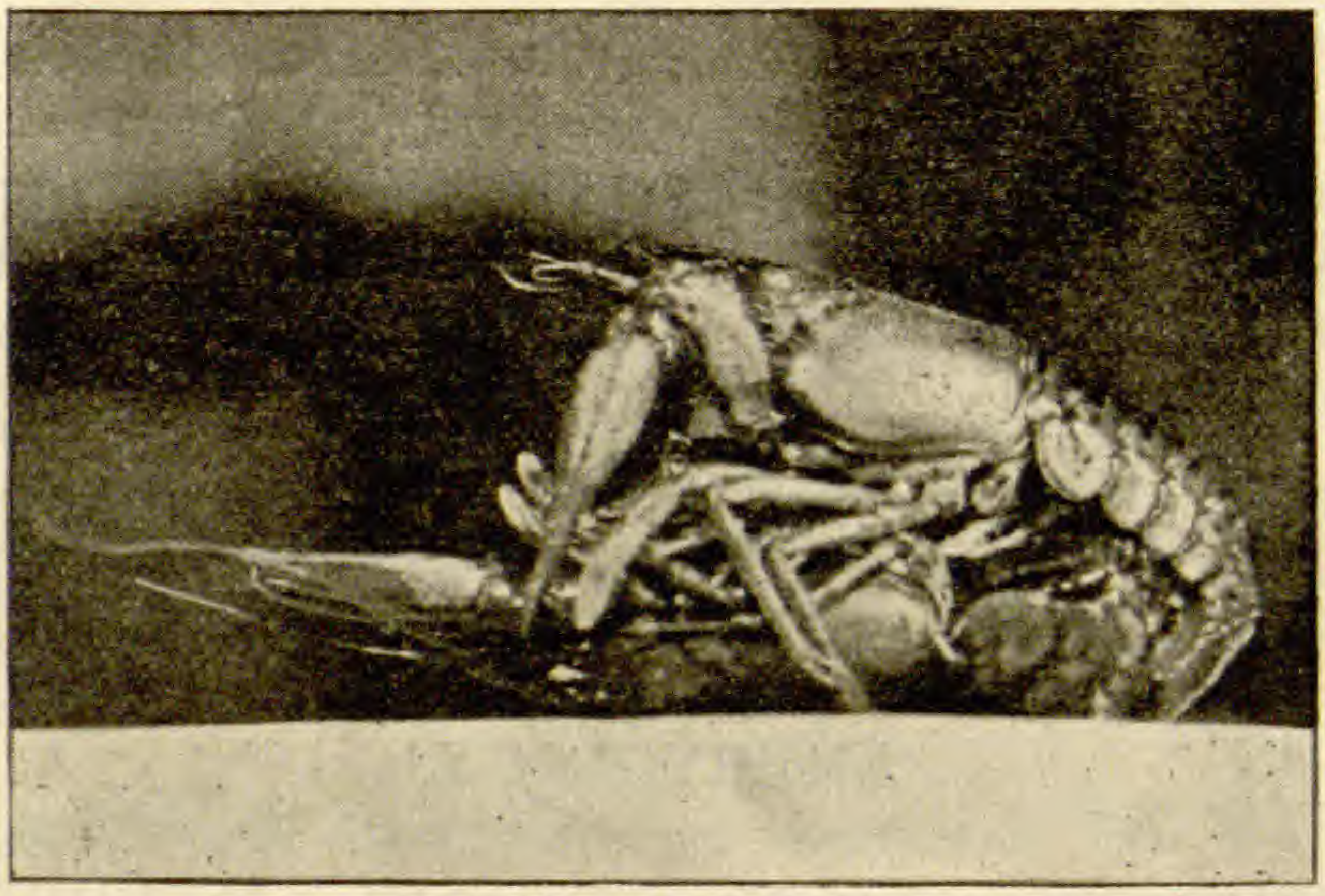


FIG. 1.

moves forward over the supine female into the position shown in the figures. This process has lasted ten to twenty minutes. It is followed by a most unexpected move: the male stands up away from the female, holding the claws as before, and deliberately passes one leg across under his body so that it projects from the opposite side. He then settles down again close to the female. The leg that is passed over is one of the fifth, most posterior, pair of walking legs. In the figures it is the left leg; it seems to be absent on the left side, Fig. 1, but projects straight out and backward between the fourth and fifth on the right side, Fig. 2. In many cases the right leg is used: in one case the leg projected between the third and fourth instead of between the fourth and fifth as usual.

This unusual position of the leg secures the proper position and direction of the intromittent organs. These are the first and second pairs of pleopodes, or abdominal appendages. They normally lie forward in a horizontal groove beneath the thorax, but now they are depressed at an angle of about 45°, and are held so by the transversely placed leg, as may be seen from Fig. 1, which shows the white tips of the intro-

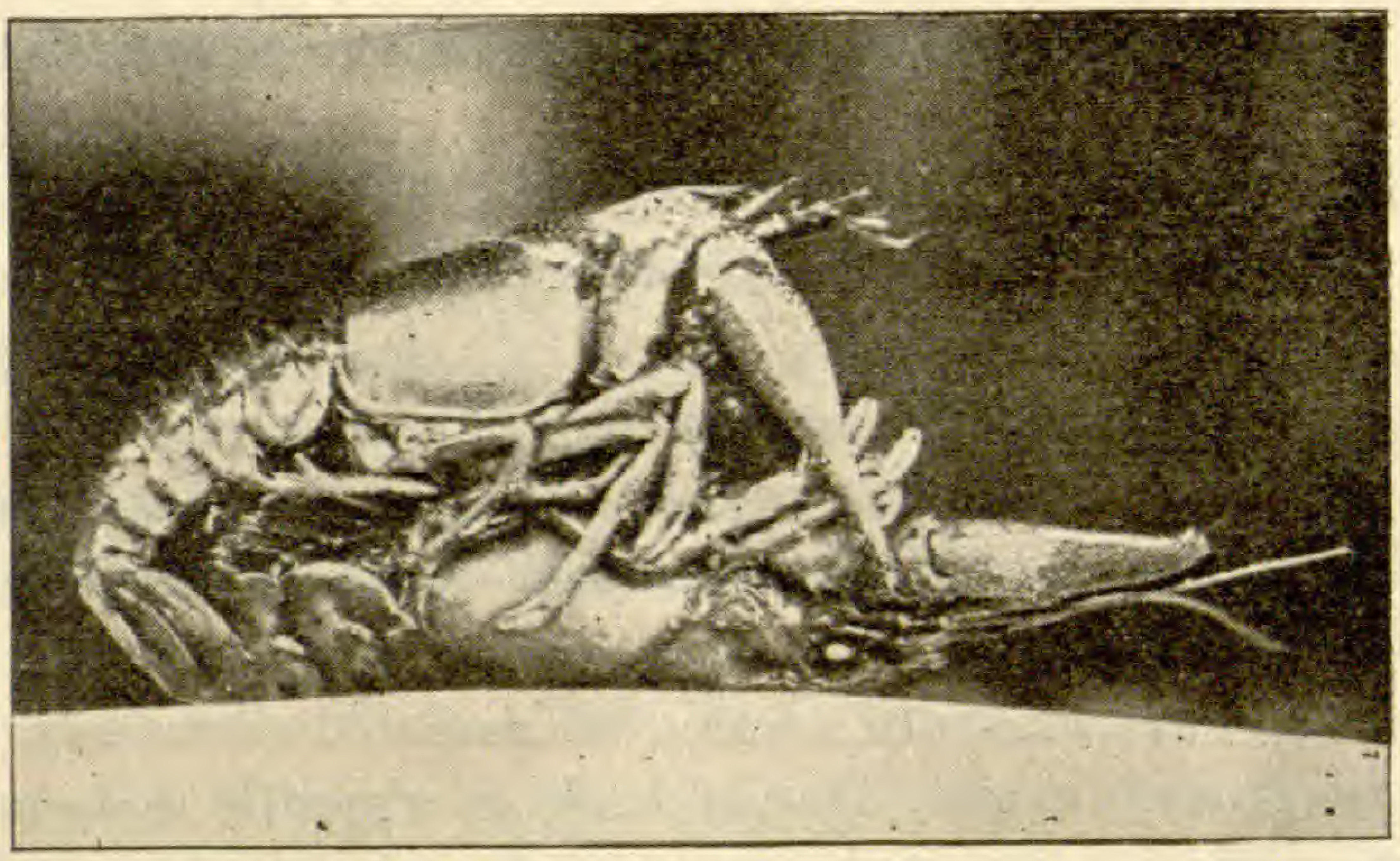


FIG. 2.

mittent organs of the left side. When the organs are thus held they may accomplish their purpose, which is to transfer the sperm to the *annulus* of the female.

As seen in Fig. 2 the abdomen of the female is bent up, and that of the male partly surrounds it. At times the male relaxes the abdomen and moves forward upon the female. Ultimately the two are so accurately adjusted—and this is a difficult problem in two such irregular, rigid masses with so many appendages—that the tips of the first pair of pleopods are thrust into the annulus.

The two are now firmly united and cannot be readily separated, in fact it was found possible to kill and preserve them in this position, and thus obtain the photographs from which the illustrations are taken. When thrown into actively boiling water for a moment, the crayfish are fixed in the normal position with no observed change, and may then be preserved indefinitely.

The firm union of the two is accomplished by the use of the hook-like spines that characterize the male of many species of Cambarus. In *C. affinis* there is one spine on the third segment, ischiopodite, of the third walking leg on each side of the body. When the male applies himself closely to the female, he fastens these two hooks to the base of her fourth walking legs, on each side.

The hooks depress the soft membrane between the coxopodite and basipodite on the dorsal-lateral aspect and catch firmly against the chitinous ridge formed by the hinge-like union of the chitinous edges of those same segments, coxopodite and basipodite. By this means the two animals are held together against the force necessary to introduce the male pleopods into the resistant annulus.

The animals now remain united for several hours, during which time sperm is transferred into the annulus or seminal receptacle of the female.

The annulus is a well known descriptive character found in the females of Cambarus, but not in Astacus: hitherto its use has not been known.

It varies in shape in different species.

In *C. affinis* its development varies, but in general it is a transversely elongated, ellipsoidal, chitinous elevation on the ventral side of the thorax between the bases of the fifth pair of walking legs. On this raised area are smaller, more prominent rounded elevations, bounding a transverse groove or pit. One of these is a gentle transverse ridge, forming the posterior lips of the groove; the other two are rather prominent bosses on the anterior lip of the groove.

Between these last is a longitudinal cleft on the middle line, opening posteriorly into the transverse groove, and not straight, but curved as it passes between the two bosses. Sections of this organ show that the longitudinal cleft leads into a small pouch or sac that, when seen from a dorsal view, projects upward into the body as a curved ridge. This sac has firm walls that are of calcified chitin and presents no discovered opening except the external slit. It is regarded as simply a pitting in of the chitinous exoskeleton.

After conjugation has taken place the annulus of the female has projecting from its groove a small plug of whitish substance that may remain for many weeks.

The same material fills the cavity of the sac in the annulus. It is a compact, paste-like substance forming a tubular sheath around a central axis or mass of granules that on examination prove to be the peculiar, radiated sperm-cells of the crayfish.

As the crayfish may be roughly handled and removed from one dish to another during the process of conjugation there is no difficulty in observing with a lens the means by which this sperm-plug is made. At this period of sexual excitement the terminal part of the vas deferens of the male is turned outward from the opening at the base of the fifth walking leg of each side and projects horizontally as a short, bent, conical nozzle or penis-like organ. This organ fits exactly into the beginning of a long groove that extends along the first pleopod. The tip of this appendage is sharp and hard and is seen to actually penetrate into the cavity of the annulus. The sperm that issues from the vas deferens passes along the groove of the first pleopod to its tip and so into the annulus.

The second pleopod plays some part in the process of transfer, but this is known only by inference, not by direct observation. It has a peculiar triangular spoon at its end which is held applied to the first pleopod and it also has a terminal filament that fits nicely into the groove at the tip of the first pleopod. It may easily act to shove the sperm masses down along the groove of the first pleopod as well as to protect them from contact with the water and from going astray (which rarely happens.)

Apparently both sides of the body are active in this sperm transfer, but this is not certain.

The process of sperm transfer continues, with interruptions, for several hours, and then the male separates from the female. He first moves backward, and rising places the crossed leg back again into its normal position, and then releases the female.

During the entire conjugation the male is obviously excited as is shown by the vibrations of the anterior maxillipedes and by the very strong current of water cast out from the gill chamber by the exhalent apparatus. The female, on the contrary, is remarkably inert and shows no sign of any activity even in the respiratory organs. At times there is, however, a slight convulsive twitching of the base of the abdomen, possibly connected with sensations during sperm transfer.

The eye-stalks were also seen to move when disturbed by the claws of the male.

In two instances the dexterity and skill of the male were well shown after the first stages of grasping the female had been imperfectly accomplished. In these cases the male mounted upon the dorsal surface of the female and seized her claws with his, having failed to turn her over in proper sequence. In this unusual position the male attempted to adjust his appendages to the female and then became aware of the fact that the conditions were unusual. The male depressed the first antennæ so that they were firmly applied to the dorsal surface of the thorax of the female and bent forward by the pressure. The sensation so obtained seemed to initiate the almost intelligent action that followed. In one case the exopodites of the third maxillipede were also used in feeling the female. In about ten minutes the male turned the female over and assumed the usual attitude seen in the figures and then continued the conjugation normally.

In accomplishing this feat the male first removed his left claw from the left claws of the female, and seized her rostrum and head region. By this means he turned her to lie on her left side while he was on her right. Next, the right claw let go its grasp of the female's right claws and seized her left claws. He was now able to turn her on the dorsal surface, and by then changing his left claws from the rostrum to her right claws succeeded in moving forward over her ventral surface as normally takes place. Ten minutes later sperm was passed and conjugation continued for some hours.

While there can be little doubt that the sperm so elaborately transferred to the annulus is subsequently used to fertilize the eggs as they are laid, this is, as yet, not demonstrated. One female deposited eggs in confinement towards the end of March, but these eggs did not develop, and part of the process was no doubt abnormal. This female was in a peculiarly sensitive state for four or five days prior to laying. During this time any approaching object, though ordinarly causing no reaction, would excite the female to active movements and the raising of the claws in an aggressive attitude. During this period the female most assiduously and diligently cleaned off the foreign deposits from the exoskeleton over the ventral surface of the abdomen and from the pleopods so that this region was conspicously white.

The fifth walking legs are employed in this function, being bent back under the abdomen and rubbed against the pleopods with an unexpected amount of precision.

During this period also the female may be found at times lying on the side or on the back, and actively moving the pleopods back and forth in a rhythmic way once in about one second. The endopodites of the third maxillipedes and the chelæ and the first and second walking legs are likewise, slightly, swung back and forth.

The actual laying of the eggs took place during a night and a day. At this time a large mass of slimy material extended like a veil from the tip of the bent abdomen to the ventral side of the thorax anterior to the third walking leg. Some of the eggs were enclosed in this mass and some in a similar mass attached to the pleopods. It would seem that the eggs could pass from the oviducts under protection of this secretion to their destination on the abdominal appendages.

This mass of secreted material disappeared entirely within two days. The eggs then remained attached to the pleopods.

The sperm-plug that was present in the annulus also disappeared a day later than the secretion. As this crayfish was alone, it seems certain that she removed the sperm-plug. It remained for weeks in cases where eggs were not laid.

The eggs, however, seem not to have been fertilized: they gradually fell off and burst from osmotic changes. E. A. ANDREWS.

PSYCHOLOGY.[1]

Professor Baldwin on "Mental Development."—It gives me pleasure to insert the following note which Professor Baldwin has recently sent me, with reference to the review of his book on "Mental Development in the Child and the Race," which was printed in the July number of the NATURALIST:

"The very cordial and appreciative review of my book on *Mental Development* by Dr. Newbold in the July issue of this journal contains one remark which a word from me may serve to throw light upon. Dr. Newbold says that I sometimes 'rest content with a careless and inadequate analysis of the psychoses which are to be explained.' This is no doubt just, as far as the actual contents of my book are concerned, and as far as the word 'inadequate' goes. But I may say that the inadequacy is due to the fact that I have already devoted my large *Handbook of Pyschology*—especially the second volume on *Feeling and Will*—to the detailed analytic treatment of the same functions which are treated genetically in the present book. I did not feel justified in doing that a second time. And moreover many of the analytic results which my *Mental Development* assumes are, I venture to think, such common property of psychologists to day that they are largely outside the arena of debate: at least, whenever my developments in this book seemed to me to turn on points in dispute, I tried not to leave the justification of them in an inadequate state. I hope it is not too much to ask of readers that they bring their general psychology with them. It is really not the psychology that I fear the inadequacy of as much as the biology of the book, but however that may be, the omissions are well-considered and not 'careless.'"—J. MARK BALDWIN.

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

In light of so explicit a disclaimer I must withdraw the objectionable word and ascribe the omissions in part to fundamental differences between Professor Baldwin's thought and my own, and in part to the limitations of space. I need only say that after writing but before printing the review in question I carefully reread those portions of Professor Baldwin's larger work which dealt with the topics I had in mind and failed to find what I sought. And while most of us, I fancy, bring our general psychology with us when we attempt to master a technical treatise like Professor Baldwin's, we do not all feel justified in ascribing to an author doctrines which his words, taken in their most obvious sense, would seem to exclude, however important those doctrines seem to the reader, or however widely they are accepted by others.—W. R. N.

"**The Psychic Factor.**" BY CHARLES VAN NORDEN, D. D., LL. D.[2]—This is a somewhat disappointing book. At the outset it challenges interest. The author finds the justification for its appearance "in the unsettled condition of the metaphysical world, in the marvelous strides of biological and psychological discovery, and the utter demoralization of the old psychology," and endeavors to cover in 217 pages the whole field of comparative and analytic psychology, with a glance aside at supernormal and pathological phenomena. The book is written in a vigorous and attractive style and the author betrays an enviable command of fact and illustration. Furthermore, it is of interest as being one of the earliest attempts to incorporate the tentative results of current psychical research into a textbook on psychology.

The earlier chapters sketch in a few words some of the more interesting manifestations of consciousness in lower forms of life, and trace the evolution of the nervous system. In the second section on consciousness in general, the author endeavors to escape from current psychological conceptions and to deal with attention, with the "enchaining and grouping function of consciousness" and with the influence of mental states on organic functions from a point of view more in harmony with the newer psychology. The third section, on subconsciousness, endeavors to bring the phenomena of hypnosis, secondary personality, etc.. into line with the phenomena of normal sleep. But telepathy and clairvoyance, although acknowledged, remain patches on the garment of the author's thought. His treatment of sensation calls for no especial comment, and in his analysis of the "cognitive powers," of feeling and of will, Dr. Van Norden frankly relapses into the old psychology which he regards as so utterly demoralized.

[2] New York, D. Appleton & Co., 1884.

On the whole, "The Psychic Factor" is written in a candid and scientific spirit, yet occasionally one finds traces of the theologian and instructor of youth which would be more in place elsewhere. We are hardly yet in a position to say that the phenomena of telepathy make divine inspiration "no longer even an unlikely phenomenon;" but "one of the most feasible and natural of religious processes." Nor can we point to the still more contested phenomena of "lucidity" as establishing on the part of the Hebrew prophets a "prophetic insight," or as proving that they "surely saw visions and dreamed dreams," that "the present and the future appeared to them as a shifting panorama." The question of possibility is one thing and the question of fact another; the possibility might be established and the fact remain highly improbable. And when, in the chapter on hallucination, we find the hallucinatory properties of opium used as a pretext for a diatribe upon tobacco, we feel that there is a form of zeal that is not edifying.

The Baboon Switch Tender.—Some years ago a statement appeared in the newspapers that a baboon had been trained to open and close the switches on a South African railroad. The following extract from a letter from Klerksdorp, S. Africa, of March 31st, 1895, confirms these accounts:

* * * "you can state that until lately, when the nervous public made such a fuss it had to be stopped, a South African monkey, like those I wrote to you about from Mooit Gedaert, was tamed by a switchman just out of Maretsburg, our college town here, to turn switches for passing trains, etc. He would wait until the engine was in sight, then run and open the switch, jump on the *cowcatcher*, have a short ride, then jump back to turn it off again, but passengers grew so frightfully hysterical, especially the strangers, that it was stopped This is honestly true."—JOANUS STUBBS.

Change of Habit in a Parrot.—A letter addressed to *Natural Science* by M. S. Evans, Natal, S. Africa, calls attention to a change in the food habit of the parrots (*Psittacus* sp.) in the valley of the Upper Umkomanzi River. Until last year (1894) the parrots, which are quite common in the bush, had not foraged in the gardens and orchards, when for the first time since the place had been settled by the Europeans—a matter of twenty-five years—they attacked the fruit. Their somewhat timid nature seemed quite altered, and they flew into the orchards in large numbers. They seemed unable to carry off the fruit alone, so broke the small branches below the joint, and were seen flying off with branches with apples attached in their bills. The excitement among them seemed intense, the discovery of such an abundant and new food-supply apparently much agitating the parrot world. As the change of habit may be permanent, Mr. Evans thought a record of the date of the change worth making.

ANTHROPOLOGY.

Another Ancient Human Jaw of the Naulette Type.—In the Pyrenean cave of Estelas (department of Ariége, Commune of Cazaret, near St-Girons), associated with cave bear, horse, an ox, Cervus elaphus, and Ursus arctos, an interesting lower human maxillary has been recently found. This presented to the Academy of Sciences of Paris (see Revue Scientifique, 27th of July, 1895) by M.M. Louis Roule and Felix Regnault should cause considerable comment in view of the recent European discussion for and against the so-called ancient types of human skulls. While late observation in craniology has seemed to undermine the value of cubical measurements of brain contents as tests of age, the peculiar jaw traits of certain old skulls have apparently held their significance. This complete child's jaw is said to present manifest characters of inferiority, together with a strength and adaptability for muscular insertion remarkable for so young an individual. Moreover it has a striking resemblance to the celebrated jaw of Naulette and to that of Malarnaud (Ariége).

Sandals in Yucatan.—I asked the Bishop of Yucatan the question propounded by Mr. Otis T. Mason in Science for August 2d, 1895. whether the sandal now in common use among the Mayas, strapped across the instep and fastened further by a single round thong between the first and second toes, was an inheritance from pre-Spanish times. He was unable to answer the question more particularly than to show me from his collection, the foot of an earthen statue from Izamal, moulded with a sandal fastened by two toe thongs instead of one. These passed between the first and second, and third and fourth toes. to reach a strap on the instep. I question whether the existing sandals have been attentively studied in Central America. Some Indians may wear the double toe strap still, but given the existence of the sandal with double toe straps in ancient America, we might reasonably suspect that the old Mayas sometimes used the simpler single thong between the first and second toes, now so common.—H. C. MERCER.

Strange Hints for Anthropology.—Schiaparelli, who observed in 1877, the markings called canals on Mars, not yet discerned by the Government telescope at Washington, still hesitates to call them trenches dug by intelligent if not human creatures. Since his observations, the existence of the markings has been verified by astronomers at Nice, at Arequipa and at Mr. Percival Lowell's observatory at Flagstaff, Arizona, where the air medium is good for seeing, and where many more lines have been discerned and named and new phenomena studied. The theories advanced and some of the results of Mr. Lowells' original observations have been interestingly summed up by him in the Atlantic Monthly for May, June, July and August, 1895.

Mr. Lowell states the remarkable probabilities to be as follows: That the long lines, because straight and regular, are artificial; that they are visible because, as Prof. W. H. Pickering first suggested, belts of irrigated vegetation about 30 miles wide fringe them and show dark against the desert face of the planet; that they fade out in the Martian autumn and become visible in the spring because their leaves fall off and reappear; that they are dug straight because no mountains exist to obstruct them; that, granted an intelligent water drinking inhabitant, they are necessary, because Mars is waterless save for the yearly melting of a polar ice cap; that round, oasis-like areas at their intersections still further indicate methods of artificial fertilization; that, by our own standards of need, intelligent creatures could exist on Mars because Mars has an atmosphere and that owing to a less hostile gravity its inhabitants might perform more work at less pains than we do.

Meanwhile the investigation of what appears to be the handiwork of a Martian intelligence must excite wide interest. As yet no explanation is offered for the strange fact that sometimes certain canals show double. And there are other doubts. Distant trees on the earth do not always lose color. The Yucatan forest, where I have seen it from hilltops, had a distinct dark blue appearance to the naked eye in February and March, though, to a great extent, leafless, and we are left to wonder what light observations of the ocular effect of patches of woodland upon the earth's surface from mountain heights may throw upon one of the vital points of the theory, namely, that belts of vegetation, when leafless, observed through a telescope against a bare background, would be invisible.

H. C. MERCER.

$4.00 per Year. $4.60 per Year (Foreign). 35 cts. per Copy.

THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

Vol. XXIX. OCTOBER, 1895. No. 346

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PHILADELPHIA, U. S. A.

THE EDWARDS & DOCKER CO.,
518 AND 520 MINOR STREET.

Entered at the Philadelphia Post Office as second-class matter.

THE

AMERICAN NATURALIST

Vol. XXIX. October, 1895. 346

THE FIRST FAUNA OF THE EARTH.

By Joseph F. James, M. D., M. Sc., F. G. S. A., etc.

One of the most interesting questions with which the geologist has to deal is the age of the earth. There is, however, no subject that is wrapped in more profound obscurity, and yet probably none to which more attention has been given. Perhaps it may never be settled positively; but, as years roll on, and more and more facts come to light, speculations may be made with a greater amount of certainty. It may be possible, in the future, to say approximately how many centuries have elapsed since the earth assumed its present form, but, of course, it can be *only* approximate. Estimates vary now between one hundred million and five hundred million years, since the first rocks were laid down.

While this matter still remains uncertain, there is another which was formerly, and still is, in much the same state. It is the beginning of life upon the earth. Geology is a young science, but her sister, Paleontology, is younger. Both are taking rapid strides forward, and, working hand in hand, they will eventually be able to tell us much of interest about this globe of ours.

The steps required to bring any science from a state of chaos to one at all approaching precision are innumerable. The records of these steps are mostly buried in official reports of governmental surveys, technical periodicals, or in the ponderous proceedings of learned societies. It is especially so with geology. To those familiar with these records there is much to excite wonder and surprise. There are romances hidden in them. There are wordy wars and fierce intellectual combats. There are charges and counter-charges. There are victories or defeats, equal in one sense to those of Austerlitz or Waterloo. It needs but the mention of the Darwinian combat to call one of these wars to mind. Another, but more obscure one, relates to the first forms of life upon the earth, and it is the intention here to call attention to this.

It is only a little over one hundred years since the first scientific observations upon stratified rocks and fossils were recorded. It was natural that, in the early part of this century, the crudest ideas should prevail regarding these subjects. The origin and cause of stratification were unknown. The nature of fossils and their value as indices to pre-existing forms of the animal or vegetable kingdom had not been thought of. Some few of the shrewder heads, Rafinesque among them, had begun to see the value of fossils as early as 1818, but the general opinion was probably that expressed by Amos Eaton in that year in the first edition of his " Index to the Geology of the Northern States." Here he announced it as his belief that the land inhabited by the first human beings was supported by two segments of granite, beneath which was an immense sea. The North American Continent, he said, " may now be supported in the same way: and the meeting of the edges of the segments may be near the granitic ridge which extends from Georgia to the Frigid Zone." He further supposed that, during the Deluge, all animals, except those preserved by Noah, were destroyed, and the petrified remains we now find are some of the species overwhelmed by that catastrophe. " Noah," said he, " took into the Ark the land animals of the island or continent whereon he resided. This is now covered with the ocean, and we know nothing of the remains to be found there." He rightly believed it would have been most interesting to have some account of the researches of the patriarch and his family " among the recent ruins of former grandeur. But we have no account," he says, " of any discoveries nor of any attempts to search out their former inhabitants. It was doubtless well known to Noah that not one foot of the ancient continent remained above water." That Prof. Eaton did not long retain his belief in the theory advanced, seems evident from the fact that these speculations are omitted from the second edition of the " Index," published in 1820. They have since faded from the public mind, and have taken their place with the still older ideas that fossils were fallen stars and Belemnites were solidified thunderbolts.

The rapid advance in public opinion as to the value of geological studies is shown by the organization of numerous State surveys. The first of these was of North Carolina. Prof. Olmstead reported on its geology as early as 1823, and this survey was followed by one in Massachusetts, where Hitchcock reported in 1831. Between that date and 1838, the States of Maine, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Georgia, Tennessee, Kentucky, Ohio, Indiana and Michigan had published reports. The general government, too, had sent expeditions to the northwest, and had published the results. It is true many of the State surveys ceased after the issuance of a few documents, but their existence, even for a short time, was evidence of the belief in their value. Some of the States organized second surveys at a later date, and published numerous volumes. Among these are especially to be mentioned New Jersey, Pennsylvania, Kentucky, Ohio and Indiana. Of all the States mentioned, New York possessed the greatest vitality; and, while there have been changes in it as in others, the work there has been more nearly continuous than in any other. Remarkable as it may seem, the present honored head of the survey, the veteran Prof. James Hall, was one of the original corps in 1837.

Although designed primarily to report upon the general economic and mineral resources of the respective States, these surveys necessarily became concerned with other work. It was soon found that in order to intelligently describe the rocky strata, it was essential to give the rocks distinct names. These were, at first, taken from mineralogical characters, and such terms as "metalliferous" and "geodiferous limerock" were the result. Or the name was given from some special physical aspect, and then "cliff limestone" and "marlite" were applied. Finally, however, the plan of giving the formations the names of localities where the rocks were either best developed or had been first observed was adopted, and then such names as "Potsdam," "Trenton" and "Niagara" were used.

Another matter, too, which soon became one of the prominent features of the geologists' work, was the study of the organic contents of the rocks. It was early observed that certain species occurred constantly in certain strata, while above or below them, other and different species were found. When once this fact was established, geologists availed themselves of it to place in one horizon, or to consider as of one age, the beds containing the same species of fossils, even when found in distant parts of the country.

The lack of any method of coöperation between the members of the various State surveys, led to great diversity of nomenclature. In New Jersey, Pennsylvania and Virginia, the formations were known by numbers; in Ohio and Indiana they received names from lithological features, while in New York it early became the plan to give the various formations names of places where they were best exposed. Perhaps it is to be considered fortunate for the science that so many of the State surveys ceased early, else the nomenclature might have been as varied as the different States had rocks. It was the vitality or persistence of the New York Survey that enabled her geologists to establish a system of names for almost the whole North American Continent, so far, at least, as the rocks lying within her borders were capable of doing. Thus the "New York System" became a standard to which was referred strata of similar character occurring in all parts of the country.

None of the rocks of New York are of later age than the Devonian. Most of them, indeed, are far older, and so complete is the series that there is no formation from the Archean or metamorphic rocks to the latest Devonian lacking. A portion of the scheme, as finally adopted, is as follows:

Upper Silurian	Lower Helderberg
	Onondaga
	Niagara
	Clinton
	Medina
	Oneida
Lower Silurian	Hudson River
	Utica
	Trenton
	Chazy
	Calciferous
	Potsdam
Archean	

All of the formations lying above the Archean are stratified, and contain a greater or lesser number of fossils. Each formation is generally separated from the one above and below by some unconformity, indicating a time during which deposition was not going on. These time breaks are also characterized by changes in the organic forms. In other localities than New York, these breaks in sedimentation and life do not always occur. Sometimes the change in physical features is so gradual that it is impossible to say where one group ends and the next one begins. Fossils, too, pass from one into the other with little or no change. In all such cases there is great difficulty in drawing any line of demarkation, but, in general, it can be readily done.

In the early years of the existence of the New York Survey, Dr. E. Emmons noted the occurrence of a sandstone in the northern part of the State, lying directly upon the metamorphic or igneous rocks. From its proximity to the town of Potsdam, he gave it the name of "Potsdam sandstone." Its position in relation to metamorphic rocks caused it to be considered the oldest formation in the State, and the organic remains found in it were regarded as representing the earliest life on the globe. These remains were scanty, consisting chiefly of a species of *Lingula* as then understood (Fig. 1), and of some

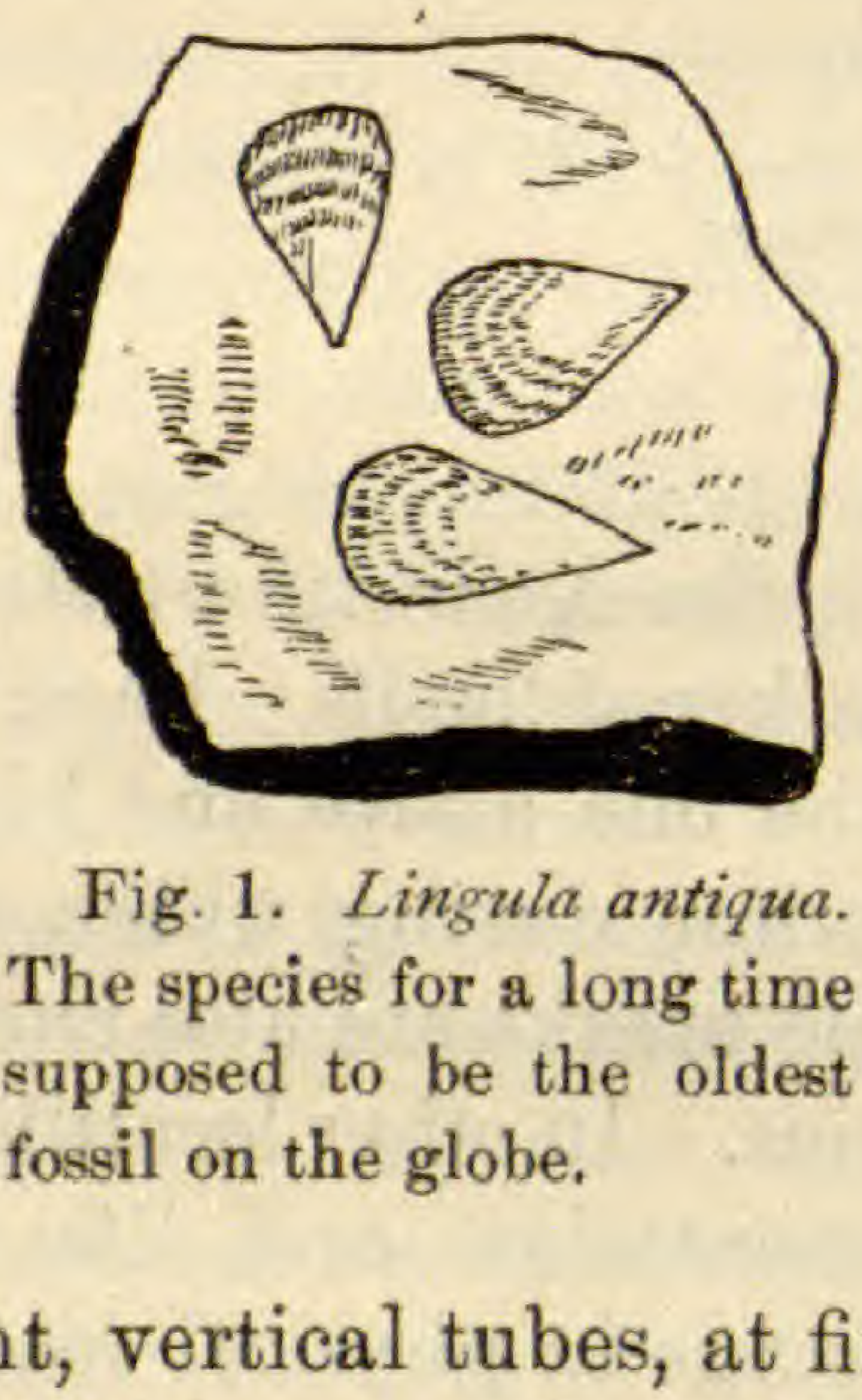

Fig. 1. *Lingula antiqua.* The species for a long time supposed to be the oldest fossil on the globe.

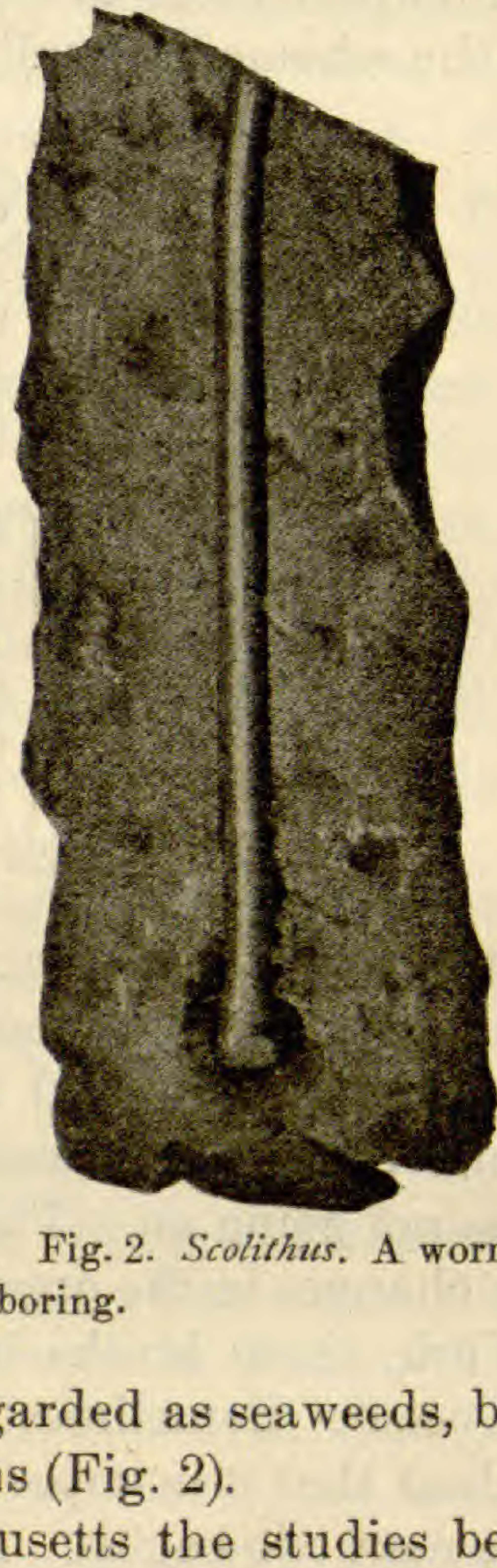

Fig. 2. *Scolithus.* A worm boring.

straight, vertical tubes, at first regarded as seaweeds, but later on as the burrows of marine worms (Fig. 2).

Continuing in western Massachusetts the studies begun in northern New York, Dr. Emmons, in 1842, announced his belief that the Potsdam sandstone was not the oldest, stratified, fossil-bearing rock in North America, but lying beneath it, and therefore older than it, was a great series of sedimentary rocks for which he proposed the name "Taconic." It was not, however, until two years later, in 1844, that he described some fossils from this older series. Among these were two trilobites, and it is probable that more has been written regarding these two fossils than almost any others in the world, and in Figure 3 is shown one of them. These specimens were, of course, regarded with great interest, as they carried life on the globe further back in time than had ever before been supposed possible. The evidence adduced by Dr. Emmons as to their great age was not, however, accepted by the geological world. Geologists were loath to believe that so highly organized an animal could have existed at so early a period. Some believed the rocks containing the fossils were younger than the Potsdam, instead of being older, considering that even if they were really lying underneath the Potsdam sandstone, that it was by reason of a fault or dislocation which had reversed the original position of the two formations. In fact, the existence of the possibility of a series of *sedimentary* deposits below the Potsdam was denied, although this has long since been admitted. Yet long and bitter has been the controversy over this Taconic system; and while it is now known that Emmons included rocks of various ages in his new terrane, no one disputes the fact that he was the first to record evidence of the existence of animal forms in what are, at present, regarded as the oldest fossil-bearing rocks of the globe.

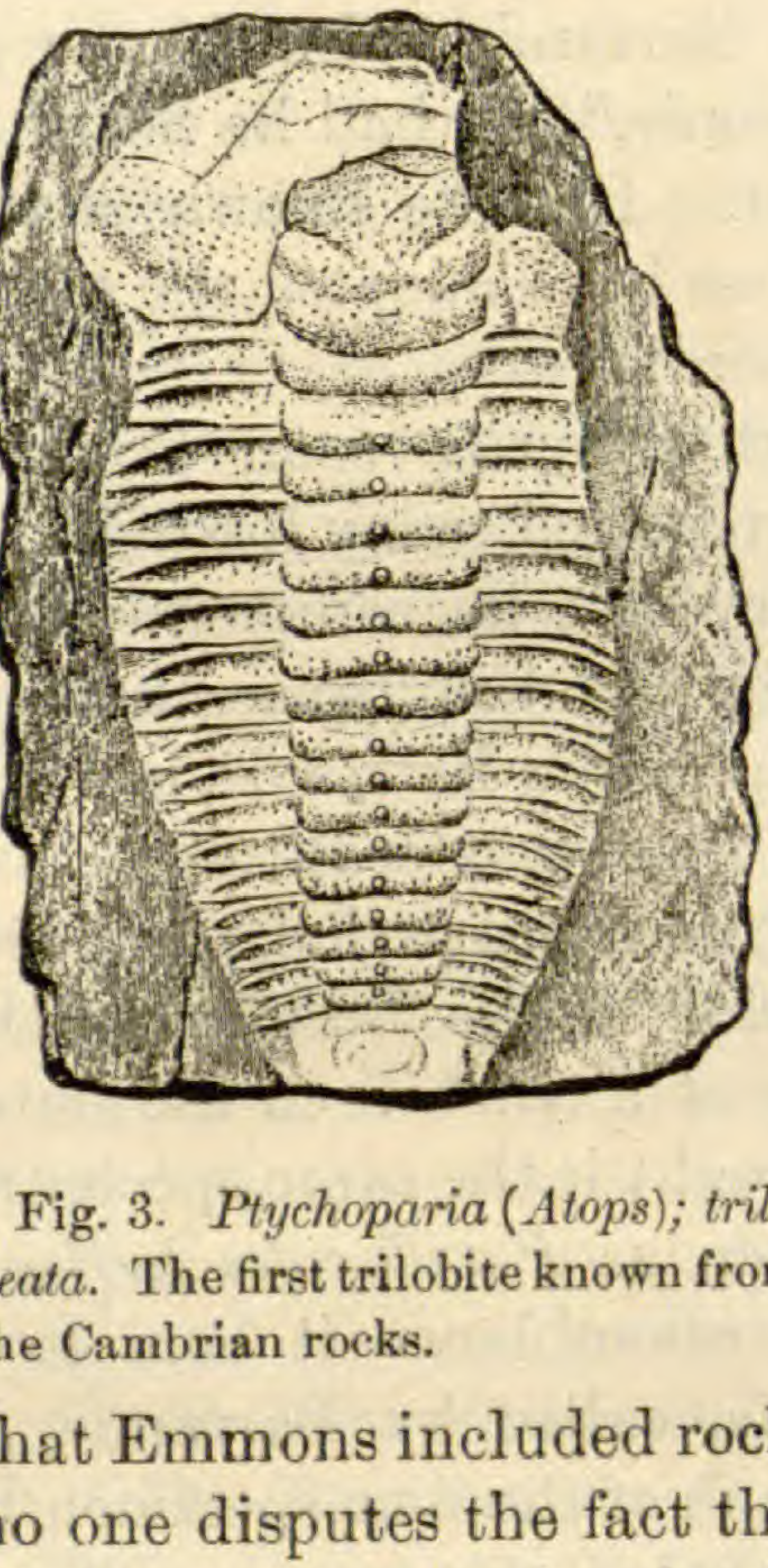

Fig. 3. *Ptychoparia* (*Atops*); *trilineata*. The first trilobite known from the Cambrian rocks.

Previous to Emmons's work in North America, Sedgwick and Murchison had been studying the formations of England and Wales; and in 1835, Sedgwick proposed the name "Cambrian" for a series of rocks in Wales, supposed by him to be without life. A little later, about 1837, Murchison proposed the name "Silurian" for another and a higher series, which he thought contained the earliest forms of animal life. A conflict soon arose between the adherents of the two systems. Murchison extended his Silurian downward as fossils were found at lower and lower horizons, against the vigorous opposition of Sedgwick. It was not until the characters of the fossils were studied that a definite understanding was reached as to the lower limit of the Silurian. These studies were made by Barrande in Bohemia. He announced, in 1846, his discovery of trilobites with peculiar features. To the fauna, as a whole, he gave the name of "Primordial." He pointed out various differences between it and the English Silurian, calling this last the "Second fauna." Barrande did not know at this time of Emmons's name "Taconic," nor had he heard of the fossils that had been described. Had he known of the work of Emmons, he would doubtless have adopted the name Taconic, instead of proposing Primordial.

Continued investigation in North America soon brought new facts to light. Owen, in 1847, reported many fossiliferous beds in the upper Mississippi Valley that he compared with the Potsdam of New York. Roemer found in Texas, in 1848, fossils similar to those of Owen; and when Barrande, in 1853, heard of and saw the fossils from these two localities, he announced that they belonged to his Primordial period. In 1856, Prof. W. B. Rogers called the attention of the Boston Society of Natural History to the discovery of a trilobite in the slates of Braintree, near Boston. He thought it the same species as that described in 1834 by Dr. Green as *Paradoxides harlani*, and noted, at the same time, the resemblance it bore to a species of the genus from Bohemia, called by Barrande, *P. spinosus.* When he sent a photograph of the new specimen to Barrande, this authority, too, concluded the two specimens were identical. Thus the presence in America of the "primordial" fauna of Barrande was at last firmly established, and the work to come was the filling in of the outlines, closing the gaps and bringing order out of the chaos that had before reigned.

One of the most intricate problems to be settled was that relating to the age of certain rocks in northern Vermont, occurring near the town of Georgia. It was in this region that the fossils described by Emmons had been found. Their age had been variously estimated as Medina, Hudson River and Potsdam (see table of formations on a previous page), but, without going into the details of the controversy, it must suffice to say that it was at last decided that these "Georgia slates" were older than the Potsdam, but not as old as the Braintree, Mass., beds, in which *Paradoxides* had been found. Prof. Hall had established the genus *Olenellus* to include the Vermont trilobites, and the idea prevailed that this genus succeeded *Paradoxides* in time. It was in 1868 that the first reference was made of the Potsdam rocks to the top of the Primordial period, instead of to the base of the Silurian where they had previously been placed. So that at this time the Braintree beds were supposed to contain the oldest fossils on the globe.

Meanwhile, geologists had been studying the fauna in rocks occurring about St. John, New Brunswick. Noting the resemblance the trilobites there bore to those from Braintree, they concluded the two deposits were of the same age. In Canada, Logan, in 1864, taking cognizance of all the discoveries in New York, Vermont, Massachusetts, New Brunswick and Newfoundland, published a scheme of classification which, for twenty-four years, perpetuated an error. This scheme in its lower portion is as follows:

(3) *Upper Potsdam*, including the rocks of the upper Mississippi Valley, northern New York and adjacent parts of Canada.

(2) *Lower Potsdam*, including the rocks of Georgia, Vermont, and some of Newfoundland.

(1) *St. John Group*, including the rocks at Braintree, Mass., St. John, New Brunswick, and St. John's, Newfoundland.

This view of the succession of the oldest fossil-bearings rocks of North America was held until 1888, except that the three divisions were called respectively, (3) Upper Cambrian, (2) Middle Cambrian, and (1) Lower Cambrian. Of these divisions the Upper was also called the *Dikellocephalus zone*, the Middle the *Olenellus zone*, and the Lower the *Paradoxides zone*, from the three genera of trilobites confined to the rocks of each terrane.

(*To be continued.*)

ORGANIC VARIATION.

By Chas. Morris.

The recent paper in The Naturalist, by Prof. Osborn,[1] on variation in organisms, and the seeming presence of certain unknown factors in development which give rise to phenomena not included in the accepted theories, suggests the desirability of further consideration of this topic. The problem is a most intricate one, the final result being affected by every external condition to which the organism is exposed throughout its whole career, and by various internal influences which are far more difficult to trace, yet are, perhaps, the leading forces at work.

The effects of environment have been abundantly dealt with and are somewhat fully understood. It is not necessary here to state the principles of Lamarckism and Darwinism. It will suffice to say that they do not embrace the whole problem. Darwinism does not attempt to do so, since it takes the great fact of variation for granted and works from that as a basis. Lamarckism attempts to explain variation, as due to use and to the resulting strain upon the organism. But it evidently does not reach the great class of individual variations which are opposed to heredity, and whose cause lies deep in the organism and must be sought in the conditions of the germinal cell itself.

Of the two great underlying principles involved in organic evolution, heredity and variation, the former seems much the most comprehensible. It is but natural to expect that the germ should unfold in the manner of that from which it was derived. Such native tendencies as exist in it must be derived from the parents, and bear a resemblance to those that have been active in the parental organisms. As a result, if parthenogenesis prevailed, we should naturally expect every offspring to repeat all the peculiarities of its parent—all variation being

[1] May, 1895.

due to subsequent influences of the environment. In the case of two parents, the offspring might be expected to possess characteristics of each, now being strictly intermediate, now approaching one parent more nearly than the other. In this method of variation, which is nearly all that Weissmann admits, the steady tendency must be to swamp all distinctions, the differences between parents continually diminishing. In short, these differences could never have arisen were heredity the only force at work. Darwinism has a similar tendency, since varying and ill-adapted organisms tend to disappear, and only those with close similarities of adaptation to be preserved. The changes due to Lamarckian influences must tend also in the direction of uniformity, through a general movement of adaptation to fixed conditions.

Yet this fixed tendency towards uniformitarianism is not what nature displays. Marked individual variations constantly appear, the seeming efforts of nature to produce similar forms being checked at every point by individual peculiarities of constitution. These variations are in opposition to the influences of heredity, natural and sexual selection, use and effort, all of which tend to uniformity. To what are they due? Can a parent transmit to its offspring characteristics which it does not possess itself? This does not seem possible; the natural conclusion being that the offspring should repeat the peculiarities of the parent or parents existing at the period of its birth.

Yet has heredity as overmastering an influence as many ascribe to it? Even if we decline to accept the Weissmann hypothesis, and hold that every portion of the organism, in some way, exerts a direct influence upon the developing germ, it is not impossible that this influence may differ in energy in different organisms, in some cases controlling almost absolutely the constitution of the germ, in others permitting foreign influences, external or internal, to operate to some extent, with consequent variations in germinal constitution.

Several hypotheses have been advanced in explanation of heredity, none of them based sufficiently on discovered facts to be quite satisfactory, and all of them leaving it possible that the germinal cell may not be rigidly controlled in its development by hereditary influences, but may have a degree of independence and susceptibility to the action of minor and local influences. As variation cannot well be due to influences proceeding from the parental organisms, it certainly seems as if it must arise from conditions existing in the environment of the developing germ and embryo, or to internal molecular forces, left free to produce variations by a degree of weakness in the hereditary influences.

Much certainly depends on the inherent conditions of the reproductive cells. These may vary in developmental energy, through excess or deficiency of nutrition. They may also vary, through position or otherwise, in the quantity of nutriment obtained during development. In consequence, there is probably an active struggle for existence at this low level of life, the numbers involved being considerable, while—in the case of the higher animals—only one or a few can survive. This early competition would seem simply to be one of comparative cell vigor, or of advantage in propinquity to the store of nutriment; but it is, perhaps, not quite so simple. The germinal cell is, to outward appearances, a largely homogeneous organism, but the facts of development prove that it is heterogeneous in constitution, its tendencies and powers being not single but multiple. It probably is made up of various groups of molecules differently arranged or organized, each of which is destined, in its development, to produce a special organ or variety of tissue in the mature form. What we can see very poorly indicates what exists. The compound of organs into which the cell unfolds indicates that conditions preliminary to those organs existed in it, each perhaps located in some definite region of the cell, which may thus be made up of distinct groups of differently organized molecules.

If this, as we have much reason to believe, is the case, the field of competition may be a much more extended one than has been supposed. In addition to competition for nutriment between cells as wholes, there may be an internal competition in each, between its different molecular groups, while differences in original strength may give some of these an advantage over others. Such a difference in original power of absorbing nutriment would, perhaps, grow more declared as development proceeded, and the several molecular groups differentiated into embryo organs.

If such a competition existed, what would be its natural result? Here we have the principle of survival—or, at least, of precedence—of the fittest active within the germ itself, and producing an effect on the constitution of the individual. Certain organs of the embryo might be better supplied with nutriment than others, and, in consequence, become larger or more vitally active in the resulting body. And it may be that this difference in nutrition would have some influence upon heredity; perhaps the weaker, perhaps the stronger, molecular groups being most under control of hereditary influences, and developing accordingly.

If the possibility of such a state of affairs as this be admitted, it may aid to explain the peculiarities of variation. We could understand, for instance, why, in two brothers—even two twin brothers—one is more vigorous in this, one in that, organic function; one has this weakness, one that. Here the heart may be specially strong or weak; here the lungs may be specially active; here the muscular, here the nervous, tissues may be particularly well-developed; here there may be a powerful bodily frame, there a large brain and superior intellect. Similar variations may occur in the digestive and excretory organs, the glandular activity, the deposition of pigment, and other organic conditions. Or one brother may have a general advantage in nutrition over the other, becoming larger and stronger throughout. Differences in the general form of the body, in its fat-making proclivities, in its degree of vital energy, might arise from similar differences in powers of assimilation of the molecular groups of the germinal cell.

The above is offered as a suggestion of a conceivable cause of organic variations. It, unfortunately, belongs to that wide category of hypotheses which are not open to proof. It is not the only suggestion that presents itself. Another influence at work—perhaps a secondary result of that described—is what is known as atavism. As the influence mentioned is a variation in growth force, atavism seems due to a check in development, the organism not attaining its full unfoldment. Atavism is usually considered as applying to the whole organism, but it may confine its action to certain parts of the organism while the others attain full development, thus producing conditions whose atavistic origin is not evident, and which are accepted as results of ordinary variation.

Two conditions are probably concerned in atavism, one being deficiency of nutriment, the other the influence of environment. In truth, there is good reason to believe that two parallel, and, to a certain extent, mutually exclusive, processes are at work in the organism—those of growth and development. The developmental powers only proceed actively under certain conditions. They differ from growth, which is simply increase of tissue, in being changes of tissue, due to chemical or other influence, and set in train by inherent tendencies in the organism.

There are abundant evidences that energetic nutrition acts as a hindrance to development, and yet is preliminarily necessary to it. The two cannot be active at the same time. While nutrition is active, development is latent, and it cannot set in actively without a marked cessation of nutritive energy. Yet it must be preceded by a period of nutritive activity to provide the tissue within which the developmental forces act, and in which a degree of chemical reduction would seem to precede or accompany the re-organization of tissue into new forms. If the preliminary nutrition be wanting, development may be slight and imperfect, or not appear at all, through lack of the quantity of tissue necessary to the changes in organization.

As regards development, or rearrangement of organic tissue, a question arises as to what influences set it in operation, so that, at fixed intervals, nutrition is checked, growth ceases, and active organic change sets in. Inherent tendencies to such change seem to exist in the tissues, their molecular constitution being such that a series of successive rearrangements take place, reproducing conditions which successively appeared in the phylogenetic evolution of the form, and were gone through ontogenetically by the parent. Continuous nutrition, and, apparently, also continuous bodily activity, act to check this process of development, which appears to need cessation of the assimilative process and of physical or nervous activity, all the organic powers being concentrated upon the event about to take place.

Nor is this all that may be necessary. Stimulation from without seems often requisite to start the developmental process. Stimulation from within is perhaps equally necessary, a psychic influence it may be, arising in the inherent instincts of the central ganglion of the nervous system. External stimulation may, in some cases, be necessary to set these instincts in action, while in other cases, they may act involuntarily at a certain stage of ganglionic growth or development. It is apparently due to such influences of instinct, that nutrition is checked and the inherent tendencies to changes in the tissues are permitted to act, the action of instinct being thus perhaps secondary; though it may be that a direct stimulation from the ganglion to the tissues is necessary to set the powers of development in operation. The action of the mental powers may, therefore, be confined to checking nutrition and activity, but may also concentrate the physical energies upon the region of coming change, and set in train the necessary chemical action. All the further powers and tendencies requisite exist in the tissues themselves.

We possess abundant evidence that, in the lower animals, development will not proceed if the surrounding conditions be unfavorable, whatever be the inherent tendencies. The life-history of intestinal parasites furnishes marked examples of this. Such creatures may continue a larval existence for an indefinite period in one host, the development to the mature stage being accomplished only after the second host is entered. Possibly, in the first host, nutrition continues active, and is checked on reaching the second host; but the influence of the new environment may have its special stimulating effect. The development of insects present many cases in point. They often continue long in the larval state, in which nutrition is active, growth rapid, and development checked. Then, during a period of pupal rest and non-nutrition, a rapid development to the mature stage takes place. Adventitious organs, useful to the larva, often develop, and are discarded in the pupal stage, as having no place in the phylogenetic order of development. This is strikingly the case in Echinoderm development, the adventitious organs sometimes forming so large a part of the larval animal that they have the power of swimming and taking food after being discarded, though incapable of digesting it. In this case, the developing portion of the animal is confined to the central life organs. In other instances, the adventitious organs are absorbed and utilized in the process of change.

As an instance of marked retention of the larval conditions, may be mentioned the Aphis, in which no further development takes place through many generations, nutrition being active, and reproduction going on by gemmation. In the autumn, when nutriment begins to fail, the long repressed instincts and developmental powers come into play, and mature insects are produced. The seventeen-year Cicadæ furnish another striking example,they continuing as larvæ during a very long period of underground nutrition, and developing to maturity only when unfolding instinct induces them to seek the surface. Numerous examples of a similar kind may be found in the Hydrozoa, in which development is checked at several larval stages, in each of which a different environment or kind of activity exists.

The ants and bees, among insects, are of high interest in this inquiry. The bees, for example, seem to have worked out the whole problem for themselves, and can produce workers, queens and drones at will. It seems a simple question of nutrition whether queens or workers shall appear, the worker larvæ being underfed, the queen richly fed and with fuller space for growth. They all pass through stages of pupal development, in a state of rest and non-nutrition, but the fully-fed larva becomes a mature female, the illy-fed ones become immature females. During the subsequent life of the latter, no opportunity for complete development occurs, activity and nutrition being incessant. In the ants, somewhat similar conditions exist.

Certain of the Amphibia present marked instances of the influence of environment as a stimulus to development. A tadpole kept forcibly in the water does not become a frog. The Axolotl, a gilled salamander, seems to have a power of choice in this particular. It continues a water breather while it elects to remain in the water, but loses its gills and develops into the lung-breathing Amblystoma if it leaves the water for a land life. Another interesting instance of this appears in the Leptocephali, peculiar larval fishes, small, pellucid and cartilaginous, which are found floating far out in the ocean. Gunther considers them the offspring of various marine fishes which have been swept away from their normal environment and their development in consequence arrested. This is, perhaps, due to deprivation of the requisite nutriment.

Many examples of a check to the full development of the higher animals, through insufficient nutrition, might be given, were it advisable to extend this examination. In the lower animals, so far considered, there would seem to be a competition between two instincts, one the instinct to devour food and move actively, the other the instinct to cease eating and enter a state of rest. External conditions are, perhaps, only influential in giving the precedence to one or the other of these instincts, though, in most animals, the latter instinct in time seems to gain a controlling influence, and development in consequence proceeds.

The instances here given are extreme ones, and are of much value from their bearing upon the question at issue. Doubtless there are many minor steps of development which need no special preparation, and which take place during the ordinary activities of life. Such steps might be pointed out in the invertebrates, while vertebrate development is generally of this character, its stages appearing successively without need of marked cessation from food or activity. Yet the examples adduced are probably exaggerated instances of what always takes place, a period of nutrition of the organ involved, a temporary check to nutrition, a diversion of energy to that organ, and a more or less rapid developmental change. If this change is a considerable one, as in the casting of their shells by crustaceans, a physical weakening results, and new tissue must be built up before the new shell can appear. A similar weakening is apt to appear in man during the development of puberty, and various other instances might be given.

All this leads back to the question of atavism. The changes indicated may not be solely due to nutrition and stimulation, but may be controlled in a measure by the original germinal conditions, the degree of developmental vigor which exists in each of the molecular groups of the germ cell. If any of these is weakly constituted, or imperfectly organized, its general development may cease before the ultimate phase is reached, or it may be imperfect, and the resulting animal lack some part, as in the absence of a hand or arm. This may be the ordinary cause of the phenomena of atavism, the original weakness of the germ causing a cessation of development before the final stage is reached. This check seems often to occur at the level of some immediate ancestor, but occasionally acts at a considerably more remote stage. Again, weakness in a special region of the germ may check development of some organ at an ancestral stage, while the remainder gains full development. Such a result, while due to atavism, would yield no evidence of it. To this class of influences may be due many of the variations in offspring which so commonly occur.

There is a further possibility to be considered: that of a condition the reverse of atavism. While defects occasionally appear in the mature body, an excess of development also at times appears in certain regions. This may be a duplication, as in the fingers and toes, the development of some limb or organ to a larger size than in the parents, or the appearance of an excrescence which has no paternal counterpart, yet, perhaps, may prove of advantage to the individual. If defects are due, as here suggested, to deficiency of energy of development, or partial formation in some molecular group of the germ, excess may, perhaps, be due to the opposite influence, a superabundance of energy, or excess of molecules in the group. The molecular groups from which the organs, tissues or members of the body are supposed to be derived, may possibly vary, as above-said, both in energy and in formative conditions, and minute variations in the germ may yield marked variations in the adult.

All this is offered as conjectural. If it be based on fact, some important conclusions follow. To atavism, partial or complete whether due to original germinal weakness or subsequent lack of nutrition, degeneration may be due. The imperfect or poorly developed offspring, if it should prove fitted to some other mode of life than that of its race, might survive and yield descendants like itself. Through such a process, long continued, the extreme degeneration occasionally seen might appear.

On the other hand, if the molecular groups can possess excess of energy or superfluous material, the result may be seen in some unusually large organ or greatly developed tissue, or a general superiority of the whole body; or, again, in the appearance of some duplicate part or excrescence. Such an excess, if advantageous, might, as in the opposite case of degeneration, induce new habits in the animal, and, in time, lead to marked differences in species. If the excess appeared in the nervous system generally, or the brain particularly, an important psychical advance might result. It is certainly not impossible that the extraordinary intellectual powers which occasionally appear in the offspring of parents of ordinary mental development may be due to this cause, and that the gradual advance in mental ability in the animal kingdom, with the superior powers of attack and defence thence arising, have a similar origin.

The problems here dealt with are very obscure ones. In considering them we are, perforce, confined to hypothesis, since facts are beyond our reach, other than such phenomena of organic nature as have been adduced. Certainly the causes of individual variation lie low down in the process of development, and while, perhaps, due in a measure to environmental forces at work on the embryo or larva, are probably due in a much larger measure to conditions connected with the organization and early development of the germinal cell.

ROOT TUBERCLES OF LEGUMINOSAE.

By Erwin F. Smith.

Among those who have contributed to our knowledge of this subject are Beyerinck, Frank, Ward, Hellriegel, Prazmowski, Nobbe, Schlossing, Laurent and Windogradski. The question of the symbiotic relationship of the bacilli, which are certainly present in the tubercles, has received rather more attention from these investigators than have the bacteria themselves. The latter are the subject of an interesting paper, "Die Bakterien in den Wurzelknöllchen der Leguminoseen," by Mr. Gonnermann in *Landw. Jahrb.*, XXIII (1894), Heft., 4, 5, pp. 649–671. The first part of the work was done at the Agr. Exp. Sta. in Rostock, and the rest in the Hygienic Laboratory at Danzig, and the internal evidence of the paper indicates a careful, competent man. The one question which the author at first set out to solve by means of purely bacteriological methods was, What bacterium causes the tubercles? Pure cultures were made from the bacteria occurring inside the tubercles and their behavior first studied on ordinary culture media—gelatine, agar, potato, bouillon, etc. Subsequently, lupine gelatine was used, and proved very suitable, the germs growing in it about equally well, whether slightly acid, slightly alkaline or neutral. The colonies which appeared on this gelatine were then inoculated into various media, from the plates to stick cultures, from these to potato, from the latter to agar, from agar into hanging drops, from these to plates once more, and so on, to insure purity and absolute certainty of the final results. To obtain material for making infections, uninjured tubercles were washed in ordinary water and the earth rubbed away with a tooth-brush, then washed several times in distilled water, and finally put for several minutes into 1-500 solution mercuric chloride. They were then thoroughly washed 3–4 times with sterile water, placed under a bell-jar on a glass plate previously heated to 150° C., cut open with a flamed knife, and crushed out in a little sterile water, which was then used for cover glass preparations and for the inoculation of culture media. All staining fluids and all culture media were examined for the presence of germs before they were used, and before commencing this investigation the author made a preliminary one of the air of his laboratory to determine what germs were present and might be expected to appear in some of the cultures. The microscope used was a Leitz, which was provided with apochromatic lenses, giving a very clear, sharp field, up even to 2,250 diameters. The root sections were made in the Pathological-anatomical Institute of Dr. Thierfelder, and mostly by Dr. Thierfelder, himself. Several hundred plants were investigated, including *Pisum sativum, Lupinus angustifolius, albus, luteus, Lathyrus tuberosus, Vicia faba, cracca, Phaseolus vulgaris* and *Trifolium incarnatum*, and more than 300 permanent preparations were made. The investigations finally covered the following subjects: (a) Pure cultures; (b) Search for the organisms in the soil; (c) Germination of sterilized seeds in sterile sand and subsequent infection of the plants. Cover-glass preparations, made from great numbers of cleaned, sterilized tubercles of *Lupinus albus* and *angustifolius* showed the well-known Y-shaped bodies and gelatine plate cultures gave two sorts of colonies, both bacilli. Cleaned and superficially sterilized roots were then wrapped in freshly sterilized cotton, put in turn into sterile netting, and finally covered by a fine-meshed sterile wire netting, buried in sterile sand and watered with sterile water. After eight days the plants were pulled up. Many of the tubercles were ruptured and the enveloping cotton was stained brown and swarming with pure growths of the bacteria. The sand was also contaminated. From this infected cotton, and also frequently from the sand, cultures were made into gelatine, bouillon, etc., and from these, plate cultures. The author cannot agree with Frank that the Y-form consists of broken down mycoplasma, for, upon being placed in hanging drops, these Y's break up into motile bacilli and their compound nature can also be demonstrated by proper staining. Beyerinck, Prazmowski and Frank speak of one organism designated variously as *Bacillus radicicola*, *Bacterium radicicola*, and *Rhizobium leguminosarum*. Gonnermann thinks that there are several germs capable of causing these galls. He calls his organisms *Bacillus tuberigenus*, 1, 2, 3, etc., having isolated no no less than seven varieties, not including two *micrococci*. All of these are characterized, but not as fully as the present state of bacteriology requires. Beyerinck's *B. radicicola* was not found. Soil examinations were begun at Rostock. Earth was scattered on gelatine plates, and soil from lupine fields was washed with sterile water and cultures made from this. By these methods four of the kinds already isolated from the tubercles made their appearance and were cultivated out and their identity established. The most abundant organism in the Rostock fields was *Bacillus fluorescens non liquefaciens*, then followed *B. tuberigenus*, No. 3. This is a motile organism, 0.3 by 0.6μ, united in 2's or more, bright red-brown on potato, yellow-brown or brownish and fine granular on gelatine plates, and able to liquify gelatine rapidly. Winter examinations of earth were made for spores. In soil taken from Rostock, in February, not a living bacterium could be found, but there were numerous spores. This soil was shaken up with sterile water, and the coarsest parts allowed to settle as sediment I. The cloudy fluid was poured off into a sterile test-tube and allowed to settle for a minute to get sediment II. Sediments III and IV were obtained in the same manner, the latter consisting of the finest silt. Cover-glass preparations were made from each sediment and stained with gentian violet for the identification of bacteria, while for spores a corresponding series was dry-heated to 150°C., and then exposed for an hour to boiling carbol fuchsin, washed in alcohol, and afterward, in some cases, faintly stained with methyl blue. Finally, plate cultures were made from each sediment. Sediment I contained numerous bacilli, 4–9, by 0.5–0.6μ, each bearing 2–6 spores. No bacteria free from spores could be found, but plate cultures gave many colonies. No such large bacilli were found in the earth in summer. In sediment II, spore-bearing bacilli were few, but plate cultures yielded many colonies, thus showing the presence of spores. In sediment III, dead Y-forms first appeared. These stained faintly with ordinary reagents, but distinct round bodies appeared in their interior when they were subjected to the spore stain. In sediment IV, no bacilli were found, but there were small stained bodies which might well be spores, and plate cultures gave numerous colonies. The plate cultures from these sediments yielded unquestionable *B. tuberigenus* 1, 2, 3. The remaining forms appeared to be ordinary soil bacteria, and were not followed further.

From the results of these cultures and the examination of a great many cover glass preparations, the author thinks it is established that the tubercle organisms pass the winter in the earth in the form of spores. Sand cultures and infections were made at Rostock and again at Danzig, the following method being employed. The sand was spread out in an oven and heated for five hours at 150° C. It was then put into 3-litre pots, previously washed many times in boiling distilled water, then several times in 1-500 solution of mercuric chloride, and finally in sterile water. The pots were then covered tightly with sterile cotton and set aside. Subsequently they were infected with organisms directly from the tubercles and also with pure cultures of the same. In the Rostock experiments the pots were watered with Frank's salt mixture and in the others they received only sterile water, bacteria being added from time to time to each watering fluid. The seeds planted in these pots were first soaked ten minutes in 1-500 sol. mercuric chloride and then washed thoroughly in sterile water. The plants grew slowly, but on the whole satisfactorily. When they reached a height of 20 cm., one which had been infected directly from a tubercle was pulled and examined. The rest of the plants prospered and no more were pulled until they were in bloom. Close together on the roots of the plant first pulled there were 5 tubercles. On cutting they showed the rose red color, and the Y-forms were clearly visible on microscopic examination. Similar results had been obtained by previous investigators. More important, therefore, is the result of the infections with cultures known to be pure. Plants grown in pots infected with *B. tuberigenus* No. 3 from Rostock and others grown in pots infected with B. tuberigenus No. 5

from near Danzig developed a considerable number of tubercles in which it was very easy to demonstrate the Y-shaped bodies, and from which pure cultures of Nos. 3 and 5 were again obtained. Since these two forms behave differently on culture media, the author insists that it is no longer a question of one tubercle bacillus, but thinks that there are at least two and probably more, the form varying with the locality. Water cultures were carried on along with the sand cultures, using peas and lupines, but with negative results. Some of the roots decayed and none developed tubercles. Hellriegel first advanced the hypothesis (1886) that the bacteria in these tubercles are capable of taking nitrogen from the air and turning it over to the host plant. This striking hypothesis at once came into favor and was accepted as proved by many writers on agricultural topics. Frank, however, in dry material, found no increase whatever of nitrogen when his Rhizobium grew with the plants. His many experiments show that the garden bean (*Phaseolus vulgaris*) which always bears tubercles under natural conditions never becomes any richer in nitrogen than do beans grown in sterile soil and free from tubercles. This certainly looks more like parasitism than symbiosis. Other experiments made by Frank show that lupines and peas can assimilate nitrogen when grown in sterile humus, and free from tubercles and bacteria. Consequently leguminous plants are able to store nitrogen and enrich the soil without the action of bacteria, and it is not settled how the nitrogen is taken up by the plant. Gonnermann reasoned that if the bacilli really assimilate free nitrogen and turn it over to the host plant, then when they are grown in an artificial medium the latter ought finally to become somewhat richer in nitrogen. Following out this idea, very careful experiments were made with potato broth of a known nitrogen content, but although the bacteria grew luxuriantly for 14 days there was absolutely no increase of nitrogen. The cultures were made in 12 150 cc. flasks and every 24 hours the air was changed, being passed through cotton, strong sulphuric acid, and strong potash liquor to free it from dust, microörganisms, ammonia and carbon dioxide. The analyses were made by Dr. Meyer of the Rostock Agricultural Experiment Station. Experiments by the author confirm Hellriegel's view that the tubercle bacilli are not capable of changing ammonium salts into nitrate, and the evidence is very good that these organisms are not the same as the nitrifying ferments of Windogradski. The Y-form occurs sparingly outside of the tubercles in various parts of the plant. The author also isolated *B. tuberigenus* from tubercles found on the roots of the rape plant. His general conclusions are as follows:

(1). The root tubercles of the Leguminosae are not caused by a single specific bacterium but rather by several, one in one locality, another in another locality.

(2). The Y-forms are zoogloea (Gebildkomplexe) which arise in the plant during the symbiotic or parasitic relations, and later when the tubercles rupture, they break up into the individual bacteria. These pass into the soil, form spores, and in the spring, as bacilli, once more enter the plant to again become Y-complexes during its growth.

(3). The symbiotic relations are not yet known with certainty, for *of themselves* the tubercle bacteria of the Leguminosae are not capable of rendering free nitrogen useful to the plant; much rather is the plant in condition *of its ownself* to take up and use elementary nitrogen without fungous symbiosis. The bacteria aid the plant in doing this and may contribute in part to a higher nitrogen content. Finally, it appears to be established that in spite of the presence of the bacteria the plants do not take up any excess of nitrogen. From the many sided experiments which have been made, it follows also that not merely symbiotic *but also parasitic influences* are at work, and that the function of the bacteria as well as the method of assimilation of free nitrogen is not yet known with any certainty.

DEVIATION IN DEVELOPMENT DUE TO THE USE OF UNRIPE SEEDS.

BY J. C. ARTHUR.

(*Continued from page 815.*)

Such deviations as have been mentioned are readily seen, and are more or less to be anticipated. But what shall we say about the final recovery of such plants? Even if plants are feeble while young, will they not eventually become firmly established and outgrow all traces of early weakness? I think we would say *a priori*, that such would doubtless be the case. It looks reasonable; and yet from both experimental and theoretical data it can be shown that rarely, and only by accident, does the entire restoration of the vigor of the plant under such circumstances take place. I am aware that the majority of observers and writers have held the contrary view, and that Cohn in his admirable treatise came to the conclusion that "in general plants raised from unripe seed are not weaker than those from ripe seed." It is undoubtedly true, that as the plants grow, the differences, which were at first readily detected by the eye, largely or quite disappear. Eventually it is necessary to resort to careful weighing and measuring to bring out the actual facts. This does not mean that the differences are slight and immaterial, but only that the eye cannot detect small variations distributed throughout large objects having irregular surfaces, although in the aggregate they may be considerable.

In the experiment with tomato plants from seed taken from green, half-ripe, and fully ripe fruit, already referred to, (manuscript record No. 82), no essential difference could be detected between the plants after they came into bearing. But weighing exposed the fact that the ripe fruit of the plants from green seed averaged ten per cent lighter than those from ripe seed (see table V).

V.—Tomatoes from Ripe and Unripe Seeds.

Experiment conducted by Arthur.

Degree of ripeness.	Number of plants.	Number of ripe fruit.	Total weight of fruit in grams.	Average weight of single fruit in grams.
Fruit green.........	13	1044	18304	17.5
Fruit half ripe.....	5	439	7858	17.9
Fruit fully ripe...	24	1889	36622	19.4

The experiment with wheat, conducted by Nowacki, and already referred to (see table III), shows a larger number of stalks from ripe than from green seed; and although not so tall, the total growth of stalks in length is greater for the plants from ripe than from green seed. Without going into further details, the general principle may be stated, that plants from green seed will, as a rule, attain a smaller development in both vegetative and reproductive parts than those from ripe seed.

It is furthermore to be pointed out in this connection, that not only are all parts of the plant smaller and less vigorous, but that the different organs bear a different reciprocal proportion. We may classify plant organs roughly as reproductive (fruit, seed, etc.) and vegetative (leaf, stem and root.) The use of immature seed increases the reproductive parts at the expense of the vegetative, and thus it comes about, that there is more fruit formed in proportion to the amount of foliage than normal. In an experiment, or rather a series of experiments originated by Goff,[30] and continued by the originator and the writer, in which the changes due to the use of unripe seed have been made more than ordinarily prominent by the cumulative effect of repetition through several generations, it was found by the writer (see table VI) that a tomato plant, selected as representative of the series grown from unripe seed, bore 3½ pounds of fruit to one pound of the vine (leaves, stems and roots taken together), while a plant of the same variety

[30] For history of these experiments, see Bot. Gaz., xii (1887), pp. 41–42; Rep. Wis. Exper. Sta., viii (1891), pp. 152–159.

grown each year under the same conditions, but always from ripe seed gave only 1⅛ pounds of fruit for each pound of the vine. In this case we have an enormous relative increase of fruitage from unripe seed, which in fact was quite apparent to

VI.—Tomatoes from Ripe and Unripe Seeds.

Experiment conducted by Arthur.

Degree of ripeness.	Weight of vine.		Weight of fruit.		Ratio of vine to fruit.
	lb.	*oz.*	*lb.*	*oz.*	
Immature series	2	10	9	2	1 : 3.475 (3½)
Mature series	5	10½	6	9	1 : 1.127 (1⅛)

the casual observer npon looking at the plants of the two series as they grew in the garden, although it required the scales to disclose how surprisingly great the difference really was. With this increased fruitfulness is also associated an increase in the number of fruit, although they are individually smaller, as also are the seeds. It is stated that von Mons,[31] of Belgium, has applied this method of using green seed to the raising of apples, in order to check too vigorous growth and to increase the fruitfulness.

In connection with the increase of the number of fruit borne by a plant, there is also a tendency to increased earliness in ripening the fruit. In the cumulative trials with tomatoes by Goff, which have just been referred to, the strain from green seed ripened from ten days to four weeks earlier in different years, than the corresponding series from ripe seed. In another experiment with tomatoes by Goff,[32] seed saved from fruit of the same variety, in different stages of maturity, described as very green, pale green, tinged red, light red, deeper red, and fully ripe (see table VII), gave an advantage in earliness of nearly three weeks for the plants from the very green seed compared with those from the fully ripe seed, and of two

[31] Williams, E., Rural New-Yorker, 1890, p. 798.

[32] L. c., iii (1884), p. 224.

weeks compared with those from the half ripe seed; and there was also about two-thirds as much gain in the ripening of the first ten fruits upon the same plants respectively. But such marked difference in earliness, or in fact any difference at all, in favor of plants from immature seed does not always occur; and several observers have noted the reverse results.

VII.—Tomatoes from Ripe and Unripe Seeds.

Experiment conducted by Goff.

Degree of ripeness.	Number of seeds.	Vegetated per cent.	First ripe fruit.	First ten ripe fruit.
Very green.........	50	2	126 days.	137 days.
Pale green	50	84	143 days.	157 days.
Tinged Red	50	100	140 days.	151 days.
Light red..........................	50	96	141 days.	147 days.
Deeper red....................	50	88	141 days.	147 days.
Fully ripe......................	50	96	146 days.	152 days.

This is not surprising in view of the fact that it is the weaker plants from which the greater earliness in fruiting is expected, and such plants must necessarily be most affected by the conditions of weather, soil and cultivation, and so their uniform development be most interfered with. It was noted by Goodale,[33] in 1885, and since by Goff,[34] that some early market varieties of vegetables indicate that they may have been originated through the use of green seed.

I have now stated the principal deviations from normal development in plants due to the use of immature seed, which I have myself observed, or for which I find authentic recorded data. They may be grouped and briefly summarized as follows: (1.) There is a loss of vigor, shown in the smaller percentage of germinations, the weakness of the seedlings, and the greater number of plants which die before maturity; (2) the full vigor of the plants is never recovered, although they may and usually do, produce an abundant harvest, and one acceptable to the cultivator, in case of economic plants; (3) the re-

[33] Physiological Botany, 1885, p. 460.

[34] Bot. Gazette, xii (1887), p. 41.

productive parts of the plants are increased in proportion to the vegetative parts, resulting in a greater number of fruits and seeds (although individually smaller) and more rapid ripening of them, than in similar plants from mature seed.

In explanation of these changes, and to bring the phenomena into proper relation with other phenomena of plant and animal life, I venture to assert that *the deviation in development, which comes from the use of unripe seed, does not differ in kind from that resulting from any other method of weakening the organism*, and is to be considered as only a special instance of *the effect of checking the uniform normal growth of the individual.*

I have in my possession a large amount of data with which to substantiate this proposition, but it would be tiresome to present it here, and I shall content myself with a bare reference to a few facts, and trust to your being able to further convince yourselves of its correctness by recalling facts from your own researches or observations.

Imperfect seed of any kind germinates poorly and produces weak plants. This is true of seed shriveled because of injury to the parent plant from insects, fungi, drouth, etc., of seed infested with fungus, of seed that is too old, or of seed deprived of part of its nutriment or otherwise seriously mutilated. That weak seedlings from any cause, as a rule, are likely to remain weak and produce a poor crop, I think is a statement that will be generally accepted without elaboration. It is in reference to the third general feature of the deviations due to immature seed that the chief interest rests; an interest that has sprung up very largely in consequence of the numerous experiments by Professor Goff, extending over the last ten years, and now very widely known, more especially his long series of experiments with tomatoes, in which notable results have been obtained, suggestive of wide economic application, but to which I have been able to make but brief reference in this paper.[35]

[35] Goff's work upon unripe tomato seed and resulting strains is recorded as follows:

Rep. N. Y. Exper. Sta., iii (1884) pp. 224–226; iv (1885), pp. 182–183; v (1886), p. 174.

Bot. Gaz. xii (1887), p. 41–42.

Garden and Forest, iii (1890), p. 427; (see also pages 355 and 392). Cited by Hunn, Bull. N. Y. Exper. Sta. No. 30 (1891), p. 478.

Rep. Wis. Exper. Sta. viii (1891), pp. 152–159.

While the use of immature seed brings about greater activity in reproduction, and a tendency to early maturity, the same is also true of plants from very old seed, as has been recognized for a very long time. It is probably best known in reference to melons,[36] which are generally believed to give more and better fruit when the seeds are five to twenty years old,[37] although the plants will be weak. Observations have not, however, been confined to melons, but are recorded for pears, beans, lentils, etc.

The retardation of the germination due to age is well shown by the tests of tomato seeds made by Lovett,[38] in which seeds from 2 to 6 years old showed the first germination in 10 days, 7 years, in 11 days, 8 and 9 years in 12 days 10 and 11 years, in 14 days, and 13 years, in 18 days. It will be observed that the effect of over-maturity is the same as results from immaturity (cf. table III). The similarity of effect is even better shown by a test of red clover seed made by Nobbe[39] in 1874, in which mature and immature seed of the crop of that year was compared with that of the crop of 1870, the trial being made in December, 1874. The germination of the immature seed was slower than that of the mature seed which had been kept four years, while the total number of germinations for both immature and over-mature seed was much decreased by four years' keeping (see table VIII).

It is evident, therefore, that aging as well as immaturity of seed leads to weakness of the seedlings, and a general lowered vitality.

Some of the same characteristics which we have seen in the plants from immature seed may also be observed when plants

36 "Es ist behaupted worden, dass Melonenkerne nach mehrjähriger Aufbewahrung Pflanzen liefern, welche weit weiniger ♂ Blüthen bringen, als Pflanzen aus frischen Samen ; nach 5 Jahren sollten angeblich gar keine ♂ Blüthen gebildet werden. Verf. säete 1878 Melonensamen von 1876 und von 1870. Von den älteren Samen keimte eine geringere Zahl; die daraus hervorgegangenen Pflanzen waren etwas weniger kräftig." Baillon (Bull. mens. soc. Linn. de Paris, No. 23, 1878) Just s Bot. Jahresb. vi (1878), p. 328.

37 Fleischer, l. c., p. 17 ; Schulz, quoted by Cohn, Symbola, p. 9.

38 Rep. N. Y. Exper. Sta., ii (1883), p. 267.

39 Samenkunde, p. 346.

VIII.—Germination of Ripe, Unripe, and Old Seed of Red Clover.

Experiment conducted by Nobbe.

Degree of ripeness.	Per cent of total germination in 2 days.		Total germination.	
	Soon after gathering.	4 years after gathering.	Soon after gathering.	4 years after gathering.
Immature seed.............	63	0	48	6
Mature seed..................	90	24	88	58

grown on good and on poor soil are compared. It has been noticed by tomato growers that more seed is obtained on poor than on rich soil,[40] which accords with the record for immature strains.[41] The difference in fertility of soil need not be especially marked to secure the effect, if other conditions are reasonably uniform, even good soil compared with yet richer soil produces the characteristic results. In some experiments on wheat made by Latta,[42] the yield on good wheat land was one pound of straw to .55 of a pound of grain, but the same land richly fertilized gave one pound of straw to only .48 of a pound of grain (see table IX); that is, the poorer soil brought about a greater development of the reproductive parts of the plants, as compared with the vegetative parts, than did the richer soil, without regard to the mode of fertilization. This phase of the subject might be extended to great length and many statistics given, but it will suffice for illustration to appeal to common observation of the remarkable size of the flowers and seed pods of depauperate weeds and other plants, and on the other hand, the tendency of plants in rich soil to produce foliage shoots rather than fruit.

It has been recognized by zoologists[43] that "checks to nutri-

[40] Allen, Amer. Gard., xi (1890), p. 358.

[41] Goff, Rep. Wis. Exper. Sta., viii (1891), p. 157.

[42] Bull. Ind. Exper. Sta., No. 41 (1892), p. 94.

[43] Geddes and Thompson, Evolution of sex, p. 218.

IX.—Wheat on Poor and Rich Soil.

Experiment conducted by Latta.

Plat unfertilized produced	1 lb. of straw to .56 lbs. of grain.
Plat with { bone black, ammonia, potash, } produced	1 lb. of straw to .45 lbs. of grain.
Plat with { bone black, ammonia, potash, } produced	1 lb. of straw to .47 lbs. of grain.
Plat unfertilized produced	1 lb. of straw to .55 lbs. of grain.
Plat with horse manure produced	1 lb. of straw to .49 lbs. of grain.
Plat with horse manure produced	1 lb. of straw to .51 lbs of grain.
Plat unfertilized produced	1 lb. of straw to .52 lbs. of grain.
Plats unfertilized averaged	1 lb. of straw to .55 lbs. of grain.
Plats fertilized averaged	1 lb. of straw to .48 lbs. of grain.

tion, especially in the form of sudden scarcity, will favor sexual reproduction." I think I may safely enlarge this statement, and say that *any cause which retards uniform progress in the development of an animal or plant favors reproduction.* By this is meant that after such a check occurs the organism will develop the reproductive parts of its structure faster and more fully than the other parts, and in the case of crops the yield of seed will be greater proportionately, than of the leaves and stems.[44]

Enough has doubtless been said to show that the deviations in development, which arise when unripe seeds are used, drop into a general category of changes dependent upon the available energy of the plant and the uniformity of its development. In general, the change is a tendency toward reproduction at the expense of the vegetative parts of the plant.

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[44] I have developed this proposition more fully, and shown its application in another direction, in an article entitled: "A new factor in the improvement of crops." Agric. Sci., vii (1893), pp. 340–345.

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EDITOR'S TABLE.

—THE late meeting of the American Association for the Advancement of Science was an occasion of instruction and pleasure to all concerned. The hospitality of the citizens of the beautiful city of Springfield and the generally delightful weather, contributed much to the comfort of the visitors. The excursions to points less remote than usual, were, on this account, more enjoyable. The leading club of the place gave a unique entertainment, furnished by the talent of the members.

The only regrettable feature was the small attendance, less than four hundred members having been present. As the locality was accessible to the most populous region of the country, this absence of many of our best-known cultivators of science excited comment. Such a considerable number of our best zoologists remained away from the meeting that the section of zoology was reduced to a fragment of what it should had been. A considerable number of the geologists failed to attend most of the sessions of their section.

There are two principal causes for this falling off in the attendance, which has been characteristic of several recent meetings. One of the principal causes is lack of patriotism and public spirit on the part of a good many of the absentee members. The Association affords to the scientific men of the country the opportunity to present their work to the public, and thus to excite its interest. The Association has a missionary service to which no cultivator of science should be insensible. It is not only a stimulant to education to men of all classes, but it offers matter of thought and occupation to the well-to-do, who are sometimes at a loss for occupation for both time and money. And it should appeal to the selfish interests of the cultivators of science as well, for the Association must influence men of means in suggesting directions for the exercise of their liberality.

The other reason for the small attendance of some of the sections is the absorption of interest in special societies which meet immediately before the Association convenes. It is well for the societies to meet at the same time and place as the Association, but they should be careful not to appropriate too much of its vitality. Due consideration of the importance of the Association to science and to the country, should influence them in this matter, and it is to be supposed that the experience of the last few years is all that is necessary to impress this view on the mind of their members with reference to the future.

In order to remove some special inducements to absenteeism which were presented by the Springfield meeting, the Association adopted two important resolutions. First, that meetings should begin on Monday, so that they should not be interrupted by a Sunday; and, second, that excursions should not be undertaken until after the close of the meeting. These arrangements will have an excellent effect in concentrating both the work and the attendance.

—THE Zoological Section passed some important resolutions with reference to the proposed bibliographical bureau and its work. It endorsed the plan introduced by Mr. H. H. Field, for the establishment of such a bureau in Switzerland. It is proposed that this bureau shall issue frequent bibliographical records of Zoölogical papers as they appear; and it is hoped that it will do the same for botanical literature. For its support the Association appropriated the sum of $250.00, to be added to the various sums already subscribed in Europe.

Mr. Field offered a resolution that the bureau undertake to fix the date of publication of all printed matter presented to it. This resolution was adopted by the Section. He also proposed that the date of publication be regarded as the date of distribution. The Section did not concur in this view. Consultation with leading publishing zoologists present, as well as with botanists, disclosed an almost unanimous sentiment in favor of regarding the date of completed printing, as the only available date of publication. Resolutions expressing this opinion were framed and passed Section F unanimously, and copies were sent to Mr. Field for presentation before the British Association at Ipswich, and the Zoological Congress at Leyden, Holland.

—Officialism is becoming more conspicuous among American office holders than was formerly the case. Years ago, our officials were conspicuous for their politeness to the public, and general disposition to forward their interests. More recently many of the customs collectors have distinguished themselves for their extreme interpretations of the provisions of the tariff laws, so as to render themselves obnoxious, and the country absurd. Still more recently the Post-Office Department developed an exaggerated officialism in refusing to transmit various articles over its routes. Naturalists have had especial difficulties in the matter of mailing specimens. Both zoologists and botanists have been met with refusals to allow the sending of their specimens, which have only been withdrawn after tedious negotiations. No sooner is this point gained than some new and superserviceable postmaster raises fresh difficulties, and the same process has to be repeated. The only permanent remedy is the enactment and enforcement of compulsory education laws, so that all our citizens may learn that the prosecution of the natural sciences is beneficial to the public, and that their cultivators are an important part of the community.

—Among the various acts hostile to science which have rendered the present administration notorious, few will excite deeper regret than the suspension of the journal formerly issued by the Agricultural Department under the name of Insect Life. As a record of the discovery in the greatest of all zoological fields, it has no equal in the world, as its value was assured by the ability of its editors, first, Mr. C. V. Riley, and more recently Mr. L. O. Howard. The policy of the present administration, as announced by the present Secretary of Agriculture, to limit the functions of government to those which are most rudimental, warrants the retort, actually made by one of his scientific experts to him, that the Department itself should then be abolished. The first Secretary, the Hon. Jeremiah Rusk, declared that he was placed at the tail of the administration on order to " keep the flies off of it." The present Secretary seems inclined to let the " flies " remain, not only on the administration, but on the entire country.

—In the death of the U. S. Commisioner of Fisheries the Hon. Marshall MacDonald, the country loses a very efficint officer. It is to be expected that an equally competent man shall succed him.

—We must again remind our contributors that the most certain way of getting soparate copies of their papers is to comunicate with the publishers directly; and the most direct method of doing this is to write their wishes on the copy which goes to the printer.

RECENT LITERATURE.

Rambles in Alpine Valleys.[1]—In this little book Mr. Tutt gives the impressions of a naturalist while exploring the valleys on the Italian side of the Mont Blanc range. Especial attention is given to the insect life, and in describing their habits and habitats, many problems are suggested for discussion. These are touched upon lightly, but never slightingly, the object of the author, as stated in his preface, being to explain simply and clearly, without going deeply into scientific technicalities, the scientific bearings of some of the facts that came under his notice during a holiday spent in that region. The book is very pleasantly written and well repays perusal by the lover of nature and of scenery. Among naturalists it appeals especially to entomologists. Five plates gives some idea of the scenery in the valleys visited.

Lead and Zinc Deposits of Missouri.[2]—This report is published in two volumes of nearly 400 pages each, the subject being treated under three heads. Part I is a general discussion of the history, compounds, modes of occurrence, distribution and industry of lead and zinc throughout the world. Part II deals with the lead and zinc in Missouri. Part III is a systematic and detailed description of the important developments and occurrences of lead and zinc ores in the state of Missouri. Accompanying the report are two papers having a bearing upon the subject: A study of the Cherts of Missouri, by E. O.

[1] Rambles in Alpine Valleys. By J. W. Tutt. London, Swan., Sonnenschein & Co., 1895.

[2] Missouri Geological Survey Vols. VI and VII. Report upon the Lead and Zinc Deposits. By Arthur Winslow, assisted by J. D. Robertson. Jefferson City, 1894.

Hovey, and Methods of Analysis pursued in the determination of minute quantities of metals in crystalline and clastic rocks, by James R. Robertson. A third appendix gives a list of the works referred to in the Report.

Forty-one page plates and 250 diagrams, sections, etc. illustrate the text.

Minot's Land-Birds and Game-Birds of New England.[3]—For nearly twenty years this remarkable and interesting book has ranked among the authorities on the subject of which it treats, and in editing this second edition, Mr. Brewster has not attempted a revision in the sense of adding fresh material, or of altering the text except where it seemed necessary in order to use it in connection with more modern works. It is practically reprinted nearly in it original form. The biographies which form the feature of the book were written from the author's personal observation and comprise descriptions of the mature bird, of their nests and eggs, of their habits, and of their notes.

Mr. Brewster has placed in foot notes the latest views as to nomenclature, etc. and in a few instances corrects some of the authors's views.

The illustrations are wood-cuts in outline, drawn by the author from nature.

Birds of Eastern North America.[4]—In this handy pocket volume Mr. Chapman aims to give the student a work, free from the technicalities that require a glossary for interpretation. He presents the subject in a comprehensive but simple way. Three introductory chapters contain suggestions as to methods of study, and the problems to be investigated by the student of ornithology—how, when and where to find birds—directions for collecting and preserving specimens including nests and eggs. The remaining pages, some 400 in number, contain the analytical keys, and descriptions of the species. The descriptions are very full, comprising the bird's general range, manner of occurrence, comparative numbers, times of migration at several specific points, its nest and eggs, and finally a brief sketch of its haunts, notes and disposition.

The illustrations are varied and include a charming colored frontispiece, several full-page half-tone plates and upward of one hundred and fifty cuts in the text.

[3] The Land-Birds and Game-Birds of New England. By H. D. Minot. Second Edition edited by William Brewster, Boston, 1895. Houghton, Mifflin and Co., Publishers.

[4] Hand-Book of Birds of Eastern North America. By Frank M. Chapman, New York, 1895, D. Appleton & Co., Publishers.

Origins of Inventions.[5]—This volume is an expansion of the principles laid down by Prof. Mason in a paper on the Birth of Invention written in 1891. Briefly stated, the author's views are to this effect. Invention is stimulated by human wants. In its broad sense the terms covers not only things, but languages, institutions, æsthetic arts, philosophies, creeds and cults. Invention is based on change. This change is in both structure and function, and proceeds from simple to complex, and is also always a change from the natural to the artificial. Prof. Mason finds that these changes follow a definite law of evolution which he states at length. In each culture-area of the earth such styles of invention have been elaborated as to confer upon the people thereof their local or tribal traits.

The book is one of the Contemporary Science Series and conforms in appearance with the other volumes of that series.

A Pretty Book on Plants and Insects.[6]—Professor Weed has shown, in this little book, that it is possible to write a popular work which does not contain the usual preponderance of error and false statement. One is sometimes tempted to say that whenever a popular and readable book appears on a scientific subject, it will certainly turn out to be bad so far as the science is concerned, and too often in the end one is justified in making this severe statement. Here, however, we have an attractive book which is very readable—in fact, popular—and yet it is not full of error. Let any one read the succeeding chapters on the glaucous willow, mayflower, spring beauty, purple trillium, Jack-in-the-pulpit, showy orchis, pink lady's-slipper, fringed Polygala, Canada lily and common thistle, and he will have learned much about plant structure and reproduction, as well as much about the habits of insects, especially their manner of visiting flowers in search of honey. In each chapter the plant named is the starting point from which the author leads the reader out on long botanical and entomological rambles, thus very greatly increasing the scope of the book. The beautiful illustrations add much to the value and attractiveness of the work. It should, and doubtless will be, widely read.

—Charles E. Bessey.

[5] The Origins of Inventions. A Study of Industry among Primitive Peoples. By Otis T. Mason. London, 1895. Imported by Charles Scribner's Sons.

[6] Ten New England Blossoms and their Insect Visitors. By Clarence Moore Weed. Houghton, Mifflin & Company, 1895; 142pp.

RECENT BOOKS AND PAMPHLETS.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Faunal Migrations.—An interesting account of the changes in the Mesozoic faunal geography of California is given by James Perrin Smith in a recent number of the Journal of Geology (May and June, 1895). These changes the author attributes to migration and points out that marine currents along continental borders are favorable to migrations. His conclusions, given below, are based on a study of the faunal relations of the various series of sedimentary rocks of California, and the faunal relations which California had with various regions during different periods of geologic history.

From the data in hand, Mr. Smith concludes that at the beginning of the Upper Devonian, some widespread disturbance occurred, opening up connection between the American and Eurasian Seas.

The lower Carboniferous fauna of California was developed directly out of Devonian fauna predecessors with the addition of some Eurasian elements by migration.

The Upper Carboniferous fauna was developed directly out of that of the Lower Carboniferous, but still with intermigration with the Russian and Asiatic regions, so that the California Carboniferous resembles the Eurasian even more than it does that of the eastern United States.

The lower Triassic fauna of the West is entirely foreign, having migrated in from unknown regions, but having reached nearly simultaneously the western part of America, the Salt Range in India, and northern Siberia, but having been cut off from central Europe.

The Middle Trias of the West already begins to show relationships to the Mediterranean province of Europe, showing a connection in that direction, while the similarity to the faunas of the Arctic Trias province is disappearing.

In the Upper Trias the nearest faunal affinities are with the Himalayan and the Mediterranean provinces.

In the Lower and Middle Jura there was no connection with European waters through the Pacific region, but rather through the Atlantic or "Central Mediterranean Sea" of Neumayr, bringing a central European fauna.

Near the beginning of the Upper Jura this connection with European waters was cut off, and one established with those of Siberia and northern Europe, bringing in a Boreal fauna.

This same connection was continued through part of the Lower Cretaceous, giving a boreal fauna to the Knoxville.

Near the beginning of the Gault, connection with the Boreal sea of Russia was cut off, and communication established with southern India and through that country with central and southern Europe, bringing in a warm-water fauna. This connection existed during the greater part of the Cretaceous, but after this time the faunas are confined much more closely to their present ranges, although even to-day many of our living and Tertiary mollusca are found in Japan.

These changes in faunal geography are too widespread and easily correlated over great areas to be charged to mere mountain-making; they must rather be of the nature of continental uplift and subsidence. A study of these changes will throw light on the problem of the extinction of faunas and explain the great poverty of certain beds, in which the conditions for life seem favorable.

The fauna of California has not been a genetic series, but rather a succession of independent faunas, derived by migration from various parts of the earth, complicated by the mixture with the products of local development. Therefore, the student that would intelligently study the genesis and history of this fauna, must not neglect the fossil records of any region, since all may have contributed some elements to this complex assemblage of forms.

A new Geomyid from the Upper Eocene.—A rodent from the Uinta beds (Upper Eocene) of Utah, representing a new genus, is described by Prof. W. B. Scott in the Proceeds. Phila. Acad. 1895, p. 269 under the name *Protoptychus hatcherii*. The skull only is known, including the dentition of the upper jaw, but this proves to be of unusual interest and brings to light some unexpected facts which are thus summarized by the author:

(1). Protoptychus, a new rodent from the Uinta Eocene, is an unexpectedly modernized form, which has already acquired very large mastoid bullae, a rostrum, incisive foramina and posterior nares greatly resembling those of the jumping-mice, and, as in that family, the articulation of the jugal with the lachrymal is retained. The infraorbital foramen is of the murine type. The dentition and the shape and construction of the mastoid and surrounding parts of the cranium most resemble those of the Heteromyidae.

(2). The genus is probably to be regarded as the ancestral type of the Dipodidæ and indicates an American origin for this family, being much more ancient than any known representative of the group in the Old World, which it appears to have reached by a comparatively late migration. Paciculus of the John Day beds is a somewhat aberrant number of the same line.

(3). It is not improbable that the Heteromyidæ were derived from some form related to Protoptychus, though not from that genus itself.

(4). The Geomyidæ are descended from early forms which may best be referred to the Heteromyidæ and in which the tympanics and the mastoids were already greatly inflated. The assumption of subterranean habits of life brought about a reduction in this region of the skull and led to the acquisition of the many peculiarities which characterize the recent pocket-gophers. Pleurolicus and Entoptychus represent stages in this change and are more or less directly ancestral to the modern Geomyidæ. (Proceeds. Phila. Acad., 1895.)

Cenozoic History of the Baltic Sea.—In a preliminary report on the Physical Geography of the Litorina Sea[1] Mr. H. Munthe gives a summary of the present saltness of the Baltic and a report of the present distribution of the Mollusca that concern the Litorina-sea especially ; he then discusses the question of the distribution of the Mollusca during the saltest part of the Litorina-time. The report includes also the author's investigations of the diatomaceous flora of the Litorina-sea and its rhizopod- and ostracod-faunas (on which subject but little has been hitherto published) and in this connection he gives briefly the testimony of diatoms in the hydrography of the Litorina-sea.

From the facts presented in the communication the late Cenozoic history of the Baltic can be summed up in the following manner:

A. Younger Glacial Epoch.

(1). *Time of the younger Baltic glacier.*

(2). *Late Glacial time.* The land-subsidence in Scandinavia now reaches its maximum during the Cenozoic period. The Baltic has the character of an ice-sea with *Yoldia arctica* Gray, etc., and is in open connection with the Cattegat across the northern part of South Sweden (Lakes Wettern, Wenern, etc.) and possibly also with the White sea across the Ladoga, etc.

[1] The author defines Litorina-time as that relatively salt phase of the Baltic Sea's postglacial history, which was subsequent to the Ancylus time during which the Baltic was shut off from the ocean and had the character of a fresh-water inland lake.

(1). *Ancylus-time.* Owing to upheaval of land in the South Baltic region and gradually also in adjacent parts towards the north, the Baltic ice-sea got the character of a fresh-water lake. Climate temperate. A transgression of the Ancylus-lake takes place at a later phase—due to upheaval of land in the central and subsidence in the southern portions of the Baltic district. At that phase the lake had its outlet within the Danish archipelago.

(2). *Litorina-time.* In consequence the Baltic by degrees came into open connection with the Cattegat through the Belts and the Sound and finally reached the salter and warmer character shown in the paper. Owing to a later upheaval of land—that has been greater the further one goes towards the central parts of Scandinavia—the saltness decreased more and more and in consequence the more stenohalinic forms retired towards the South Baltic district, and *Limnæas,* etc. immigrated ; the Baltic thus entering into the

(3). *Limnæa-time.* This time seems to come, however, so near the present or *Mya-time* that I hesitate whether it is suitable to maintain the *Limnæa-time* as a particular one. (Bull. Geol. Inst. Univ. Upsala Vol. II, 1894).

Fossil Elephants of Tilloux.—M. Marcellin Boule calls attention to the discovery recently made in the " ballastiere " of Tilloux near the station of Gensac-la-Pallue, of the remains of gigantic elephants, associated with implements of human industry. The most noteworthy among these fossils are two tusks of *Elephas meridionalis,* whose size surpasses all the tusks belonging to the Museum of the Acad. Sci. Paris. But slightly bent, their line of curvature measures 2 m., 85, while that of the Durfort elephant in the Museum measures 1 m., 70, and the modern elephant in the gallery of Zoologie 1 m., 87. M. Boule announces also, finding in the same deposit two molar teeth belonging to the same individual, and the remains of other Proboscidians, such as *Elephas antiquus* and *E. primigenius,* also the molar teeth of Rhinoceros, Hippopotamus, *Cervus e laphus* a Bos, probably the *Bison priscus* figured in the collections of M. Chauvet. We have here then, says M. Boule " a deposit similar to those of certain localities in the north of France, characterized by *Elephas antiquus,* but in which there is found a lingerer (*E. meridionalis*) and a fore-runner (the Mammoth) ; another proof of the continuity of geological and paleontological phenomena."

As to the flint fragments found in the same beds with the animals above mentioned, they are often very fine and reproduce the diverse forms of Chelles and of Saint-Acheul. M. Boule states that in addition to the usual almond forms, there are discs, scrapers, small carefully made, and even plates skillfully cut, things one would hardly except to find in a deposit of this sort. It is the first time, adds the author, that indisputable objects of human industry have been found contemporary with an elephant of which the species has, heretofore, been characteristic of the Pliocene age. (Revue Scientifique, Août, 1895).

The Latest Connection between the Atlantic and Pacific Oceans.—Before the Geological Section of the American Association for the Advancement of Sciences assembled in Springfield, Dr. J. W. Spencer presented a short abstract of some investigations of no small interest to biologists, under the title of "Geological Canals between the Atlantic and Pacific Oceans." In extending his researches on the great changes of level of land and sea and the evolution of the present continental reliefs, the author carried his explorations to the Tehuantepec Isthmus. In that region he found that late in the Pleistocene period there were shallow straits connecting the Atlantic and Pacific Oceans, in a region now elevated about 1000 feet above sea level. The deeper parts of these straits evidently formed canals, now elevated 800 feet. These discoveries show for the first time the very late Pleistocene connection between the two oceans, and the occurrence of shallow waters which have permitted considerable intermingling of littoral fishes and invertebrates, while excluding from the Gulf of Mexico all deep sea fishes, and thus explaining in part the distribution of modern marine life in the waters adjacent to Central America.

BOTANY.

Notes on Recent Botanical Publications.—In the Contributions from the Gray Herbarium of Harvard University (New Series, No. IX), B. L. Robinson and J. M. Greenman publish papers on (1) The flora of the Galapagos Islands, as shown by the collections of Dr. G. Baur; (2) New and noteworthy plants chiefly from Oaxaca, collected by Messrs. C. G. Pringle, L. C. Smith and E. W. Nelson; (3) A synoptic revision of the genus Lamourouxia; (4) Miscellaneous New Species.—The List of plants obtained on the Peary Auxiliary Expedition of 1894, collected by Dr. H. E. Wetherel has been published in Bulletin No. 5 of the Geographical Club of Philadelphia. It contains 108 species as follows: flowering plants, 77; fernworts, 5; mosses and liverwort, 6; algæ, 2; fungi, 2; lichens, 16. Twenty-two families of flowering plants were represented as follows: *Gramineæ*, 12; *Caryophyllaceæ*, 10; *Cruciferæ*, 8; *Cyperaceæ*, 6; *Rosaceæ*, *Saxifragraceæ*, *Ericaceæ*, *Scrophulariaceæ*, 5 each; *Compositæ*, 4; *Ranunculaceæ*, *Onagraceæ*, *Polygonaceæ*, *Salicaceæ*, 2 each; *Papaveraceæ*, *Portulacaceæ*, *Diapensiaceæ*, *Plumbaginaceæ*, *Boraginaceæ*, *Betulaceæ*, *Empetaceæ*, *Liliaceæ*, *Juncaceæ*, 1 each.—Recent Contributions from the Herbarium of Columbia College contain papers by Mrs. Elizabeth G. Britton (72) on the Systematic Position of *Physcomitrella patens*, and a couple of hybrid mosses; by John K. Small (73) some new hybrid oaks from the Southern States (*Quercus phellos* × *digitata*, *Q. georgiana* × *nigra*, *Q. catesbæi* × *cinerea*); by George V. Nash (74) notes on some Florida plants (including a number of new species); by N. L. Britton and Anna M. Vail (75) an Enumeration of plants collected by M. E. Penard in Colorado during the summer of 1892; by Albert Schneider (76) the biological status of lichens; by N. L. Britton (77) new or noteworthy North American Phanerogams (including several new species, one being *Ranunculus allegheniensis*, from the Mountains of Virginia and North Carolina).—From the Proceedings of the American Microscopical Society for 1894, we have two valuable papers, viz.: The Aeration of Organs and Tissues in Mikania and other Phanerogams, by W. W. Rowlee, and the Structure of the fruit in the order *Ranunculaceæ*, by K. M. Wiegand. Both are fully illustrated by good plates.—Professor V. M. Spalding's paper on the Traumatropic Curvature of roots (*Annuals of Botany*, Dec., 1894) familiarizes us with a new word, and gives a somewhat different explanation to root motions than that made by Mr. Darwin.—In the contributions from the Subtropical Laboratory of the Division of Vegetable Pathology of the U. S. Department of Agriculture (pub. in Report of Mo. Bob. Garden, Vol. 6) Herbert J. Webber gives the results of his studies on the dissemination and leaf reflexion of *Yucca aloifolia* and other species. Some interesting adaptations are shown by the author The leaf reflexion is shown to be a protective device against climbing animals which would be tempted by the succulent fruits.—"American Nomenclature" is the title of a long article by the editor of the *Journal of Botany* (London) in the July issue. The most remarkable part of the paper is that quoted anonymously from an American letter, in which occur some astonishing statements, e. g. "We are now in a very critical position in this country." "I do not know what the result will be." "You have no conception of the violence of the discussions on nomenclature now going on in this country." It is not conceivable that any reputable botanist would write thus of his fellow workers, and the editor of the *Journal* must have been imposed upon by some petty writer.—CHARLES E. BESSEY.

Fertilization of the Yellow Adder's-Tongue (*Erythronium americanum*).—The common Dog-Tooth Violet or Adder's-Tongue differs remarkably from its nearest ally, the tulip, in its method of fertilization. The blossoms of the latter being deficient in nectar in this country, are visited by small bees for the pollen only. Observations made by me in the spring of 1888 upon the Adder's-Tongue show that small drops of nectar are secreted at the base of the inner petals of the perianth, and that male bees (*Nomada luteola*), together with female bees of the genus *Halictus*, visit the flowers for this nectar, searching the base of the stamens and inner petals to secure it.

W. H. PATTON, Hartford, Conn.

"Aboriginal" Botany.—Mr. F. V. Coville, the Chief of the Division of Botany, and Honorary Curator of the Department of Botany of the U. S. National Museum has issued directions for collecting specimens and information illustrating the aboriginal uses of plants. Information of this kind is so important that it is desirable that more attention should be given to obtaining it by all who have the opportunity. It is suggested that the following points should be kept in mind. (1) Specimens of the plants or parts of plants used for any purpose by the Indians should be secured in such condition as to be readily identified by botanists, and accompanied by notes and memoranda. (2) Specimens of all kinds of manufactures from plants are desired by the National Museum. (3) Great care should always be taken to properly, and fully label every specimen of whatever kind, since much of its value depends upon such data as can be given only by the collector. We would urge all who may be able to contribute to our knowledge in the matter to send to the National Museum for a copy of these directions.

New Species of Physalis.—In the July number of the *Torrey Bulletin* Mr. P. A. Rydberg describes four new species and one new variety of *Physalis*, a genus of which he is preparing a monograph. The new species are as follows, viz.: *Physalis subulata*, from Mexico; *P. comata* from Nebraska, Kansas and Texas; *P. versicolor*, from New

Mexico, Arizona and Mexico; *P. versicolor microphylla* from Mexico; *P. macrophysa*, from Arkansas, Kansas, Texas, and doubtfully North Carolina and Ohio.

The Mycetozoa.—These organisms which have generally been regarded as plants, and which are treated in the ordinary botanical works under the name of Slime Moulds have been recently studied more from a biological standpoint by Arthur Lister, the results of which have been brought out by the trustees of the British Museum in the form of a monograph of the group.[1] The work is of such interest to students of this group that we quote the following selections from the introduction since they contain so much of general information regarding these curious organisms.

"Fries gave the name of *Myxogastres* in 1833, to the group of organisms described in this Monograph, placing it among the Gasteromycetous Fungi. In 1836 Wallroth substituted the term *Myxomycetes* (Schleimpilze) for the older name, and this came to be the generally accepted designation. Later investigations showed that the spores, instead of producing a mycelium, as in the case of fungi, gave birth to swarm-cells, which coalesce to form a plasmodium. In consequence of this discovery, which indicated a relationship with the lower forms of animal life, De Bary in 1858 introduced the name *Mycetozoa*. Under this head he still retained the term *Myxomycetes* for the section so named by Wallroth, but linked with them the *Acrasieæ* of Van Tieghem, a small group inhabiting the excrement of animals; in these the spores are said to produce swarm-cells, as in the *Myxomycetes*, which multiply by division but do no coalesce to form a plasmodium. At a certain period, when the fruits are about to be formed, they become attached in branching strings which concentrate to a point, where they are massed together in aggregations of more or less definite shape; the swarm-cells, however, do not lose their individuality. In *Dictyostelium*, a genus of the *Acrasieæ*, a stalk is formed by the arrangement of a number of swarm-cells in vertical rows in the centre of the heap; the surrounding amœboid bodies creep up this stalk and form a globose cluster at the extremity; here each amœboid swarm-cell acquires a spore-wall, and they become a naked aggregation of spores not enclosed by a definite sporangium-wall. Rostafinski followed De Bary in the

[1] *A Monograph of the Mycetozoa*, being a descriptive catalogue of the species in the Herbarium of the British Museum; illustrated with 78 plates and 51 woodcuts by Arthur Lister, F. L. S. London, 1894. 224pp. 8vo.

view that the formation of a plasmodium indicates a wide separation in the natural position of the *Myxomecetes* from the fungi, but he suppressed that name entirely, adopting De Bary's class name *Mycetozoa* in its place; at the same time, he admitted into his Monograph *Dictyostelium*, a genus of the *Acrasieæ*. The reason for his including this genus may be the fact pointed out by De Bary, that Brefeld in first describing the dense aggregations of swarm-cells into the stalked spore-masses of *Dictyostelium*, refers to them as being "plasmodia; that is, products of the coalescence of swarm-cells;" and it was not until after the publication of Rostafinski's Monograph that Van Tieghem in 1880 and Brefeld in 1884 corrected this view. Accepting the *Mycetozoa* as established by Rostafinski, but excluding *Dictyostelium* on the ground of its not forming a true plasmodium, we have a clearly defined group of organisms separated from all others by the following combination of characters. A spore provided with a firm wall produces on germination an amœboid swarm-cell which soon acquires a flagellum. The swarm-cells multiply by division and subsequently coalesce to form a plasmodium which exhibits a rhythmic streaming. The plasmodium gives rise to fruits which consist of supporting structures and spores; in the *Endosporeæ* these have the form of sporangia, each having a wall in which the free spores are developed. A capillitium or system of threads forming a scaffolding among the spores is present in most genera. In the *Exosporeæ* the fruits consist of sporophores bearing numerous spores on their surface.

The affinities of the *Mycetozoa* have been dealt with by de Bary and Zopf in the works before referred to. It had been suggested that they were allied to the fungi through the *Chytrideæ*, which do not always form a mycelium, and in which the entire vegetative body is finally transformed into a many spored sporangium, the vegetative body and spores having the power of amœboid movement for a longer or shorter time. De Bary, however, mentions among other points of difference that the *Chytrideæ* do not form a plasmodium by the coalescence of swarm-cells, "and there is, therefore, no ground for assuming their direct relationship with the *Mycetozoa*."

The position of the *Acrasieæ* in which the swarm-cells exhibit amœboid movements, but do not produce a flagellum, and aggregate without coalesceing into a true plasmodium, has already been referred to. The view held by De Bary that the *Mycetozoa* are more closely associated with the *Protozoa* is supported by a comparison with the pelagic *Protomyxa* of Hæckel, which is stated to develope a plasmodium by the coalescence of swarm-spores, and differs from the *Mycetozoa* chiefly in the absence of a firm spore membrane; also by comparison with *Bursulla*, which, according to Sorokin, forms a true plasmodium and minute sporangia on horse dung; the spores do not become invested by a firm membrane, and escape from the swollen apex of the sporangium in the form of swarm-cells, without cilia, but capable of amœboid movement. Zopf extends the *Mycetozoa* so as to embrace the *Monadineæ* of Cienkowski, but De Bary maintains that, whatever may be the points of agreement between the *Monadineæ* and the *Mycetozoa* they are not such as to warrant their being classed with the latter division as defined by himself. Lankester accepts the groups as defined by de Bary, and places them in his grade *Gymnomyxa* of *Protozoa;* he suggests their affinity with the *Sporozoa*. The ingestion of bacteria by the swarm-cells appears to strengthen the view that the group is more nearly associated with the lower forms of animal than of vegetable life, and the name of *Mycetozoa* appears to mark its true position in the borderland between the two kingdoms. For a more complete discussion of this subject I must refer to those who have paid special attention to the allied groups.

In preparing this catalogue of the collection of *Mycetozoa* in the British Museum, the arrangement of orders and genera given by Rostafinski in his Monograph has been mainly followed, with such alterations as observations made during recent years have rendered necessary. DeBary made the group the subject of minute and thorough investigation; and Rostafinski, while studying under him at Strassburg, devised a system of classification which is clear and comprehensive, and is now generally accepted.

The division by Rostafinski of the main section *Endosporeæ* into two parts, distinguished by the color of the spores, has been objected to as being artificial and wanting in universal application, but the cases in which species offer difficulty with regard to their position under this scheme are few, and on the whole the organisms range themselves under the separate heads in a remarkably natural manner, while for determining the species the plan is simple and convenient."

Synopsis of the Orders and List of the Genera of the Mycetozoa.

Subclass I.—EXOSPOREÆ. Spores developed outside the sporophores.

Order I.—Ceratiomyxaceæ. Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolated sporophore. Gen. *Ceratiomyxa*.

Subclass II.—ENDOSPOREÆ. Spores developed inside the sporangium.

Cohort I.—AMAUROSPORALES. Spores violet, or violet-brown, except in *Stemonitis* and *Comatricha*, in a few species of which they are pale ferruginous.

Subcohort I.—CALCARINEÆ. Sporangia provided with lime (calcium carbonate).

Order I.—Physaraceæ. Lime in minute innate granules. Gen. *Badhamia, Physarum, Fuligo, Cienkowskia, Physarella, Craterium, Leocarpus, Chondrioderma, Trichamphora, Diachœa.*

Order II.—Didymiaceæ. Lime in crystals. Gen. *Didymium, Spumaria, Lepidoderma.*

Subcohort II.—AMAUROCHÆTINEÆ. Sporangia without lime.

Order I.—Stemonitaceæ. Sporangia simple. Gen. *Stemonitis, Comatricha, Enerthenema, Lamproderma, Clastoderma.*

Order II.—Amaurochætaceæ. Sporangia combined into an æthalium. Gen. *Amaurochœte, Brefeldia.*

Cohort II.—LAMPROSPORALES. Spores variously colored, never violet.

Subcohort I.—ANEMINEÆ. Capillitium wanting, or not forming a system of uniform threads.

Order I.—Heterodermaceæ. Sporangium-wall membranous, beset with microscopic round granules, and (except in *Lindbladia*) forming a net in the upper part. Gen. *Lindbladia, Cribraria, Dictydium.*

Order II.—Liceaceæ. Sporangium-wall cartilaginous; sporangia solitary. Gen. *Licea, Orcadella.*

Order III.—Tubulinaceæ. Sporangium-wall membranous, without granular deposits; sporangia tubular, compacted. Gen. *Tubulina Siphoptychium, Alwisia.*

Order IV.—Reticulariaceæ. Sporangia combined into an æthalium, the sporangium-wall incomplete, perforated or forming a spurious capillitium. Gen. *Dictydiœthalium, Enteridium, Reticularia.*

Subcohort II.—CALONEMINEÆ. Capillitium present, a system of uniform threads.

Order I.—Trichiaceæ. Capillitium consisting of free elaters, or combined into an elastic network with thickenings in the form of spirals or complete rings. Gen. *Trichia, Oligonema, Hemitrichia, Cornuvia.*

Order II.—Arcyriaceæ. Capillitium combined into an elastic network with thickenings in the form of cogs, half rings, spines, or warts (scanty and often reduced to free threads in *Perichœna corticalis*). Gen. *Arcyria, Lachnobolus, Perichœna.*

Order III.—Margaritaceæ. Capillitium not consisting of free elaters, nor combined into an elastic network. Gen. *Margarita*, *Dianema*, *Prototrichia*.

Order IV.—Lycogalaceæ. Sporangia forming an æthalium, capillitium consisting of smooth or wrinkled branching colorless tubes. Gen. *Lycogala*.

VEGETABLE PHYSIOLOGY.[1]

Bactericidal Action of Metals.—Under the title, "The effects of various metals on the growth of certain Bacteria," Dr. Meade Bolton, formerly Associate in Bacteriology in Johns Hopkins University, and now bacteriologist to the City Board of Health of Philadelphia, contributes an interesting study to the *International Medical Magazine* for December, 1894. Following up the experiments of Nägeli, Miller and Behring, he has tested the bactericidal effect of various metals The following are some of his conclusions, stated as nearly as possible in his own words. For the most part agar plates were used and bits of metal were put on as soon as the agar was inoculated with the micro-organism and poured. In some cases the metals were absolutely pure, in some cases they were commercial but marked chemically pure, in one set brass foil was used, and a few preliminary experiments were made with impure metals. *Copper.*—In all cases there is around the metal a clear zone, in some cases narrower, in others wider, and then a narrow zone where there is increased growth. This intensified zone does not have as sharply marked borders as with certain other metals. Both the clear zone and the intensified zone vary appreciably in width, even with the same micro-organism. Tests were made with *Staphylococcus pyogenes aureus* and the colon, typhoid, cholera, and anthrax bacilli. *Brass.*—The zones obtained with the different micro-organisms were similar to those obtained with copper. *Silver.*—The results with this metal were somewhat less uniform than with copper and brass. The intensified zone is better marked with silver than with copper or brass, but is also narrower. In some cases with anthrax no clear zone was to be seen, in others there was a wide zone of lessened

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

growth or a narrow clear zone followed by one in which the colonies were not as thick as on the rest of the plate. *Gold.*—Purified gold, especially if recently glowed, had no inhibitory effect. In those cases where inhibition was noticed (some plates of anthrax) the gold had not been glowed for several weeks. Miller showed that velvet gold has no antiseptic properties but that certain gold preparations used by dentists, e. g., Pack's pellets, Quarter Century gold foil, and Abbey's non-cohesive foil, inhibited the growth for about 5 mm. all around. *Magnesium.*—Tests were made only on *Staphylococcus pyogenes aureus* and the cholera bacillus. With both these organisms there was a clear inhibitory zone, followed by a zone of increased growth, sharply marked off from the clear zone and gradually fading out on the outside. *Zinc.*—Many experiments were made with ordinary scrap zinc, cast into a sheet, but no note was kept of these. There was a clear zone, however, in every case, and there was probably not much difference between the action of this and of pure zinc. With the latter, all the organisms tested gave a broader or narrower clear zone, surrounded by an intensified zone. With *Staphylococcus p. a.* the clear zone averaged 7 mm. With the cholera bacillus there is a wide clear zone about 1.5 centimeters, and the effect of the zinc is seen as far as 3 cm. away from the metal. With other organisms the clear zone is usually 5 mm., or more, broad, followed by a broad intensified zone that is not sharply marked. *Cadmium.*—With this metal the reactions obtained differ quite strikingly, as a rule. The most peculiar zone observed in the whole set of experiments is that obtained with the micro-organism of anthrax and the pure metal cadmium. In this case there is a perfectly clear zone 5 mm. wide, then an intensified zone of 2 mm. breadth, and a second inhibitory zone 1 mm. wide. In some cases this second inhibitory zone is not entirely free from colonies, but it can always be made out very distinctly. *Mercury.*—There is considerable difference in the behavior of different micro-organisms towards mercury. With *Staphylococcus p. a.* there is a clear zone, about 7 mm. around the metal, followed by a slightly intensified zone which in different cases varies in width from 1 to 3 mm. With *Bacillus pyocyaneus* there is a clear zone 4 mm. broad around the metal and outside an intensified zone, sharply marked toward the clear zone and falling off gradually on the outside. With the cholera bacillus there is a clear zone, 2 mm. around the metal, then a very narrow intensified zone that is well marked. With the bacillus of anthrax there is a broad clear zone, 9 mm. around the metal, surrounded by a very slightly intensified zone that is not sharply marked. With the colon bacillus there is a clear zone often 7 mm. broad, sharply marked on the inside, then an intensified zone gradually shading off on the outside. With the typhoid bacillus the clear zone is much broader, often 1 cm. across, but the peculiarity is the character of the intensified zone. This is about 2 mm. across, more intense on the outside, away from the metal, and in different cases more or less double, i. e., there is a narrow almost clear zone running all around which divides the intensified zone into two zones. *Charcoal.*—No reaction. *Silicon.*—Do. *Aluminum.*—Do. *Niobium.*—Do. *Antimony.*—With *Staphylococcus p. a.* this metal gives a clear sharp zone about 1 cm. wide, then a zone about 5 mm. wide where there is diminished growth. In one of the plates there was only a very narrow clear zone. With the colon bacillus there is a breadth of 8 mm. where the growth of the colonies is somewhat thinner than on the rest of the plate, but no clear zone. The intensified zone is quite distinct and about 1 mm. broad. With the typhoid bacillus there is an almost clear zone of 1 cm., then an intensified zone 2 mm. broad. With the anthrax bacillus there is a perfectly clear zone 1.8 cm., then an indistinct intensified zone. With the cholera bacillus there is no sharply marked clear zone, but diminished growth can be made out as far as 1.5 cm. to 2 cm. around the metal. *Bismuth.*—*Staphylococcus p. a.* with this metal gives a clear zone about 2 mm. wide and an indistinct, narrow, intensified zone. With anthrax cultures there is a clear zone 1 mm. wide. Pyocyaneus, cholera, typhoid and colon bacilli gave no reaction with bismuth. *Iron.*—A bright polished wire nail gave a clear zone about 7 to 10 mm. wide with the typhoid bacillus and with the colon bacillus. Other organisms were not tested. Behring is said to have obtained negative results with iron. *Nickel.*—Pure nickel failed to give any reaction with most of the micro-organisms tested. *Platinum.*—Platinum wire and platinum black failed to give any reaction with any of the micro-organisms tested. From the above results it is notable that it is precisely those metals that are resistent toward chemical reagents in general which fail to show any reaction or do so only to a limited extent. On the other hand, metals that are readily attacked by chemical reagents all exhibit a marked inhibitory action on the growth of the bacteria. The effect is, therefore, probably due to a solution of the metal in the medium, and putting bits of metal on the cultures is really equivalent to the addition of a small amount of that salt of the metal formed by the action of the nutrient medium. Traces of the metal may, moreover, be detected by chemical reagents in the nutrient medium surrounding the metal. The explantion of the clear zones is thus quite evident, but the explanation of the intensified zones and of the second inhibitory zone, sometimes seen, is not very apparent. It is probable, however, that the dissolved oxides or salts of the metals are in too great concentration in the clear zone, and that the trace present in the intensified zone may stimulate growth. This does not explain the second inhibited zone. The length of time it is necessary to leave the metals in contact with the agar, in order to develop the inhibitory action was tried with brass, copper, cadmium and zinc. Plates of *Staphylococcus p. a.* were made in the usual way and the metals put on and removed at various intervals. With cadmium there was a clear space where the metal had lain and for 1 mm. around, where the metal had been left on for a minute. Where the metal had been left on for 3 or 4 minutes or more the clear space usually extended over 3 mm. around where the metal had lain. With zinc the results are similar as regards length of time, but the edges of the clear zone are not well defined and there is an intensified zone that is not apparent with cadmium. With brass there was no effect produced by leaving the metal on for 36 minutes; after this there was more and more marked inhibition up to 50 minutes, but no clear space except where the metal was on for a longer time than this. With copper no visible effect was produced in less than 36 minutes. After this time there was more and more marked inhibition, but only where the metal had been allowed to lie on for 50 minutes was there a clear space. The whole paper is very suggestive and is commended to experiment station workers and all who have to deal with problems relating to fungicides and germicides. Probably the increased development and prolonged activity of chlorophyll in foliage sprayed with Bordeaux mixture is also attributable to the stimulating effect of the minute traces of copper that must pass into the leaves. The paper contains 10 pages and 11 figures, and has been distributed as a reprint.—Erwin F. Smith.

ZOOLOGY.

Antivenine.—Prof. Fraser has laid before the Royal Society of Edinburg some important results of his admirable experiments on snake poisons and their antidote. His method is to ascertain the minimum lethal dose for an animal, to begin experimenting upon a similar animal with a smaller dose. After a short interval he increases this dose until, in time, he can inject fifty times the minimum lethal dose into the animal's blood without producing any bad effects. This animal is immunized, and its blood serum, injected into another animal of the same size and weight, will prevent the action of snake poison when injected. This immunized blood serum is called, by its discoverer, *antivenine.*

In experimenting with rabbits it was found that the blood serum of one which had received thirty times the minimum lethal dose was as effective in its antitoxic properties as that of one which had received fifty times the minimum lethal dose.

The antivenine obtained from a horse was found to be twice as powerful as that from the rabbit. In immunizing a horse the same method is adopted as is used for the rabbit, viz.: to begin by injecting a small dose; then to give regularly increasing doses, every few days, until fifteen times the minimum lethal dose is administered. The blood serum from from a horse thus immunized is found to be so powerful an antivenine that a hundredth, and even the thousandth part of a cubic centimeter per kilogramme of animal was sufficient to prevent death from the minimum lethal dose of the venom. For a horse to arrive at this stage of immunism requires four months and a half.

The antivenine can be kept for use in two forms, liquid and dry, of which the latter is preferable as less liable to decomposition.

In the course of his experiments, Prof. Fraser discovered that dietary has an effect upon venom poisoning. If a herbivorous animal be put upon a flesh diet, the effect of venom upon it is lessened.

Through another set of experiments Prof. Fraser concludes that the deadly effects of serpents' venom is due to its action on the blood. Venom is almost inert when introduced into the stomach. Nevertheless, an animal may be immunized by the administration of poison into its stomach. This fact is due to the absorption of the poison by the blood. This may account for the immunity from snake-bites said to be enjoyed by some of the snake-charmers of India, who eat the poison-glands of the snakes.

Snakes themselves have been noticed to be impervious to the effects of the poison. This may probably be due to the absorption of venom shed from poison-glands through the mucous surfaces of the mouth, or by the blood-vessels and lymphatics passing to and from the glands. In some cases it may be secured by serpents devouring other members of their tribe.

It is now within the range of certainty that, at no distant date, Dr. Fraser will be able to have sufficient quantities of antivenine from the immunized horse to be of practical value to those who are exposed to the bites of venomous snakes. It remains now to discover the chemical constituents of the antivenine, so that it may be manufactured in such quantities as to reduce its cost. (Knowledge, Aug., 1895).

Dall on the Lamellibranchiata.—In his contributions to the Tertiary Fauna of Florida, Part III, Dr. Dall adopts a new classification of the Pelecypoda for which he claims the merit that the groups are comparably defined. The general features of the system proposed by the author in 1889 have been revised, and form the basis of the one now offered. As a matter of convenience, the division Pleoconcha made by Neumayer to contain certain synthetic types is retained for a temporary resting place until more is known of these undifferentiated ancient forms.

For the present, then, the class is divided into the following groups, of which the third represents the most perfected (although not always the most specialized) modern type of Pelecypoda.

Order Prionodesmacea containing 34 families grouped under 10 superfamilies. Order Anomalodesmacea, 15 families under 3 superfamilies. Order Teleodesmacea, 46 families under 18 superfamilies. The Palæoconcha, 11 families.

Under each family is an enumeration of the chief generic groups believed to be referable to it.

The genus Solemya Lamark, in this new classification, is placed with the Prionodesmacea. (Trans. Wagner Free Institute, III, Pt. 3, 1875).

On the Species of Uma and Xantusia.—In The Naturalist for 1894, p. 434, I gave descriptions of the two species of Uma known to me at that time. An examination of the material in the U. S. National Museum has revealed two additional species, which I describe below. The *U. rufopunctata* is based on nine specimens, of which seven are from Arizona, where they were obtained by Dr. E. A. Mearns, U. S. A. The *U. inornata* is represented by a single specimen (No. 16,500), from the Colorado Desert, San Diego Co., Cal., from Mr. C. R. Orcutt.

I. Black crescents on the throat, and a black spot on each side of the belly.

Labial scales strongly keeled, six keeled suborbital scales; eight loreal rows; hind-foot shorter, one-third head and body; femoral pores 40–50; dorsal spots black; *U. scoparia* Cope.

II. Black spots on side of belly, but no crescents on throat.

Labial scales strongly keeled, three or four keeled suborbitals; five or six loreal rows; ten or eleven supraocular rows; hind-foot shorter, one-third head and body; femoral pores 24–28; dorsal spots rufous; *U. rufopunctata* Cope.

Labial scales weakly keeled; nine loreal rows; fourteen supraorbital rows; hind-foot longer, two-fifths head and body; femoral pores nineteen; *U. notata* Baird.

III. No black spots on belly or crescents on throat.

Labial scales strongly keeled; five or six loreal rows; ten or eleven supraocular rows; hind-foot shorter, one-third head and body; femoral pores 19; *U. inornata* Cope.

In the young the disciform areas are imperfectly outlined.

All the species are from the Sonoran region.

In the last number of THE NATURALIST, p. 859, I described a new Xantusia from California, but neglected to give it a name. I propose that it be called *X. picta*.—E. D. COPE.

Comparisons of Marriages and Births in the Different European Countries.—The following facts were compiled by M. Chervin and presented by him to the Anthropological Society at its recent conference at Broca. The first fact to be noted is that in respect to the number of marriages France falls a little below the number recorded in the principal countries of Europe, as the following table testifies.

Of 1000 people of both sexes, over 15 years of age, the per cent. that marry is as follows: Hungary, 91.6; Germany, 53.0: England and Wales, 52.6; Denmark, 52.0; Austria, 51.3; Italy, 50.1; Finland, 49.2; Holland, 49.0; France, 45.8; Belginm, 41.9; Greece, 41.6; Scotland, 40.9; Switzerland, 40.8; Ireland, 23.0.

But the number of marriages is only one of the factors in the problem of the increase of population. The most important thing is the fecundity of these unions. Statistics in regard to births are given as follows: (1) Legitimate living children born of 1000 married women from 15 to 50 years of age—Germany, 270; Scotland, 269; Belgium, 265; Italy, 251; England and Wales, 250; Austria, 250; Sweden, 240; Ireland, 240; Switzerland, 236; France, 163. (2) Illegitimate living children born of 1000 unmarried women from 15 to 50 years of age—Germany, 265; Scotland, 199; Belgium, 198; Italy, 246; England and Wales, 121; Austria, 444; Sweden, 444; Ireland, 41; Switzerland, 102; France, 167.

These lists show that in respect to legitimate births France falls below the other European countries, and even taking into account the illegitimate births, she is far behind Germany, Austria and Italy in point of increase of population. (Revue Scientifique, May, 1895).

Additions to the Mammal Fauna of British Columbia.—MICROTUS PRINCIPALIS sp. nov. Type, ad. ♂ ; col. of S. N. Rhoads, No. 2346. Col. by A. C. Brooks on the Mt. Baker Range (alt. 6000 ft.), Westminster Dist., B. Columbia, Aug. 16, 1895.

Description : Size, largest of the western *Microtinæ*, color and proportions as in *M. pennsylvanicus*. Skull broad, rectangular. Incisors strongly produced anteriorly ; molars relatively very weak. Incisive foramina short and compressed, not reaching anterior molars by 3 millimeters.

Above, including tail and feet, grayish-brown, not darker along median line. Below, sooty gray, darkest where bases of hairs are exposed, distal two-thirds of hairs dull white ; sides of lower neck and lips white. Pelage soft and silky. Fourth loop of $\underline{\text{m. 1}}$ triangular, meeting fifth loop medially, the latter nearly twice as large as former and scroll shaped. The same remarks apply to the last two sections of $\underline{\text{m. 2}}$. Trefoil posterior section of $\underline{\text{m. 3}}$ one and two-thirds length of anterior section of same tooth, this section being composed of an anterior loop and two opposing triangles. The formation of $\overline{\text{m. 1}}$ is as follows : an anterior subcircular loop opening broadly into two angular wings whose lateral points form the anterior pair of a series of five angles on the inner and four on the outer sides of the tooth, including the opposite angles of the posterior loop and the lateral points of two outer and three inner closed triangles.

Measurements : Total length 246 millimeters ; tail vertebræ (tip missing), 78+ ; hind foot, 29.5. Skull : basilar length, 36 ; length of nasals, 11.6 ; interorbital constriction, 5.2 ; zygomatic expansion, 23.2 ; crown length of molar series, 8 ; length of mandible, 25 ; greatest breadth of mandible 12.5.

This large Vole need be compared with only one described species, *Microtus macropus* (Merriam) from the mountains of Idaho. The most decided differences which can be noted from Dr. Merriam's description and figure are in the molar dentition as particularized above and which can best be understood by a comparison with the diagnosis and plate II in North American Fauna No. 5. Besides the type, Mr. Brooks sent me a two-thirds grown specimen of this Vole which is very similar in color to type, with softer and shorter pelage. Its tail is unicolor, dark and very thinly haired.

PHENACOMYS ORAMONTIS sp. nov. Type, ad. ♂; col. of S. N. Rhoads, No. 2354. Col. by A. C. Brooks on the Mt. Baker Range (alt. 6000 ft.), Westminster Dist., B. Columbia, Aug. 6, 1895.

Description: Above uniform blackish-brown, feet grayish, blackish at instep and wrist, nearly white on digits. Upper tail blackish, lower tail gray, tip white. Lower parts soiled white, showing the plumbeous bases of pelage. Ears smaller, but nearly as prominent, as in an *Evotomys* of same size.

Measurements: Total length, 154 mm.; tail vertebræ, 38; hind foot, 20.5. Skull: basilar length, 23; length of nasals, 7.8; interorbital constriction, 3.4; zygomatic expansion 15.7; length of interparietal, 4.1; width of same, 6.9; length of mandible, 16.3; greatest breadth of same, 9.2.

This short-tailed Tree Vole is very different from *P. longicaudus* True, its nearest geographic ally. From *P. intermedius* of south central British Columbia it is distinguished by the exceedingly small size of the outer last triangle of $\underline{\text{m. 3}}$ and that it is distinctly cut off from the posterior loop. In $\overline{\text{m. 1}}$ there is a broad crescentic loop as in Dr. Merriam's figure of *P. latimanus* but differing therefrom in its being completely cut off from the first outer triangle (loop) with which, in *latimanus*, it forms a trefoil. From all the four forms first described by Dr. Merriam it differs in having the second loop of $\overline{\text{m. 3}}$ almost completely divided into two sections by the exaggeration of the outer angle of this loop (see fig. of *latimanus*, pl. IV, N. A. F., No. 2) and the acuteness of the next entrant angle on the same side, forming a small outer median triangle whose inner angle is so nearly closed by the impinging enamel walls that the gap can only be seen by a glass. In this feature it resembles *P. orophilus* of Idaho, from which it differs in no essential dental characters. In color, however, the two are distinct and *oramontis* has an interparietal like *celatus*, which Dr. Merriam states to be very different from that of *orophilus*. There may be other cranial differences, but these are all that can be distinguished from the rather meagre description of *orophilus*. Only one specimen was sent me by Mr. Brooks.

TAMIAS QUADRIVITTATUS FELIX subsp. nov. Type, ad. ♀; col. of S. N. Rhoads, No. 2355. Col. by A. C. Brooks on the Mt. Baker Range (alt. 7000 ft.), Westminster Dist., B. Columbia, Aug. 13, 1895.

Description: Colors and color pattern as in *quadrivittatus* but much darker than that type. Darker also than *T. q. affinis* or *T. q. luteiventris*, which latter it most nearly resembles. From *luteiventris* of the same season it is distinguished by: (1) greater breadth and depth of rusty orange suffusion of sides, cheeks and lower tail; (2) rusty brown of upper head, neck, shoulders and fore-back; (3) greater breadth and blackness of dark dorsal stripes and corresponding diminution and rustiness of white stripes; (4) absence of hoary appearance of whole upper surface seen in *luteiventris.*

Measurements: Total length, 245 mm.; tail vertebræ, 105; hind foot, 32.5. Skull: basilar length, 26.5; length of nasals, 10.5; inter-orbital constriction, 7.4; zygomatic expansion, 20; length of mandible, 11; greatest width of mandible, 20.

So far as I am able to examine specimens, this is the darkest representative of the *T. quadrivittatus* group. It is represented by a male and female, both adults and from the same locality. Their measurements show *felix* to be as large as, if not larger than, any of its conspecific allies.

The above newly described mammals formed part of a small collection recently made and forwarded to me by Mr. Allen C. Brooks. They demonstrate emphatically the wonderful variety which characterizes the Zoology of the mountain regions of the Pacific Slope, even in northern latitudes.—S. N. RHOADS.

Zoological News.—MAMMALIA—At the June meeting of the Linnean Society of N. S. Wales, Mr. Robert Brown read a paper on a new fossil Mammal allied to Hypsiprymnus, but resembling, in some points, the Plagiaulacidae. The remains, described under the names of *Burramys parvus*, are those of a small marsupial not larger than an ordinary mouse. The form is specially interesting in having but three true molars in each jaw, and a very large grooved premolar with serrate edge, very similar to that found in the Eocene genus Neoplagiaulax. Its affinities are dealt with at some length, and an endeavor made to trace its relationship phylogenetically. (Proceeds. Linn. Soc. N. S. W., 1895).

ENTOMOLOGY.[1]

Entomology at Springfield.—The most important entomological meeting at Springfield in connection with the A. A. A. S. was that of the Association of Economic Entomologists, August 27 and 28. The

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

President's address was delivered by Prof. J. B. Smith, after which the following papers were read:

J. M. Aldrich, Moscow, Idaho, Spraying without a pump; M. H. Beckwith, Newark, Del., The San José Scale in Delaware; F. H. Chittenden, Washington, D. C., Herbivorous Habits of certain Dermestidæ; T. D. A. Cockerell, Las Cruces, N. Mex., On the natural conditions which affect the distribution and abundance of Coccidæ; G. C. Davis, Agricultural College, Mich., Insects of the season in Michigan; C. H. Fernald, Amherst, Mass., The Gypsy Moth; C. P. Gillette, Fort Collins, Col., How shall we improve our Collections? F. L. Harvey, Orono, Me., Article on Smerinthus cerisyi; A. D. Hopkins, Morgantown, W. Va., (1) On the Study of Forest-tree Insects. (2) Some notes on observations of the season; L. O. Howard, Washington, D. C., Some shade-tree insects of Springfield and other New England towns; J. A. Lintner, Albany, New York, A paper; C. L. Marlatt, Washington, D. C., (1)The Elm-leaf Beetle in Washington. (2) Some notes on insecticides; J. B. Smith, New Brunswick, N. J., The uses of insect-lime; E. B. Southwick, New York City, (1) Economic entomological work in the parks of New York City. (2) A city entomologist and insecticides; F. M. Webster, Wooster, O., (1) Some interesting facts regarding the genus Diabrotica. (2) Importation and repression of destructive insects. (3) Insects of the year in Ohio; C. M. Weed, Durham, N. H., An important modification of the kerosene sprayer; H. E. Weed, Agricultural College, Miss. (1) Experiments with the kerosene knapsack sprayer. (2) Bisulphide of Carbon for Crayfish.

Prof. C. H. Fernald was elected President for the next year and Mr. C. L. Marlatt was re-elected Secretary, Resolutions indorsing the work of the Gypsy Moth Commission, and expressing regret at the discontinuance of *Insect Life* were passed.

In Section F. perhaps the most interesting entomological papers were those on the mouth parts of insects by Messrs. J. B. Smith and C. L. Marlatt.—C. M. W.

Pigments of Pieridæ.—Mr. F. G. Hopkins publishes[2] an abstract of a contribution to the study of excretory substances which function in ornament. The wing scales of the white Pieridæ are shown to contain uric acid, which substance bears the same relation to the scale as do the pigments in the colored Pieridæ, so that it practically functions as a white pigment. The yellow pigment found in the majority of the Pieridæ is a derivative of uric acid. The yellow pigment may be arti-

[2] Proc. Royal Soc. lvii, 1895, pp. 5 and 6.

ficially induced by heating uric acid with water in sealed tubes at high temperatures, and the identity of the natural and artificial products may be demonstrated by the similarity of their spectrum. Mr. Hopkins believes that this yellow substance, which may be called lepidotic acid, together with a closely allied red substance, will account for all the chemical pigmentation of the wing scales of the colored Pieridæ, though modifications may be produced by superadded optical effects. These uric acid derivatives, though universal on the Pieridæ, are apparently confined to this group among the Rhopalocera. This fact leads to the interesting observation that where a Pierid mimics an insect belonging to anothers family, the pigments in the two cases are chemically quite distinct. The fact that the scale pigments are really the normal excretory products of the animal utilized in ornament is emphasized by the observation that the yellow Pierids on emergence from the chrysalis are apt to void from the rectum a quantity of uric acid, colored by a yellow substance, which exactly resembles the pigment of the wing.—*Journal Royal Microscopical Society.*

Sense of Sight in Spiders.—Professor and Mrs. Peckham in continuing their studies of spiders have published[3] some extremely interesting observations upon the sense of sight. Concerning the range of vision the authors think their experiments " prove conclusively that Attidæ see their prey (which consists of small insects) when it is motionless, up to a distance of five inches; that they see insects in motion at much greater distances; and that they see each other distinctly up to at least twelve inches. The observations on blinded spiders and the numerous instances in which spiders which were close together, and yet out of sight of each other, showed that they were unconscious of each other's presence render any other explanation of their action unsatisfactory. Sight guides them, not smell."

The authors also experimented with the color sense of spiders, and reached the opinion " that all the experiments taken together strongly indicate that spiders have the power of distinguishing colors."

[3] Trans. Wisconsin Acad. X, pp. 231–261.

EMBRYOLOGY.[1]

Eggs of Nematodes.—Hans Spemann contributes to the May number of the Zoölogische Jahrbücher an elaborately illustrated account of the cleavage of the eggs of the Nematode *Strongylus paradoxus.* In general it is a confirmation of the results obtained by Boveri upon *Ascaris megalocephala.*

The egg divides into two equal cells, yet one contains all the yolk. Each divides into two and the four so produced become rearranged in a characteristic way.

Tho two cells from the one containing no yolk divide into right and left cells that increase to form the major part of the ectoderm at the period of gastrulation. One of the other two cells gives rise at its first division to entoderm and mesoderm, while the other produces four, of which three add themselves to the ectoderm and one remains as the originator of the sexual cells.

The author compares this cleavage to the divisions of an apical cell in a plant; the egg divides off an entoderm cell, a mes-entoderm cell and ectoderm cell, another ectoderm cell and finally remains as the origin of the sexual cells. The sexual cells may be thus readily traced backed to their ancestors amongst the blastomeres. They are separated as special cells in the fourth generation, starting from the undivided egg.

In this process of rapid separation of sexual and somatic cells, Boveri found in *Ascaris megalocephala* a peculiar nuclear differentiation. At the first cleavage the nucleus of one cell looses part of its chromatin and its chromosomes undergo a change of shape. The other cell undergoes a like change when divided, and so on till after five divisions all the cells but one have the modified nuclei. This cell with the unchanged nucleus becomes the the beginning of the sexual cells.

This remarkable nucleus differentiation has been sought for by Oscar Meyer[1] in the eggs of other nematodes namely, *Ascaris lumbricoides, A. rubicunda, A. labiata, A. mystax, A. perspicillum, Strongylus tetracanthus, S. paradoxus* and *Oxyuris vermicularis.* In the first three he finds essentially the same process as in the species studied by Boveri,

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Jenaische Zeitschrift., 29, May 15, 1895.

in the other cases the material was not suited to a decision on this point; the author thinks this differentiation between the nuclei of somatic and sexual cells may well be common to all the Ascaridæ.

A second subject taken up by Oscar Meyer in this paper is the origin of the centrosomes in the eggs of *Strongylus tetracanthus*. By the methods employed no centrosome could be found near the female pronucleus. The sperm-head is, on the other hand, accompanied by a very marked system of radiations surrounding an evident centrosome. As the male pronucleus approaches the female pronucleus two systems of radiations and two centrosomes are formed by the division of the single centrosome that accompanied the male pronucleus. When the pronuclei are united these two centrosomes become the centrosomes of the first cleavage spindle. In some abnormal cases the female pronucleus has a centrosome close to it, but this probably migrates from the male pronucleus. It thus seems that in this egg the centrosomes arise only in connection with the sperm.

The third problem taken up by the author is the question as to the nature of the difference between the two kinds of *Ascaris megalocephala*. Boveri found that some individuals have two chromosomes in each egg or sperm while others have but one. The former have been called the variety *bivalens*, the latter *univalens*.

Oscar Meyer examined 154 horses and found 19 infected with this parasite, 10 with the variety *univalens*, 8 with *bivalens* and 1 with both *univalens* and *bivalens*.

A careful examination of the external and internal anatomy and histology of both kinds failed to reveal any difference except in the sexual products. The eggs of *bivalens* measure 78–88 and those of *univalens* only 65–70 microns. The sperms are larger in *bivalens* and have a nucleus twice as large as in *univalens*.

The two kinds are very closely related and may, it seems, interbreed; at least the occurrence of eggs with three chromosomes as well as the finding of eggs of *univalens* penetrated by very large sperms points to such a conclusion. Copulation between the two kinds seems established by the discovery of worms with both sizes of sperms in the same egg-tube. A consideration of the numbers of apparent crosses so formed as compared with the possibilities that result from the presence of both kinds of sperm, leads to the conclusion that the crosses are not as frequent as they might be and that there may be some impediment to interbreeding. In other words the two kinds of Ascaris seem to be somewhat separated as physiological varieties in spite of their very close morphological relationship.

Cell Phenomena in the Triton Egg.—Following in the steps of Drüner Dr. H. Braus[2] of Jena, has made a careful study of cell division in the blastula stage of *Triton alpestris.* By special methods the achromatic spindles and polar radiations of cell division are brought out with great distinctness. In the spindle three kinds of fibers may be present; delicate fibers that aid in moving the chromosomes; fibers with a sheath, also pulling the chromosomes; and stout fibers that connect the two centrosomes and serve as a supporting system tending to resist the pressure exerted by the other fibers.

In the later blastula with several layers of cells just as in the gastrula and in the adult testis as made out by Drüner, the arrangement of the fibers in the spindle is such that the contracting ones that act upon the chromosomes form the mantle or outer part, while the pressure-resisting fibers form the axial part of the spindle.

In the early blastula, however, cell division is different; the spindle has its contracting fibers in the axial part and the resisting fibers in the outer part or mantle.

The author comes to the conclusion that the more primitive form of spindle is that found in the older stages of the ontogeny of the Triton.

In the same way the author thinks that the origin of the spindle within the nucleus in the early stages of the development of the Triton's egg is a cœnogenetic process, while its origin outside the nucleus, in the protoplasm of the cell, in the later stages and in the adult testis is really the more primitive method of spindle formation. In general the formation of a spindle within the nucleus is to be regarded as a recent innovation, not as the original method.

The very important question as to the reason for form in organisms, the laws of growth of organisms, receives a contribution from the author's decision that the position of the spindles in the Triton's blastulæ (the angle which the axis of the spindle forms in successive cell divisions) does not necessitate the arrangement of the cells to form parts and organs. The author shows that the position of the spindles would not give rise to sets of cells placed as they are in the two-layered blastulæ if there were no rearrangements of the cells after division. It is change in position of cells after their formation and not forces in the processes of cell division that leads to the growth of form.

In this Triton as many as nine sperms may enter one egg. These supernumerary sperms give rise, the author maintains, to certain extra nuclei recognizable even up to the blastula stage, so that the possibility of polyspermy having some lasting effect in the embryo receives some material basis.

[2] Jenaische Zeitschrift., May 15, 1895.

PSYCHOLOGY.[1]

Will and Reason in Animals.—One of the greatest needs of psychology is a suitable technical terminology. In most of the other sciences, the words used have a constant meaning, and one feels reasonably sure of understanding what the author wishes to say. In psychology there are few terms in use that are not ambiguous. The psychologist has adopted the phraseology of current speech, and too often, in endeavoring to free it of its ambiguity, he forgets that that very ambiguity bears witness to a complexity in the matter to be described which should not be arbitrarily simplified.

Especially is this found true when we endeavor to interpret the mental processes of the lower animals in terms of our own. We are ourselves "conscious," we "judge," "reason," "will," and we ask whether the lower forms of life are "conscious," whether they can "judge," "reason," "will." Such questions are vain unless we know precisely what mental processes we designate ourselves when we use the words. Yet, in most current discussions, it is apparently taken for granted that these words have a meaning; that the writer not only understands their meaning himself, but is assured that his readers will take them in the same sense. Even in the few cases where some serious attempt is made to exhibit the exact sense of the terms used, the writer proceeds upon the assumption that they have but one legitimate sense, and that that is the sense in which he uses them.

But, in fact, no words in common use have any precise meaning, and if this is true of all, it is doubly true of those which express the results of crude introspection, performed, for the most part, with practical ends in view only. Such are most of our psychological terms. While the processes which are designated by any one always have some inner bond of similarity, that bond may be, from the point of view of the scientific psychologist, of relatively slight importance in view of the variations to be found within it.

Let us, for example, examine some of the words used of conduct. The reflex and instinctive are commonly contrasted with the voluntary, and the impulsive are contrasted with the rational. The reflex, instinctive and impulsive are regarded as "lower types," since we share them with the lower animals; the voluntary and rational are the

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

"higher types," and much discussion has been expended on the question whether these also are found in the lower animals or not.

The word "voluntary" is used in three quite distinct senses, but all contain a common element. In its broadest sense, any act is voluntary which is performed at the instigation of a thought. In this sense it is contrasted with "forced" acts, such as those performed under physical compulsion with acts performed under physiological compulsion, such as reflexes, and with acts performed under what we may turn psychical compulsion, as the instinctive. Many impulses, especially those which hurry into action without allowing time for reflection, are felt to be only partly voluntary.

Now, at all times, one's actual thought content comprehends two groups of elements—those originated from within by association and habit and those originated from without by the suggestions of the environment. For the most part, the two blend into a harmonious whole and both find expression in conduct. But, occasionally, the two clash. If then, the environment wins the day and controls conduct, even though it be done through the intervention of thought, we are inclined to deny that the conduct is voluntary. If I surrender my purse at the the point of a pistol, I would not call the act voluntary, yet it is not involuntary in the same sense in which it would have been had the highwayman taken my hand and, by main force, thrust it into my pocket, closed it upon my purse, and withdrawn it.

So of other cases. Control by the idea train invariably implies, in some degree, the ability to withstand the solicitations of the environment. The adult feels most of those solicitations so slightly that he is scarcely aware of their presence. But it is different with a child. The child is ever "in mischief," because his ideation has not developed far enough to offset the tempting invitation "Eat me," "Break me," "Set me on fire," by foresight of the latter end. It is in those cases in which the inner control clearly gets the better of the outer that we feel the power of "will" to be manifested. This, then, is a second sense of the word voluntary.

It is only through sensation and idea, on the whole, that the environment can enter into a man's mind and control his acts. The reflexes are exceptions, but they are, for present purposes, negligible. And its entrance is accompanied by a sense of conflict, as if the kingdom were divided against itself. Now a similar feeling often arises in cases in which the influence of the environment as such is scarcely to be noticed. Every man's mind is a polity, and its habitual usages and active principles not infrequently conflict. Then we commonly invoke our more remote past in some fashion at present incomprehensible, and there emerges that intangible, contentless power which, like the rudder on a ship, avails to hold us steadily to the course already planned, and makes our present and future symmetrical with our past. This is what we term "will" in the narrowest sense, and it is a comparatively rare phenomenon in the experience of most of us.

If we turn from such an analysis to the problem of volition in the lower animals, we find it much simplified. There can be no doubt that in the higher vertebrates, at least, the idea trains, however rudimentary, control conduct to some degree. Yet the part played by the reflexes and instincts is so much greater in them than in us, and ideation is so scanty that the sphere of the voluntary is much restricted. Cases of conflict, in which the ideal control overcomes the solicitations of sense, are probably of rare occurrence. I noted, a case not long ago, however, which seems here in point. A friend of mine had a very intelligent Irish terrier, who, having been bred to thrifty habits, knew better than to eat a scrap of food which had "cost money" until it had been "paid for." In the agonizing interval I have frequently seen him resort to what seemed to be expedients to overcome the temptation. He seemed to feel that the bit of meat exerted a specific attractive force upon his organized reflexes, that he could not help snapping at it if he allowed himself to look. He would dance about near it, carefully keeping his head twisted to one side, so as to keep the tempting morsel out of sight; sometimes, if the words "It's paid for, Patsy," were long delayed, he would run to the farthest corner of the room and stay there until he heard them. Then he would dart for the food so hastily that he sometimes fell in turning towards it, showing that he had had it in mind all along. It would seem that this dog, at least, was able to exert some direct ideational control over his reflexes, and was sufficiently intelligent to use suitable means to support that control when it was about to fail.

For the existence of the highest form of will in the lower animals, we have no direct evidence, and it is difficult to see how we ever can have any. In ourselves it is rare and elusive; it is known by introspection only, and can not be inferred in another by any external signs. The very fact that it is so unusual in us, and that it appears to be characteristic of the more highly evolved types of the human mind, raises a strong presumption against its existence in the lower minds.

The word "rational" has had a history very like that of "voluntary". In its simplest sense it designates conduct controlled by a more distant end; it is thus opposed to the impulsive conduct which seeks the present end. It implies, therefore, the presence of complex associative processes. "Irrational" conduct is that which is inconsistent with some accepted end.

Foresight of the future and its accompanying apprehension of various possible ends always involves competition between those ends for the control of conduct. For various reasons into which I cannot now enter, the intrinsic attractiveness of most ends tends to vary from time to time, hence it is always possible that the end which survives competition and controls conduct soon loses its power, and the actor falls a prey to regret. This is especially likely to be the case when there has been little deliberation, or when the end adopted is near at hand. Thus the word "rational" has been transferred from conduct controlled by a distant rather than by a nearer end, to conduct controlled by an approved end, that is, by an end whose attractive power remains constant under all circumstances. In ordinary parlance, that conduct is "reasonable" which most men are inclined to, but a little reflection will convince any one that no conduct is reasonable for one, save that whose adoption does not involve the relinquishment of some end of greater or more permanent attractiveness.

In the first sense of the word "irrational," it is probable that some of the lower animals are more rational than others. But, on the whole, brutes are adapted to the coming environment rather by instinct than by reason, *i. e.*, rather by a series of psychical reflexes awakened by present stimuli than by conscious foresight of the future, giving rise to an analogous series of representative ideas. The sphere of ideational control is probably restricted to the immediate future. Hence it is scarcely possible that brutes should be rational in the second sense.

Some writers use "rational" as equivalent to "ethical," *i. e.*, of ends enforced by the community upon the individual. The usage rests upon the assumption that those principles which ultimately approve themselves to the individual are essentially in harmony with those enforced by the community. But it is not customary to enquire whether animals are rational in that sense, and I may ignore it for the present.

ANTHROPOLOGY.[1]

New Evidence of glacial Man in Ohio.—In a paper before a joint meeting of the Anthropological and Geological sections of the A. A. A. S. I presented detailed evidence of the discovery, in the glacial

[1] The department is edited by Henry C. Mercer, University of Penna, Phila.

terrace on the Ohio River at Brilliant near Steubenville, Ohio, of a chert implement one inch and three-quarters long and three-quarters of an inch wide in its widest part, making the third instance in which glacial man is proved by satisfactory specific evidence to have been in Ohio. The discovery was made in the summer of 1893 by Mr. Sam Huston, the county surveyor of Jefferson County. Mr. Huston resides at Steubenville and is well known to many scientific collectors who have availed themselves of his services; while his familiarity with gravel deposits and with the indications of their being disturbed or undisturbed is unexcelled by any one in the country.

For a long time the railroad has been engaged in removing gravel from pits along the extensive glacial terrace below Brilliant Station, on the Cleveland and Pittsburg R. R., about seven miles south of Steubenville. While excavations were in progress two years ago, Mr. Huston was engaged in overseeing public work in the immediate vicinity. When operations were suspended for dinner, Mr. Huston went into the pit on one occasion, where his attention was attracted by the flat end of a chipped implement slightly projecting from the perpendicular face of the gravel which was being removed. The material at this immediate locality was well-washed sand with very few pebbles. The bedding and cross-bedding were very clearly displayed both above and below the implement, and it was perfectly evident that there had been no disturbance of the strata since their original deposition.

The situation in the face of the bank was such that Mr. Huston was barely able to reach it with his hand by standing upon the slight amount of talus that was at the bottom. The implement was about half way up to the top of the bank, making it about eight feet below the surface. Mr. Huston conducted me to the locality, so that the evidence was collected by me upon the spot. The bank was subsequently worked off about twenty feet farther and then abandoned, but according to Mr. Huston the stratification was essentially the same as is shown in fresh sections near by. The evidence is so specific that there is no chance to question it in detail, since every item was carefully noticed and has been clearly retained in Mr. Huston's memory.

The gravel terrace at this point is one of the most extensive in that portion of the Ohio River, and is part of a series of terraces traceable from Pittsburg down to Wheeling, and indeed throughout the whole length of the river as far as Louisville. There is no question among geologists as to its glacial age. It corresponds precisely, in the Ohio River valley, with those along the Delaware, in New Jersey, and the Tuscarawas and the Little Miami in Ohio, in which relics of glacial man have, heretofore, been found. These terraces along the Ohio regularly alternate from one side to the other. At Beaver, Pa., the terrace is 125 feet above the river. The height, however, diminishes gradually as we get farther away from the glacial boundary and the supply of material contributed by streams coming from the glaciated area. The terrace at Brilliant rises sixty-eight feet above the river, and extends southward for a distance of two miles, being more than a quarter of a mile wide for a considerable portion of the way. The implement was found near the lower end of this section of the terrace, and about half way between Riddle's Run and Salt Run coming in from the west. To any one who inspects the locality it will be seen to be impossible to separate the gravel strata in which this implement was found from the glacial deposit which is here so plain and so characteristic of the region.

On being carefully examined by Professor Putnam he remarked that the implement was a knife of very early type, and that under the glass it was clearly seen to be coated with the patina which indicates that it is a relic of great antiquity, and has lain for a long time in some such conditions as that described by Mr. Huston. Professor Putnam regarded it as a very important discovery.

Mr. F. H. Cushing, Vice-President of the Anthropological Section said that we have in this case an implement concerning which there can be no doubt that it was completely finished and is not a "reject." It had been carefully chipped to an edge all round; and not only so, but it had been used and sharpened; and what was still more significant it had been sharpened by the older, and not by the later processes, the edge had been chipped in sharpening not by pressing against it with a bone but by blows with another stone. Mr. Cushing also remarked with Professor Putnam upon the antiquity of the type. While continuing in use through later times on account of its convenience, it is without doubt one of the earliest types of implement and everything about it agrees perfectly with the conditions of its alleged discovery.

George Frederick Wright.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Microscopical Society held its Eighteenth Annual Meeting at Ithaca, N. Y., Aug. 21–23, 1895. The following were the proceedings: Address of welcome, by the Hon. D. F. Van Vleet; response by the President of the Society, Professor S. H. Gage.

The following papers were read and discussed during the sessions: Some Notes on Alleged Meteoric Dust, Magnus Pflaum, Pittsburg, Pa.; Corky Outgrowth of Roots and their Connection with Respiration, H. Schrenk, Cambridge, Mass.; A Practical Method of Referring Units of Length to the Wave Length of Sodium Light, Professor Wm. A. Rogers, Waterville, Me.; Some Peculiarities in the Structure of the Mouth Parts and Ovipositor of *Cicada septendecim*, Professor J. D. Hyatt, New Rochelle, N. Y.; The Lateral Line Systems of Sense Organs in Amphibia, Dr. B. F. Kingsbury, Defiance, O.; The Chlorophyll Bodies of *Chara coronata*, Professor W. W. Rowlee, Ithaca, N. Y.; Secondary Thickenings of the Rootstalks of Spathyema, Mary A. Nichols, Ithaca, N. Y.; Comparison of the Fleischel, the Gower and the Specific Gravity Method of Determining the Percentage of Hæmoglobin in Blood for Clinical Purposes, F. C. Busch and A. T. Kerr, Jr., Buffalo, N. Y.; The History of the Sex-Cells from the time of Segregation to Sexual Differentation in *Cymtogaster*, Professor C. H. Eigenmann, Bloomington, Ind.; A Fourth Study of the Blood, Showing the Relation of the Colorless Corpuscle to the Strength of the Constitution, Dr. M. L. Holbrook, New York City; Two Cases of Intercellular Spaces in Vegetable Embryos, K. M. Wiegand, Ithaca, N. Y.; The Fruits of the Order Umbelliferæ, Dr. E. J. Durand, Ithaca, N. Y.; The Action of Strong Currents of Electricity upon Nervous Tissue; Dr. P. A. Fish, Ithaca, N. Y.; The Morphology of the Brain of the Soft-Shelled Turtle and the English Sparrow Compared, Susanna P. Gage, Ithaca, N. Y.; The Flagella of Motile Bacteria, Dr. V. A. Moore, Washington, D. C.; The Primitive Source of Food Supply in the Great Lakes; Some Experiments in Methods of Plankton Measurements, Professor Henry B. Ward, Lincoln, Neb.; The Fruits of the Order Compositæ, Professor W. W. Rowlee and K. M. Wiegand, Ithaca, N. Y.; The Spermatheca and Methods of Fertilization in some American Newts and Salamanders, Dr. B. F. Kingsbury, Defiance, O.; Cocaine in the Study of Pond-life; Paraffin and Collodion Embedding, Professor H. S. Conser, Sunbury, Pa.; Formalin as a Hardening Agent for Nerve Tissue, Dr. Wm. C. Krauss, Buffalo, N. Y.; The Use of Formalin in Neurology, Dr. P. A. Fish, Ithaca, N. Y.; The Lymphatics and the Lymph Circulation, with Demonstration of Specimens and Apparatus, Dr. Grant S. Hopkins, Ithaca, N. Y.; New Points in Photo-micrographs and Cameras, W. H. Walmsley, Chicago, Ill.; The Question of Correct Naming and Use of Micro-reagents, Miss V. A. Latham, M. D., Chicago, Ill.; A New Way of Marking Objectives, Dr. Wm. C. Krauss, Buffalo, N. Y.; Demonstration of Histological Preparations by the Projection Microscope, Drs. Krauss and Mallonee, Buffalo, N. Y.; Improvements in the Collodion Method, Professor S. H. Gage, Ithaca, N. Y.; The Syracuse Solid Watch-Glass; A Metal Centering Block; A New Method of Making Cells and of Mounting in Glycerine, Dr. A. C. Mercer, Syracuse, N. Y.

The afternoon of Wednesday was devoted to an inspection of the Library and other University buildings. Illustrations of methods of marking micrometers upon a ruling engine were shown at Franklin Hall (Physical Building).

In the evening, President Gage gave his address: The Processes of Life Revealed by the Microscope—a Plea for Physiological Histology.

Thursday afternoon and evening were spent in an excursion on Cayuga Lake.

Friday afternoon was the business meeting of the Society, and in the evening there was an exhibition of microscopical objects, especially designed to give people who have not had the opportunity of making extended study with a magnifying glass, the privilege of seeing for themselves some of the interesting and instructive revelations of the microscope.

The Society appropriated $25.00 in support of Dr. Field's Bibliographical Bureau, and voted to send their proceedings regularly to it.

The forty-fourth meeting of the American Association for the Advancement of Science met in Springfield, Mass., from August 28th to September 4th inclusive. The officers of the meeting were:

President, E. W. Morley, Cleveland, Ohio; Vice-Presidents, A. Mathematics and Astronomy, Edgar Frisby, Washington, D. C.; B. Physics, W. LeConte Stevens, Troy, N. Y.; C. Chemistry, William McMutrie, Brooklyn, N. Y.; D. Mechanical Science and Engineering, William Kent, Passaic, N. J.; E. Geology and Geography, Jed. Hotchkiss, Staunton, Va.; F. Zoölogy, Leland O. Howard, Washington, D. C.; G. Botany, J. C. Arthur, Lafayette, Ind.; H. Anthropology, F. H. Cushing, Washington, D. C.; I. Economic Science and Statistics, B. E. Fernow, Washington, D. C.; Permanent Secretary, F. W. Putnam, Cambridge, Mass; General Secretary, Jas. Lewis Howe, Lexington, Va.; Secretary of the Council, Charles R. Barnes, Madison, Wis.; Secretaries of the Sections, A. Mathematics and Astronomy, Asaph Hall, Jr., Ann Arbor, Mich.; B. Physics, E. Merritt, Ithaca, N. Y.; C. Chemistry, W. P. Mason, Troy, N. Y.; D. Mechanical Science and Engineering, H. S. Jacoby, Ithaca, N. Y.; E. Geology and Geography, J. Perrin

Smith, Palo Alto, Cal.; F. Zoölogy, C. W. Hargett, Syracuse, N. Y.; G. Botany, B. T. Galloway, Washington, D. C.; H. Anthropology, Stewart Culin, Philadelphia, Pa.; I. Economic Science and Statistics, W. R. Lazenby, Columbus, Ohio; Treasurer, R. S. Woodward, New York, N. Y.

The papers which were read in Sections E, F, G and H, which include the natural sciences as usually defined, were the following:

FRIDAY, AUG., 30TH. *Section E, Geology.* The Relations of Primary and Secondary Structures in Rocks, by C. R. Van Hise; The Archæan and Cambrian Rocks of the Green Mountain Range in Southern Massachusetts, by B. K. Emerson; Gotham's Cave, or Fractured Rocks in Northern Vermont, by C. H. Hitchcock; Recent Discovery of the Occurrence of Marine Cretaceous Strata on Long Island, by Arthur Hollick; Geological Canals between the Atlantic and Pacific Oceans, by J. W. Spencer; Geological Notes on the Isles of Shoals, by H. C. Hovey; Great Falls of the Mohawk at Cohoes, N. Y., by W. H. C. Pynchon; Subdivision of the Upper Silurian in Northeast Iowa, by Andrew G. Wilson; Supplementary Notes on the Metamorphic Series of the Shasta Region of California, by J. P. Smith; Recent Elevation of New England, by J. W. Spencer.

Section F. The Evolution of the Insect Mouthpiece, by J. B. Smith (Lantern Illustrations); The Mouthpiece of Insects with Special Reference to the Diptera and Hemiptera, by C. L. Marlatt; On the Olfactory Lobes, by Charles S. Minot; Notes on Fleas, Mosquitoes and the Horse-flies, by L. O. Howard; On the Visceral Anatomy of the Lacertilia, by E. D. Cope; Characters which are useful in raising larvae of Sphingidae, by George Dimmock.

Section G. A Leaf Rot of Cabbage, by H. L. Russell; The Southern Tomato Blight, by Erwin F. Smith; Observations on the Development of Uncinula spiralis, by B. T. Galloway; The effect of sudden changes of turgor and of temperature on Growth, by Rodney H. True; Recording Apparatus for the Study of Transpiration of Plants, by Albert F. Woods; Pressure, Normal Work and Surplus Energy in Growing Plants, by George M. Holferty; Notes on the Ninth Edition of the London Catalogue of British Plants, by N. L. Britton; Obolaria virginica L. A Morphological and Anatomical Study, by Theodore Holm; Botany of Yakutat Bay, Alaska, by Frederick V. Coville.

Section H. The Dynasty of the Arrow, by Frank Hamilton Cushing; The Origin of Playing Cards, by Stewart Culin; The Origin of Money in China, by Stewart Culin; Mustach Sticks of the Ainus, by Stewart Culin; Some Arabic Survivals in the Lauguage and Folk-usage of the Rio Grande Valley, by John G. Bourke; The Sacred Pole of the Omaha Tribe, by Alice C. Fletcher; The mystery of the name Pamunkey, by William Wallace Tooker; A Vigil of the Gods, by Washington Matthews.

MONDAY, SEPT. 25TH. *Section E.* Views of the Ice Age as two epochs, the Glacial and Champlain, by Warren Upham; Glacial Phenomena between Lake Champlain and Lake George and the Hudson, by G. F. Wright; Whirpool of Niagara, by G. W. Holley; Distribution of Sharks in the Cretaceous, by C. R. Eastman; Terminology proposed for the description of Pelecypoda, by A. Hyatt; The Equatorial Counter Currents, by W. M. Davis; Address by Maj. Jed Hotchkiss, the Vice-President of Section E, at 2 o'clock.

Section F. Stemmiiulus as an Ordinal Type, by O. F. Cook; Characters which are useful in raising larvae of Sphingidae, by George Dimmock; The Affinities of the Pythonomorph Reptiles, by E. D. Cope; Temperature Variations of cattle observed during extended periods of time, with reference to the Tuberculosis Test, by Julius Nelson.

Sections F and G. Variation after Birth, by L. H. Bailey; Rejuvenation and Heredity, by Charles S. Minot; The Distinction between Animals and Plants, by J. C. Arthur; Fungous Gardens in the nests of an Ant (Atta tardigrada Buckl.) near Washington, by Walter T. Swingle; Poisoning by Broad-leaved Laurel, Kalmia latifolla, by Frederick V. Colville; The Physiology of Isopyum biternatrum L., by D. T. McDougal; The Transmission of Stimuli-effects in Mimosa pudica L., by D. T. McDougal; Personal Nomenclature in the Myxomycetes, by O. F. Cook; A New Californian Liverwort, by Douglas H. Campbell; The number of spare Mother Cells in the Sporangia of Ferns, by Willis L. Jepson; The Constancy of the Bacterial Flora of Sour Milk, by H. L. Bolley; The Watermelon Wilt and other Wilt Diseases due to Fusarium, by Erwin F. Smith.

Section H. The year of Pleiides of Prehistoric Starlore, by R. G. Haliburton; An Iroquois Condolence, by W. M. Beauchamp; Mental Measurement in Anthropology, by J. McKeen Cattell; Some Symbolic Carvings from the Ancient Mounds of Ohio, by F. W. Putnam and C. C. Willoughby; Account of the Discovery of a chipped chert implement in undisturbed Glacial Gravel near Steubenville, O., by F. G. Wright; Notes on the Bushmen of Transvaal, by George Leith; presented by F. W. Putnam; Village Life among the Cliff Dwellers, by Stephen D. Peet; An Ojibwa Transformation Tale, by Harlan I. Smith; Old Mohawk Words, by W. H. Beauchamp; The Different

Races described by early Discoverers and Explorers, by Stephen D. Peet; Root Fungus of Maize, by George Macloskie; Enantiomorphism in Plants, by George Macloskie.

TUESDAY, SEPT. 3RD. *Section E.* Interesting Features in the Surface Geology of the Genesee Region, illustrated with lantern slides, by H. L. Fairchild; Japan, Gardner G. Hubbard; Great Falls of the Mohawk at Cohoes, N. Y.; illustrated with lantern slides, by W. H. C. Pynchon. In the afternoon the Section met with Section H.

Section F. On the Girdling of Elm Twigs by the Larvæ of *Orgygia leucostigma*, and its Results, by J. A. Lintner; Notes upon the Eupaguridæ, by Charles W. Hargitt; On a Revision of the North American Craspedosomatidæ, by O. F. Cook; A New Character in the Colobognatha, with Drawings of Siphonotus, by O. F. Cook; A New Wheel for Color Mixing in Tests for Color Vision, by J. H. Pillsbury; Some Further Results of Investigation of Areas of Color Vision in the Human Retina, by J. H. Pillsbury; A Study of Panorpa and Bittacus, by E. P. Felt.

WEDNESDAY, SEPT. 4TH. *Section H.* A Study in Anthropo-geography as a Branch of Sociological Investigation, by William Z. Ripley; The Algonquian Appellatives of the Siouan Tribes of Virginia, by W. M. Wallace Tooker; Indian Songs and Music, by Alice C. Fletcher; The Spider Goddess and the Demon Snare, by F. H. Cushing; The Influence of Prehistoric Pigmy Races on Early Calendars and Cults, with Notes on Dwarf Survivals by R. G. Haliburton; Account of the Discovery of a Chipped Chert Implement in Undisturbed Glacial Gravel near Steubenville, Ohio, by G. F. Wright; Palæothic Culture, its Characteristic Variations and Tokens, by Stephen D. Peet; A Melange of Micmac Notes, by Stansbury Hager; Grammatic Form and the Verb Concept in Iroquoian Speech, by J. W. B. Hewitt; Anthropometrical, Psychoneural and Hypnotic Measurements, by Arthur Mac Donald; The Education of Blind-deaf Mutes, by John Dutton Wright; A Study in Child Life, by L. O. Talbot; The Indians of Southern California, by Franz Boas; The Cosmogonic Gods of the Iroquois, by J. W. B. Hewitt; Word Formation in the Kootenay Language, by Alex. F. Chamberlain; Kootenay Indian Personal Names, by Alex. F. Chamberlain.

The following officers were elected for the coming year:

President—Edward D. Cope, of Philadelphia; *Vice-Presidents*—A—Mathematics and Astronomy, William E. Story, of Worcester; B—Physics, Carl Leo Mees, of Terre Haute, Ind.; C—Chemistry, W. A. Noyes, of Terre Haute, Ind.; D—Mechanical Science and Engineering, Frank O. Marvin, of Lawrence, Kansas; E—Geology and Geography, Benjamin K. Emerson, of Amherst; F—Zoology, Theodore N. Gill, of Washington, D. C.; G—Botany, N. L. Britton, of New York City; H—Anthropology, Alice C. Fletcher, of Washington, D. C.; I—Social Science, William R. Lazenby, of Columbus, Ohio; *General Secretary*—Charles R. Barnes, of Madison, Wis.; *Secretary of the Council*—Asaph Hall, Jr., of Ann Arbor, Mich.; *Secretaries of the Sections*—A—Mathematics and Astronomy, Edwin B. Frost, of Hanover, N. H.; B—Physics, Frank P. Whitman, of Cleveland, Ohio; C—Chemistry, Frank P. Venable, of Chapel Hill, N. C.; D—Mechanical Science and Engineering, John Galbraith, of Toronto, Can.; E—Geology and Geography, A. C. Gill, of Ithaca, N. Y.; F—Zoology, D. S. Kellicott, of Columbus, Ohio; G—Botany, George F. Atkinson, of Ithaca, N. Y.; H—Anthropology, John G. Bourke, United States Army; I—Social Science, R. T. Colburn, of Elizabeth, N. J.; *Treasurer*—R. S. Woodward, of New York, N. Y.

The Annual Report of Secretary Putnam showed that 367 members have been in attendance, all parts of the country being well represented. From Springfied there were 15 and from the rest of Massachusetts 56. The other leading States were as follows: New York 90, District of Columbia 39, Pennsylvania 29, Ohio 18, Connecticut 14, Indiana 12. There were 185 new members elected and 58 made fellows. Four have died during the year. There have been three public lectures and 207 papers, divided as follows among the sections: A 16, B 34, C 42 D 6, E 17, F 16, G 28, H 33, I 13.

SCIENTIFIC NEWS.

Dr. Charles Valentine Riley curator of the department of Entomology in the U. S. National Museum died Sept. 15th in consequence of being thrown from a bicycle on the previous day.

The eminent scientist was born in London in 1843 and he attended schools in France and Germany. For six years he studied on the Continent of Europe. Two passions characterized his boyhood—one for collecting insects, the other for drawing and painting.

At the age of 17 he sailed for New York, where, after a seven weeks' voyage, he arrived with little means. He went West and settled upon a farm in Illinois. Here he remained for four years, and acquired an experience of practical agriculture. About the time of his majority he commenced journalistic work in Chicago, where, in connection with his work on the paper, he gave special attention to botany and entomology. In 1868 he accepted the office of State entomologist of Missouri. In the Spring of 1878 he was tendered the position of entomologist to the

Department of Agriculture, which he accepted, but shortly afterward relinquished, retaining, however, his position at the head of the Entomological Commission, and continuing his work in the service of the Government. In 1881 the Division of Entomology in the Department of Agriculture was formed, and Professor Riley was placed at its head —a position which he continued to occupy until last year, when, on account of impaired health, he tendered his resignation.

Professor Riley has given to the National Museum at Washington his private collection of American insects, containing more than 20,000 species, and represented by 115,000 pinned specimens, and much additional material unpinned and in alcohol. In 1889 he received the insignia of Knight of the Legion of Honor. At this time the French Minister of Agriculture wrote him a personal letter acknowledging the distinguished and valuable services which he had rendered to French agriculture.

Dr. Riley was a man of great energy as well as persistence of character. In his personality he was of full medium height and of graceful figure; and his face would have adorned a gallery devoted to poets or the heroes of sentimental fiction. He was of attractive manners, and an amiable disputant. He had retired from the responsibilities of official position to devote himself to study, of which he apparently had many years before him. His sudden death is a blow to science, and a great loss to his friends.

Dr. Samuel Henshaw of the Boston Society of Natural History has been spending a few months in Europe.

Prof. F. L. Washburn of the zoological department of the Oregon Agricultural College has accepted a position in the Oregon State University.

Professor F. Wm. Rane has resigned from the chair of agriculture and horticulture at the University of West Virginia to accept a similar position in the New Hampshire College of Agriculture and Mechanic Arts.

Prof. G. E. Morrow has accepted the presidency of the Oklahoma Agricultural and Mechanical College at Stillwater.

Prof. Edwin W. Doran has accepted the presidency of Ozark College at Greenfield, Missouri.

Prof. H. J. Waters of Pennsylvania State College has been elected Director of Missouri Experiment Station. Prof. F. B. Mumford of Michigan has been appointed Professor of Agriculture in the Missouri State University.

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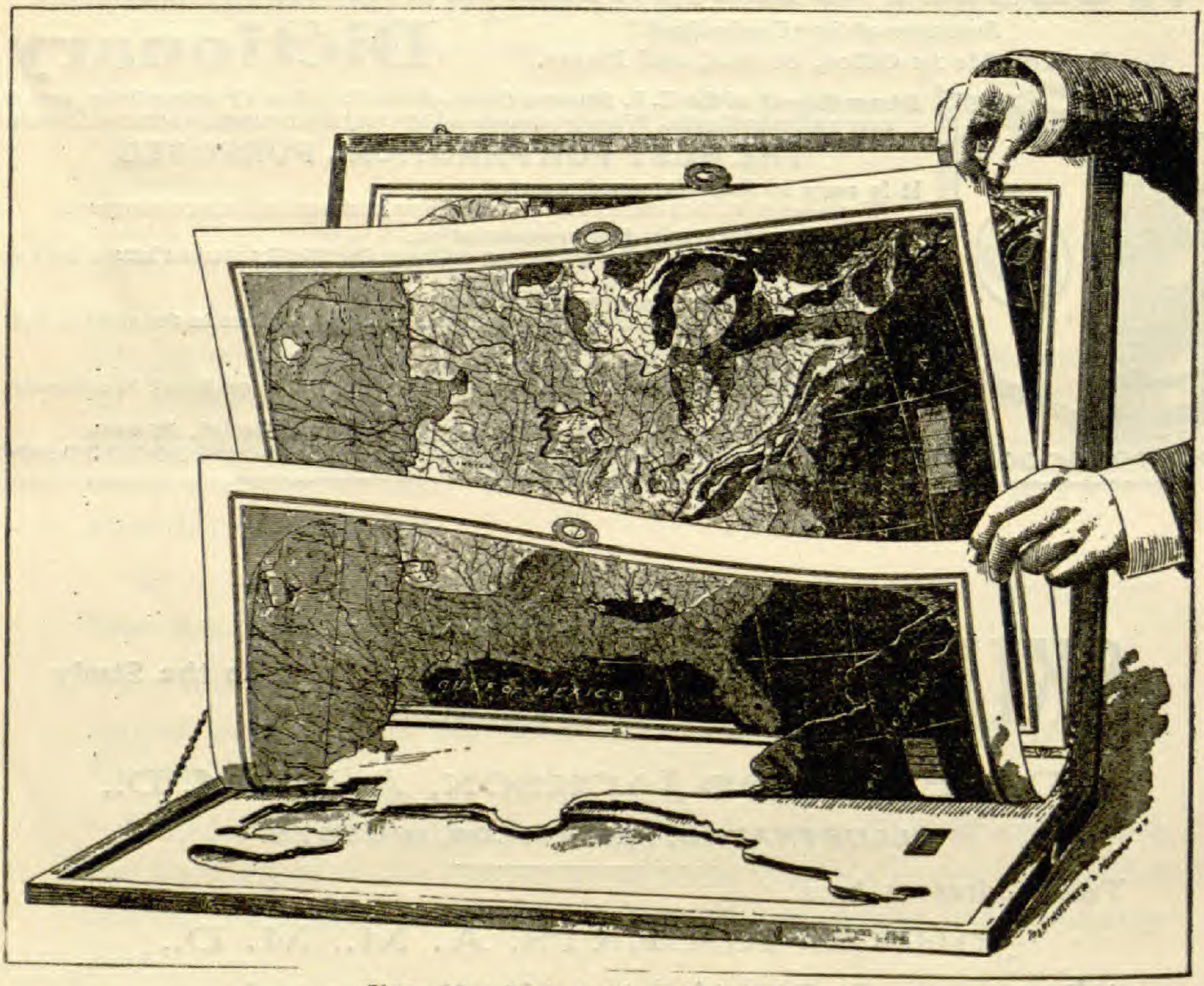

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Professor E. D. Cope, of the University of Pennsylvania, writes: "Useful to the student of topography and geology. The map indicating elevations in relief is an important aid to the stratigraphic map—both together elucidate the structure to the eye of the student."

President D. C. Gilman, of Johns Hopkins University, writes in reference to the Strata Map: "Wherever American geology is taught your map should be part of the apparatus."

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Walker Prizes in Natural History.

By the provisions of the will of the late Dr. William Johnson Walker two prizes are annually offered by the BOSTON SOCIETY ON NATURAL HISTORY for the best memoirs written in the English language on subjects proposed by a committee appointed by the Council.

For the best memoir presented a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the committee.

For the next best memoir, a prize not exceeding fifty dollars may be awarded.

Prizes will not be awarded unless the memoirs presented are of adequate merit.

The competition for these prizes is not restricted, but is open to all.

1. In all cases the memoirs are to be based on a considerable body of original and unpublished work, accompanied by a general review of the literature of the subject.

2. Anything in the memoir which shall furnish proof of the identity of the author shall be considered as debarring the essay from competition.

3. Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before April 1st of the year for which the prize is offered.

SUBJECTS FOR 1896:—

(1) A study of an area of schistose or foliated rocks in the eastern United States.

(2) A study of the development of river valleys in some considerable area of folded or faulted Appalachian structure in Pennsylvania, Virginia, or Tennessee.

(3) An experimental study of the effects of close-fertilization in the case of some plant of short cycle.

(4) Contributions to our knowledge of the general morphology or the general physiology of any animal, except man.

SUBJECTS FOR 1897:—

(1) A study of glacial, fluviatile, or lacustrine phenomena associated with the closing stages of the glacial period.

(2) Original investigations in regard to the chalazal impregnation of any North American species of Angiosperms.

(3) An experimental investigation in cytology.

(4) A contribution to our knowledge of the morphology of the Bacteria.

SAMUEL HENSHAW,

Secretary.

Boston Society of Natural History,
Boston, Mass., U. S. A.

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THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

Vol. XXIX. NOVEMBER, 1895. No. 347

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PHILADELPHIA, U. S. A.
THE EDWARDS & DOCKER CO.,
518 AND 520 MINOR STREET.

Entered at the Philadelphia Post Office as second-class matter.

THE

AMERICAN NATURALIST

Vol. XXIX. November, 1895. 347

THE DISTINCTION BETWEEN ANIMALS AND PLANTS.

By J. C. Arthur.[1]

The animal kingdom and the vegetable kingdom were not sharply distinguished in the days when science was young, some two or three centuries ago, when even learned men believed in the Scythian lamb,[2] that grew on the top of a small tree-trunk in place of foliage, and in the wonderful tree of the British Isles,[3] whose fruit turned to birds when it fell on the ground, and to fishes when it fell into water; and the two kingdoms are not sharply distinguished to-day, when learned men do not agree upon the systematic position of the Myxogastres and other low forms, some going so far as to assert that many of the simple organisms are on neutral ground, belonging no more to one than to the other kingdom. Dr. Asa Gray[4] once said that "no absolute distinction whatever is now known between them. It is quite possible that the same organism

[1] Read before joint session of Sections F and G of the A. A. A. S., Springfield meeting, Sept. 2, 1895.

[2] Duret, Histoire admirable des plantes, 1605; Jonston, Dendrographias sive historiæ naturalis de arboribus, 1662; LaCroix, Connubia florum, ed. 2, 1791.

[3] Duret, l. c.; Gerarde, Herball, 1597.

[4] Atlantic Monthly, 1860; Darwiniana, p. 124.

may be both vegetable and animal, or may be first the one and then the other."

So numerous have been the vain attempts to find some character of universal diagnostic value that it seems rash indeed to make another trial. But, in case of failure, no harm will be done, even if no advance has been made.

In all attempts, so far as they have come to my notice, the characters selected to distinguish the two kingdoms have been physiological, and not structural. Yet, in the classification of plants among themselves, or of animals among themselves, the characters of acknowledged value are drawn from structure, and physiological distinctions are only considered when the organisms are very minute or simple, like the bacteria and yeasts, or for some other exceptional reason. It seems, therefore, highly illogical to accept a purely physiological character as fundamental for separating the two kingdoms.

On this ground we would discard Linnæus' classification:[5] Lapides crescunt, vegetabilia crescunt et vivunt, animalia crescunt, vivunt et sentient; and that of Hæckel[6] who accords the chlorophyll function to plants and not to animals; and that of Sedgwick and Wilson[7] who find the sole characteristic of animals to be dependence upon proteid food; and also that of Dangeard[8] and Minot,[9] who distinguish the two kingdoms by the manner in which the food, or food material, is taken into the organism. There are also characters, for which I need cite no authority, that were advocated at different times in the past, which have since been discarded for lack of universality, such as a carbon dioxide respiration in plants and an oxygen respiration in animals, that plants exclusively convert inorganic matter into organic matter, that plants alone produce chlorophyll, or cellulose, or starch, etc.

[5] Philosophia botanica, ed. 4, 1809, p. 1.

[6] Systematische Phyl genie der Protisten und Pflanzen, 1894; abs. in Science, i, 1895, p. 272.

[7] Biology, 1886, p. 167.

[8] Ann. des sci. nat., 7th ser., Bot. T. V.; Comp. rend., 1887; Le Botaniste, 1895, p. 188.

[9] Science, i, 1895, p. 311.

In attempting to distinguish animals and plants by means of definite characters, there is another point that needs attention. Primary characters are to be drawn from the mature condition of the organism, and not from the reproductive or the immature state. This is such an obvious proposition in the ordinary classification of animals or plants, that it seems strange that in diagnosing the two kingdoms it should have been entirely overlooked. There are remarkable similarities in methods of reproduction among plants and animals, not only in the processes, but in the external means for protection and in the methods of dissemination of the reproductive bodies. Especially is this true of non-sexual reproduction among the lower orders. The reproductive structures are sometimes very elaborate, and the organism in that state often attracts more attention than in the vegetative condition, as in the case of the Myxogastres. It is obvious that the individual is the object that we are studying and classifying, and therefore the most fundamental of characters should apply to the individual—the vegetative organism, and not to the mode by which a succession of individuals is maintained.

The following definition of plants and animals is suggested as meeting the requirements of the conditions of classification mentioned above:

PLANTS are organisms possessing (in their vegetative state) a cellulose investment.

ANIMALS are organisms possessing (in their vegetative state) a proteid investment, either potential or actual.

The organism may be a cellular body with the investment extending to each protoplasmic unit, as is usual in plants, or it may be a cœnocytic body with the investment extending only to the compound units, as in most animals and in some plants (*e. g., Mucorinæ, Siphonaceæ*). As a rule, the investment is most prominently developed upon the general outer surface of the organism.

By designating the constitution of the walls, it is intended to cover only the original or basic substance of which they are composed, and has no reference to subsequent depositions or infiltrations, of whatever character they may be. Thus in the walls of grasses and Equiseti there is often a great amount of silica, in certain seaweeds (*Corallina*) much lime, in tunicates so much cellulose that it sometimes amounts to one-fourth of the dry weight,[10] and yet, in the case of the plants named, the original and fundamental substance of the wall is cellulose, and in the animals proteid. A small amount of nitrogen has recently been found by Winterstein[11] associated with the cellulose of fungi, but in what form has not yet been determined. Other instances of a similar nature might be cited.

It may be well to say that by cellulose is meant both primary and compound celluloses and their various modifications, all of which are carbohydrates, and by proteid is meant the nitrogenous, non-protoplasmic substance of walls, no formula for which is known, but which Cross and Bevan[12] suggest "may prove to be of similar carbon configuration to that of cellulose."

There are some organisms which, in their vegetative state, consist of so-called naked protoplasm, of which the most conspicuous and well-known examples are the Myxogastres. Many species of these fungus-animals (Pilzthiere), however, are known to possess a distinct proteid envelop about the plasmodium[13] which, by its chemical reaction, is shown to be non-protoplasmic, and it may be inferred that careful examination will find it present in most of the species, and that it can be considered as potential or undeveloped in the others. They are, therefore, distinctly animal in their fundamental characteristic. Although usually treated in botanical text-books and studied by botanists, they were long since shown by DeBary[14] to have more points of agreement with animals than with plants, and he believed them to be "outside the limits of the vegetable kingdom." This separation by DeBary was made

[10] Schmidt, Zur vergleichenden Physiologie der wirbellosen Thiere. Ann. d. Chem., liv, 1845, p. 318; Schacht, Müller's Archiv, 1851, p. 185; Schäfer, Ueber Thiercellulose, Ann. d. Chem., clx, 1871, p. 312.

[11] Ber. d. d. chem. Ges., xxviii, (1895) p. 167.

[12] Cellulose, 1895, p. 88.

[13] DeBary, Morphology and biology of the fungi, mycetozoa and bacteria, p. 426.

[14] Die Mycetozoen, ed. 2, Leipzig, 1864; l. c., p. 444.

without any reference to a proteid membrane, which may, however, be considered the crucial diagnostic character.

Another set of organisms, with apparently naked protoplasm during the vegetative stage, are the endophytic parasites belonging to the group of genera represented by Synchytrium, Woronina, Olpidiopsis, Rozella and Reesia. Whether they ever possess any demonstrable proteid envelop has not been ascertained, but it is known that they have no cellulose envelop; they are, therefore, not plants, and must, in consequence, be animals. This disposition of them has already been made by Zopf[15] on the ground that a "plasmodial character of the vegetative condition is entirely foreign to the Eumycetes." The Chytridiaceæ, which are usually associated with the Synchytria, have a much reduced but demonstrable mycelium formed of cellulose, and are, therefore, unmistakable plants.

Among the lowest forms, as generally classified, the Rhizopods, including Amoeba, and the far simpler Monera, show no distinct proteid envelop, but neither do they show any indication of a cellulose envelop, and as the other affinities appear to be with animals rather than with plants, they are doubtless rightly placed in the animal kingdom. It is reasonable to expect that more careful examination will, in some cases, show a simple or imperfectly formed proteid envelop.

It may be well to specifically state for sake of clearness that the nature of the investment of spores or sporophores has no significance in this connection. They are to be regarded as adaptations without primary classificatory value.

The crucial diagnostic character, which is here proposed, has in its favor the separation of plants and animals upon a line which accords well with the consensus of opinion of thoughtful students, both botanists and zoologists, an opinion which has been formed from a variety of structural, physiological and developmental data. True relationship must necessarily be adduced from a study of the full life-history of organisms, diagnostic characters only forming points of departure.

[15] Die Pilze, 1890, p. 2.

NOTES ON THE REPRODUCTION OF PLUMULARIAN HYDROIDS.

BY C. C. NUTTING.

During the past spring and summer, while studying the *Plumulariidæ* at Plymouth, England and Naples, Italy, the writer came across certain facts which are deemed to be of such general biological importance as to render an immediate announcement desirable, without waiting for the completion of a work in which a more formal discussion of these facts and their significance will appear.

Asexual reproduction of Plumularia pinnata Linn.

This species is the most abundant plumularian at Plymouth affording ample material for satisfactory study. The first specimens with young gonangia were brought to the laboratory on May 2nd. Ten days before this I noticed that several fresh specimens were peculiar in having a number of the hydrocladia greatly produced into thread-like extensions ending in a clavate enlargement. Neither hydranths nor nematophores grew upon these processes, although the usual number were found in their normal position on the unmodified portions of the hydrocladia.

These specimens were kept alive in a separate jar, and three days later it was found that the curiously lengthened hydrocladia had continued their abnormal growth, and that some of the enlarged ends had become forked. A microscopic examination showed that the hydrocladial extensions were almost or entirely destitute of nodes, the whole structure being a simple tube, with perisarc, ectoderm and endoderm enclosing the axial cavity in which the life currents were moving in unusual activity. The most notable histological feature was the surprising number of nematocysts embedded in the cœnosarc. The colony seemed in good condition, the hydranths being fully expanded and active.

Under date of April 27th, four days later, I find the following note:

"To-day I noticed some delicate, thread-like lines adhering to the inside of a jar containing living colonies of *P. pinnata*. Upon moving a piece of stone, I found that these lines were the long, thread-like processes or continuations of hydrocladia noticed several days ago. Upon close investigation hydranths were seen fully expanded arising from these processes attached to the glass, and one small colony with the primate branching of *Plumularia* had advanced so far as to show seven hydranths on branches. The original process from the hydrocladium of the parent colony has become a creeping stolon attached to the glass. It is sending up the new colony on the one hand, and giving forth delicate rootlets on the other. A single hydranth growing on the stolon a little to the right of the incipient colony already described, seems to indicate the starting of a second colony. Several other stolons (derived in the same way from greatly elongated hydrocladia) are giving off little colonies. There have been no other plumularians in this jar, and the original colonies were without gonangia."

These new colonies were kept alive for a week longer, by which time their connection with the parent stocks had been destroyed by atrophy of the hydrocladial extensions from which the new colonies arose, and the daughter colonies had attained considerable size and all the characteristic features of *P. pinnata*.

In another jar a colony showing the hydrocladial extensions was purposely placed so that they could reach neither the side of the jar nor any other point of support. This did not interfere with the asexual reproduction, however, as the processes became forked at their distal ends, and from these forks arose incipient colonies. After a week had elapsed the parent colony died and the main stem became withered and dropped to the bottom of the jar, carrying with it the daughter colonies which were then able to attach themselves and proceed with their development as would any other colony.

After a careful search through the literature of the subject, I am unable to find any account of this mode of reproduction either among hydroids or any other of the metazoa, and I propose for it the name *Stoloniferous reproduction* on account of the great similarity which it bears to that process among plants.[1]

Asexual multiplication has long been known to exist among the hydroids, where it usually presents itself in some form of gemmation. Fission has been found to occur in a medusa, *Stomobrachium mirabile* Köll., but the most remarkable case heretofore recorded is described by Allman in a campanularian named by him *Schizocladium ramosum.*[2] The process is, in brief, as follows:

An ordinary ramulus, instead of bearing a hydranth on its distal end, elongates and the cœnosarc ruptures the chitinous investment at the tip and protrudes naked into the water. A constriction takes place by which this naked cœnosarc is divided off and finally separated from the parent stem. "The detached segment is now the $\frac{1}{100}$ of an inch in length, and strikingly resembles a planula in all points except in the total absence of vibratile cilia. It attaches itself by a mucous excretion from its surface to the walls of the vessel, and exhibits slight and very sluggish changes of form. After a time a bud springs from its side, and it is from this bud alone that the first hydranth of the new colony is developed."

Although this process resembles the stoloniferous multiplication of *Plumularia pinnata* in the formation of a new colony from a modified branch termination, it differs greatly in the fact that in *Schizocladium* the divided portion or "frustule," as Allman calls it, becomes entirely separated from the parent stock before the new colony begins to develop, while in *P. pinnata* there is a vital connection by means of the greatly elongated hydrocladium.

The stoloniferous multiplication must not be confounded with any of the many modes of branching heretofore found among the hydroids, which do not give rise to separate colo-

[1] "Stolons are trailing or reclining branches above ground which strike root where they touch the soil, and then send up a vigorous shoot which has roots of its own, and becomes an independent plant when the connecting part dies, as it does after awhile." Gray, School and Handbook of Botany, p. 37.

[2] Report Brit. Association, 1870, and "Gymnoblastic Hydroids," p. 151, 152.

PLATE XXXII.

Plumularia pinnata L.

nies having independent hydrorhizæ; neither is it equivalent to the multiplication often effected by mutilation. There is no mutilation in this case, unless we may so regard the spontaneous atrophy of the connection between the old and new colonies.

That this stoloniferous multiplication is normal is indicated by the fact that specimens fresh from the sea exhibited the greatly elongated and forked hydrocladia.

It may be well to note that *P. pinnata* seems to have reproductive powers greater than those of any other Plumularian known to me. At the proper season that part of the stem from which the hydrocladia spring is fairly packed with gonangia which may even be crowded out onto the hydrocladia. In some instances it seemed as if the reproductive potentiality demanded some other outlet, and long processes, exactly like the hydrocladial processes described above, were seen springing from the interior of the gonangia themselves.

The possibility of conjugation among the Plumularidae.

During the months of June, July and August a small species of *Aglaophenia* was brought almost daily to the Naples Zoological Station. It grows on a long ribbon-like alga in shallow water and bears a general resemblance to *A. pluma* Linn., from which it differs in exhibiting a frequent intercalation of intervening internodes on the distal half of the stem, in the more distant hydrocladia, and in having, as a rule, not more than three hydrothecæ to each internode.

In June it was noticed that a large proportion of the colonies had the end of the main stem greatly elongated and enlarged, the proximal part of this extension being divided into a great number of short internodes, while the distal portion was abruptly bent over so as to form a nearly closed hook. In many cases the ends of two colonies would be hooked together, clasping each other so tightly that they could not be separated without mutilating the specimens. This state of affairs was so common at this time that one could not regard the attachment as accidental or abnormal, and further developments were awaited with great interest.

In July this attachment was seldom seen, although the enlarged stem terminations were still common. These latter appeared to be shedding their perisarc, which was often seen to be partly peeled off.

About the middle of August I observed that these enlarged ends were *forking* just as did the produced hydrocladia of *P. pinnata.* Still later, immediately before my departure from Naples, I found some of these enlarged ends attached to the sides of the jar and budding, although the buds had not yet developed into hydranths. There is practically no doubt that we have here a case of stoloniferous reproduction in the genus *Aglaophenia.*

Although I was unable to demonstrate the use of the clasping hooks at the ends of the stems, it was impossible to escape the constantly recurring suggestion that they might possibly signify a mode of *conjugation* such as is found among the Protozoa (e. g., *Paramecium*) and the Algæ (e. g., *Spirogyra*).

That these hooked ends are for some definite purpose can be confidently assumed, and there are but two explanations which appear plausible.

1st. These terminal hooks may aid directly in the stoloniferous reproduction by attaching themselves to some adjacent object upon which the new colonies can grow.

2nd. They may be clasping organs for use in conjugation. As a matter of fact they may serve both purposes. My observations strongly indicate that they are useful as a means of attachment, and the following considerations indicate a strong possibility that conjugation may take place.

1st. They were seen so often in a position favoring conjugation, i. e., with the ends of two colonies clasped in a close embrace as to indicate a normal function.

2nd. It was after this supposed conjugation that the stoloniferous multiplication was observed to be under way.

3rd. These enlarged ends of the stems were found to contain a number of amæboid cells which were unusually active, sending out pronounced pseudopodia. I could not decide definitely whether these cells were in the ectoderm or endoderm, on account of the unfavorable position of the living colony under inspection.

Stained sections of these hooks failed to throw much additional light on the subject, the only noticeable histological feature being an appearance of great activity in cell multiplication, and the presence of an unusual number of nematocysts. These sections were of value, however, in demonstrating that the enlargement of the stem termination was *not* due to the presence of a parasite, as is sometimes the case among hydroids, e. g., *Syncoryne eximia* and *Coryne mirabilis.*

The clasping of the hooks is probably effected mechanically by the undulations of the ripples passing along the alga which supports the hydroid colonies.

Conjugation is essentially the union of two individuals of a species during which an interchange of protoplasm is effected without the intervention of ova or spermatozoa. So far as I have been able to discover this process has not heretofore been found among the metazoa,[3] and the observations recorded above must be regarded as merely an indication of the possibility of conjugation among hydroids.

It is now a well established fact that the sex cells, both male and female, of the Plumulariidæ originate in the endoderm of the stem; and any process which would enable the contents of the endodermal cells of one stem to mix with the contents of the endodermal cells of the stem of another colony would render conjugation possible so far as the purely mechanical part of the question is concerned. This would be effected in the case under consideration by the solution of the contiguous walls of the hooks when clasped as already described. While this solution was not actually seen in any of the specimens described by me, it was found that the perisarc was usually thinner in the region of contact than elsewhere.

It must be remembered, moreover, that in the normal reproduction of most hydroids a solution of the perisarc of the stem is effected, probably by chemical action, whenever a gonangium is formed,[4] and therefore no new principle would have to

[3] The permanent union of individuals which results in *Diplozoon* cannot be termed conjugation in the sense here used, because in the Diplozoon the intervention of ova and spermatozoa occurs.

[4] "Die Entstehung der Sexualzellen bei den Hydromedusen." Dr. August Weismann, p. 182.

be invoked to accomplish this end in the case under discussion.

In passing from below upward in the stem of a plumularian examined just before the appearance of the gonangia, we find that the sex cells intergrade perfectly with the ordinary endodermal cells, many of which are themselves destined to become sex cells. The endodermal cells, then, in the distal part of the stem, contain that which will ultimately become ova or spermatozoa, or they contain what might be called the undifferentiated sex elements. A given colony of Aglaophenia is always unisexual. That is, all the gonangia contain sex cells of one kind, and both ova and spermatozoa are never found in one colony.

Now it is evident that the hooking together of a male and a female colony by the upper parts of their stems, accompanied by a dissolving of those portions of the perisarc which are in contact, would leave only the thin ectoderm between the endodermal cells of the two colonies, and a communication between the undifferentiated sex cells would be an easy matter; for Weismann found that the undifferentiated sex cells exhibited pronounced amœboid movements[5] and such movements would, of course, greatly facilitate conjugation. The amœboid cells observed by me in the clasping hooks may be of significance in this connection. Not only did these cells exhibit activity in sending forth pseudopodia, but they also moved bodily from place to place among the surrounding cells.

State University of Iowa, Sept. 26, 1895.

Explanation of Plate.

1. Colony of *Plumularia pinnata* Linn. showing (a) hydrocladial extensions; (b) forking of ends of hydrocladia; (c) new colony still attached to parent stock; (d) new colony separated from parent stock.
2. New colony, magnified, showing polyps and rootlets.
3. Portion of hydrocladium showing terminal extension.
4. Tip of hydrocladial extension showing (a) the budding of a new colony.

[5] This fact was repeatedly observed by the present writer.

5. Colonies of *Aglaophenia* sp. showing (a) terminal extension of stem; (b) terminal hook; (c) clasping of hooks; (d) budding of hooks; (e) new colony attached to side of jar and to parent stock.
6. Clasping hooks, magnified.

ANTIDROMY IN PLANTS.

BY G. MACLOSKIE.

In November, 1893, I published observations on Maize, from which it appeared that there are two castes of this plant, the leaves of one reversing the arrangement of those of the other. I also traced this diversity to the arrangement of the minute leaves in the young embryo in the seed; thus in figures 1, 2, the first foliage-leaf has its right margin overlapping its left margin. In other seeds from the same ear the first leaf would have its left margin external. I further found that the grains arising on adjoining rows in the ear of corn are of different castes, and produce "antidromic" plants (that is, growing up in opposing curves), and that the same property belongs to all the Gramineæ.

Fig. 1.
Grain of Maize; cross section.

Fig. 2.
Young leaves of Plumule of Maize.

During the past summer I have extended this law so as to embrace the flowering plants. Every species is represented by two sets, differing antidromically as to the structure of the mother-seed, the stem, leaves and inflorescence. My attention was first attracted to this in the Ladies' Tresses (*Spiranthes præcox* Watson), which had, in some plants, dextral, in others sinistral, rows of white flowers; and on examination the dextral and sinistral anthotaxy were found to be accompanied respectively by dextral and sinistral phyllotaxy. Fig. 3, representing *Spiranthes aestivalis* Rich., shows, in a less crowded manner the sinistral anthotaxy[1] This specimen would doubtless have sinistrorse phyllotaxy, and there should be other specimens with dextrorse tresses and leaf spirals. Thus it appears that the much-belabored phyllotaxy of the old botanists is a special case of a larger subject. The homodromy of phyllotaxy and anthotaxy within a single individual may be observed in *Ænothera biennis*, *Verbascum thapsus*, *Laportea* and *Pontederia ;* and even in *Gladiolus* and *Iris* we may trace a correspondence between the order of equitant leaves and the inflorescence. Whilst the produce of propagation by cuttings, buds, and bulbs is always homodromic with the parent stalk, some forms, like Calla-lily, Iris and Rush, when growing from division of a root-stalk, appear to be antidromic as if produced from different seeds. Fig. 4 shows the spathes of two Calla-lilies, from the same root-stalk, *d* having the dextral margin overlapping, and *s* having the sinistral overlapping. We may add that the akenes on the spadix of *d* make a dextrorse spiral, and those on that of *s* make a sinistrose spiral.

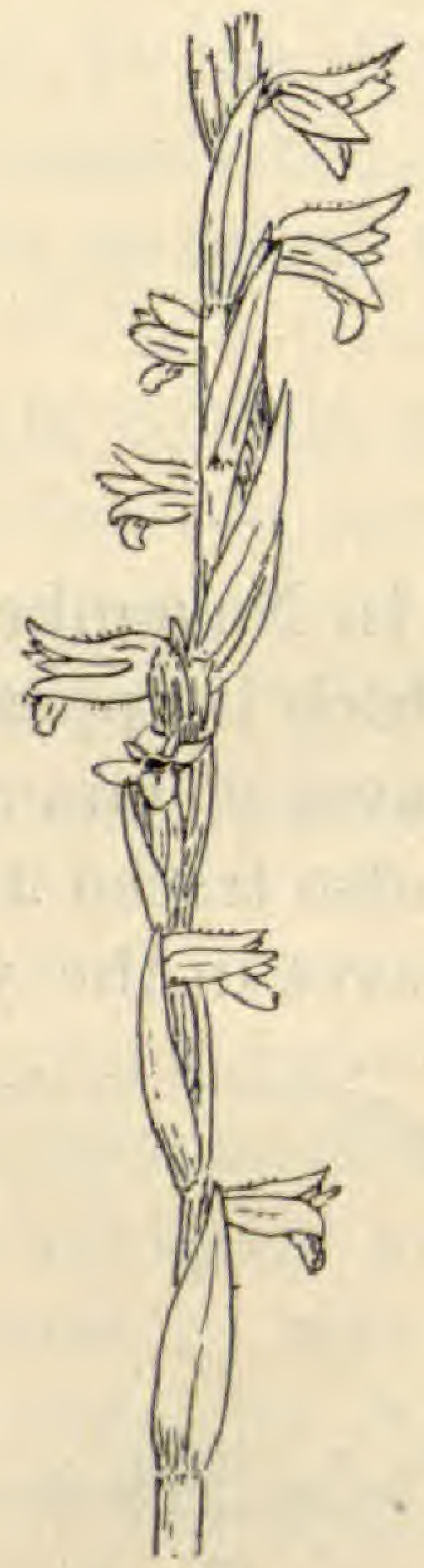

Fig. 3.
Spiranthes aestivalis Rich., after Engler and Prantl.

In this connection it is interesting to observe that (so far as I am able to determine from leaves of *Bryophyllum* supplied me by Amherst Agricultural Station) the buds growing on opposite margins of the leaves are relatively antidromic.

Secondary changes, due to twining of stems, spreading out of leaves under the light, opposition of leaves, and crowding of flowers, and perfect symmetry of seeds, often disguise the primitive character, especially in the Dicotyledones. But, even in these cases, we commonly find some trace remaining. In the great majority of plants, in fruit trees, garden flowers and weeds, the phyllotaxy immediately divides the representatives

[1] Dextral and sinistral in this connection signify in the direction, or against the direction, of the thread of a common screw.

of every species into a right-handed and a left-handed caste; and even when sunlight interferes, we often get help from

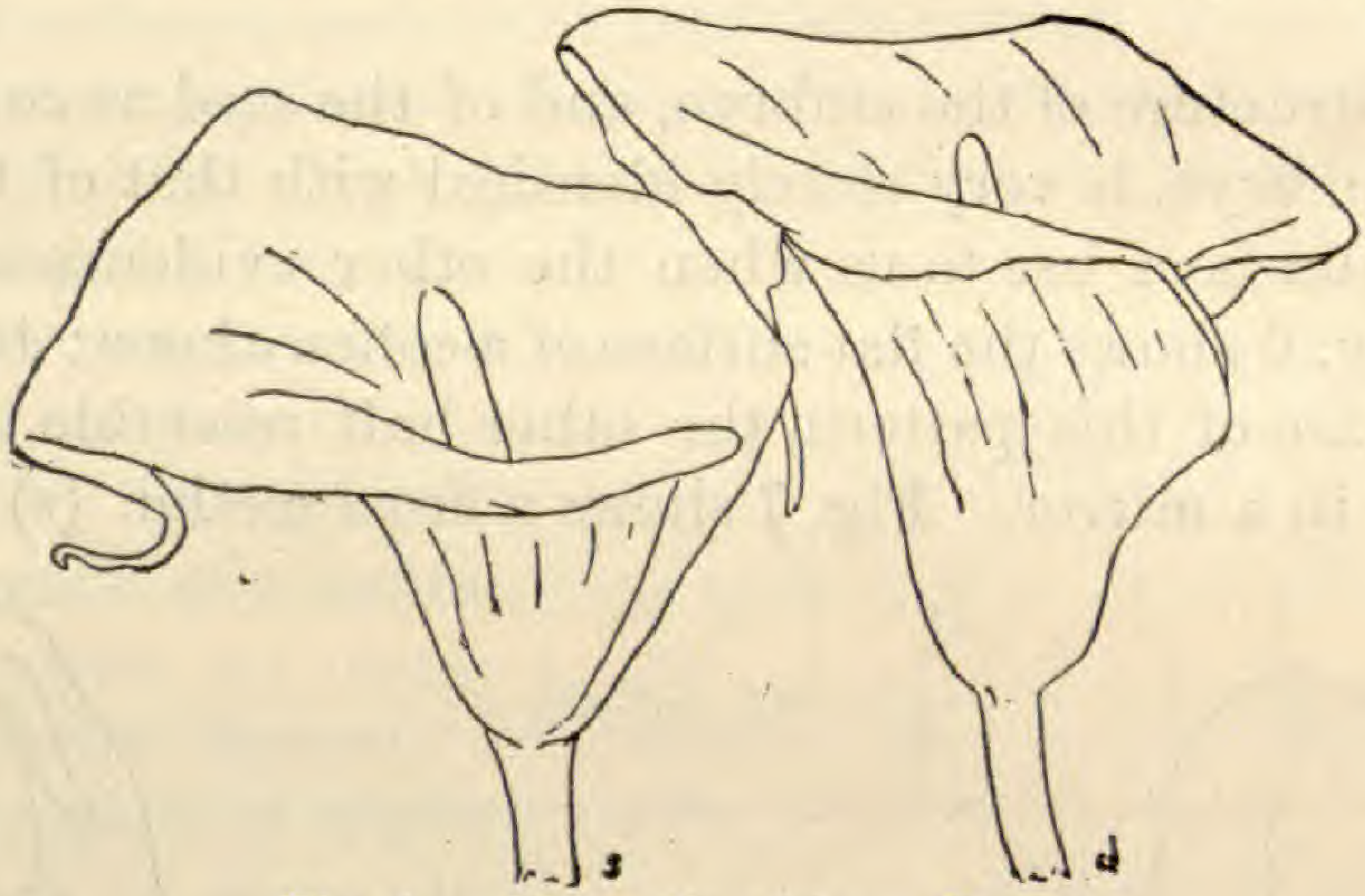

Fig. 4.—*Richardia africana* Kunth.

branches in the shade. Examples of it abound in all the more important orders of plants, and there seems to be no exception, though in opposite-leaved forms the evidence from phyllotaxy is not easily available. I have found no case of heterodromy as between the true foliage leaves of an individual plant; and the only case in which I have failed to observe antidromy between different plants is the Canna, which is mostly propagated by bulbs. (Doubtless there are specimens with a right-handed twist of the young leaves, though I have failed to find any.) In a bed of *Lily of the Valley,* half of the specimens have the inner leaf diverging 120° to the right, and the rest have similar divergency to the left. (Fig. 5.) In this, as in other Liliaceæ, the anthotaxy will be found to vary in harmony with the phyllotaxy.

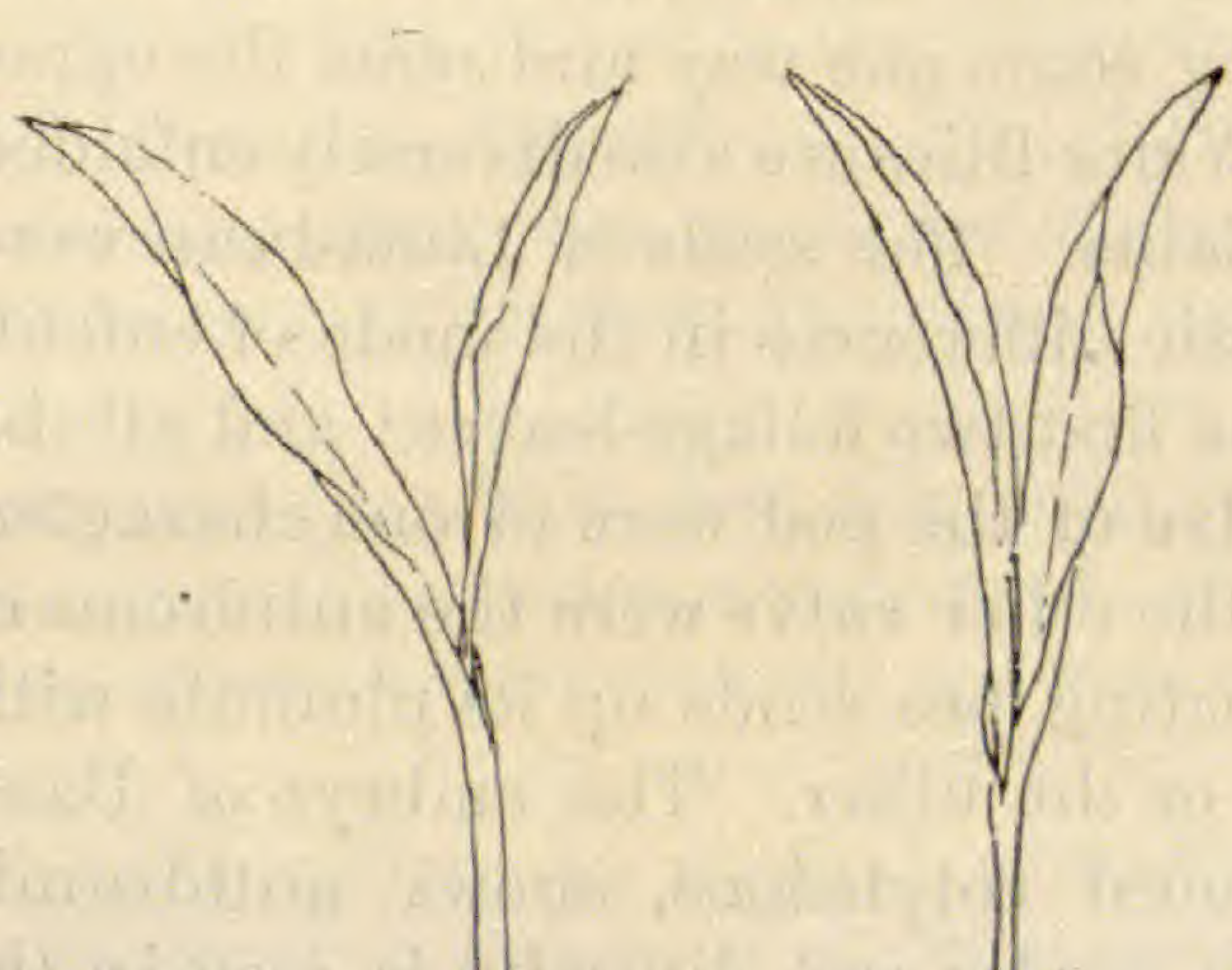

Fig. 5.

Doubtless the antidromic phyllotaxy causes a corresponding antidromy of the leaf-traces, and of structure of the stem. This has escaped anatomists who expected symmetry; but some of the figures in the books show a trending of leaf-traces to one side, and in all such cases we may be certain that some of the individuals have similar trending to the opposite side.

The structure of the embryo, and of the seed as conforming to the embryo, is very closely identical with that of the adult plant, and is of use to us when the other evidence is hidden. Thus fig. 6 shows the flat surface of a coffea-akene; half of the akenes are of this pattern, the other half resemble the image of this in a mirror. Fig. 7 shows a cross-section (r) of fig. 6;

Fig. 6.

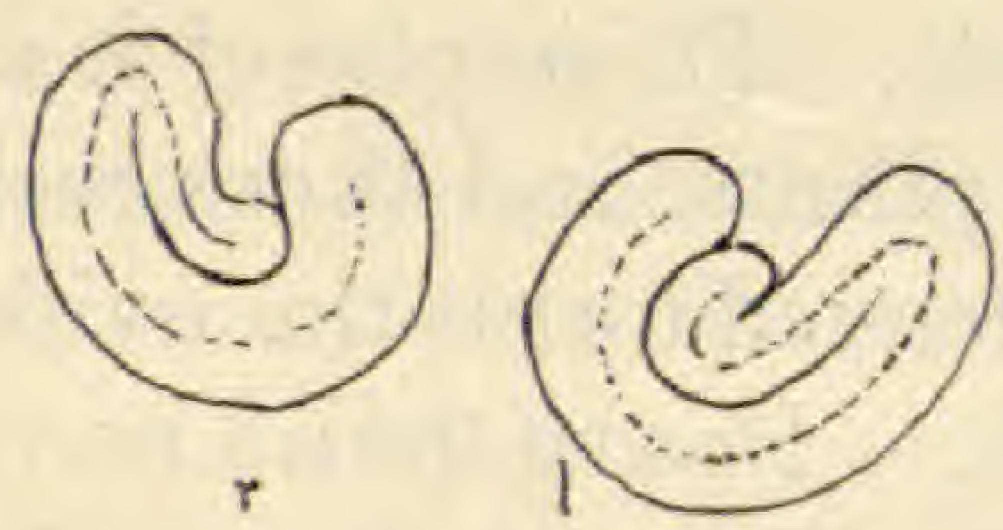

Fig. 7.

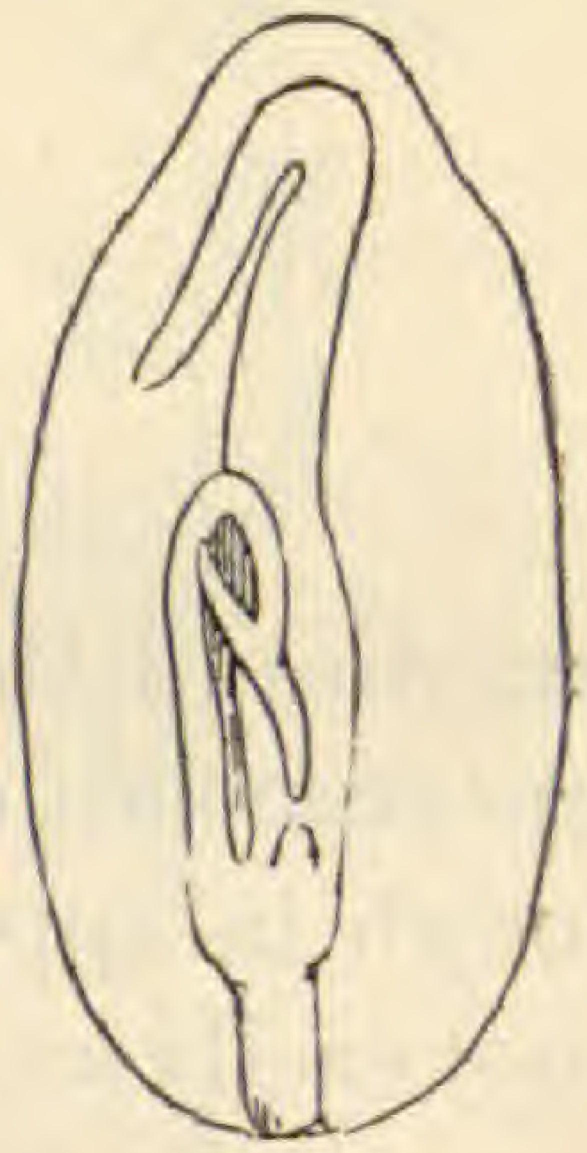

Fig. 8.

and also (l) of the antidrom of fig. 6, under the same orientation, and thus revealing the reverse order of the infolding of the endosperm. Fig. 8 presents the seed and embryo of *Nelumbium;* on seeing this I predicted the existence of other seeds with the embryo facing the opposite way, and promptly Mr. Barney and myself fished out of the Lily-ponds of Springfield, Mass., plenty of seeds which showed, under similar orientation, the embryos facing some one way and some the opposite way. The petals of Water-lilies are also diversely enfolded in the bud of different plants. The seeds of Lima-bean were found to have characteristic differences in the mode of enfolding upon each other of the first two foliage-leaves; and all the seeds growing on one valve of the pod were of one character, whilst those growing on the other valve were the antidroms of the former. The germinating pea sends up its plumule with a slight twist to one side or the other. The embryo of Basswood, with its large 5-lobed cotyledons, shows antidromic twists as between different seeds; and diversity is seen in the mode of folding of the embryos of the two seeds, produced by one flower, of Maple (*A. platanoides* L.). In Horse-chestnut the radicles of different seed incurve antidromically (*a* and *c* of fig. 9), and the young leaves of the plumule (situated inside the radicle at *p* of fig. *a*, enlarged at fig. *b*) show the leaflets differently arranged at the two sides, indicating the same primitive torsion as in other plants. The torsion of the plumule of *c* would be antidromic as compared with that figured.

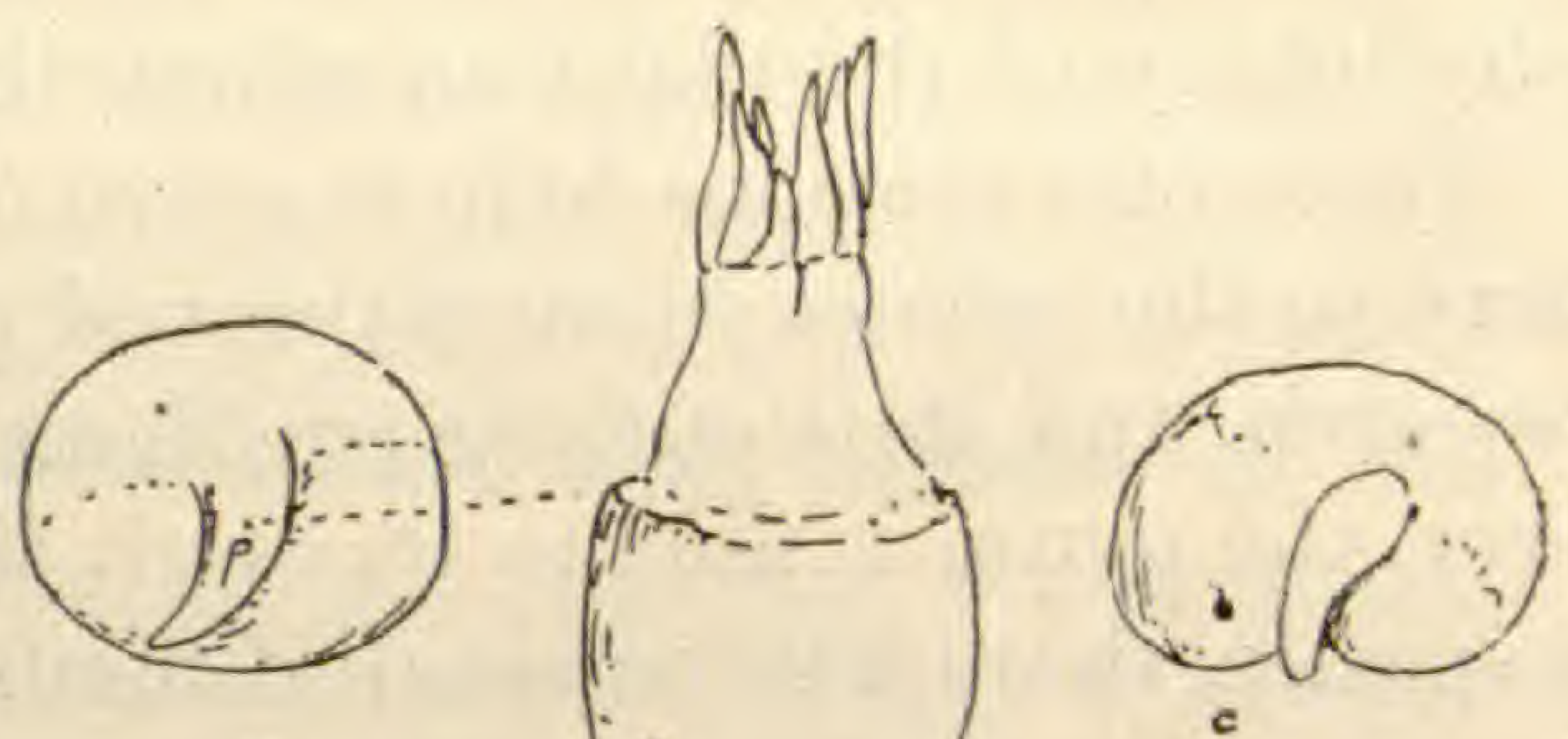

Fig. 9.

Embryo and Plumule of Horse-chestnut.

That the place of origin of the seeds is ordinarily the determining cause of this character is proved by Corn, Coffee, Bean, Lepidium, and other seeds. In Gymnosperm the bilateral origin of the seeds, and the spiral arrangement of their numerous cotyledons point to the same inference, which is confirmed by the phyllotaxy, and by the primary spirals formed by the scales of their cones, as well as by the lateral bending of their woody tissues. We may ascribe to this cause the habit of splitting of tree-trunks in contrary spirals, and I think that the same tendency sometimes shows itself in the sculpturing of the cortex, so that from the bark of Chestnut and hard-barked Hickory I can infer the direction of the phyllotaxy without seeing the leaves.

Direct evidence as to the Convulvulaceæ is difficult because of secondary distortions. But indirect evidence is available. Morning-glory has an incumbent curvature of the embryo as in many Cruciferæ, indicating such a diversity between the two seeds in a locule as produces in Cruciferæ antidromic phyllotaxy. This may also help to explain the twist of the embryo of *Lepidium virginicum* L. which has puzzled botanists, and if our surmise is good, we may expect to find the embryos of two seeds of the same fruit antidromically twisted.

After writing as above I examined the seeds from the two carpels of a flower of *L. virginicum*, and found them antidromic. The same explanation applies to the embryo of *sisymbrium officinale*, and to the spirally-folded embryos of *Chenopodiaceæ*. The two forms of the embryo of *Salsola kali* are figured in Engler and Prantl's Pflanzenfamilien (III, 1a, p. 84, Y, Z). The pods of mesquit (*Prosopis*) and of *Impatiens* have a right or left twist in harmony with the antidromic phyllotaxy of the plant on which they grow.

These observations help to solve old problems, recall phyllotaxy to the science in an improved garb, open up new lines of research, and start curious problems about heredity. If, however, the ovum is able to transmit the secondary characters of a species, there will be small difficulty found in admitting that it can transmit the primitive characteristics that are common to all Phanerogams, and that possibly belong also to the higher Cryptogams. But the curious point is the difference of heredity as between the two sides of a carpellary leaf; and other problems are started by such cases as Richardia. I wish to explain that my work has been necessarily done in haste, and whilst, as a whole, I think it is sound, it will doubtless need rectification in details.

Postscript.—In the above I have unfortunately overlooked the valuable observations of Prof. W. J. Beal on *Phyllotaxis of Cones*, published in the American Naturalist of August, 1873 and March, 1877. He found the cones of individual spruce and larch trees to be heterodromic. If this should prove to be general or frequent, it may possibly be accounted for by secondary torsions during growth. My own observations on *Tsuga*, *Pinus*, etc., favor the view given above; and I may add that the arrangement of florets in heads of sunflowers and other compositæ appears to be antidromic and in accord with the phyllotaxy of the respective plants.

The cones of coniferæ change in opening so as to make the secondary spiral appear the dominant one. I have a cone of *Picca excelsa*, with ten scales open on one side, where they appear dextrally arranged, whereas the unopened side shows the primary arrangement to be sinistral. Taking the opened and unopened cones of the whole tree, one might conclude that half the cones were antidromic to the others.—G. M.

THE FIRST FAUNA OF THE EARTH.

BY JOSEPH F. JAMES.

(*Continued from page 887*).

In 1886, there came an announcement from Sweden that was received with incredulity upon this side of the Atlantic. The geologists there had determined that instead of the *Olenellus* fauna occupying the middle position, it was at the base, and the *Paradoxides* fauna was in the middle. Continuous sections showed the rocks of Lower, Middle and Upper Cambrian age in conformable succession, and the question at once arose, Could there be one sequence upon the eastern and a different one on the western side of the Atlantic? If not, then which was correct? The difficulty on this side was to find a continuous section, and it was not until 1888 that it was found. In that year, Mr. C. D. Walcott, now the Director of the U. S. Geological Survey, found in Newfoundland the desired section. Here the *Olenellus* fauna was at the base, and the *Paradoxides* fauna was above it.

The base of the Cambrian being thus at last defined, it then remained to ascertain the extent and variety of organic life in these old rocks. To Mr. Walcott again the world owes the best exposition of this fauna. In a paper published in 1890, he showed there was a variety and profusion of life that had never before been imagined. In this fauna there were representatives of all the great classes of invertebrates. Strange to say, the most highly organized class had the greatest number of species, as shown below:

Spongiæ	4 species.
Hydrozoa	2 species.
Actinozoa	9 species.
Echinodermata	1 species.
Annelida (?)	6 species.
Brachiopoda	29 species.
Lamellibranchiata	3 species.

Gastropoda	13 species.
Pteropoda	15 species.
Crustacea	8 species.
Trilobita	51 species.

The astonishing number of 141 American species was therefore known in 1890 from this very old series of rocks, and this has since been added to until there are now known from the world nearly 200 species, distributed among about 75 genera. The illustrations accompanying this article show some members of most of the classes above-mentioned. In Figure 4 is shown the cup of a small specimen of *Archæocyathus profundus*, one of the Actinozoa. In Figure 5 we have two views of *Medusites lindstromii*, one of the Hydrozoa, and supposed to represent casts of the gastric cavity of a jellyfish. In Figure 6 there are shown a number of forms of Brachiopoda, a class which, in times past, was very abundant, but which now has only a limited number of representatives. Figure 7 shows some species of

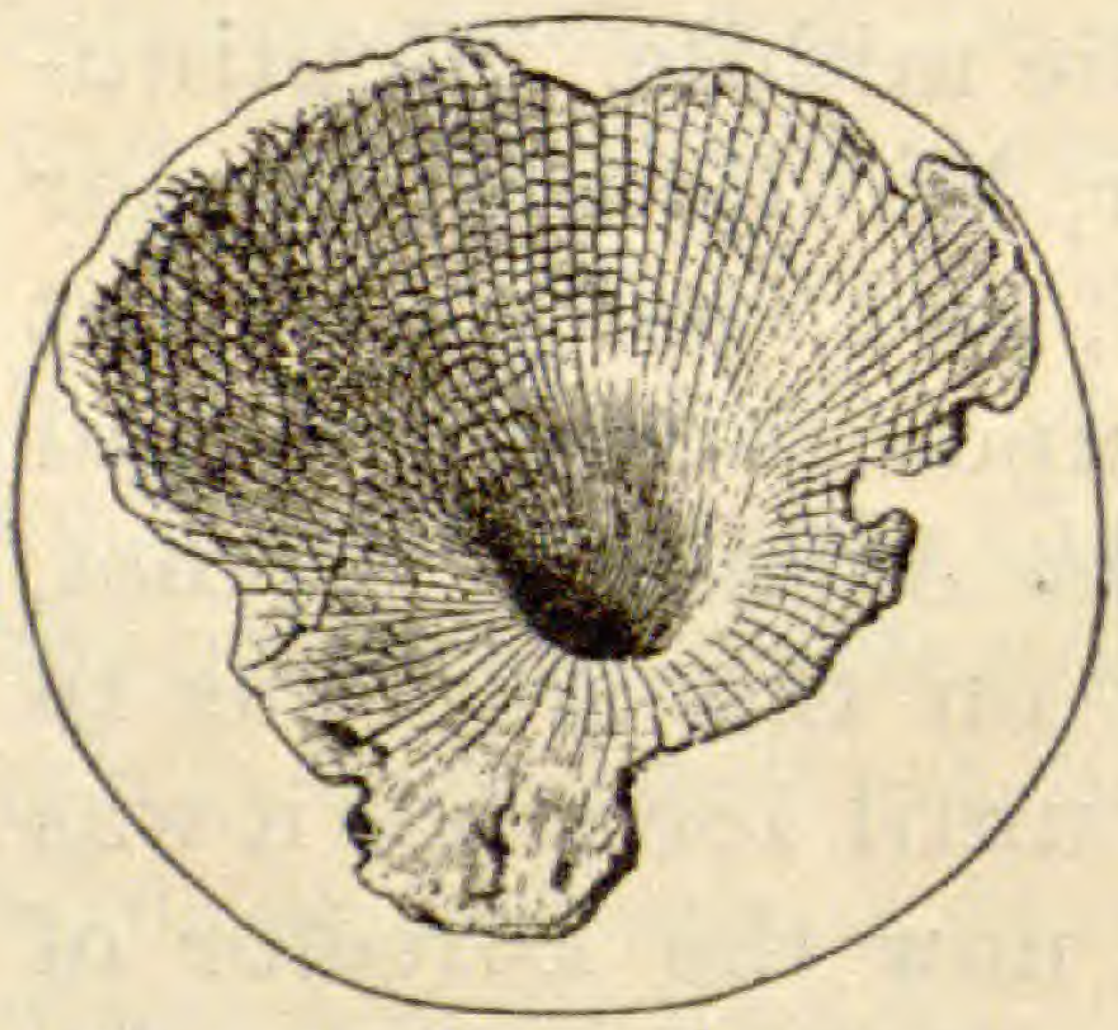

Fig. 4. *Archæocyathus profundus.*

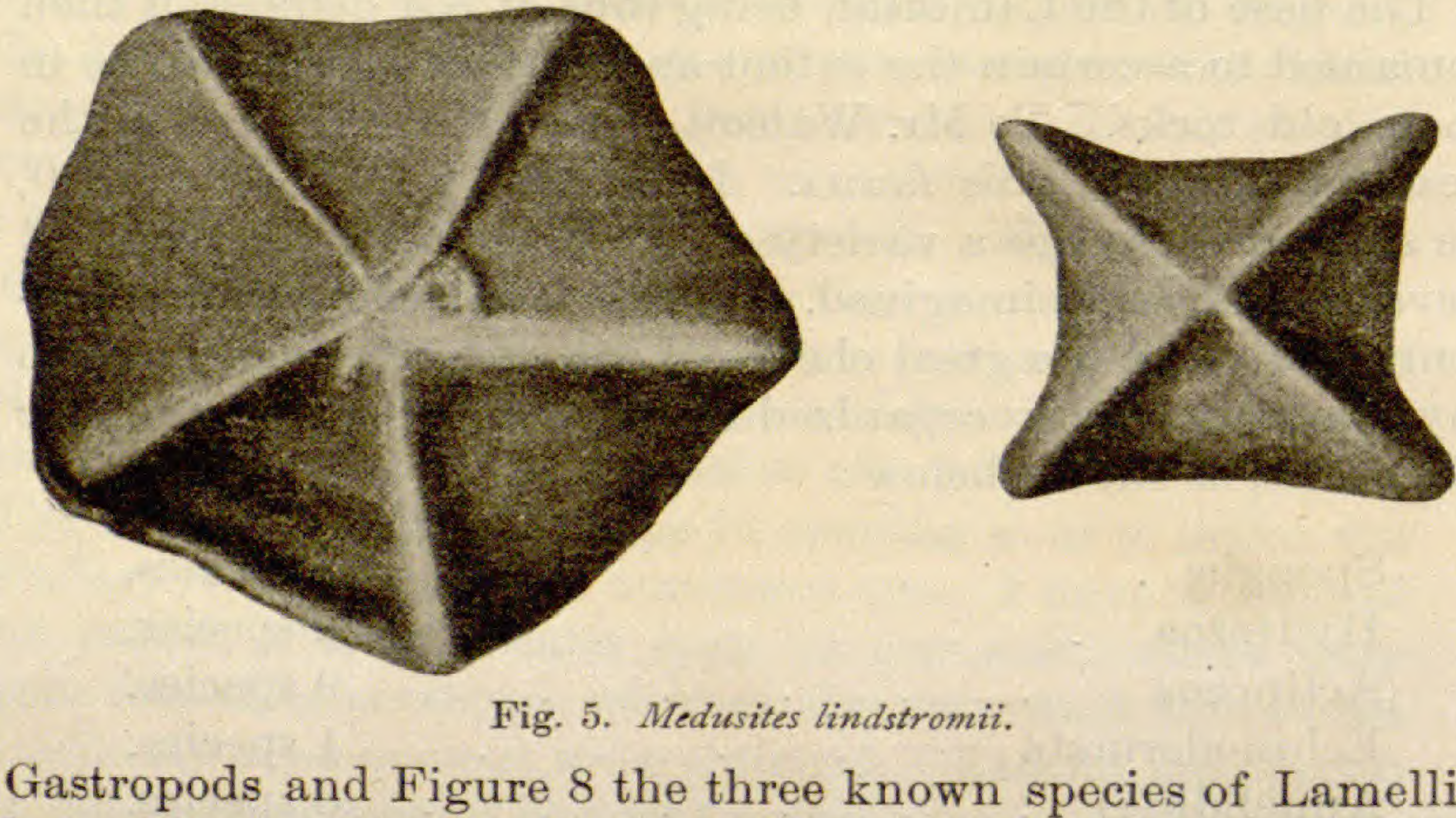

Fig. 5. *Medusites lindstromii.*

Gastropods and Figure 8 the three known species of Lamellibranchiata or bivalve shells which are, to-day, so abundant in the fresh and salt waters of the globe. In Figure 9 there is shown one of the species of annelids. The soft bodies of these animals have, of course, decayed, and all that remains to tell of their former existence is a vast variety of trails and burrows, which, in some places, cover the rocks in myriads. The problematic character of fossils has caused them to be described as Algæ, but there seems no reason to doubt that they were really worm casts, burrows or trails. In Figure 10 are shown some species of Hyolithes, a genus of *Pteropods* now entirely extinct, but represented in the Lower Cambrian by eight species and one variety. Figure 11 is a representation of a

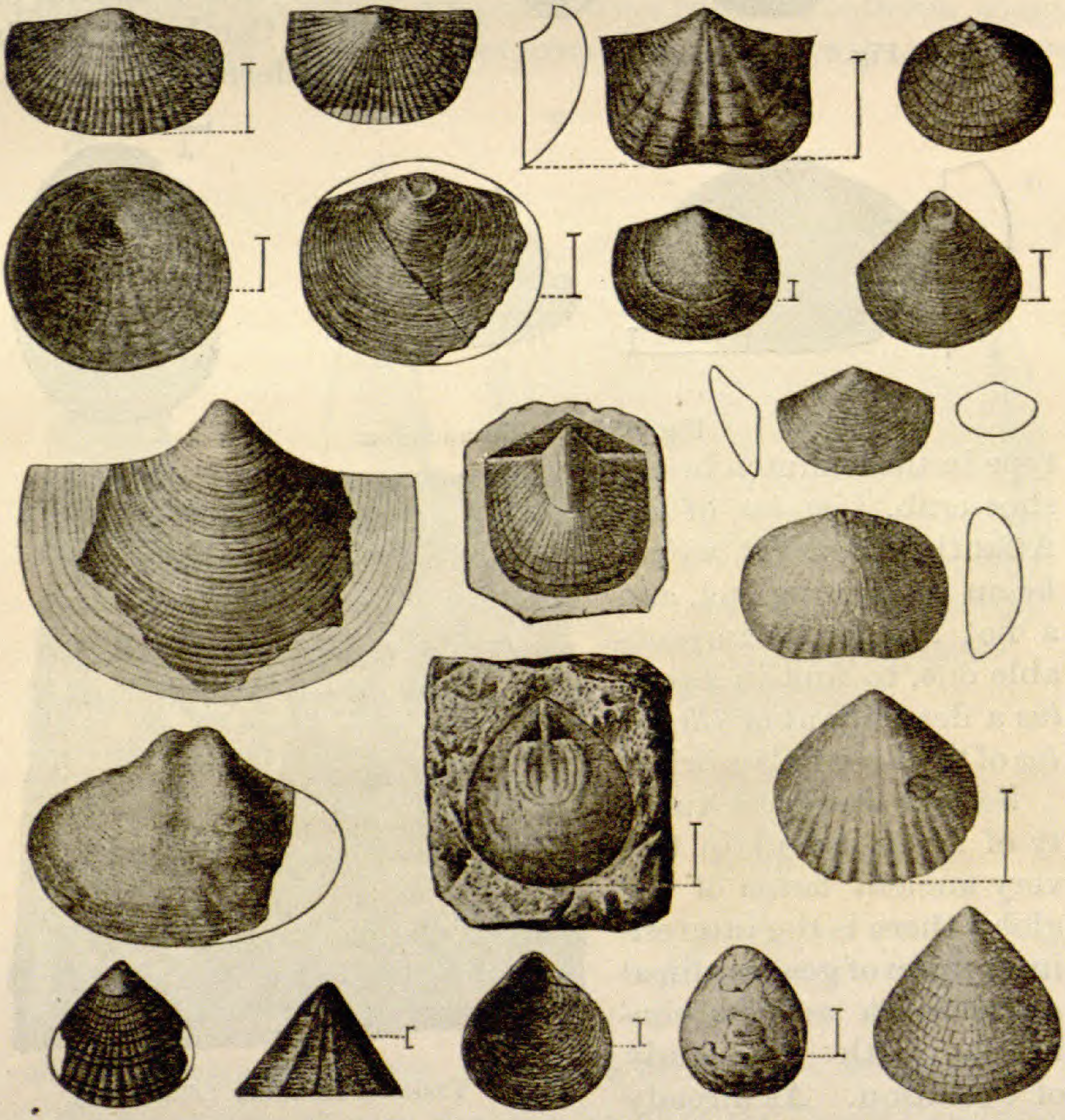

Fig. 6. Various species of Brachiopoda.

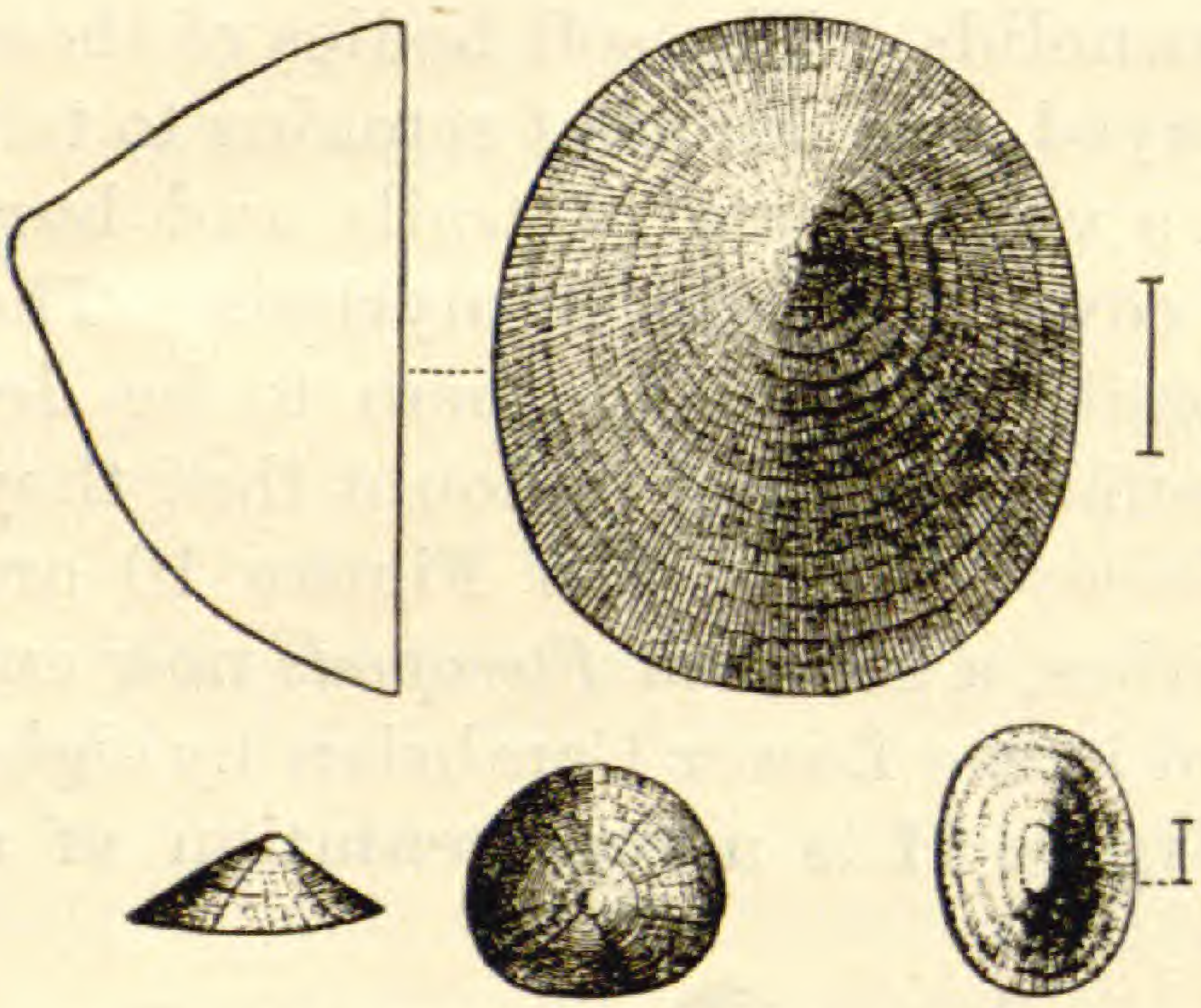

Fig. 7. Gastropoda.

crustacean in a nearly perfect state of preservation, and Figure 12 is a group of trilobites of various genera, most of them belonging to the typical genus of the Lower Cambrian, *Olenellus*. This genus, as pointed out by Walcott, is probably genetically related to *Paradoxides*, the typical genus of trilobites of the Middle Cambrian, and it has its modern, living proto-

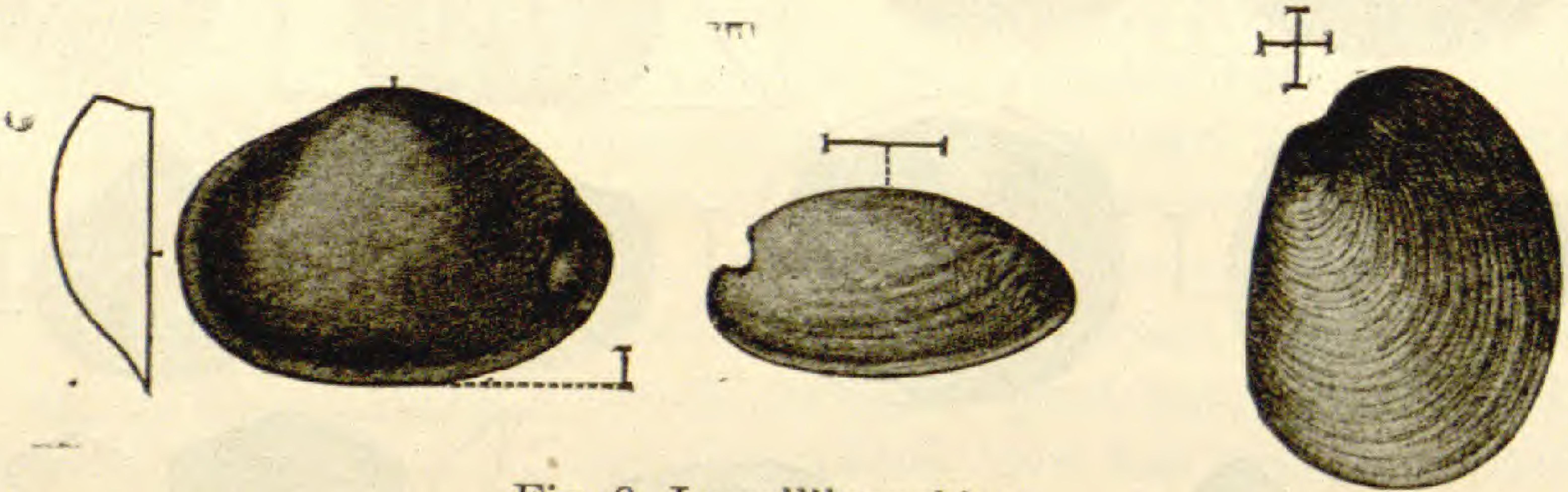

Fig. 8. Lamellibranchiata.

type in the common horseshoe crab, *Limulus*, of the Atlantic coast. It would be an interesting fact, and a not altogether improbable one, to find in *Limulus* a descendant of *Olenellus* of the Lower Cambrian.

Fig. 9. Trails of Annelids (*Planolites*).

Besides the great variety of forms found in this very ancient fauna of the globe, there is the interesting subject of geographical distribution and its connection with the study of evolution. As already stated, the three great divisions of the Cambrian, the Lower, Middle and Upper, are each characterized by a special genus of trilobite. In the lower zone we have *Olenellus*, in the middle zone *Paradoxides*, and in the upper zone *Dikellocephalus*. These three genera are so closely related that it does not require any stretch of the imagination to regard one as a descendant of the previously existing form. It is true there are no exactly connecting links between the three, and yet there are genera known which have certain intermediate characters. In some localities the three zones present an almost conformable sequence, with scarcely a break in sedimentation, but in other places there is a very perceptible time interval between them. In the former cases, the intermediate genera are known to occur.

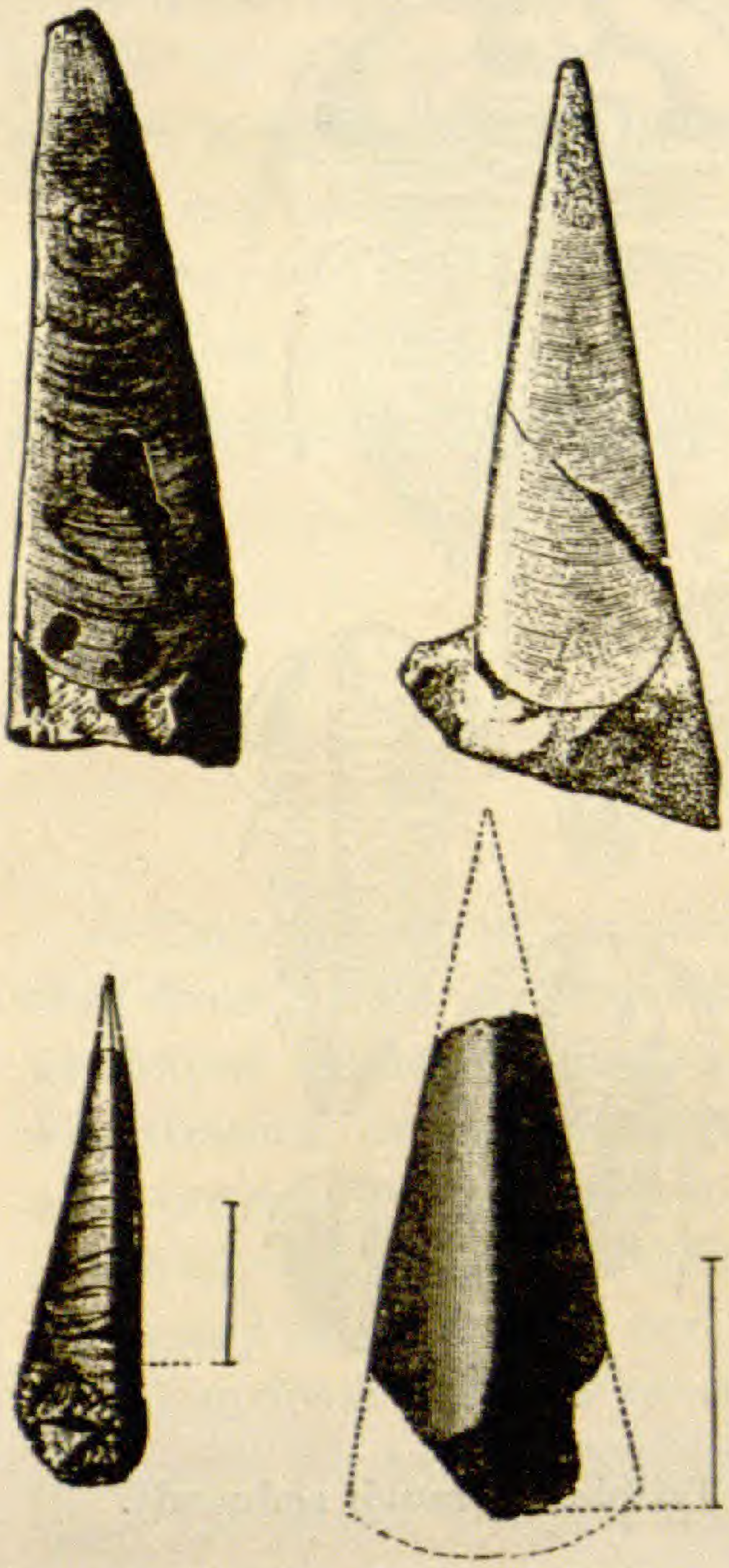

Fig. 10. Pteropoda (*Hyolithes*).

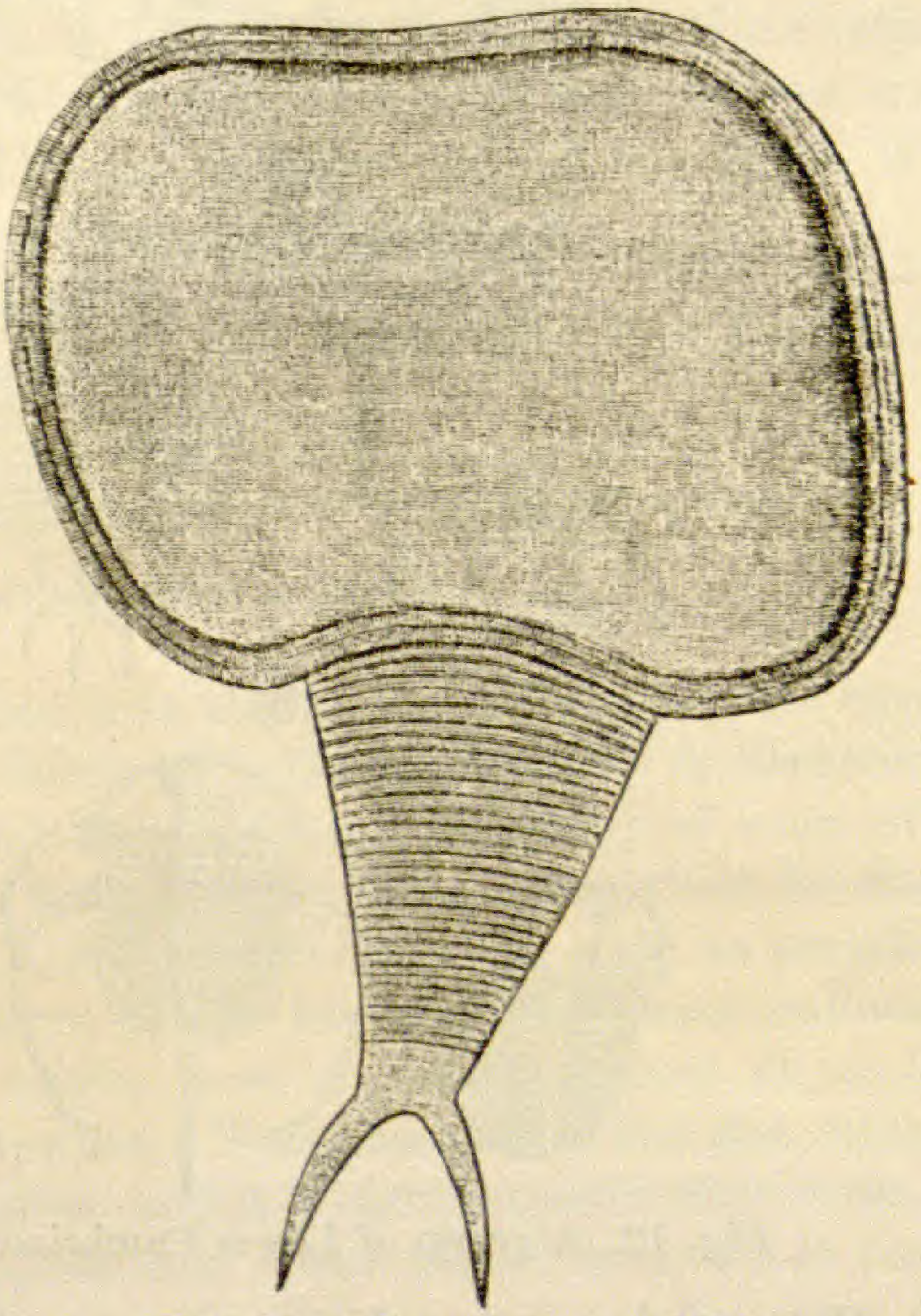

Fig. 11. *Protocaris marshii*.

We have already seen that the fossils of the Lower Cambrian are found in New York, Vermont, New Brunswick, Newfoundland, Sweden, Wales and Bohemia. But they have likewise been collected in Massachusetts, Georgia, Alabama and Tennessee on the Atlantic side of North America, and from British America, Utah, Nevada and California on the Pacific side. They have also been found in France, in Sardinia, and in Russia, while fossils of the immediately succeeding middle and upper zones occur in all these places and in India, China, Australia and South America. It would thus appear that at a very early period in the history of the earth, the faunas then living had an almost world-wide distribution. There is, however, little to be wondered at in this, since it is probable that the conditions of existence at that early day were very uniform.

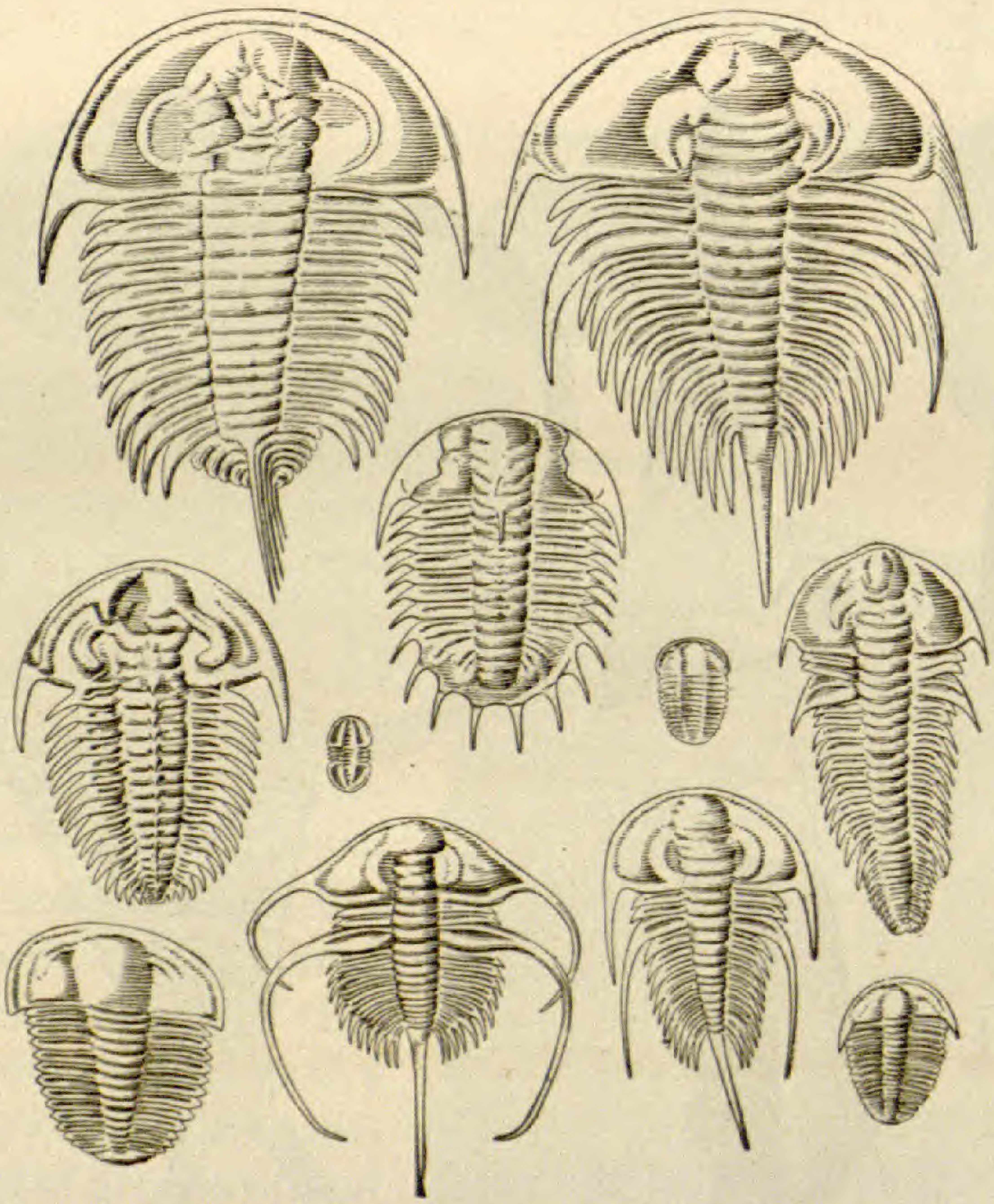

Fig. 12. A group of Lower Cambrian Trilobites (much reduced).

What these conditions were in other countries besides Europe and North America can not be stated, since the rocks in the more remote places have not been studied with the same care as in America and Europe. From the studies of Mr. C. D. Walcott and others, it seems clear that the continent of North America in Cambrian time had essentially the same outline it now has, although it was considerably less in extent. In brief, it has been ascertained that there was a depression along the margin of what is now the Appalachian chain from Newfoundland to Alabama, protected from the open sea, the primitive Atlantic, by a fringe of islands. Along the western slope of the site of the Rocky Mountain chain the same conditions prevailed, and in these two troughs the fauna lived and flourished. During Middle and Upper Cambrian time, conditions became modified so as to allow the fauna to exist in other localities, notably in Minnesota, Wisconsin and Texas.

Where the faunas originated, and how they spread from place to place, so as to become so widely scattered over the globe, are questions it is not, at present, possible to answer. That we know as much as we do about the life on the earth at so distant a period in its history, is owing to the patient work of a few enthusiastic students, among whom Mr. C. D. Walcott must always occupy a prominent position.

EDITOR'S TABLE.

—THE public is acquainted with the results of Peary's last expedition from which he has just returned. He was not able to discover his principal caches of food, and this, with the treachery of some of his Esquimaux, prevented him from reaching the coast which he discovered on his first expedition. He turned back in time to permit his reaching his camp of departure just as his provisions were exhausted. A heavy storm at the end might have ended his career at no great distance from his base of supplies. This season and the last were unfavorable for arctic exploration, and it is quite possible that some one may yet utilize Peary's supplies and reach higher latitudes in Greenland. It is, however, certain that Greenland does not lie in the most available route to the pole, which is by way of the islands north of Siberia. Science awaits with interest the results of Nansen's bold enterprise by sea, and of Jackson's Expedition across Franz Joseph land. When once the way is open, science will send its votaries to the field which is awaiting them.

Peary's observations and collections in Ethnology, Meteorology and other departments on Inglefield Gulf will repay the cost of the expedition; and the results of the relief expedition, like those of its predecessors, are of great value. Large collections were made by the latter, which will go to the American Museum of Natural History of New York, and the Museum of the University of Kansas.

—Mr. L. O. Howard, of the Department of Agriculture of Washington, has made a discovery which will probably be of great practical importance. He finds that a thin stratum or film of oil on the surface of the water where they breed, will destroy the larvæ of mosquitoes. This will prove welcome news to people living in many localities. How to destroy this pest of many parts of the earth has been a subject of thought for a long time. The late Dr. Robert Lamborn gave two prizes for essays which advocated the propagation of dragon-flies as the most feasible mode of attack, since the mosquito is the natural food of these raptorial insects; but no one has yet undertaken to demonstrate the practicability of the plan. The application of oil to the waters of swamps and lagoons where the Culices breed, is a simple matter, and the expense will be small in comparison with the advantage gained. The use of oil in the valley of the Missouri River, and on many parts of our coast, would increase the value of the land to an untold degree. In fact, the habitable part of the earth in many latitudes must be greatly increased in extent by this discovery. Meanwhile we must be content to let these small creatures render life miserable or impossible, and hide behind "bars" which do not always protect, or suffocate in stinking smudges, until the use of oil for their destruction becomes general. In waters which are not private property, it will be well for the States to lead the way, and make appropriations for the purpose.

RECENT LITERATURE.

Bulletin of the U. S. Fish Commission for 1893.[1]—The contents of this volume comprise the papers that were read at the congress

[1] Bulletin of the U. S. Fish Commission, Vol. XIII, for 1893. Washington, 1894.

of persons connected with fishery interests, held in Chicago Oct. 16, 1893. The papers cover a wide range of subjects, and being the views of men qualified by experience and study to speak upon the subjects treated, are of practical worth. A synopsis of the topics discussed includes: 1. Fishery laws and administration of the fisheries. 2. The sciences in relation to fisheries and fish-culture. 3. Methods of capture, utilization and distribution of fishery products. 4. Fish-culture. 5. The world's fisheries. In addition, an interesting paper is contributed by G. F. Kunz on pearls, and the utilization and application of the shells in which they are found, in the ornamental arts, as shown at the World's Columbian Exposition. The illustrations of this article are beautiful both in subject and execution.

Geological Survey of Michigan, Vol. V.[2]—The contents of the present volume comprise a report upon the Iron and Copper regions of the Upper Peninsula by Dr. Rominger; and a paper by A. C. Lane, on deep borings in the Lower Peninsula, based on the work done by the late Mr. Wright. Mr. Lane's paper is prefaced by a brief chapter on the origin of salt, gypsum and petroleum written by the State Geologist, Mr. L. L. Hubbard, and is accompanied by 73 plates and a map.

Dr. Rominger's report covers the work done in the iron region in 1881 and 1882 and includes recent observations made in the Copper-bearing or Keweenan group.

Geology of Minnesota.[3]—The materials for this quarto volume have been accumulating since the Survey began, and it has been found desirable to issue the publication in two parts. Pt. 1, includes 5 chapters on the paleontology and systematic geology of the Lower Silurian which is found in the southeastern part of the State, and a historical sketch of investigation of the Lower Silurian in the Upper Mississippi Valley. The paleontological work is distributed as follows: Cretaceous Fossil Plants, Leo Lesquereux; Cretaceous Microscopical Fauna, A. Woodward and B. W. Thomas; Notes on other Cretaceous fossils, N. H. Winchell; Lower Silurian Sponges, Graptolites, Corals and Brachiopods, N. H. Winchell and C. Schuchert; Lower Silurian Bryozoa, E. O. Ulrich. Each chapter is accompanied by page plate illustrations, 34 in all.

[2] Geological Survey of Michigan, Vol. V, 1881–1893. Lansing, 1895.

[3] Final Report of the Geology of Minnesota, Vol. III, Pt. 1, Paleontology. Minneapolis, 1895.

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General Notes.

MINERALOGY.[1]

An Instrument for Preparing Accurately Oriented Sections and Prisms from Crystals.—Mention has been made in these notes of the valuable instruments which Tutton has designed in connection with his recent studies in the field of chemical crystallography. One of them[2] is an instrument of precision for preparing prisms or sections of the delicate crystals of artificially prepared compounds. The methods now in use for making these preparations require a prodigious amount of labor while securing only a rough approximation to the desired orientation. Of his new instrument Tutton says:

"It is possible by the use of the instrument to grind and polish a truly plane surface in any direction in a crystal so as to be true to that direction to within ten minutes of arc, an amount of possible error which would exercise no measurable influence upon the values of the optical constants. Moreover, this result may be achieved in a small fraction of the time hitherto required, and with only the very slightest risk of fracturing the crystal. An arrangement is also provided by which a second surface may be ground parallel with a like degree of accuracy to the first."

This somewhat elaborate piece of apparatus is constructed like an inverted goniometer with horizontal circle, being provided with graduated disc, the usual centering and adjusting device, telescope, collimator and lamp. A revolving table mounted in an excentric position under the crystal and driven by a turning table, carries a ground glass plate for grinding and a finer one for polishing. The pressure of the crystal on the glass is delicately regulated by means of counterpoised levers which support any desired portion of the weight of the instrument's axis, the remaining portion bearing directly on the crystal.

A larger, stronger, and somewhat modified form of this apparatus[3] has been designed for carrying out the same operations on the hard natural crystals. This form is provided with a cutting apparatus, which, when not in use, is rotated out of the way so as not to interfere

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Philosophical Transactions, Vol. 185, (1894), A, pp. 887–912.

[3] Tutton, Proc. Roy. Soc., Vol. 57, pp. 324–330.

with adjusting the crystal or grinding. The grinding table is supplied with nine different laps suited to minerals of different degrees of hardness and to artificial crystals. The apparatus may be driven by a small motor, the current from three pint bichromate cells being ample. These instruments are constructed by Messrs. Troughton and Simms, the smaller instrument at a cost of £40, and the larger one, which is adapted for use of mineralogists and chemical crystallographers alike, at a cost of £60.

An Instrument for Producing Monochromatic Light of any Wave Length.—The same author has constructed an instrument to furnish strong light of any desired wave length, which wave length may be changed at will.[4] The source of light is an oxy-coal gas lime lantern and the dispersive apparatus a specially constructed spectroscope in which the telescope is replaced by a collimator tube and slit exactly like the one on the side of the instrument toward the source of light. The prism has a refracting angle of 60°, is prepared from heavy flint glass, and is rotated on a graduated circle so as to allow any desired wave length of the spectrum to pass through the exit slit. This is diffused by a plate of ground glass before it enters the goniometer, total refractometer, or axial angle apparatus, in which it is utilized in determining the index of refraction or the size of the optical angle. It is thus possible to extend indefinitely the measurements to show the amount and character of the dispersion of crystals, while greatly facilitating the measurements themselves. By replacing the exit slit by diaphragms having two or more slits at proper distances apart, composite light made up of any desired wave lengths may be employed, which is very useful in studying crystals with crossed axial planes like brookite.

Other Mineralogical Apparatus.—Wolff[5] gives detailed instructions for making diamond saws suitable for section cutting, also directions for sawing sections so thin that only a small amount of subsequent grinding is necessary.—Federow[6] describes the simplest form of his universal microscope stage, which is specially adapted for rapid petrographical determinations. At the same time he advocates lengthening the heretofore circular opening in his ebonite section holder.

[4] Philosophical Transactions, Vol. 185, (1894), A, pp. 913–941.

[5] Am. Journ. Sci., XLVII, pp. 355–358, (1894).

[6] Zeitsch. f. Kryst., XXIV, p. 602.

Determination of Optical Sign in Random Mineral Sections.—Using the universal microscope stage Federow[7] shows that it is possible and usually quite easy to determine the optical character of a mineral from random sections. In the case of uniaxial minerals the section is revolved between crossed nicols to extinction. It is then tilted first about one and then about the other axis of its ellipse of elasticity. The one of these corresponding to the ordinary ray is distinguished by the resulting *slight* change in double refraction (due entirely to increase of thickness of the slide). Having determined this direction (n_0) it is only necessary to determine by use of the quartz wedge or mica plate whether this direction corresponds to the greater (positive) or less (negative) elasticity. In the case of biaxial minerals a section is sought having the highest double refraction (nearest plane of optic axes). This is now tilted until it gives the lowest possible double refraction, when the light comes through it most nearly along an optic axis. If the angle which this direction makes with the axis of least elasticity (nearly in the plane of the section) is less than 45° (half the optical angle) the mineral is positive, otherwise negative. This latter method is only approximate, but is accurate enough for minerals having an acute optical angle of 75° or less, and these are the only ones in which determination of the optical sign is of much value for purposes of identification.

Pseudochroism and Pseudodichroism.—The same author[8] furnishes an explanation of certain variations in color which are often observed in minerals having a lamellar structure when observed under the microscope. A bundle of white rays incident on any inclined plane separating two lamellæ is in part totally reflected, the reflected portion being obviously made up of more rays from the violet than from the red end of the spectrum. Of the light which is transmitted the red rays are the less refracted, and hence take their direction nearer the axis of the microscope. As a consequence the color observed near the centre of the field is due to the mixing of the red rays with the darkness due to partial total reflection, and it is, therefore, brown. Nearer the margin of the field the more refrangible rays produce green. This effect is observed in ordinary (non polarized) light, and v. Federow proposes to call it *pseudochroism*. If the polarizer is used the amount of total reflection will evidently be greatest when the direction of vibration of the incident light is parallel to the surface of incidence,

[7] Ibidem, pp. 603–605.

[8] Tscherm. min. u. petrog. Mitth., XIV, heft 6.

hence a variation in the depth of the color, called by v. Federow *pseudodichroism*, is observed when the stage is revolved. Of use in distinguishing pseudodichroic substances from truly dichroic substances is the fact that the former always show brown shades in the centre of the field.

Meteorites in Field Columbian Museum.—Farrington has prepared a "Handbook and Catalogue of the Meteorite Collection" of the Field Columbian Museum[9] modeled somewhat after Fletcher's admirable handbook describing the meteorites in the British Museum collection. The popular introduction is well written, with reference for the purpose of illustration to catalogue numbers of typical specimens in the collection. This important collection includes 180 falls or finds and the aggregate weight of the specimens is over 4700 lbs. With the exception of the Canon Diablo specimens, the largest specimens of the collection, are those from Kiowa Co., (Kan.), (466 and 345 lbs.) and the Phillips Co., (Kan.), meteorite (1184½ lbs.). The list includes 355 numbers which are described with considerable detail. Six excellent plates illustrate typical structures.

Crystallography of Wisconsin Minerals.—In a Bulletin of the University of Wisconsin, Hobbs[10] has studied the Wisconsin minerals crystallographically. The specimens are chiefly from the zinc and lead region of the southern part of the State, where they occur in the cavities of limestone, the principal species being calcite, smithsonite, cerussite, galena, sphalerite, azurite, malachite, barite, gypsum, chalcopyrite, marcasite and pyrite. Four generations of calcite are distinguished by different habits as well as by slightly different colors and degrees of translucency. These four types appear in scepter-like parallel growths. The new form 24R $(24.0.\overline{24}.1)$ has a large development on two of the types. At Mineral Point and Highland galena appears in hopper-shaped octahedral as well as arborescent aggregates, and individual crystals show polysynthetic twin lamellæ according to the laws, (*a*) twinning plane a face of the octahedron and (*b*) composition plane a face of the dodecahedron. On sphalerite from Galena, (Illinois), the new form (775) was observed. The azurite of Mineral Point exhibits the new forms (307), $(\bar{2}03)$, $(\bar{2}05)$ and (9.12.8). The "anglesite" from Mineral Point is found to be selenite. Some new crystal habits are observed on marcasite and on cerussite.

9 Field Columbian Museum. Publication 3, Geol. Ser., Vol. 1, No. 1, pp. 64, pls. 6, (1895).

10 Bull. Univ. Wis., Sci. Ser., Vol. 1, No. 4, pp. 109–156, pls. 4–8, (1895).

Miscellaneous.—Hillebrand[11] has made an analysis of a tellurium ore which occurs sparingly in the Cripple Creek district of Colorado, and determined it as calaverite. The corrected analysis (disregarding traces of elements) from the Raven Mine is Fe 57.40, Au 40.83, Ag 1.77, total 100.00. The mineral is very imperfectly crystallized, but as a result of a crystallograpbical examination Penfield thinks it is probably triclinic but near sylvanite in angles and axial ratio. It is interesting by reason of the unusually low percentage of silver, which in the three specimens analyzed ranged from 0.90 to 3.23 per cent.—Emerson[12] notes several peculiar mineral transformations from Massachusetts. The so-called "quartz pseudomorphs" from Middlefield he finds to be serpentine pseudomorphs after olivine resembling the Snarum forms. In a boulder at Holyoke was found calcite probably pseudomorphous after common salt. A large sapphire corundum crystal from Pelham encloses a crystal of allanite which is much puckered for a distance of an inch from the allanite, but elsewhere possesses its usual parting.—v. Federow[13] finds that in the rocks of the shores of the White Sea (granites and gneisses) a vicareous relation seems to exist between plagioclase and garnet, the former being developed in large quantity only when the latter is present in small quantity and vice versa. Hobbs[14] describes cerussite from Missoula, Mont., showing the forms (110), (100), (130), (010), (001), (332), (111) and (380). The crystals are covered by a paper-thin film of galena, doubtless due to alteration through the action of sulphuretted hydrogen. Crystallized barite from Negaunee and chloritoid from Michigamme are also described.

[11] Am. Jour. Sci., Vol. L, pp. 128–131, (1895).
[12] Bull. Geol Soc. Am, Vol. 6, pp. 473, 474, (1894).
[13] Tscher. min. u petrog. Mitth., XIV. pp. 550–553, (1894).
[14] Am. Jour. Sci., L, pp. 121-128, (1895).

PETROGRAPHY.[1]

The Rocks of Gouverneur, N. Y.—An interesting feature of the biotite hornblende gneisses[2] of the vicinity of Gouverneur, N. Y., is

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] C. H. Smyth, Jr., Trans. N. Y. Acad. Sciences, xii, p. 203.

the abundance in them of microperthitic intergrowths of orthoclase and plagioclase. From the relations of the plagioclase to the orthoclase and to the surrounding minerals there can be no doubt that it is of secondary origin. It fills cracks between quartz and orthoclase, and from these areas it sends long stringers into the orthoclase along its cleavage cracks and into its fracture lines, without suffering the least interruption in its continuity. The gneiss in its structure is sometimes granular and sometimes granulitic, and in the appearance of its constituents it shows plainly that it is a dynamo-metamorphosed rock. The dark bands occurring with the predominating light colored ones consist, as a rule, of the same minerals as the latter, but one band noted is composed of monoclinic pyroxene and hornblende in addition to the feldspars. The normal granites of the region differs in composition from the gneiss in the absence from them of hornblende, except in certain basic segregations. The granite, like the gneiss, has suffered the effects of pressure, but to a more limited extent. Among the limestones associated with these rocks are phases containing much colorless pyroxene, tremolite and scapolite. Near the base of the limestone series the pyroxene-scapolite rocks are foliated, and are apparently interstratified with unaltered beds. They consist of feldspar, quartz, pyroxene, mica, sphene, apatite, graphite, pyrrhotite and pyrite, or of these components, with the feldspars replaced by secondary scapolite.

Diorites and Gabbro at St. John, N. B.—Among the intrusive rocks cutting the Laurentian near St. John. N. B., Matthew[3] finds a granite-diorite and a gabbro. The diorite is coarse grained and porphyritic in its larger masses, and fine grained and granular in its smaller bands. Quartz, plagioclase, orthoclase, hornblende, biotite and the usual accessory constituents compose the rock, while epidote and microcline-microperthite are present in it as alteration products of plagioclase and orthoclase. The microperthite is also noted as forming a rim between plagioclase and quartz. As the rock becomes finer grained orthoclase and biotite diminish in quantity. Although the contacts of the diorite with the surrounding rocks are usually faulted, it can be clearly seen that the latter have been altered by the intrusive. On the contact with a gabbro, this latter rock has been changed to a granular aggregate of hornblende and plagioclase. The diorite, on the other hand, is very fine grained, and is composed of an allotriomorphic mixture of plagioclase, quartz, orthoclase and a few small shreds and grains of hornblende and biotite. Limestone in contact with the

[3] Trans. N. Y. Acad. Sci., xiii, p. 185.

eruptive has been marbleized. In it are pyroxenes and garnets, the latter often in large numbers. This diorite has heretofore been regarded as a metamorphosed sediment, but, from the evidence at hand, the author concludes that it is a true irruptive. The gabbro of the region is confined to two small knobs. In one, the rock grades from an anorthosite into a peridotite. In the latter phase olivine constitutes nearly half of its mass. Hypersthene is abundant, while augite, plagioclase, and the usual accessories, spinel and magnetite, are present in small quantities. Reactionary rims always surround the olivines when in contact with plagioclase. These are composed of three zones, an inner one of hypersthene which is continuous with the large hypersthene components; a middle one, composed of fine needles of uralitic amphibole, and an outer zone consisting of uralite and a deep green, highly refracting substance in grains, probably a spinel. The contact rim is supposed to be secondary. The various phases of the rock are usually much altered into actinolitic varieties.

South American Volcanics.—The collection of Argentine volcanic rocks belonging to Berlin University has been investigated by Siepert.[4] The collection embraces quartz-porphyries, porphyrites, diabases, augite-porphyrites, melophyres and an epidiorite-porphyrite. In the quartz-porphyries quartz grains are often surrounded by aureoles of the same substance, whose optical orientation coincides with that of the surrounded particles. Many of the grains show undulous extinction, which the author regards as secondary. In some of the specimens the granophyric structure, in others the microgranitic, and in still others the felsophyric structure predominates. In many instances the granophyric structure is unquestionably secondary. The porphyrites include diorite-porphyrite, eustatite-porphyrite and epidiorite-porphyrite. In one of tha latter a feldspar granule was seen to be surrounded by a feldspar aureole. The other rocks examined present no unusual features.

Specimens of the younger volcanic rocks gathered by Sapper in Guatemala were submitted to Bergeat[5] for study. They comprise trachytes, rhyolites, dacites, andesites and basalts. The trachytes, though of the "Drachenfels" type, contain about 66 % of silicia, and are thus closely related to the rhyolites. The andesites are the most abundant types. They include pyroxene, hornblendic and mica hornblende varieties. Some of the pyroxenic andesites contain two pyrox-

[4] Neues Jahrb. f. Min., etc., B. B., ix, p. 393.

[5] Zeits. d. deutsch. geol. Ges. xlvi, I, p. 126.

enes—a hypersthene and an augite, both of which are pleochroic in the same tints parallel to *B* and *C*, a difference of color being noticeable only in the direction of *A*. The author notes that the volcanoes on the principal fissures have eruptive andesites, while the others have yielded basalts.

Rock Classification.—A new classification of in organic rocks, based on the nature and past history of their components, is proposed by Milch.[6] The original rocks are the *archaiomorphic*, embracing those whose constituents have separated from a molten magma. Through alteration processes these have given rise to the *neomorphic* rocks, including the three groups: *anthi-lytomorphic*, *allothi-stereomorphic* and *anthi-neomorphic*. The first of these groups includes those rocks whose material was originally in some other condition, but whose constituents possess forms independent of outside influences, as, for instance, the chemical precipitates. The second group embraces those whose material has been transported and been laid down with its own form to produce a rock different from the original one, as the mechanical sediments. The third group comprehends rocks whose material is in its original position, but in a different condition from the original one, as in the case of the residual and metamorphic rocks.

Miscellaneous.—Levy and Lacroix[7] describe a Carboniferous leucite-tephrite from Clermain, that is associated with micaceous porphyrites. The tephrite contains large leucites and pyroxenes in a groundmass composed of biotite, augite, plagioclase and leucite. All of this latter mineral, whether in large or small crystals, is transformed into aggregates of albite.

Palache[8] announces the discovery of riebeckite and aegerine in the

[8] Neues Jahrb. f. Min., etc., 1895, I, p. 100.

Forellen granulite of the Gloggnitzer Berges, near Wiener-Neustadt in Austria. The rock is a typical granulite, consisting of a quartz-plagioclase aggregate in which are imbedded acicular crystals and grains of the amphiboloids mentioned.

[6] Neues Jahrb. f. Min., etc., B. B., ix, p. 129.

[7] Bull. Soc. Franc. d. Min., xviii, p. 24.

GEOLOGY AND PALEONTOLOGY.

A Batrachian Armadillo.—The significance of certain fragments which I observed several years ago in Permian material from Texas, has been established by a more complete specimen which I have received from the same locality. This consists of a portion of the skeleton, which includes ten consecutive vertebrae and their appendages, of the rhachitomous type, similar in general to those of Trimerorhachis. The genus differs from Trimerorhachis in this important respect. The neural spines are elevated, and the apex of each sends a stransverse branch which extends in an arch on each side to the ribs. These spinuous branches touch each other, forming a carapace. Above and corresponding to each of them is a similar dermal osseous element, which extends from side to side without interruption on the median line, forming a dermal layer of transverse bands which correspond to the skeletal carapace beneath it. To this remarkable genus I propose to give the name of Dissorophus. It is a veritable batrachian armadillo.

As to species characters, it is to be remarked that the intercentra are longer in proportion to their width than in the *Trimerorhachis insignis.* The heads of the ribs have a small free truncate angle below their capitulum. The extremities of the spinous roof-processes are free from each other for a short distance, and each has a depressed rounded sharp edge. The dermal bands above them terminate a little proximad of them and in a similar manner, and their extremities are closely appressed to the surface of the band below them, with which they slightly alternate. Their surface is very coarsely rugous, with ridges and fossae, whose long axes agree with those of the segments. This species I propose to call *Dissorophus multicinctus.* Length of ten vertebrae in place 93 mm.; width of intercentrum 16; length of do 9; elevation to roof 30; thickness of carapace 8; width of a carapacial band 9; length of do on curve 75. The species appeared to have been about the size of the Japanese salamander *Megalobatrachus maximus.*

The genus Dissorophus adds another to the remarkable forms already known from the American Permian. It is remotely approached by the genus Zatachys Cope, where a dermosseous scute is coössified with the apex of the neural spine.—E. D. Cope.

Cope on the Temporal Part of the Skull, and on the systematic position of the Mosasauridæ—A reply.—In the September Number of this Journal Prof. Cope has published a review of two of my papers (Bemerkungen über die Osteologie der Schläfengegend der höheren Wirbelthiere Anat. Anz. x, 1894, pp. 315–330 and: On the Morphology of the Skull in the Mosasauridæ, Journ. Morphol. VII, 1892, pp. 1–22, pl. I–II), to which I should like to make some remarks.

1. *The Paroccipital.*

The bones of the temporal region in question I have termed squamosal, prosquamosal and quadratojugal. Cope states that I adopted the name prosquamosal (Owen, 1860), because the name supratemporal was used previously for a different element peculiar to the Teleostomous fishes. But this was not the only reason; the principal reason was, that with the name supratemporal, totally different elements were designated in the Stegocephalia and Ichthyosauria and in the Lacertilia (Anat. Anz. x, 1894, p. 320.)

Cope has called the three bones, the paroccipital, supratemporal and zygomatic, "after earlier authors" as he says. But the paroccipital is not the squamosal, the name supratemporal is misleading as stated before; and the name zygomatic has been used since the beginning of Anatomy, for the jugal or malar; how can Prof. Cope use this name for the quadrato-jugal? I thought I had shown once for all, that the opinion held by Prof. Cope, that the squamosal of the Squamata is homologuous to the paroccipital (opisthotic) is wrong. But it seems, that he is not convinced. He is, however, the only one among all living morphologists who has this opinion.

He believes that the exoccipital together with the paroccipital process in the Reptilia in which there is no free paroccipital (Ichthyosauria, Testudinata) represents the exoccipital alone. He states that nobody has ever found the paroccipital process as a separate ossification. But he is wrong about this: The free paroccipital, uniting later with the exoccipital and forming the paroccipital process has been first described, as far back as 1839, by Rathke[1]; in *Tropidonotus natrix* and this passage has been translated by Huxley in his well known Croonian lecture on the Theory of the Vertebrate Skull, delivered the 18st of November, 1858 before the Royal Society. It was also described by Leydig[2] in *Anguis fragilis*, in 1872.

[1] Rathke, Heinrich Entwicklungsgeschichte der Natter. Königsberg, 1839, pp. 201-202.

[2] Leydig Franz. Die in Deutschland lebenden Arten der Saurier. Tübingen, 1872, p. 26.

The paroccipital has been described in *Sphenodon* by me in 1889[3] in the following words. "In the old animal supraoccipital, exoccipitals, paroccipital, petrosals are united, but on the young all these elements are free. There is much cartilage between the supraoccipital and the petrosal and paroccipital. The paroccipital is united to the exoccipital by suture, the elements in question of a young *Sphenodon* resemble those in Chelone and especially in Ichthyosaurus." I may state here, that in a skull of *Sphenodon*, of 50 mm. in length from anterior end of premaxillary to occipital condyle, the suture between exoccipital and paroccipital is quite distinct, and also the characteristic Y-shaped sutures between the paroccipital, supraoccipital and petrosal.

Siebenrock[4] has independently, not knowing my paper in the Journal of Morphology, found out the same in *Sphenodon* and has given very good figures of the conditions. He has also shown in an absolutely convincing way,[5] that in the Lacertilia the paroccipital process is also homologuous to the paroccipital, and has given excellent figures demonstrating it. These two papers were mentioned by me in the paper published in the Anatomischer Anzeiger, discussed by Prof. Cope, but he certainly did not consult the papers, which are easily accessible.

After this demonstration of the free nature of the paroccipital in *Sphenodon* I think Prof. Cope will have to give up his view on the homology of the paroccipital of the Testudinata with the squamosal of the Lacertilia. I do not understand, how Prof. Cope could fall into such a fundamental error. We know since Hallman and it has since been redemonstrated dozens of times, that in the Reptilia and Birds, the semicircular canals of the ear are placed into 3 bones: 1, the petrosal; 2, the supraoccipital and 3, the paroccipital. These 3 bones come together and form that exceedingly characteristic Y-shaped suture, first mentioned by Hallman, and fully discussed by Huxley in his lectures on the Elements of Comparative Anatomy, London, 1864.

He already stated in his Croonian Lecture: "when the petrosal, mastoid (paroccipital) and squamosal are determined in the turtle, they

[3] Baur, G. On the Morphology of the Vertebrate Skull. Journ. Morph., III, 1889, pp. 467–468.

[4] Siebenrock, Friedrich. Zur Osteologie des Hatteria-Kopfes. Sizungsberichte d. Kais. Akad. Wiss. Wien. Mathem. naturw. Cl. Bd. CII, Abth. I, Juni, 1893, pp. 7–10. Pl. fig. 3. 5.

[5] Siebenrock, Friedrich; Das Skelet der *Lacerta simonyi* Steind., und der Lacertiden familie überhaupt; Sizungsb. d. Kais. Akad. Wiss. Wien. Mathem. naturw. Cl. Bd. CIII, Abth. I. April, 1894, pp. 4–9, Fig. Pl. III.

are determined in all the Reptilia. But the Crocodilia, Lacertilia Ophidia, differ from the turtle and Chelonia generally, in that their mastoid (paroccipital) is, as in the bird, anchylosed with the exoccipital." The matter is so simple and clear, that it can be demonstrated to any student who begins his work in Osteology.

Prof. Cope also states, that he has been hitherto alone in the opinion that the suspensorium of the quadrate of the Ophidia is the squamosum of the Lacertilia, but he forgets that this opinion was held already by Spix[6] in 1815. who has given excellent figures of these conditions in Lizards and Snakes; by Hallmann, Troschel, Gegenbaur and many others before 1870, when Cope read his paper.

Prof. Cope believes that the squamosal (his paroccipital) in the squamate can not be homologous with the squamosal in the Ichthyosauria, Colylosauria and Stegecephalia, with which it is identified by me, since it is a brain-case bone, while the latter is a temporal roof-bone, a fundamental difference, as he says. I never knew that the squamosal (paroccipital, Cope) of the Squamata is a brain-case bone, it is certainly not in the many skulls I have examined, but is homologuous to the squamosum of the Stegocephalia and Ichthyosauria is shown by *Saphæosaurus* which bridges over *Sphenodon* with *Ichthyosaurus*. In regard to the homologies and nomenclature given in my paper in the Anat. Anz. I have not to change a single point.

2. *The systematic Position of the Mosasauridæ.*

"Like Owen, Marsh and Dotto, he [Baur] does not perceive that this group (Mosasauridæ) is essentially distinct from the Latertilia, and concludes with them that I have erred in alleging it to present affinities to the Ophidia." Cope, p. 857.

In order to determine this matter, Prof. Cope, thinks it necessary to know, what the characters are that distinguish snakes from Lizards. The first character, the descending of the parietal and frontal bones to the basicranial as is in the Ophidia is as he admits himself, not constant, being found also in the Amphisbænians and Anniella.[7]

As a second character he mentions, that the prosquamosal (supratemporal) is present in the Lacertilia, but absent in the Ophidia, stat-

[6] Spix J. Baptista, Cephalogenesis, sive capitis ossei structura. gr. fol. Monachii, 1815.

[7] I may mention here the interesting fact that in some Amphisbænians, the parietals and frontals are connected by a especial element with the basisphenoid, in other genera they unite with this element. The basisphenoid of snakes is also a composite of this bone and the basisphenoid proper.

ing the Amphisbænians and Anniellidæ to be exceptions; but the Geckonidæ and Uroplatidæ also lack the prosquamosal. Therefore, this character does not hold.

A third distinction according to Prof. Cope is that the quadrate bone is supported by the paroccipital [squamosum] in the snakes, and the exoccipital [paroccipital] in the Lizards. In the Mosasauridæ the squamosal (paroccipital) is said to be more largely developed than in the Lacertilia, and that it supports the quadrate bone as in the Ophidia.

This is by no means correct. It is the squamosal (paroccipital, Cope) which supports the quadrate in most of the Lacertilia; in some forms only, the paroccipital (exoccipital, Cope) takes part (Chamæleon). But in many Lizards, the Iguanidæ for instance, the paroccipital processes do not support the quadrate at all. This character, therefore, falls to the ground. I can not see any principal difference in the relation of the squamosal (paroccipital, Cope), the paroccipital (exoccipital, Cope) and quadrate in the Mosasaurs and the Iguanidæ. In the squamosal (paroccipital, Cope) of *Platecarpus* (fig. 20, 21, Pl. II) of my paper we can distinguish 3 portions: first, an upper one, which joins the parietal processes; second, an inner one which is suturally united with the paroccipital and petrosal, and a lower one, which supports the quadrate.

In a skull of *Conolophus* (Iguanidæ) before me, I find very similar conditions, the inner process only is not so much developed, but it reaches the petrosal. The differences enumerated by Prof. Cope between the Lacertilia and Mosasauridæ do not exist; and I can not discover one trace of a character of the snakes. The phlogenetic conclusions of Prof. Cope are not supported by the facts. I believe as firmly as formerly, that the Mosasauridæ are true Lacertilia adapted to aquatic life; and that their closest living representatives are the Varanidæ. The Varanidæ have retained the terrestrial limbs, and the free nasal bones but have lost the postorbital bar. The Mosasauridæ have required fins with digits[8] with numerous phalanges, the nasals have become united with the premaxillaries, but the postorbital arch has been retained.

[8] In a specimens of *Thorosaurus*, which I have lately examined through the kindness of my friend, Prof. S. W. Williston, Lawrence Kas. I find in the fore-limb the following number of phalanges.

1st. digit 5 (+3); probably 8, the 5 proximal ones are preserved.
2nd. digit 7 (+2); probably 9, the 7 proximal ones are preserved.
3rd. digit 9 (+1); probably 10, the 9 proximal ones are preserved.
5th. digit 10 (+1); probably 11, the 10 proximal ones are preserved.
5th. digit 11 or 12; all preserved, but some covered up.

Reply to Dr. Baur's critique on my paper on the Paroccipital bone of the Scaled Reptiles and the Systematic Position of the Pythonomorpha.—In the following pages I continue the discussion of the questions raised by Dr. Baur in his papers.

I. THE PAROCCIPITAL OF THE SQUAMATA.

Dr. Baur in the paper just preceding reiterates the opinion that the parotic process of the exoccipital bone of the scaled reptiles includes the paroccipital element, and that I have fallen into a serious error in supposing that his squamosal is the true paroccipital. He cites various authorities against me and intimates that I am not familiar with the literature, which he says is accessible. In this last statement he is undoubtedly correct, as the greater part of it is in my private library.

I must call my critic's attention at the outset to the fact that my last paper has reference to the elements which support the quadrate bone, and not to the presence or absence of the opisthotic element of Huxley. It was not necessary, therefore, to enter into an exposition of the evidence for the existence of the latter which, as he says, has been proven by Siebenrock and Leydig in the lizards, Rathke in the snakes, and himself and Siebenrock in the Rhynchocephalia. It is the element which supports the quadrate bone for which the name paroccipital (Owen) is appropriate, while the element which includes the posterior semicircular canal is the opisthotic of Huxley.

Baur asserts that the so-called parotic process of the exoccipital which supports the quadrate in the Squamata is the same element as that termed opisthotic by Huxley. This I deny, and believe that in this it is Baur and not myself who has fallen into error. Siebenrock instead of asserting this to be the case, denies it in the following language:[9] "It is not the processus paroticus of the pleuroccipital (exoccipital) which is homologous with the (paroccipital Owen) opisthotic Huxley, but the portion anterior to the foramen nervi-hypoglossi superius which protects the organ of hearing." Siebenrock here uses the names of Owen and Huxley as referring to the same element, but he makes the clear distinction, which is the important point, between the parotic process of the exoccipital and the element which contains the posterior semicircular canal. What then is the element which articulates with the quadrate in the different orders of the Reptilia?

In the Testudinata, and, according to Baur, in Sphenodon,[10] the

[9] Sitzungsber. Wiener Akademie, 1894, p. 285; On the Skeleton of *Lacerta simonyi*.

[10] Siebenrock, Sitzungsberichte Wiener Akad. Wiss, 1893, p. 254.

element which extends externally from the exoccipital to the quadrate is continuous with the opisthotic, but the semicircular canal is included in its proximal part only. Here the structure is entirely different from that which characterizes the Squamata, where the opisthotic does not extend distad of the canal and fuses early with the exoccipital. This character is to be added to those which distinguish the Rhynchocephalia from the Squamata. The paper which Dr. Baur criticizes above had reference to the Squamata, and the question at issue is what is the element attached to the end of the parotic process of the exoccipital in this order, which I call paroccipital, and which Dr. Baur calls squamosal. That it is not the opisthotic is clear enough.

The reasons for supposing that the element which I call paroccipital in the Squamata is really such, are as follows. In the orders Testudinata and Rhynchocephalia, where a continuous element extends from the posterior semicircular canal to the quadrate, this so-called paroccipital is not distinct. In the Squamata, where the opisthotic is restricted to the region of the canal and does not reach the quadrate, this so-called paroccipital is distinct. It becomes then probable that the paroccipital of the Squamata is represented by the distal, non auditory part of the element whose auditory portion is the opisthotic of the Testudinata and Rhynchocephalia. This hypothesis is confirmed by the structure in the Pythonomorpha, which is intermediate between that of the two types mentioned. The paroccipital extends proximad to the position of the opisthotic and petrosal, which it does not do in the Lacertilia or the Ophidia.[11]

Neither Owen nor Huxley distinguished the single element of the Testudinata as composed of two. The name paroccipital is the prior, and I have retained it for the distal or quadrate portion, while Huxley's name of opisthotic belongs to the auditory portion for which he designed it. The direct evidence for such a primitive division of this element in the Testudinata has, however, yet to be produced, and I am entirely willing to give up the view above defended should it turn out on further investigation to be untenable.

II. The Affinities of the Pythonomorpha.

No one who has examined carefully the relations of the paroccipital to the surrounding proximal elements in this suborder and compared them with their relations in the Lacertilia, can fail to see the important difference between the two. My opportunities of studying

[11] See Transac. Amer. Philos. Soc., 1892, p. 19, where the structure in Mosasaurus is represented in fig. 3.

these characters have been good, including the principal collections of European Museums and those of this country. I have at hand crania of all but one or two of the North American genera of Lacertilia, and the principal ones of all other countries, and I maintain that the difference between them and the Pythonomorpha is universal. I maintain, contrary to Dr. Baur's statement, that in all Lacertilia the exoccipital supports the quadrate, and that in the Pythonomorpha and the Ophidia the exoccipital does not support it or generally touch it. I also maintain that the paroccipital (squamosal Baur) does support the quadrate in the Ophidia, while it is only in contact with a very small part of it in the Lacertilia. This assertion is true of the Iguanidae as well as of all other Lacertilia. Of this family I have many crania. These do not include Conolophus, to which Dr. Baur refers, but I have the nearly allied genus Cyclura, which has the character of other Lacertilia in this respect. Steindachner's figures of Conolophus show that it closely resembles Cyclura in the point in question, and I have no doubt that if Dr. Baur will take to pieces the proximal articulation of the quadrate of Conolophus as I have done in Cyclura, he will find an articular facet on the exoccipital and none on the paroccipital (squamosal). In fact the quadrate extremity of the paroccipital in Lacertilia is so insignificant, and the proximal end of the quadrate is so considerable, that the support of the latter by the former is a mechanical impossibility. Since the articulation of the quadrate in Pythonomorpha, of which I have seen all the American genera, is exclusively with the paroccipital, it is clear that the distal as well as the proximal relations of that element are different from those of the Lacertilia. On the other hand the relations to the quadrate are the same in the Pythonomorpha as in the snakes, and the proximal articular characters are approached by the Tortricid snakes more nearly than by any lizard. In the distal articulation of the paroccipital with the supratemporal, the Pythonomorpha and lizards agree, as was long since pointed out by authors.—E. D. Cope.

Recent Elevation of New England.[12]—I submitted some conclusions to the American Association for the Advancement of Science in advance of the preparation of a detailed paper upon this subject. Indeed in a discussion of a paper by Prof. C. H. Hitchcock before the Baltimore meeting of the Geological Society of America (December 1894) the present writer called attention for the first time to certain terrace phenomena which might be used as a yard stick in

[12] Read by J. W. Spencer at the Springfield meeting of the Am. Ass. Adv. Sci.

measuring recent terrestrial elevations. Since that meeting I have gone over many critical localities and the phenomena confirm the conclusions then announced. The importance of this contribution is not so much in a determination of the magnitude of post-glacial elevation as in finding a means of physical measurement of it and in my consequent challenge of the doctrine of ice dams in the late formation of high-level beaches and terraces. For no apparent reason has the structure of the terraces escaped early observation to such a degree that hitherto it has not been described in such a way as to be used as a meter of recent terrestrial changes of level.

The structure may be briefly set forth. The terraces are not those of the sloping rivers, but are the much more horizontal remains of water plains. The platforms do not merge from one step to the next below and thus make the ancient slopes of the rivers as has been often assumed, but they abruptly descend as steps to the lower plains. Thus a small meadow widens out into a broad flat, with the river near the surface of the plain along the upper part of the flat, but further down, it descends to greater depths below the same floor or plain, which on being eroded become a lateral terrace bounding the still lower plains. Thus as meadows, plains and remanie terraces, the same platforms may often be traced for many miles in length, disappearing owing to erosion, and to the distance of the terraces from the source of supply of sands and gravels. The terraces often cross the country and extend from one valley to another. Subject to certain corrections, these meadows, flats, and terraces mark the lowering of the base planes of erosion, or in other words indicate the elevation of the land. That is to say, the land has approximately been elevated as much as the sum of the heights of the terrace-plains one above the other. In some places, these are situated only a few feet apart in elevation, yet in other localities several of the steps are so combined that the great terraces may be from 50 to 250 feet above the river. Occasionally, in the course of a few miles, scores of terraces, may be ascended or descended and counted with certainty. Yet at any one locality, there are seldom more than four or five lateral terraces distinguishable; but these four or five are not identical with the four or five platforms observed several miles away, in the same great valleys.

Such distinct terraces are seen to an elevation of 2700 feet at the base of Mount Washington, with terrace material much higher, but without the preservation of the structure upon the steep mountain slopes. The terrace forms described have now been observed under so many conditions and over such a wide extent of territory that they appear to be the prevailing conditions and not exceptional.

Did these accumulations in the great valleys, often two miles or more in width, occur only on the northern and western sides of the high lands the theory of glacial drains might be supported. But they also occur on the southern and eastern sides of so many mountain masses so as to preclude the idea of their formation in glacial lakes. And the author has found the same structure within a few degrees of of the equator.

The platforms are commonly cut out of till deposits filling preglacial valleys, and are covered with sands and gravels. From these evidences, the author concludes that the New England Mountain regions have been elevated at least 2700 feet in the post-glacial epoch, or in other words the post-glacial submergence was at least 2700 feet in New England, but much less farther westward. Although this great continental movement has so recentlv occurred, yet the magnitude of the coastal changes have not yet been fully considered, but it was probably much less.—J. W. SPENCER.

BOTANY.[1]

Sacaline.—Under this name a species of *Polygonum* (*P. sachalinense* F. Schmidt, from Saghalin Island) has been freely advertised in this country within the last six months as a forage plant, especially adapted to the conditions which prevail upon the Great Plains. Extravagant claims as to its great value were made by dealers who wished to supply the farmers with roots or seeds. It was said that from one hundred to nearly two hundred tons of the plant could be grown upon an acre, and the forage yielded by it was said to nearly or quite equal that of Alfalfa or Red Clover in nutritiousness.

For two years the writer has watched carefully a clump of this plant growing upon a favorable spot upon the campus of the University of Nebraska. In spite of the fact that the plants have had better care than they would have in an ordinary field, they have made but a moderate growth, at no time exceeding three feet in height. The clump is moderately ornamental, about as much so as a fine growth of dock (*Rumex*), and less so than rhubarb (*Rheum*). The foliage is neither dense nor abundant, while the stems and branches are very

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

tough and hard; the latter are evidently unfit for forage, while thus far no animals have shown any disposition to eat any part of the plant.

While it blossoms freely late in the summer, it has not produced seeds. It is slowly spreading under the ground by its creeping root-stocks.—CHARLES E. BESSEY.

Saccardo's Sylloge Fungorum.—The eleventh volume of this work has recently appeared. It contains 4220 additional species, scattered through the whole of the fungi. Many of the descriptions are rather badly mutilated, often being reduced to little more than mere measurements. This suggests that the author may have become weary of his work, and that we have in this volume the last of the Sylloge. The total number of species thus far described in the eleven volumes of the Sylloge is 42,383.—CHARLES E. BESSEY.

North American Fungi.—The thirty-third century of Ellis and Everhart's "North American Fungi" appeared not long ago. The former excellence of this standard distribution is fully maintained in the present volume. The more important genera represented are *Cercospora* (5 species), *Phyllosticta* (8 sp.), *Puccinia* (3 sp.), *Ramularia* (4 sp.), *Septoria* (11 sp.), and *Valsa* (5 sp.).

Hough's American Woods.—This distribution of wood sections has reached Part VI, bringing the number of species thus far represented up to about one hundred and fifty. The part before us is devoted to the woods of the Pacific Coast. The species represented are *Rhamnus purshiana, Aesculus californica, Cercidium torreyanum, Prosopis juliflora, Cercocarpus parvifolius, Garrya elliptica, Arbutus menziesii, Arctostaphylos pungens, Chilopsis saligua, Platanus racemosa, Quercus garryana, Quercus agrifolia, Quercus densiflora, Castanopsis chrysophylla, Salix lævigata, Libocedrus decurrens, Sequoia gigantea, Sequoia sempervirens, Taxus brevifolia, Torreya californica, Pinus lambertiana, Pinus ponderosa, Pinus contorta, Picea sitchensis, Pseudotsuga taxifolia.* These sections should find a place in the collections of every botanical department of the universities of the country, and for the forestry departments of our agricultural colleges they are indispensible.

CHARLES E. BESSEY.

Seymour's Grasses and Grass-like Plants of North America.—The second half-century of this useful collection was sent out during the summer. The numbers from 51 to 61, inclusive, include sedges, the remainder being true grasses. The specimens are large and well dried, and the labels are full and of neat form and size. Occasionally, a specimen is somewhat deficient in roots, a fault which may easily be avoided in subsequent issues.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.[1]

Saccardo's Color Scale.—The learned author of the Sylloge Fungorum has issued a second improved edition of his color scale (*Chromotaxia seu nomenclator colorum polyglottus additis speciminibus coloratis ad usum Botanicorum et Zoologorum.* Editio altera. Patavii. Typis Seminarii, 1894) which is very useful and ought to be in the hands of every botanist. The pamphlet contains 22 pages of Latin text and two well executed tables of 25 colors each. The text gives in regular order, from left to right: (1) The Latin name of the type color. (2) Latin synonyms. (3) Latin names of colors approaching the typical color. (4) Italian names. (5) French names. (6) English names. (7) German names. (8) Explanatory remarks. To illustrate, we have under the first entry: "Albus. Candidus, niveus, ermineus, virgineus, calceus, gypseus, cretaceous, cerussatus, olorinus. Albatus, albicans, albidus, albidulus, albineus, albinus, albulus, eburneus; pallidus, pallens, pallidulus; lacteus, lacticolor, galactites, galochrous; argenteus, argyraceous; candicans, canescens. Bianco, eburneo, pallido, latteo, argenteo, canescente. Blanc, blanc d'ivoire, pâle, blanc de lait, argentin. White, ivory-white, pallid, milk-white, silver-colored. Weiss, elfenbeinweiss, blass, milchweiss, silberfarben. Typical examples: *Lime, gypsum, snow, white lead, ermine.* Pallidus is an impure white. Argenteus, argyreus (from *argyros,* silver) is a metallic, shining white. Lacteus is the color of fresh cow's milk. Galactites, galochrous are from *gala,* milk. Candicans, canescens is pure or impure white resulting from a tomentum such as on the under side of the leaf of *Populus alba* or *Alnus incana.* Olorinus (from *Cygnus olor*) is a pure shining white (example *Clitocybe olorina*)." An examination of the color scale cannot fail to deepen the impression that it is futile to attempt to use color terms in natural history without referring them to some particular scale or standard. On first thought, nothing seems less likely to be misunderstood than such terms as flesh-

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

color, bay, or chestnut, and yet these names and many others call up quite different conceptions in different minds, and, where much depends on the accurate description of colors, are sure to mislead, unless referred to some exact color scale or well known object or substance of invariable color. In this particular scale, for example, *ater* does not represent the usual conception of a lusterless coal black, but is a lighter color between plumbeous and slate; *latericius* is not the color of any bricks commonly found in this country, but rather what the writer would designate a light chocolate; *badius* is scarcely the color of a bay horse; and *incarnatus* is certainly *not* the lively color of the lips. These matters. however, are trifles provided the colors of the scale are made from pigments that will be permanent and provided those who use it as a guide remember that it represents in many cases not the universal concept of particular colors but only the author's, and specify accordingly, e. g., "*violaceus* Sacc., No. 47." It is to be regretted that directions for reproducing these colors are not given. To see how widely color concepts vary, even among distinguished naturalists let the reader compare Saccardo's hazel (7), isabella (8), chestnut (10), scarlet (15), cream-color (27), emerald green (36) glaucous green (38), violet (47), and lilac (48) with Ridgway's numbers, IV 12, III 23, IV 9, VII 11, VI 20, X 16, X 17, VIII 10, and VIII 19 which bear the same names but are by no means the same colors. Evidently the perfect color scale is yet to be put upon paper, and owing to defects in pigments is not likely to appear soon. Meanwhile we may be thankful for those we have, using them as intelligently as possible, and never forgetting to specify, in cases where color is important, the particular scale in which a similar color may be seen. Saccardo's scale has a special value to mycologists, since it affords the users of that immense and indispensable work, the Sylloge Fungorum, a ready means of determining in a thousand and one descriptions exactly what color is meant, provided, of course, the author has used the terminology of this scale consistently throughout.—ERWIN F. SMITH.

Kroeber's Transpiration Experiments.—It will be remembered that Müller-Thurgau believed he had demonstrated the amount of transpiration-water to be different in different varieties of vines and orchard trees, and that this fact could be turned to practical use by horticulturalists who, in dry soils or climates; should plant varieties, making small demands on transpiration, and in moist ones those transpiring abundantly. Very recently Mr. E. Kröber, assistant in the plant-physiological experiment station of the Königliches Lehranstalt at Geisenheim on the Rhine, has gone over the same ground in a long series of experiments (Ist die Transpirationsgrösse der Pflanzen ein Maassstab für ihre Anbaufähigkeit? *Landw. Jahrb.*, Bd. 24, 1895, H. 3, pp. 503–537) which throw doubt on Müller-Thurgau's methods and lead to the following opposite conclusions: (1) In determining the amount of transpiration the entire decrease in weight of the plant and apparatus must be taken into account and not simply the decrease of water in the flasks, since under pressure, in short experiments, the error resulting from the forcing into the wood of water which is not transpired is very considerable. (2) The demonstrated transpiration of any branch can *never* be taken as a measure of the transpiration of the whole tree. (3) The amount of transpiration of different branches of the same tree may be wider apart in many cases than that of branches of different trees or even of different varieties. (4) In parallel experiments, under exactly the same transpiration conditions, the ratio of the amount of water given off by different branches is by no means constant. (5) The influence and interchange of the different factors governing transpiration is quite different in different individuals. (6) The present condition of the individual and the circumstances under which it previously transpired have a great influence upon transpiration. (7) It follows that the amount of transpiration of a single individual cannot be regarded as a measure of the water requirements of the whole variety. According to the writer, Müller-Thurgau has also left out of account the capacity of individuals and varieties to adapt themselves to changed conditions.—ERWIN F. SMITH.

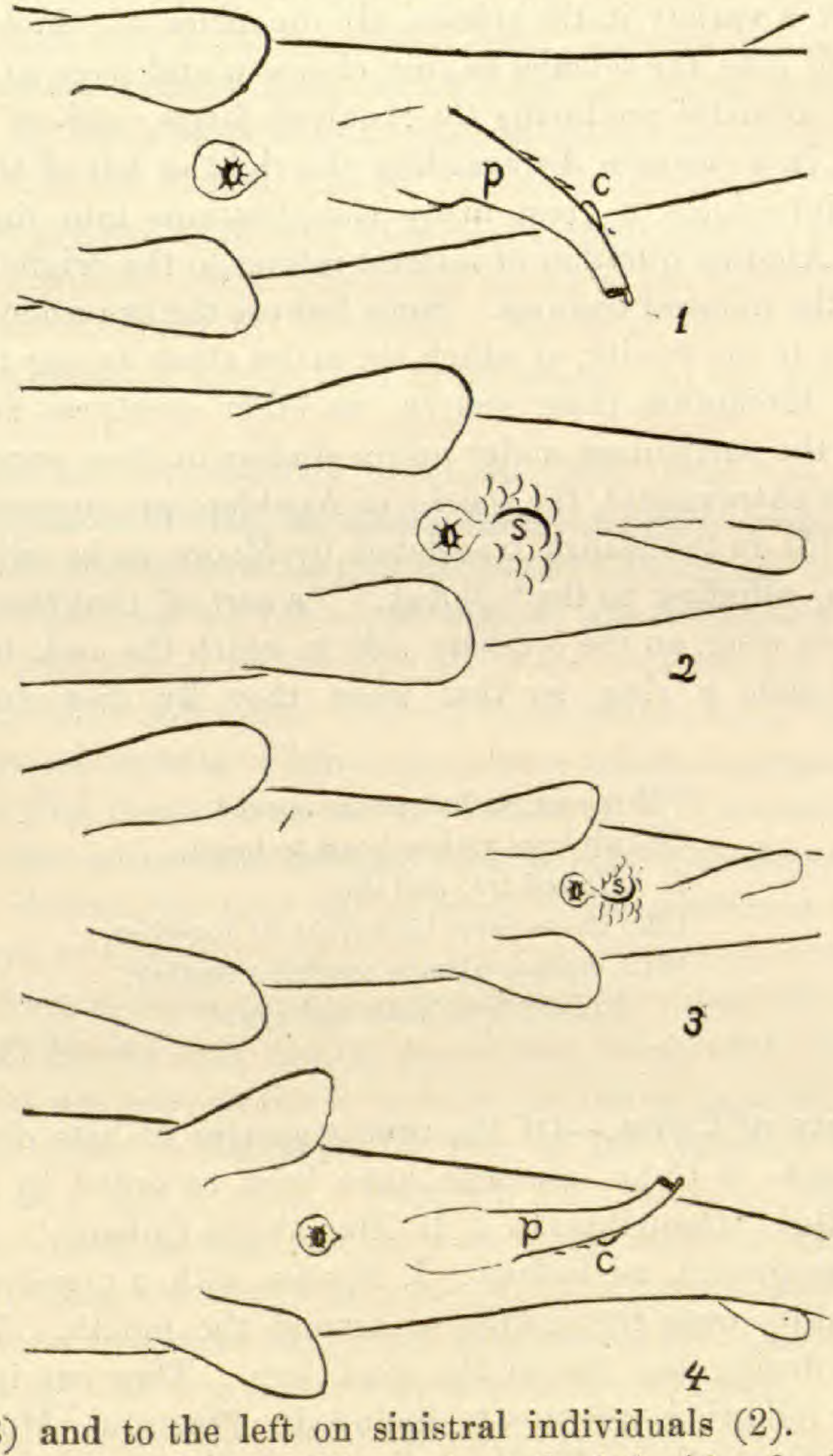
ZOOLOGY.

A Stratified Lake Fauna.—One of the most interesting results achieved by the naturalists of the Russian Biological Station on the island of Solowetzk in the North Sea, has been the discovery of a remarkable lake on the island of Kildine in the Arctic Ocean. This lake, which is completely separated from the sea by a narrow strip of land, was discovered by the Russian naturalist, M. H. Herzenstein, who was struck by finding in the lake a fish which is exclusively marine in habit, namely, the common cod. Further observations by MM. Faussek and Knipowitsch have elucidated the peculiar features of the fauna of the lake. On the surface the water is fresh, and is inhabited by fresh water animals, such as Daphnids, etc.; this water is brought to the lake by streams from a neighboring marsh. Under the superficial layer of fresh water is found salt water, supporting a Marine fauna—Sponges, Sea-anemones, Nemertines, Polychætes, marine Molluscs, Starfish and Pantopods. There is even a regular littoral zone beneath the fresh water, characterized by small Fuci.

The bottom of this lake is covered with mud exhaling an odor of sulphurretted hydrogen, and is not inhabited. The water of the lake shows a slight ebb and flow, attaining a vertical height of only a few inches, while the tides in the adjacent sea are considerably greater. This fact would appear to point to the existence of some subterranean communication between the lake and the sea. (Nature, July, 1895.)

Sexual Rights and Lefts.—The genus Anableps includes several species of the most extraordinary of the fishes. With other novel characters, they have the eye divided into a lower section, looking downward, and an upper protruded above the head conveniently for seeing on the surface of the water; the pelvis also is divided; and the young are retained in the ovary until well developed. Our present, interest, however, concerns only their means of fertilization. In a study of the Cyprinodonts (Monograph published as Vol. XIX, No. 1, of the Memoirs of the Museum of Comparative Zoology, from which this item is repeated) particular examinations of the anal fin of the males, which is modified into an intromittent organ, disclosed the fact that its structure adapts it for sidewise motion, rather than vertical. Directing attention to the species *A. anableps* of Linné (*A. tetrophthalmus* of others), comparisons of the males showed that this organ differs in individuals, being functionally dextral on about three-fifths, and sinistral on about two-fifths of the specimens. Among the females in the Museum's collection a similar state of affairs exists, but with the numbers reversed, two-fifths of them being rights and three-fifths lefts. Once possessed of the facts, dextrals and sinistrals are easily recognized. Happily Professor Agassiz, on his Brazilian Expedition, had provided a considerable amount of material to compare.

Of the accompanying diagrams, figure 1 represents the lower side of the hinder portion of a dextral male, figure 2 that of a sinistral female, figure 3 that of a dextral female, and figure 4 that of a sinistral male. In its posterior half the anal fin of the male (*p*), the sexual organ, is bent to the right on dextrals (1), or to the left on sinistrals (4); it has on the convex side of the bend a small fleshy tubercle or gland (*c*), while the urogenital tube lies along the concave side. The opening to the oviducts of the female, behind the vent, is covered by a larger scale (*s*), a foricula (a diminutive shutter), which opens to the right on



dextral (3) and to the left on sinistral individuals (2). Evidently copulation is effected by a right male at the left side of a left female, and by a left male at the right side of a right female, the anal (*p*) of the male being turned so as to bring its tip under the free edge of the foricula (*s*) into the mouth of the oviducts.

From the specimens examined it would appear, at sight, as if the male sex was eventually to become dextral and the female sinistral, and as if by selecting rights or lefts one might exclusively raise either rights or lefts as he chose; but the proportions of the sexes, and of dextral and of sinistral of each sex, in the progeny are really determined by tendencies in the ovary, tendencies which may vary from connection with different males, from food, temperature, etc. To bring about a variety in the species, all the males of which might be rights, or all lefts, the females to suit, choice would have to be made of individuals actually producing the required forms, and of particular conditions, in a measure disregarding the right or left of the parents. And this introduces a great many complications into the selection problem. Another question of interest relates to the origin and development of the unusual features. Some light is thrown upon this by an allied genus in the family, of which the males alone appear to be rights and lefts. Excepting these genera, no other creatures are recalled that are in the particulars under notice similar to these peculiar fishes. Though less extravagant, the species of Anableps are suggestive of the fanciful birds in the stanza translated by Moore, as he tells us, from the Persian, alluding to the "Jaftak," "a sort of bird that is said to have but one wing, on the opposite side to which the male has a hook, and the female a ring, so that when they fly they are fastened together:"

"How can we live so far apart?
Oh, why not rather heart to heart,
United live and die,
Like those sweet birds that fly together,
With feather always touching feather,
Linked by a hook and eye!"

—S. GARMAN.

The Bats of Cuba.—Of the twenty species of bats observed by Dr. Gundlach in Cuba, nineteen have been recorded by him in his paper entitled "Contribucian á la Mamalogia Cubana." He places them in two groups, as follows: I. Species with a nose-leaf or with fleshy wrinkles over the nostrils or around the mouth. They hang themselves during the day by the hind legs. They eat insects and fruit. The following genera are included: Macrotus, Monophyllus, Phyllonycteris, Artibeus, Phyllops, Brachyphylla, Mormops, Chilonycteris, Noctilio. II. Species without a nose-leaf and with no wrinkles about the mouth. These sleep in crevices and do not hang themselves by the hind feet. They eat only insects. The following genera are included: Molossus, Nyctinomus, Natalus, Vesperus, Nycticejus, Atalapha. (Abstr. Proceeds. Linn. Soc. New York, No. 7, 1895.)

Fatigue and Toxicity.—A series of experiments carried on by M. Redon show the toxicity of the blood of cattle that have died of fatigue. The arrival at the abattoir (Paris) of a consignment of cattle from South America gave opportunity for the experiments. Five individuals died after a panic stricken race. The autopsy revealed that the animals had suffered from both hunger and thirst during the long journey. Of three rabbits inoculated with the serum of the dead cattle the first, injected with a dose of 12 cubic centimeters, died in five hours; the second, inoculated with 5 cubic centimeters, was seized with a violent diarrhœa, which terminated its life at the end of the fifth day, having lost one-third of its weight; the third, having received one cubic centimeter of serum, died in 30 hours. In the first and third case the liver was very much congested and enlarged.

Although the intravenous injections differ from the accustomed mode of ingestion of food, M. Redon thinks it highly probable that the eating of the flesh of animals that have died from fatigue is detrimental to health. Acting on this presumption, the veterinary inspectors promptly quarantined all the animals of the consignment that showed signs of the fever of fatigue. (Revue Scientifique, June, 1895.)

Poisons of Putrid Fish.—In a short article, incorporated in the Bull. U. S. Fish Commission recently issued, Dr. J. Lawrence Hamilton points out the connection between foul fish and filth diseases. Beginning with cholera, he notes the outbreak of this disease in 1893, in the fishing ports of Grimsby and Hull, and instances cases of deaths which occurred from mussels, cockles and oysters from those infected ports.

It is well known that fishing populations, from their slovenly and dirty habits, are more prone to endemic as well as epidemic affections. The author refers to Astrakan, the seat of the sturgeon and caviare industries, as a case in point. Statistics show that the population of this place would become extinct were it not recruited from external sources. During the winter of 1878–79, the plague devasted the place, and the worst and most fatal cases were among the laborers employed in fish salting, who live under very miserable conditions. The price of bread being beyond their reach, they subsist chiefly on the leavings of the inferior parts of the prepared fish. Formerly, Government rules enforced that the unused remains of the prepared fish should be thrown directly into the the water, but now these, collected and accumulated in masses, are left to rot in and about the banks of the rivers under the heat of sometimes an almost tropical sun. The local atmosphere is further vitiated by many fat-boiling, fish-oil, isinglass, etc., works. During the five years preceding the outbreak of plague in 1878, enteric fevers, measles and small-pox were epidemic, whilst scarlet fever raged in 1876–77. Previous to 1878, the town of Astrakan, during 22 years, had suffered from nine epidemic attacks of cholera and three of enteric fever.

Such skin diseases as elephantiasis, ichthyosis, and beri-beri are suspected of being produced by a combination of fish, filth and poverty.

Wounds caused by the handling of decomposed fish are often very serious. The author gives a list of such cases. The Norwegian whalers take advantage of this fact by using prepared putrefactive poisoned harpoons. The whales are driven toward shore, surrounded by a net to prevent escape, and then struck with the poisoned harpoons. After twenty-four hours they show signs of exhaustion, probably through septic poisoning, and are readily captured. The harpoons are recovered and carefully preserved, without wiping, for future use.

The importance of the question of putrid food cannot be overestimated, hence the author's strong language in urging a better supervision of the fish-markets. Especially does he condemn the practices of leaving fish ungutted and unbled until sold, and of keeping fish soaked and sodden with water to make the skin look bright.

The foul condition of the boats, and of the boxes in which the fish are shipped to market, and the unsanitary condition of Billingsgate Market, are described in disgusting detail, and suggestions are given for, at least, mitigating these evils.

The infection of fish by impure preservatives, such as ice made from impure water and dirty salt and also bacterial infection, are referred to. In this connection the author remarks that "the cleanliness in the United States caviare factories is unknown in southern Russia, the home of astounding dirt and disease, augmented by the most hideous poverty and ignorance."

It has been supposed that prolonged soaking would render diseased animal food innocuous, but it would seem, from the experiments conducted by Prof. Pamem and again by Dr. Bremton that the vitality of poisons derived from putrid and other animal matter, though weakened, is not destroyed by boiling. Accordingly, to avoid all possible danger of the use of condemned food, the author recommends that it be burnt in properly-constructed local furnaces, and he includes, under this head, particularly "fish, its offal and refuse."

Another important suggestion as to public welfare is for all fish to be bled, gutted, cleaned, and dry-air-frozen at the place of capture. This would do away with many of the evils complained of, and is, moreover, a feasible business project. The author's investigations on this point warrant him in stating that "every day in the year, 2 pounds of bled, gutted, cleaned, dry-air-frozen (imperishable) fresh herring (about 6 fish) could be profitably retailed by costermongers for one penny, or 2 pounds of sprats for one halfpenny."

A sharp arraignment of the "Billingsgate Ring," which Dr. Hamilton accuses of diminishing the market supply of fish, in order to keep up the price, by getting the fish destroyed at various places along the coast, and a brief description of the "koshering" process for preserving animal food, closes this interesting paper.

The idea embodied in the article is, that foul fish is one of the most unwholesome, disease-producing factors in existence, but the conditions that result in such food being put upon the market are not necessary, but are due to ignorance, carelessness and greed, and can be remedied at no great expense. (Bull. U. S. Fish Commission, Vol. XIII, pp. 311–334).

ENTOMOLOGY.[1]

The Genera of Lysiopetalidæ.—The genus Spirostrephon was founded by Brandt on *Iulus lactarius* Say, in 1840. Owing to the fact that many subsequent naturalists have not had an equally vivid appreciation of generic characters and limits, Spirostrephon has usually appeared as a synonym of Lysiopetalum, the typical species of which is *L. fœtidissimum* (Savi).

Through the kindness of Mr. Pocock of the British Museum I have had the opportunity of comparing specimens of *fœtidissimum* with abundant material of *lactarium* from Pennsylvania, Ohio, and the District of Columbia. The form, and ornamentation of the body and the location of the repugnatorial pores render the generic distinctness evident, as Brandt pointed out. Brandt also remarks[2] the similarity with Cambala, but holds the genera distinct because the ocelli of Cambala are represented as arranged in a single row. There seems to be no ground for Latzel's inference that Brandt included Cambala under Spirostrephon.[3] Brandt saw but one specimen, which must have been young, as the length and number of segments are less than in mature specimens of *lactarium.*

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Recueil, p. 90.

[3] Myr. Ost. Ung. Mon., II, p. 353.

The Lysiopetalidæ seem to be in need of careful generic revision. The result would probably be the recognition of several new genera from Europe and Western Asia. Recently Dr. C. Verhœff has attempted to arrange some of the European species[4], and with his usual disregard for the association of generic names with their typical species has placed *Lysiopetalum fœtidissimum* under a subgenus Silvestria, while other species unknown to Brandt form the basis of the subgenus Lysiopetalum, *sensu strictu.* The conjecture is offered by Dr. Verhœff that *Lysiopetalum carinatum* Brandt belongs in the latter subgenus, and if this is really the case there is no need of a new generic or subgeneric name. According to Berlese[5] *Callipus rissonius* Leach (1826) is a synonym of *Lysiopetalum carinatum* Brandt, but the earlier designation having priority, Dr. Verhœff's second subgenus seems to be entitled to a name seventy years old.

The late Mr. C. H. Bollman conjectured from the description of Callipus that it is the same as Lysiopetalum, and proceeded to form the names of the family and superfamily accordingly. Mr. Pocock has adopted this suggestion. However, it seems clear that we must identify a type species for Callipus, or it is a *nomen nudum,* and may be neglected; also, if we are to use the name Callipus we must accept Berlese's identification until reasons to the contrary are shown, and the meagre description of Callipus will make these hard to find. I have examined a specimen purporting to be *Lysiopetalum carinatum* Brandt and agreeing with the original description, as far as that goes. The differences between it and the specimens of *fœtidissimum* are very considerable and render it probable that the two genera may be maintained on sufficient characters when a careful study of the European forms has been made. In the meantime we may accept the three genera as distinct, and continue the use of the older name Lysiopetalidæ, which would need to be resumed in case it were at any time proven that *fœtissimum* represents a generic type distinct from *rissonius,* whatever that may be.

The genus Eurygyrus C. L. Koch may also prove to be distinct, and the enormous species *Platops xanthina* Newport evidently represents an independent generic type, if the analogy of other Diplopoda does not fail in the Lysiopetalidæ. The genus *Platops* Newport was founded, according to Pocock, on *Lysioptalum lactarium* Say, and so becomes a synonym of Spirostrephon. Two other genera, *Cylindrosoma* Gray

[4] Zool. Anzeiger, XVIII, p. 207.

[5] Studi Critici dei Chilognati, etc., Part I, Julidæ, p. 31.

and *Reasia* Gray, have been referred to the Lysiopetalidæ. As no species have been published under them and practically no descriptions are given, they may be looked upon as *nomina nuda*, and not included in the synonymy of any of the genera. The following, then, are the genera of Lysiopetalidæ which have not been properly disposed of, and may for the present be assumed to be valid:

Genus Callipus Leach (1826); type *rissonius* Leach; locality, Nice.
Syn. (Subg.) *Lysiopetalum* Verhœff; type *illyricum* Latzel.

Genus Lysiopetalum Brandt (1840); type *fœtidissimum* (Savi); locality, Italy.
Syn. (Subg.) *Sylvestria* Verhœff (1895); type *fœtidissimum* (Savi).

Genus Spirostrephon Brandt (1840); type *lactarium* (Say); locality, North America.
Syn. *Platops* Newport (1844); type *rugulosa* (Gray)=*lactarium* (Say).

Genus Eurygyrus C. L. Koch (1847); type *rufolinatus* C. L. Koch; locality, Constantinople.

Genus Megastrephon nov.; type *xanthinum* (Newport); locality, Asia Minor.—O. F. COOK.

Habits of Ants.—In an interesting paper on the ants of India[6] Mr. G. A. J. Rothney reports that the nest of a colony of *Myrmicaria fodiens* Jerdon, under a banyan tree in the park at Barrackpore which had been constantly under the author's notice between 1872 and 1886 was still flourishing in January, 1894, showing a continuous residence in one spot of twenty-two years. In Madras he found *Monomorium salomonis* Lin. used in protecting bales of paper from white ants. The paper merchant scattered sugar around the sides of the bales every day to ensure the attendance of these red ants.

Concerning *Pheidole rhombinoda* Mayr. Mr. Rothney says: "I found some nests in Barrackpore Park, covered over in a perfect circle (taking the centre from the entrance, the circumference would equal about 10 to 12 inches), with the leaflets of some species of mimosa, but no leaflets were found in the nest itself on digging it up, and the even and umbrella-like appearance of the arrangements seems to suggest a protection against heat or rain, as the objects the ants have in view.

"In Madura, I came across a number of nests of a very curious and, to me, novel form.

"The entrances were surrounded by little mounds arranged in a circle, composed of the dead bodies, or parts of bodies, of *Camponotus com-*

[6] Trans. Ent. Soc. London, 1895, Part II, pp. 195-211.

pressus and *C. rufoglaucus,* but chiefly the big soldiers of compressus. There were heads alone, heads with the thorax attached, thorax without the head, bodies without thorax, with a scattering of legs and antennæ, attached and unattached, in every possible form, but I could not find any of these portions in the nests. Now the question arises, What are these mounds for, and how does Pheidole collect and form them? Are they simply carcases stacked, to be cut up at leisure and carried into the nest in suitable sizes for future provision, or are these bodies arranged as a grim warning to prowling enemies, after the fashion of skulls set up at the entrance to the villages of some wild and primitive tribe? and, then, how does Pheidole collect them? It is hardly possible that they are killed and brought in, for Pheidole would have to be in overwhelming force to master a single giant-headed soldier of compressus. Perhaps they act as undertakers, and collect the dead thrown out by Camponotus for some special purpose of their own; and, then, why should this trait break out in Madura, for certainly I have not met with it in other parts, although compressus and rhombinoda are practically common everywhere."

Mr. Rothney was unsuccessful in getting ants to stridulate while on the march. He thinks they do so, however and concludes that "in laying down rules for ant conduct some allowance should always be made for the different little traits of character, the whims and fancies, as it were, which are to be found not only in a given species but in individual ants."

Entomological Notes.—Mr. R. I. Pocock figures and describes[7] an interesting stridulating organ in the male of the spider *Cambridgea antopodiana* (White). He believes it is used as a sexual call, no such organ being found in the female.

Professors J. H. Comstock and V. L. Kellogg have prepared an extremely valuable laboratory handbook entitled The Elements of Insect Anatomy. It is published by the Comstock Publishing Co., Ithaca, N. Y.

Bulletin 48 of the U. S. National Museum consists of a Revision of the Deltoid Moths by Prof. J. B. Smith. There are 126 pages of letterpress and fourteen plates of figures.

"A Preliminary List of the Hemiptera of Colorado" is the title of Bulletin 31 of the Colorado Agricultural Experiment Station. In it Messrs. Gillette and Baker have prepared a faunistic paper of unusual value. There are 647 species listed, belonging to 261 genera; five new genera and 111 new species are described.

[7] Annals & Mag. Nat. Hist., XVI, 230.

In Bulletin 33 of the U. S. Division of Entomology, Mr. L. O. Howard presents a valuable compilation concerning American Legislation Against Injurious Insects.

EMBRYOLOGY.[1]

Conjugation of the Brandling.—Of the many kinds of earthworms common in the Eastern United States one of the best known is the prettily colored but offensive-smelling species often called the striped worm from its conspicuous cross bands of red-brown and yellow, but known to the specialist at present as *Allolobophora fœtida.* It abounds in decaying vegetable matter especially in compost and manure heaps where it lies a few inches beneath the surface and may be readily captured though quick and active in its movements. In some regions it is regarded by the youthful angler as especially attractive bait for trout and as bait it has been used ever since the days of Isaac Walton who refers to it repeatedly in the Complete Angler by a name too characteristic to be lost from our vocabulary—the brandling. Thus in speaking of bait for the perch he says—"and of worms the dunghill worm called the brandling I take to be the best, being well scoured in moss or fennel."

It is well known that earthworms, though they are hermaphrodites yet interchange sexual products in a remarkable process of conjugation. Our knowledge of this process, is however, confined to the accounts of two naturalists who studied the large European earthworm *Lumbricus terrestris.* W. Hoffmeister, whose work on earthworms published in Brunswick in 1845 was the pioneer in a field that was later so diligently tilled by French and of late by English specialists, observed the worms as they came out on the surface of the ground in the night-time and obtained a pretty good idea of the main phenomena of conjugation.

His account is in the main as follows: "The old worms leave their holes first, the younger ones only when it is quite dark. They protrude their bodies with great caution and very slowly, after resting a while they feel about with the anterior end of the body till they reach a neighbors's hole or come upon another worm. They now crawl along

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

against and carefully examine one another. If the worm that is found is not mature or even if it is smaller than the seeker, greeting does not last long and the worm continues his search in some other direction till he succeeds in finding some other individual like himself . . . .

. . . . He generally finds one waiting or else entices one from its hole by thrusting his head into it. They undulate against one another; now one now the other drawing back is always followed by his companion. The movements soon become more active; they strike one another with their heads.

At length they both lie still with the ventral surfaces near together. The body begins to undulate, especially at the girdle and within a few minutes the sucking action of the girdle comes into play to establish a more firm union of the two animals. The side parts of the girdle that bear the sucking disks are spread out in wing-like expansions while the ventral part is much drawn in. In this way a sort of tube is formed and in this the other individual is enclosed.

The mutual adjustment of one to the other becomes more and more close and accurate while the undulations of the transverse muscles and of the girdle constantly increase. Meanwhile mucous flows copiously from the dorsal pores and from the girdle. Usually a lot of young worms now assemble and greedily suck up the mucous.

The pair lie motionless for a good half hour before the seminal fluid could be seen flowing out . . . .

Once I watched for a pair the day after conjugation, in vain, but the following day I found one of the two in conjugation again. Conjugation seems to be repeated so often that one may imagine a separate fertilization for each egg.

In the above account all that refers to the actual transfer of sperm has been omitted as it contains many errors that have been corrected by our only reliable authority on this problem, Ewald Hering,[1] who in 1856 as a medical student in Leipzig made so careful a study of the reproductive organs of the earthworm that many years elapsed before his discoveries were rediscovered and introduced into text books in place of the erroneous views long lingering there.

His account of the conjugation of earthworms is all the knowledge we have of the process, at present, and is here translated in full to make intelligible the facts that we have to add in regard to conjugation in the brandling.

" When conjugating the worms lie in opposite directions with their ventral sides applied to one another. By drawing in the ventral side

[1] Zeit. f. wiss. Zool., VIII, 1856.

each hollows out the girdle and the neighboring rings into a boat-shaped depression. The other worm lies in this excavation. There is then a copious secretion of mucous that gradually hardens on the surface and encloses both worms is a common envelope. The union becomes closer and closer, especially so in the regions of the girdle and of the male openings.

The ventral elevations of the girdle always lie opposite to the 9th, 10th and 11th rings of the other worm while the ventral elevations about the male openings lie opposite to the 26th ring.

The elevations of the girdle begin to contract rhythmically. Anterior to the girdle the region between the upper and lower setæ on each side swells up as a longitudinal elevation bounded by two longitudinal grooves. As the worms lie on one side this can be seen only on the other, upturned side. This elevation forms gradually from behind forward as far as the 15th ring when it terminates in the glandular swelling about the male opening. In a live worm the position of the grooves bounding the above elevation is indicated by two more or less darkly pigmented parallel lines on each side from the 15th ring to the girdle (Hoffmeister erroneously regarded these as canals). When a worm is thrown into spirit it generally forms in its violent contractions both the longitudinal elevations and the boat-like excavation of the girdle.

Since the ventral surface is flattened out or even made concave during conjugation the ridges of both worms lie pretty close together and the lower or less essential furrow is concealed from observation. The upper furrow, however, is evident as a longitudinal groove along which we may see waves of muscular contraction passing from before backward. This contraction consists essentially in a change in the furrow and its rims. The rims draw together to form a pit in the 15th ring which then passes back to the girdle, like the trough of a wave. In one minute about fourteen such pits may be seen to form and pass back.

The ejection of sperm takes place only after an hour or more from the beginning of conjugation. We see a small drop ooze out of the slit in the elevation of the 15th ring and enter the longitudinal furrow where it looks like a white rod about as long as a ring is wide. This drop of sperm is taken up by the pit above described and led backward. When it has proceeded abouts its own length from the opening a new drop is poured out and so on. The ejection of sperm thus takes place with rhythmic interruptions and we see passing back in the furrow a row of small white rods separated by intervals equal to their own length. As the rods as well as the intervals between them just equal the length of a ring, every other ring will have a drop of sperm in its furrow at any given moment. The sperm thus flows from the 15th ring to the girdle outside the animals, covered only by a layer of mucous. We may calculate the time taken as about 80‴.

The girdle now becomes especially active. Its muscular elevations on the sides and at each end contract rhythmically about fifty-five times a minute to form shallow depressions which advance in a wave-like manner. The lateral depressions move downward and the end depressions toward the middle of the girdle ridge so that the sperm that has been poured out and accumulated between the worms under the girdle is concentrated, more and more, about the openings of the seminal receptacles, which lie opposite to the swollen part of the girdle. The same object is accomplished also by a second rhythmic motion that occurs about twice a minute; the lateral part of the girdle alternately presses against and lifts up from the other animal and so drives the sperm towards the openings of the seminal receptacles. There is no doubt that the sperm is taken into the seminal receptacles; their openings lie free under the mucous envelope and the sperm may be seen collecting about them. Perhaps the taking in is brought about by some sucking action of the receptacles. Though the ridge on the girdle continues to collect the sperm about the openings it cannot press it in as it does not cover them. G. Meissner mentioned accessory organs concerned in introducing sperm and eggs into these narrow openings, but as yet I have found none.

When the ejection of sperm is finished the longitudinal swelling and furrow slowly disappear in the direction opposite to that in which they appeared. The contractions of the girdle yet continue for some time till the sperm has so far disappeared that only a small drop remains about each opening of the seminal receptacles. When the conjugation has taken a normal course these white drops are found on both worms and on both sides of each. I often examined them microscopically and never found any eggs though they probably would have been present if, as Meissner supposed, they are taken into the receptacles along with the sperm.

At length the worms separate from one another by a powerful wrench for which the tail ends that still remain in the ground serve as points of resistance. If we cut off both tails at once the worms often remain united for hours. If thrown into spirit they die without separating.

The entire act of conjugation lasts two to three hours and may be easily observed under the lens since the worms are shy only in the early stages while when an intimate union has taken place we may use a brilliant light and even lightly touch without disturbing them.

PLATE XXXIII.

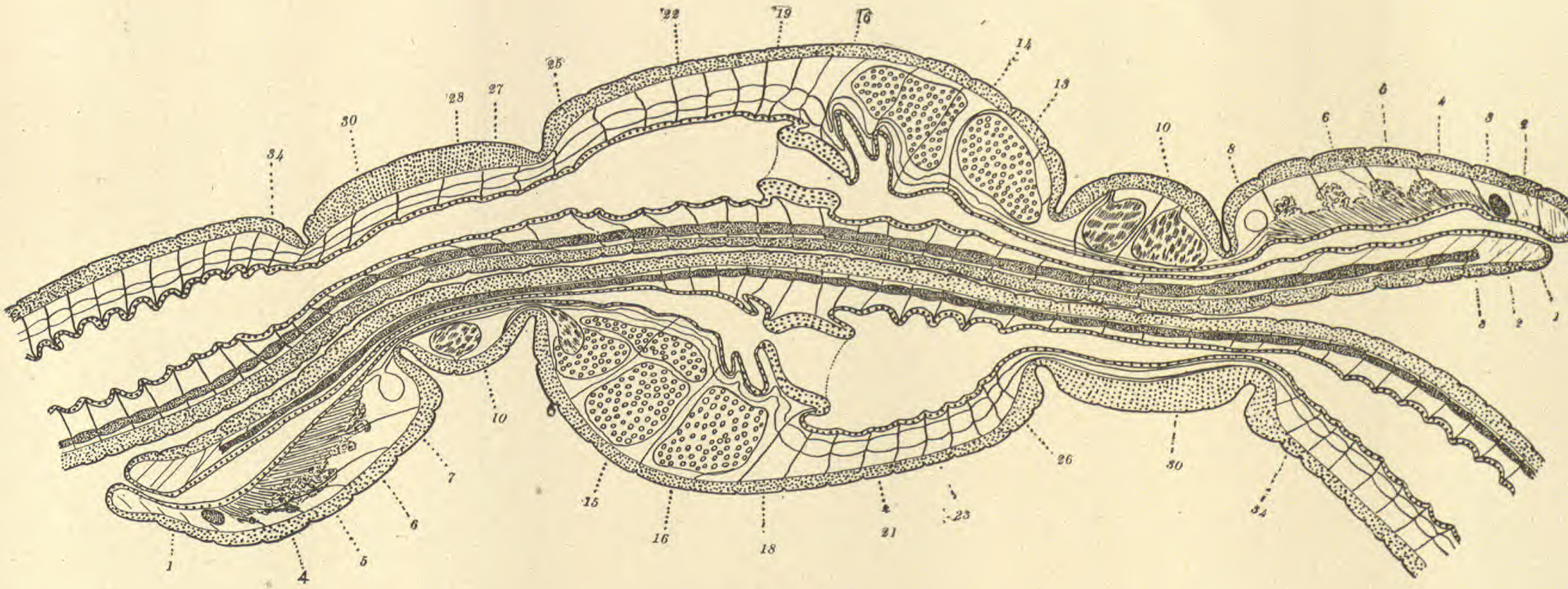


FIG. 2.

Andrews on Allolobophora.

PLATE XXXIV.

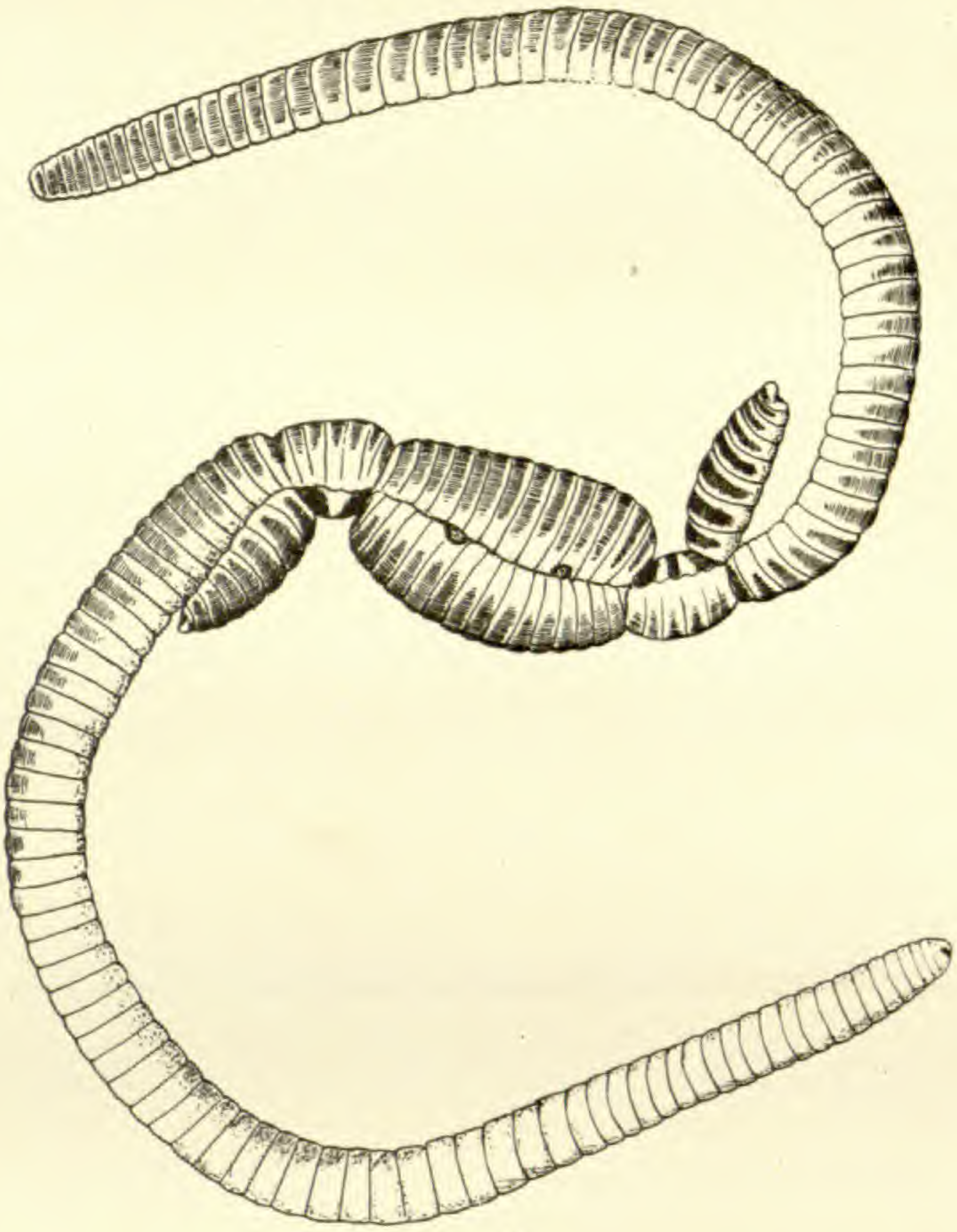


Fig. 1.

Fig. 4.

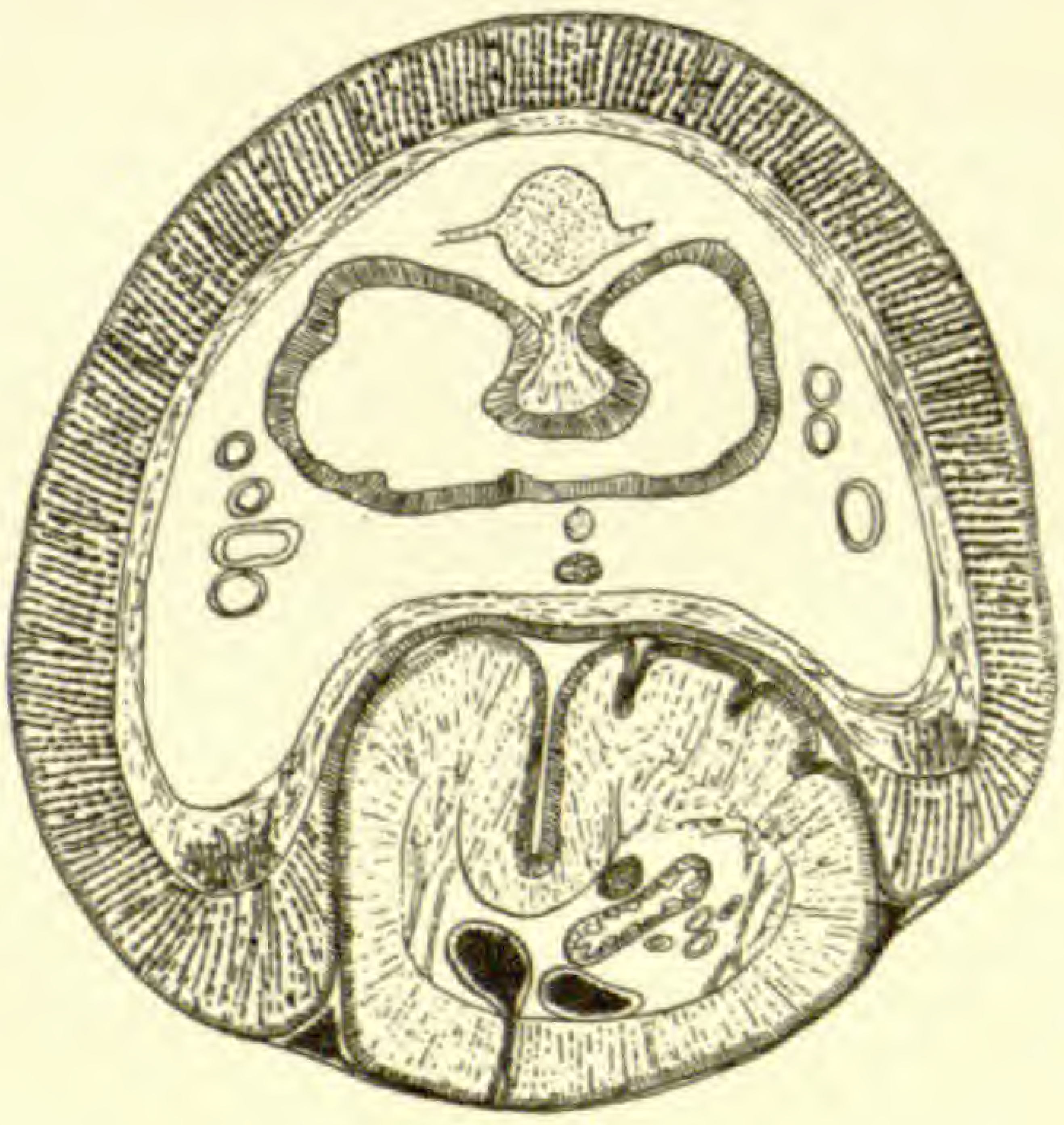


Fig. 5

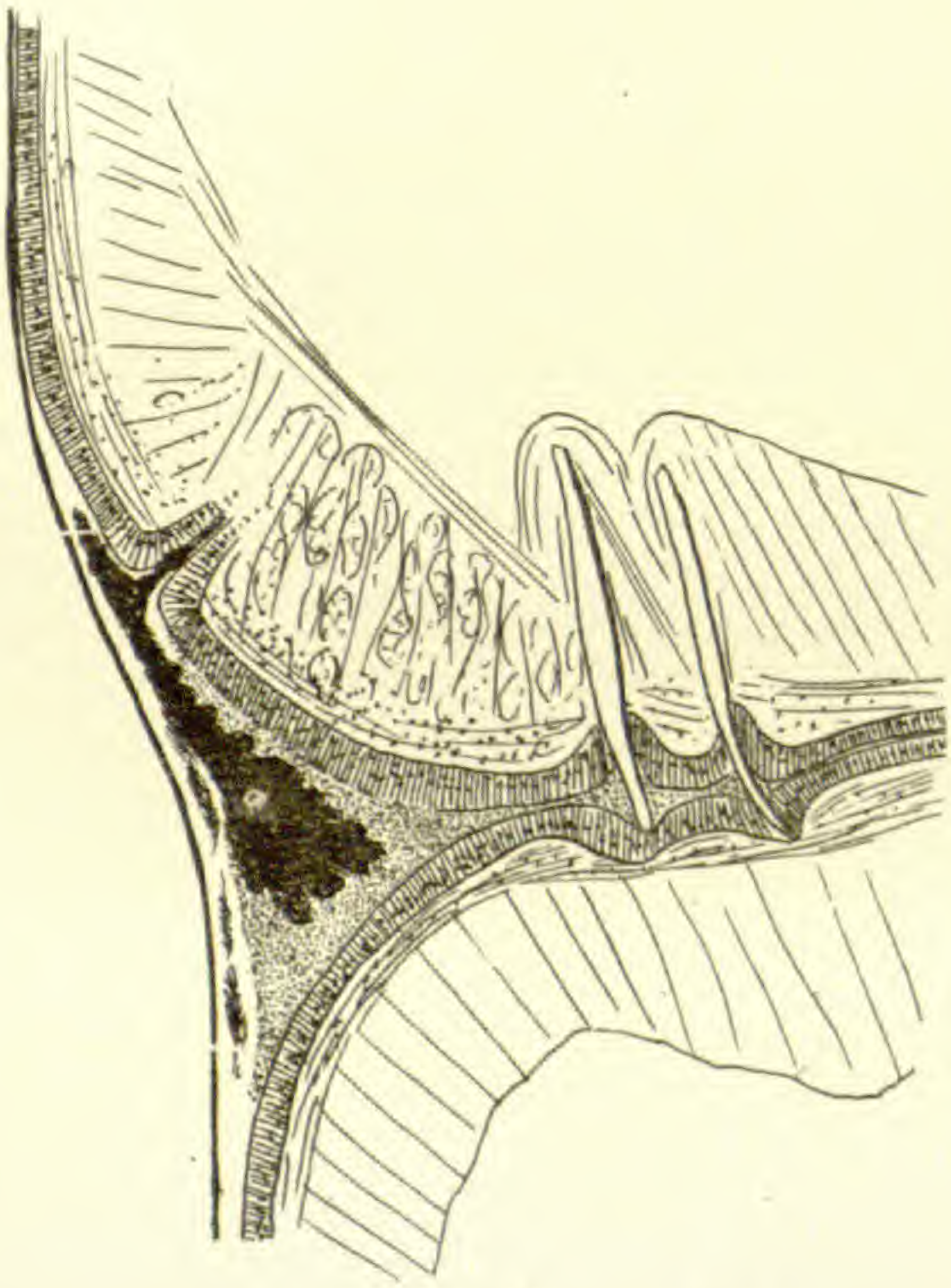


Fig. 6.

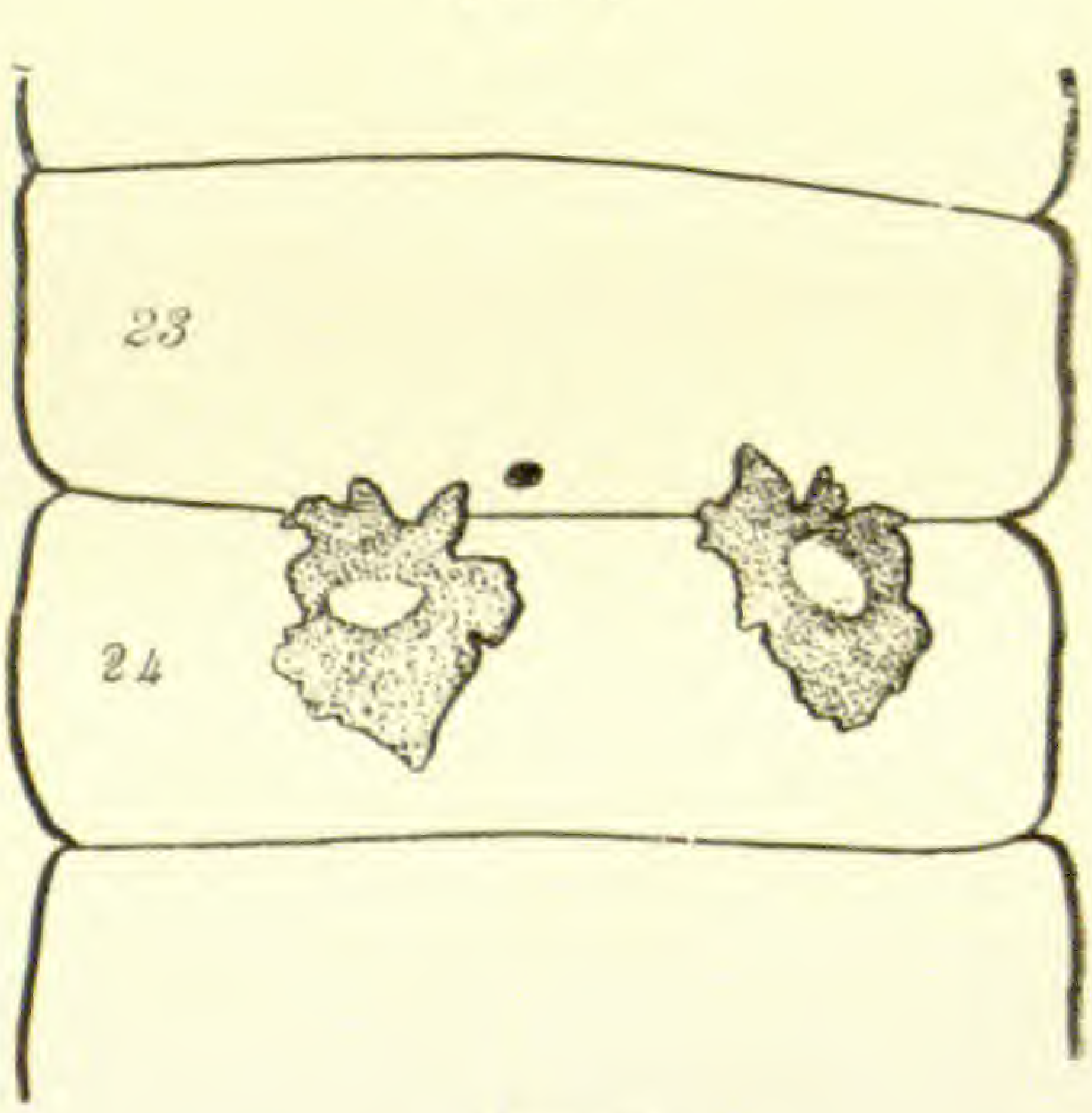


Fig. 3.

Andrews on Allolobophora.

The formation of the grooves and the ejection of sperm do not always take place simultaneously in both worms. They may also be of considerably different dimensions and yet accomplish conjugation since they are so changable in form. As a rule, however, both worms act in every respect alike.

As it seems scarcely credible that the sperm should not spread out on the moist surface of the body one might at first suppose that it flowed back in a canal covered only by the transparent epidermis, yet no such canal is to be found nor any opening at the girdle. Moreover the seminal ducts open directly to the exterior and in handling a long worm, I once saw issue a white drop of what proved under the microscope to be sperm.

After conjugation a small flat, club-shaped process is found on each side of the worms. This so-called penis is about 1‴ long and is generally in the region of the 26th ring, seldom at the girdle. It generally lies in the region of the ventral setæ, sometimes on and sometimes between rings. It is sometimes duplicated and sometimes absent upon one or both sides. It gradually becomes harder though at first soft; it is a hyaline mass with a droplet of sperm imbedded in its free end. In my opinion it is made of hardened mucous. Before conjugation it is absent; if we separate conjugating worms before ejaculation it is soft and contains no sperm; it is demonstrably a product of conjugation. When formed in the region of the 26th ring opposite the male opening it receives sperm from the other individual and in the few cases in which it is on the girdle it receives sperm from the worm on which it is found. In the exceptional cases in which it lies on other regions of the body it contains no sperm.

It seems superfluous to describe all the varieties of form, number and position of such an unessential structure."

Many features of the above remarkable interchange of sperm may be readily observed in wet nights in the Spring and Autumn in the public parks of Baltimore where this large earthworm, *Lumbricus terrestris* has been introduced.

In the case of the smaller brandling, direct observation is precluded by the fact that the worms do not come to the surface to conjugate but lie closely appressed and bent some inches beneath the surface of the wet dung heaps they abound in. When disturbed they slowly separate. The following facts relative to their conjugation are hence confined to observations upon preserved material.

At Byrn Mawr, Penn. in May, 1892 and in Baltimore in May, 1895 attempts were made to harden the worm in pairs by the use of Perenyi's liquid, picric acid, chromic acid and Merkel's liquid but the worms separated in hardening; it was found, however, that when thrown into hot corrosive sublimate or even into boiling water the animals remain in a very natural position. This is due to the fact they are enveloped, especially in the region of the girdle, by a secretion that is coagulated by heat while the worms themselves are so quickly killed that they do not contract enough to change shape or to tear themselves apart. It is thus possible to obtain preserved pairs such as indicated in figure 11 that very accurately indicate the appearance of the conjugating worms when alive.

Even the large Lumbricus may be well preserved in pairs by plunging into actively boiling water and then hardening in alcohol.

From figure 11 it will be seen that a pair of conjugating brandlings lie in a somewhat S shaped figure with the heads in opposite directions and the ventral sides turned toward one another anteriorly though posteriorly each may have it ventral side in the normal position, downward. Each may twist so that its anterior part lies on the side, the right or left in both worms. It is noticeable that at two regions the worms appear constricted as if threads had been drawn about them but in reality it is only the firm envelope of mucous which binds them together. These two regions are separated by a long expanded region on the side of which may be seen the swelling about the male opening. Each constricted region is made up by the light colored girdle on one worm and the small dark colored region near the head of the other, a region of three rings that we will find subsequently are nearly enclosed by the girdle. The most anterior part of each worm may be free and is then immediately followed by the short region so very firmly clasped by and attached to the girdle. This free tip of the body contains seven rings in each worm. The following part that fits into the girdle contain three or four rings. The expanded region between this and the following girdle contains fifteen or sixteen rings and the girdle itself six or seven. Posterior to the girdle the animals may be nearly or quite free from one another so that the extend of the closely united region when the seven anterior rings are free, may be only twenty-four to twenty-seven rings of the entire one hundred, approximately, that make up the worm. The applied areas do not fit together exactly ring to ring and though they begin and end at the same distance from the head in each worm a fixed point, such as the male openings in the fifteenth ring, is not exactly opposite the same ring in each case. Approximately the male opening on the fifteenth ring of one is opposite the twenty-first ring of the other worm whereas we would expect it to be diagrammetically opposite the twenty-fifth if the seventh ring of one is opposite the thirty-third of the other.

(*To be continued.*)

PSYCHOLOGY.[1]

Recent Work in Hypnotism.—With the June number the "Revue de l'Hypnotisme" completed its ninth volume and in turning over its pages I find several articles that are of more than merely technical interest.

Liébeault of Nancy contributes two articles on the psychology of normal sleep and its relations to hypnotic sleep and waking life. The essential characteristic of waking life is the activity of attention and will; in sleep both faculties become quiescent; in hypnosis we find an anomalous "polarisation" of attention, it being riveted on the idea of sleep on the one hand, whereby actual sleep is induced, and on the personality of the hypnotizer on the other. Will is quiescent, and thus the patient becomes amenable to suggestion. Violent passions, "fascination," aboulia, and all other states in which will power is weakened, are to be regarded as akin to sleep.

Prof. Matias-Duval outlines a histological theory of sleep suggested by the Golgi-Cajal doctrines. Admitting that the ultimate nervous elements are functionally related, not by actual physical continuity, but by mere contiguity, it is natural to suppose that the transmission of nervous activity would be facilitated by approximation of the terminal filaments. It is not improbable that they may be capable of amœba-like extension such as has been observed by Wiedersheim in the brain of *Leptodora hyalina.* It is possible that a paralysis of these terminal filaments may be brought about by the absence of oxygen and excess of carbonic acid; the transmission of nervous activity would thus be impeded and sleep supervene.

Dr. Raphael Dubois contributes a paper on the physiological conditions of hibernation in the marmot. He has been unable to find traces in the blood of the hibernating animals of toxalbumens, toxines or other somniferous agents, but has found an excess of carbonic acid which he ascribes in part to the depression of circulation, respiration

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

and temperature, but chiefly to a dehydration of the blood. A portion of this water accumulates in fluid form in the stomach and caecum, and another portion in the peritoneum and other membranes in the form of lymph containing leucocytes. At the same time, owing to a diminution in the portal circulation, glycogen accumulates in the liver. Upon awaking, these fluids are reabsorbed, the leucocytes convert the glycogen into sugar and the temperature rises. All these phenomena are under the control of the center for thermic sensibility in the anterior portion of the aqueduct of Silvius; and between this center and the polar plexus, which controls the portal circulation, there is direct anatomical relation. Acetone, which is known to have soporific powers, is also found in the blood of the hibernating marmot and doubtless contributes to the total effect. "The winter sleep of the marmot may therefore be described as a carbonico-acetonemic autonarcosis."

The doctrine of the subconscious fixed idea has never been as clearly and succinctly stated as by Pierre Janet in the June number of the *Revue.* He gives first a typical case of a conscious fixed idea. A woman, aged 33, of neurotic ancestry and hysterical antecedents, fell at sight violently in love with a physician called to attend her child, and for some years remained under the control of this fixed idea. Here we have (1) Marks of mental weakness, (2) An irrational passion attached to one idea, (3) Its natural consequences in words, acts, etc. Four other cases are then detailed, precisely analogous, save in the absence of the second factor, there being no conscious fixed idea. A hysterical woman, aged 21, has repeated attacks of vertigo and of groundless terror. Another sustained, at 29, three great shocks: her father lost his money, a near friend died of phthisis in her presence, and she saw a man crushed to death. For four years afterwards she fell into an apparently dreamless sleep upon the least shock. A girl aged 16 has nocturnal micturition, but affirms that she never dreams. A woman of neurotic family, a brother being hysterical, a sister insane, father and grandfather drunkards, has monthly attacks of mental and physical distress which end in an uncontrollable desire to drink. After a spree of several days' duration, she recovers consciousness and has no memory of the attack. While her normal self she is a total abstainer, and has a horror of the liquor which has ruined her family. In all these cases we have no conscious fixed idea. But when hypnotized, it apparently comes to light. Case (1) in hypnosis tells of a horrible dream she once had, in which she jumped from a bridge; this dream recurring produces the vertigo. When a child, she was frightened by a snake, and she claims that her terrors are due to seeing snakes about her. Case (2) is told, while hypnotized, that when she falls asleep she is to dream aloud; her dreams are invariably repetitions of her friend's death-scene. Case (4) confesses to an insane desire to drink, of which her normal self is wholly unconscious, and Janet, upon tracing the history of the case, ascribes this to the fact that in her earlier convulsive attacks, the suggestion to drink was constantly given her by the presence of her drunken father. Case (3) hypnotized, has no memory of dreams which could cause her annoying trouble, but her hand, in automatic writing, tells of nightmares utterly unknown to her, during which micturition takes place. From these cases Janet draws the inference that in all a fixed idea exists subconsciously, producing in the upper consciousness effects analogous to those produced in the first case by a conscious fixed idea.

Prof. Pitres reports a case presenting analogous features. L. G., aged 37, became subject to hysterical convulsions in consequence of a runaway accident in which she and her child were thrown from a cart. The recurrence of this experience in the form of a dream or nightmare was the basis of her crisis. By hypnotic suggestion Prof. Pitres abolished its more terrifying features and diminished the violence of her attacks, but was unable to affect her sensory symptoms, pains, etc. While experimenting with another end in view, he made her dream that a certain surgeon performed an operation upon her; next day upon seeing the surgeon she had a, to her, inexplicable feeling of aversion for him, and, at the same time, felt a pain in the part upon which the imaginary operation had been performed. It would seem that the sight of the surgeon awakened into subconscious life the dream and its consequences. Acting on this hint, Prof. Pitres suggested dreams in which sundry doctors cured her pains, and so obtained results which he could not get by direct suggestion.

From the medico-legal point of view, the possibility of criminal suggestion is discussed by Prof. Delboeuf, of Leyden, and Dr. Liébeault, of Nancy. Prof. Delboeuf recants at length the affirmative view which he has expressed in his earlier works. Laboratory experiments are worthless; the patient is always more or less influenced by the suggestions of the environment as well as by the command of the hypnotizer, and is consequently fully aware that the whole performance is a mere comedy. We are all subject to criminal auto-suggestions in our dreams, and we know how little mischief actually results from them; the danger from hypnotic suggestions is no greater; it will never be as great as that of evil communications and corrupt example. Yet

Prof. Delboeuf admits that signatures to wills, etc., may be secured and attempts on chastity made easier by hypnotic suggestion.

Dr. Liébeault's articles in reply adduce no new arguments and wholly fail to meet the points raised by Delboeuf. He merely emphasizes the power of suggestion and the helplessness of the subject. The single case which he quotes as conclusive is of no value. Dr. X. and himself successfully suggested theft to a working man; some years later he was convicted of numerous petty thefts and imprisoned. After his release he told Dr. Liébeault, while hypnotized, that his second series of thefts had been committed in obedience to a second suggestion from Dr. X. The total lack of evidence for the man's previous honesty and of confirmation of his story, taken in conjunction with Liébeault's obvious predisposition to accept this view of the case, robs it of the interest it would otherwise have had.

Two cases of death in the hypnotic state are reported. One was a patient of Bernheim's; the autopsy showed that death was due to a pulmonary embolism with which the hypnosis could have had nothing to do. The other is the sensational case in Hungary of which a brief account appeared at the time in the American papers. Frl. Elsa Solomon, living in the neighborhood of Buda-Pesth, had suffered from hysterical attacks for several years, but had found considerable relief during the last 18 months of her life in hypnotic treatment at the hands of her physician. A man named Neukomm, described as a "specialist in well-digging," happened to be visiting at her father's house and hypnotized her for experimental purposes. She was found to be possessed of clairvoyant powers. On Sept. 17, 1894, Neukomm hypnotized her, much against her will, as she was feeling badly, and told her to visit in spirit his brother, ill at Werschetz, and describe his condition. This she professed to do. He then asked what would be the outcome of the illness. She replied, with difficulty, "Prepare for the worst," and immediately fell from her chair with a cry. Her heart was still beating, and an injection of ether was given, but she died in a few seconds. A medico-judicial commission appointed by the Government reported that her death was due to cerebral anaemia, and refused to inculpate Neukomm. As he continued experimenting, the Hungarian Government issued an edict restricting the practice of hypnotism to regular physicians, and requiring that the patient in every case sign an order, before witnesses, asking to be hypnotized. The hypnotization must also be in presence of witnesses.

Casimir de Krauz contributes six admirably impartial articles upon the experiments conducted by Dr. Ochorowicz and others with Eusapia

Palladino in Warsaw. He has given in concise form and a civilized tongue the gist of the discussion which raged about the case in the Polish magazines and newspapers. Lack of space prevents my giving any extended account of these remarkable experiments at present.

Dr. Quintard, of Angers, reports the case of a child of six who appears able to read his mother's thoughts. The case seems to deserve careful investigation.

As usual, the *Revue* abounds with accounts of remarkable cures wrought by suggestion, but the most interesting of the articles from the therapeutic point of view is one on "The Clinical Indications of Hypnotism," based upon Prof. Morselli's sixteen years' experience. Prof. Morselli belongs to the school of Braid, Richet, and Bernheim; he has found about one-fifth of his patients hypnotizable, neurasthenics, hysterics and maniacs being the most refractory. He has never observed clairvoyance, telepathy, cerebral polarization, etc., and holds a negative attitude with reference to their possibility. He does not believe that hypnosis has dangerous results; is not oversanguine as to its therapeutic value, but has had good results in functional neuroses and in dealing with symptoms of organic disorders. The effects of hypnotic treatment he has found neither constant nor durable, and thinks it must be supplemented by other agencies.

The Cebus and the Matches.—A *Cebus apella* in the Philadelphia Zoological Garden has become an expert in striking matches. He distinguishes the end with the fulminate, and I have not seen him make an error in this point. He seizes the match at the proper distance from the fulminate and so avoids breakage. He uses for friction the rough side of a kettle which is used for water, and spends no time on the glazed surface. As soon as the match is lit he throws it away, and I have not seen him burn himself. No man could handle the match more appropriately. He does not however always select a a proper surface, as he tried on one occasion to strike a match on my finger, without success.—E. D. Cope.

Sand Swallows and Sawdust.—Mr. C. O. Thurston writes to the Naturalist, that during a visit at Groton, Conn, he observed sand swallows in great numbers building their nests in a large pile of sawdust instead of their usual resort, a sand bank.

ANTHROPOLOGY.[1]

The Discovery of Aboriginal Netting Rope and Wood Implements in a Mud Deposit in Western Florida.—I was in Florida, last April, tarpon fishing, and had been drawn down in the course of this pursuit to the neighborhood of the settlement of Marco—a few frame houses on the south-east coast, collected near the pass of the same name through the reef. This pass is an important one, as importance goes in this thinly-peopled region, it being a road to the safe shelter in Marco Bay, and also to the little wooden pier in Collier's Creek, leading from Mr. Collier's store and house. And Marco has clearly, for very many years, been thus important. A Spanish settlement was remembered by a friend of the "oldest inhabitant," and, from the more distant past, numerous kitchen middens, formed chiefly of shell-heaps, bring us heavy conch axes or clubs sharpened at the point and bored for handles, smaller conch and other shell implements, bits of black pottery, shell sinkers, and various ornaments, all presumably relics of the mysterious Mound-Builders. Hard cement-like floors of former huts or cottages are reported to be visible in the locality—Collier's is, in fact, built on Mound-Builders' débris, and the rows of these shell-heaps show the extent of their occupation of the place, both in time and numbers. Yet, withal, there has been hitherto a complete absence of wooden articles or of any textile fabrics from the discovered remains.

Here and there shell-heaps form the banks of what are locally called "muck" tracts, former creeks or inlents, now filled with peaty mud, ill-smelling when first disturbed. The drier of these have been for years overgrown with trees and bushes, some of which trees are old and dead. This peat muck is valuable as a fertilizer, and it is this property that originally brought the special basin, that I shall describe later on, particularly under notice.

I had been looking with curious eyes at a somewhat similar formation in the neighborhood of Naples City, a Floridian watering place, of from ten to fifty inhabitants, according to the season of the year, where we had been staying at its comfortable little hotel. At Naples there is an ancient waterway now in various stages of peat muck and stagnant pool—an artificial canal, cut with the clearly deliberate purpose of forming a canoe or boat pass from the sea to the lagoon or bay.

[1] The department is edited by Henry C. Mercer, University of Penna , Phila.

PLATE XXXV.

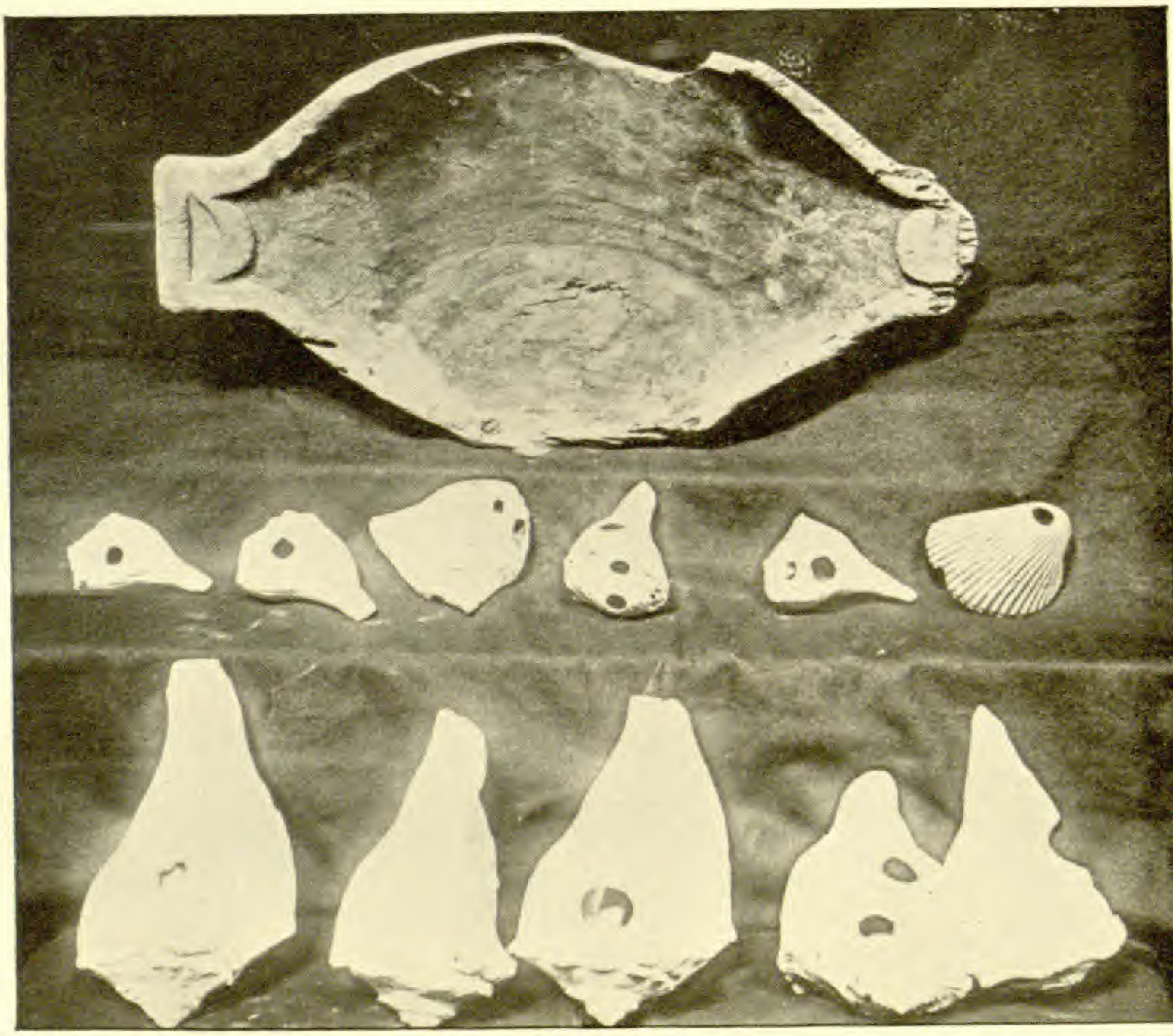


Fig. 1.

Aboriginal wooden trencher and perforated shells discovered by Lieutenant Colonel C. D. Durnford in a mud deposit near Marco, Southwestern Florida, in April, 1895.

PLATE XXXVI.

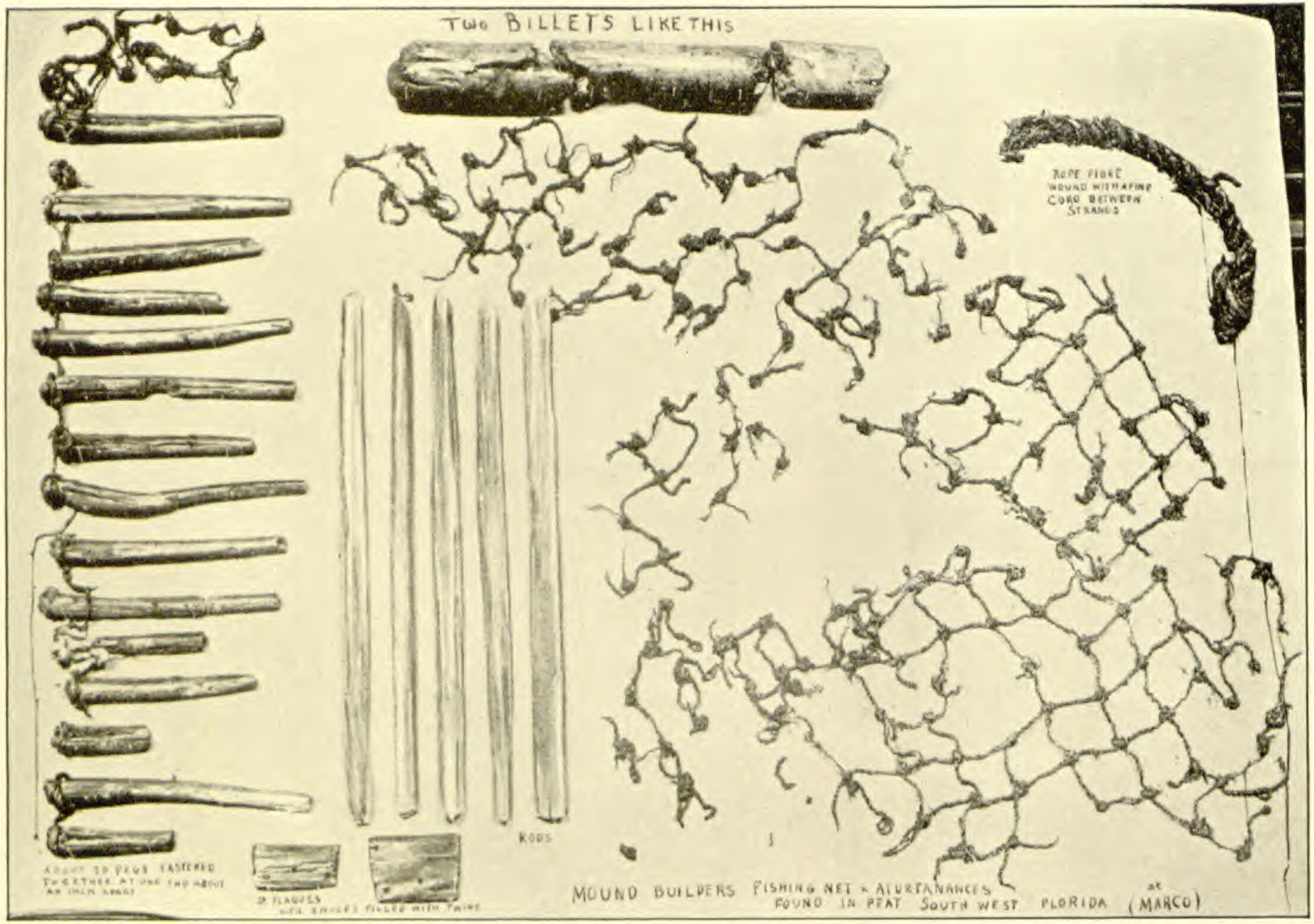


FIG. 12.

Aboriginal rope fish net and appurtenances discovered by Lieutenant Colonel C. D. Dunford, in a mud deposit near Marco, Southwestern Florida, in April, 1895.

It is cut large and well for a distance of considerably over half a mile, and is an undertaking so extensive that it would have been looked upon as unreasonable to have credited the Mound-Builders with it, were it not that there exist similar and longer canals formed, I believe indisputedly, by these prehistoric people from their mounds to some of the larger watercourses in the neighborhood of the Everglades.

The preservative properties of peat at home, and the family likeness of this peat muck to the British article in its moister and more boggy condition, made me very loth to forego an effort to find out the secrets that I felt sure must be hidden at the bottom of the canal, and of its adjacent peat basins. It was, however, far too extensive and difficult a work to attempt under the circumstances, although various means of doing so had been canvassed with the other guests of the hotel.

Archæological instinct having been aroused, an amateur exploring expedition was accomplished to a curious cement-capped mound in the neighborhood, of which more anon.

Mr. Charles Wilkins, of Rochester, N. Y., left me still at work at this mound on the second morning, and went on to Marco in the hopes of coming across tarpon there. Two days later he returned to Naples, having made a find in a muck basin at Marco that excited our interest greatly. The results of this find it will, perhaps, be out of place for me to describe in detail here; suffice it to say that the articles consisted of wooden cups, a carved head of an animal, conch cups and conch clubs, with remains of their handles, and other most interesting articles of wood, pottery and bone. He had been led into this search, I believe, by a casual find of some kindred objects by one of Mr. Collier's people when getting "muck" for fertilizing purposes. One of the wooden articles had remains of fire still on it, and the black rubbed off upon the fingers as if it had been charred yesterday, although it must have been done before 2 feet 6 inches of deposit had formed over it, and a tree, a foot across, had grown and died above the old fire-site.

I at once made preparations for going to Marco to try and add further to this treasure-trove, and a few days afterwards my wife and myself were off with a boatman for the long row south, within the reef, through bay and canal with a strong tide which turns for or against at the most odd places and times, seemingly without reason, until one learns the ways of this strange reason, and that all depends upon which of the passes intersecting the outer reef, the particular canal or bayou is ebbing or flowing through. A small bayou between two passes will have the ebb tide running out of both its north and south channels at the same time. Through miles of narrow waterways we row or are rowed, waterways bordered by the green mangroves with oysters hanging from their boughs, oysters grating against the boat's bottom here and there as the low tide made it difficult to pass through the canals cut in the oyster bars between the different lagoons, bays, reaches, bayous, lakes, channels, creeks, rivers, passes, as the lanes and sheets of brackish and salt water are variously termed, according to their special size and nature.

On our way we stayed for a few minutes at the rookery, an island teeming with sea-birds and their nests. The latter were close together on the mangroves, under which we rowed, for it was high tide and the roots were covered with salt water. We took some young cranes and pelicans out of their nests and returned them ungrudgingly thereto after they had bitten our fingers. So also I returned one of two eggs, the inhabitant of which, a juvenile pelican, was in a sufficiently advanced stage of composition to squawk reproachfully at being shaken.

We arrived at Collier's, Marco, at sunset, and the sandflies and mosquitoes being in full charge, I did not examine the muck-bed until next morning, when, with the aid of a " smudge," the smoke of which was less objectionable than the sandflies, and a hat-net for the mosquitoes, we proceeded to work. The basin is an oval about 150 feet long and 120 feet across (I write from memory), filled with peat muck, the bottom a hard shell bed that the sounding-wire, when pushed through the soil, struck each time in regular grade, giving, as far as I could tell from the cursory trials that I made, an even saucer-like pool, formerly filled with water, now with the peat muck deposits of centuries of disuse, the flat surface of which is covered with grass and trees, young and old, alive and dead. It is situated about 200 yards up from Collier's on the same bank of the creek, *i. e.*, the right bank. All the way up the creek rows of old oyster-shell banks or mounds are met with at right angles to the creek and to the road by the creek side. They have narrow openings, over which, at high tide there is, in one or two cases, still a trickle of water. At other times the road is dry over what used to be old canals or small side creeks, in which the canoes lay when the old world people sorted their drafts of fishes, opened their oysters or cooked their fish or game.

That these operations were habitually carried out here there is too much evidence to doubt.

On the morning after our arrival, I obtained the services of two of Mr. Collier's employés to dig in the peat basin. The pits already made by Mr. Wilkins were half filled with water, which percolates into all of them a few hours after they are dug out. They average in size about 4 feet 6 inches in length and 2 feet 6 inches to 3 feet in width and depth.

I decided to dig in the direction of the shore, that is, between the last pit opened—from which we removed the water—and the nearest exposed shell-bank, perhaps 20 feet away.

Hardly had two barrow-loads of the earth been taken out when the finding and excitement, on my part, at least, began. One after another they came, the first of importance being a wooden tray or trencher, the rounded feel of which at first made us believe that we had found a canoe, two spikes of a fish, etc.

The trencher (See Plate XXXV) (which, with other of the articles found, is now in the British Museum) is of wood, in shape oval, with ends extended, squared and notched to form handles for the fingers to grip more readily. It is hollowed out and was well made. Underneath it is flattened, so that placed on a level surface it is capable of being rocked lengthways only. It is in a good state of preservation. Its length is 19 inches by 11 inches broad and 4 inches deep; in thickness it varies from $\frac{3}{8}$ to $\frac{3}{4}$ of an inch.

One of the next articles that we came upon, also, I believe, unique, was a curious funnel made of a clam-shell; it is shown in the accompanying photograph (See Plate XXXV). It had a hole, about $\frac{7}{8}$ of an inch in diameter, cut through its deepest portion, and there were signs of some brown fluid having been poured through it. Small pieces of black pottery and a small conch or two pierced for handles and sharpened, were also discovered; but the most curious of these old remains was the fishing-net which lay close to the trencher and to the other articles. It was well and evenly made, of about a 2-inch mesh, netted with a two-strand cord, the strands being spun from some vegetable fiber, perhaps cocanut or banana bark. Of this net, (See Plate XXXVI) a specimen of which has been deposited at the Museum of Archæology of the University of Pennsylvania, only a small portion was obtained, and that, unfortunately, in a very rotten condition, but a small piece of rope, an inch in diameter, of a coarser fibre, the division between its strands being interwound with a fine cord, and a number of interesting wooden appurtenances of the net were also discovered. (See Plate XXXVI). These consisted of five wooden sticks about 20 in. x 1 in. of irregular section, apparently made of the central palm-leaf stem, heavy and strong; their use is difficult to determine. There is no apparent mark of cords having been used in connection with them. There were also about thirty pins, made of an exceedingly light, tapering, reedy wood, each about 9½ inches long by 1 inch in diameter at their thickest end. They were fastened together at one end—the thickest—at intervals of an inch, by a strong cord about $\frac{3}{16}$ of an inch in diameter. Each pin had a hole bored in it and a groove cut round the head to receive the cord, which, passing through the hole, was knotted after one turn and a half round the groove. There are also two small plaques of thin wood about ¼ of an inch thick, quadrilateral in shape, the sides measuring severally 3⅝ inches, 2⅜ inches, 3 inches and 2⅜ inches, the short equal sides making with the longest equal interior angles. Of one of these plaques only half was found, but they are evidently the same in design. The complete one contained five holes about ¼ inch in diameter; the three holes in the incomplete one corresponded in position with the three in the same part of the complete. The holes contain remains of cord which evidently had run freely through them. (See Plate XXXVI).

Two round wooden billets, about 17 x 3 inches, and one irregular block, about 5 or 6 inches across in its thickest portion, completed the appurtenances which seemingly form some kind of trapping arrangement to the net. Everything was found resting on the shell bottom of the "basin," and all nearly together. It seems to point to some sudden desertion of the spot, whether from fear or for some hurried foraging expedition or other reason. From whatever cause the place was left, the party did not return, though certainly intending to do so, as witness the beauty of the cup conches found by Mr. Wilkins, and the value of the nets and wooden articles, the condition of which, when found, points to their having been left there in excellent order.

The net was certainly placed where it lay by man, for the five loose sticks which served some unknown purpose were on the top of the bunch of the thirty or so smaller pins, and lying as if placed there by one hand hold. These smaller pins were piled in uncertain rows as to number and position, all seemingly tied together and at one end only. The idea that the whole position gave, was the arrival home of a fishing canoe, the net with its appurtenances being taken out, the heavier round billets (purpose unknown) first laid on the beach with the block between or next them, the trapping arrangements of thirty pins placed on the billets with the five sticks loose over the whole. The two small plaques, probably part of the trapping arrangement also, were a short distance above the main heap.

The net was placed joining the trapping-pins, but lower down the beach, and the rope lower still, near them being the necklace of fish fin-bones in a cup. Unfortunately, one of my assistants working in the pit which I had cleared of water, broke through into the next one, just as the rope was discovered, and the water poured in and flooded both the one that had been freed, and the one that had just been opened, and not being then sure of the nature of my find, I gave up and left off at that point. I caused several other pits to be dug, but with little result.

As I could learn of no similar ancient articles having been discovered in this region, and as their nature, position and surroundings pointed to the probability of their having belonged to some uncivilized race who had inhabited this spot centuries ago, I preserved them as well as I could, keeping them wet until I was able to show them to experts. At the University of Pennsylvania I was fortunate in meeting not only Mr. Stewart Culin,[1] but also Mr. Frank Hamilton Cushing,[2] from whom I learnt the antiquity of these relics and the archæological value of the discovery. Mr. Cushing, whose experience and knowledge of these subjects is probably without parallel, considers them to be of pre-Columbian origin, and as, under the direction of Dr. William Pepper, Mr. Cushing is, I hear, to undertake a further exploration, we will, I hope, before long, be in possession of fuller information concerning the race who made use of them.

I mentioned, in the earlier portion of this account, a curious cement-capped mound which was partially examined by some of the tarpon fishers at Naples. The mound had been for some time the subject of discussion of the guides and hunters, and had created no small curiosity in the mind of at least one of the guests at the hotel.

This, as related by them, was the largest of three sandhills near Sandhill Bay (lagoon), not far from little Marco. The hills (I write from memory) are about a hundred yards apart, and joined by low ridges in a slight curve. The story of the guides was roughly as follows:

The mound was the most easterly of the three, and was about 30 feet above the sea level, perhaps the highest land between Naples and Cape Sable, a distance of 50 miles, excepting one—Caximbas Mound, the summit of which may be 40 feet above the sea. It lies about ten or twelve miles from Naples and five or six from Marco, and having water on two sides at a distance from its centre of about 70 or 80 yards on one side, and, perhaps, 100 yards on the other. It had been opened

[1] Director of the Dept. of Archeology and Paleontology of the University of Pennsylvania.

[2] Ethnologist Smithsonian Institute, Bureau of American Ethnology, Washington, D. C.

about two years before; first by two of the local hunters and guides, including one of the Weeks brothers, who came afterwards with our party, and again by one of the guides named Walker, who was also with us. These told the same story, viz.: that it was covered in by a regular "bottle" top of cement—hard stone cement—smoothed and even on the inside at the point where the men had got through, which they had accomplished at the summit. They found one skeleton which was described as lying about 4 feet below the cement. The cement was said to be more than a foot thick, and so hard that they could only cut just enough away to allow the passage of a man. Below it was a soft, fine, dry sand. They soon had to stop digging when they began piling up this sand on the edge of the hole, as it came falling in again. They did not get more than 4 or 5 feet below the cement, and found nothing but this fine, soft sand; in some parts it was "just the color of dripping blood, so red, not ordinary sand red, but as if it had been painted red, just like dripping blood," so said Bill Weeks, one of the hunters. They were looking for treasure, of course. This cement work and the blood-red sand being quite out of the common, Dr. Durrett, of Louisville, Ky., and myself, with a party of boatmen and hunters, therefore set out one morning, prepared to cut more deeply into this mound, and did so. We did not, by any means, fully explore it, but we cut into and across the "cement" dome, and found the guides' account to be practically correct. The dome is composed of a gray-colored close-binding mud. The blood-red sand or powder we did not come upon, but it is quite possible that that found by the hunters was some of the same hematite found by Professor Othniel Marsh in the Taylor Mound near Newark, Ohio, and which he supposed to have been used as paint. A description of this will be found in the *American Journal of Science and Arts*, Vol. XLII, July, 1866.

The remains of the hunters' former dig for treasure lay about the mouth of the small man hole made by them through the cement, and in clearing away these and the shrubs near, we came upon several of the old and whitened bones that had been thrown out at that time, including half an arm bone that had been splintered, apparently, by some sharp weapon. Later on, the other half of the same bone, the fractures fitting perfectly, was produced, yellow from the sand below where it had been sheltered by the cement from all rain, except the direct fall into the small man-hole.

I am writing this description of our partial examination of this mound, solely on account of the curious, and, I believe, unique, rude dome formed over, so far as we know at present, one skeleton buried in soft sand. We found therein no relics except these bones, which were in good preservation. The base of the cement dome rests on a ring of shells—chiefly oyster shells—evidently placed there to receive it, about 60 feet in circumference, 6 inches deep, and 18 inches across. The ring was laid upon sand. Rather above the level of this ring and in the centre, had been placed the body, and apparently over this had been made a rounded hill of fine sand, and again over this had been plastered the layer of light slate-gray mud, which, whatever had been the intention of the depositors, now remains as a waterproof, solid, self-supporting dome, about 15 to 18 inches thick, and 20 feet or so across, and perhaps 5 or 6 feet high. It defied a spade or ordinary hoe, requiring a grubbing-hoe and, in places, a crow-bar to pierce it.

On my return the second day in company with Mr. Wilkins, who remained a short time—Mr. Durrett, who had camped near the spot, having left earlier in the morning after completing the cutting across through the north side—I laid bare the whole inner base of one side of the dome; the sole result was the verification of the fact that the dome was evenly formed interiorly, and rested on the evenly formed shell-ring.

I am personally of opinion that the hardening quality of this slate mud was understood and deliberately utilized by these people. Floors of prehistoric huts and other buildings are said to exist in the neighborhood, formed of the same material, and a piece of the cement carried away by myself has hardened perceptibly since its exposure to the air. It is difficult to conceive of an observant people, who were also capable of making very fair pottery, not knowing or noticing this property of a material used by themselves in such a position. It has, however, been suggested, and, though not agreeing with the suggestion, I give it as a possibility, that the cement-forming capabilities of this gray mud were not understood by the builders, and that it was not intentionally employed to this end, but was simply mud from the nearest lagoon, placed over the sand-heap to prevent the sand from blowing away, and laying bare the remains. This hypothesis is based upon the uneven quality of the cement cover—that next the northern lagoon being softer and coarser than that next the south. Further enlightenment will probably be thrown upon this question also by the expedition which Dr. William Pepper is sending to Florida in the coming autumn.

—C. D. Durnford.

SCIENTIFIC NEWS.

Louis Pasteur was born at Dôle in the Jura region on Dec. 27, 1822. His father, a journeyman tanner, was poor, but he was a soldier who had been decorated for his valor on the field, and it is supposed that from him the famous man of science imbibed the patriotism which has always been one of his striking characteristics. His father superintended personally his early education, and the boy was sent to school at Arbois and began his classical studies there. It is said that in those days his devotion to study was not great. He was fond then of drawing, and preferred sketching his neighbors to spending time over his books, and this inclination seemed so strong that it was predicted he would ultimately become an artist. But the capacity for work which developed so strongly later asserted itself when he began to study at the college of Besançon. He took the degree of Bachelor of Letters there, was appointed a tutor, and in the intervals of his duties he studied to prepare himself for the École Normale. On his first examination he was admitted, having passed fourteenth on the list of candidates.

But this did not satisfy his ambition. He went to Paris, started on a new course of study in the Institution Barbet, and in 1845 tried the examination for a second time and won fourth place. He spent two years at the École in the study of chemistry, and was appointed a doctor in 1847. The following year he was appointed a professor of physics in the college at Dijon, and three months later was called to the University of Strassburg, where he was appointed professor of physics in the Faculty of Sciences. In 1854 he accomplished the organization of the newly formed Faculty of Sciences at Lille, and three years afterward he returned to Paris and assumed the "direction of the scientific studies" at the École Normale.

In 1865 he was made a professor of geology, physics, and chemistry, at the École des Beaux Arts, and in 1867, professor of chemistry at the Sorbonne, and he remained here until 1875. He was elected a member of the Academy of Sciences in 1862, and six years later, the faculty of medicine at Bonn gave him the title of Doctor, but he returned the diploma on account of the Franco-German war. In 1869 he was made a foreign member of the Royal Society of London, and in 1881 a member of the French Academy. The University of Oxford conferred on him the title of Doctor of Sciences, and he was made, unanimously, a perpetual Secretary of the Academy of Sciences to replace Vulpian, who died in 1887; but the state of his health and his personal scientific researches did not allow him to assume the duties of the position. He resigned after two years, and was made an honorary perpetual Secretary.

He has received almost every distinction that the French Government could give him. By a decree of Napoleon III, not promulgated, he was made a Senator, and in 1885 became a member of the Legion of Honor, in which he was steadily promoted to the highest rank.

M. Pasteur began his well-known series of investigations with the study of crystals while he was an assistant in the École Normale. He had no allowance for the expenses of his studies, and so he worked in a laboratory of his own with no funds except what was supplied by his own slender resources. His success in this particular branch of inquiry was regarded as remarkable for so young a man, and it was only through the force of circumstances that his labors were led into another direction.

He began the study of fermentation when he became connected with the Faculty of Sciences at Lille. It was a subject little understood at that time, and he speedily succeeded in bringing the scientific men of France to agree with his conclusions.

In 1849 an epidemic threatened to destroy the entire silk worm industry of France. Pasteur went to Alais where the plague was raging in its worst form to see what scientific measures could be taken to abate it. His investigations there proved that the disease was contagious, and the simple method suggested by Pasteur to separate the diseased eggs from the healthy ones has since been adopted to prevent a recurrence of the epidemic.

The discoveries which were to make him best known were yet to follow. In 1870 he commenced his studies in inoculation for diseases other than small-pox, with which his name is most associated. He achieved some remarkable results in the prevention of hydrophobia. Patients from all parts of Europe and America travelled to Paris to put themselves under his care, and his treatment has long been given at Pasteur institutes established in London and New York.

The cholera epidemic of 1892 led him to begin experiments in anti-cholera vaccination which proved successful in the case of animals.

Pasteur was one of the greatest men of science of the present century, but in one respect he disappointed his admirers. His refusal to accept recognition from Germany appears to have been a mistake. Science is cosmopolitan, and the attempt to localize its rewards is inconsistent with the spirit of the age.

Marshall McDonald.—To his many friends, to the public having an interest in the fisheries which he labored so successfully to enrich, and to the biologists whose scientific labors he appreciated and utilized, the death of Colonel Marshall McDonald, the late U. S. Fish Commissioner, is a severe loss.

Though the work in which he was directly engaged in his official capacity was of an eminently practical nature, he early recognized that science was the ally of practice, or rather that the best practice is science, and sought in the working biologist his most helpful colaborer whom he always urged to turn to the solution of the problems which he had ever before him.

With Col. McDonald pisciculture in this country was fast advancing to the secure foundations of scientific method now enjoyed to a considerable degree by its sister art, agriculture. His method was not to experiment at hap-hazard in the hope of making a lucky hit that might solve the problem at hand, but by the most painstaking investigation to study the fisheries in their widest relations, to build up a firm basis of facts scientifically acquired, and from these to draw conclusions which were as practical as they were far-reaching and accurate. This method was necessarily as slow as its results are enduring, and we have yet to see the full fruition of his labors. As a consequence the work has met with the usual criticism from impatient persons of circumscribed view, who would measure the value of the Fish Commission's labors only by the number of young fry annually raised, or supposed to have been raised, failing to recognize the practical fact, which alone will appeal in such cases, that many of the methods and apparatus now generally employed in local hatcheries have resulted from the careful scientific inquiry conducted under Col. McDonald's direction, and without which the highly gratifying and useful results attained would not now be possible.

One of the last important works of Col. McDonald's life was to plan a biological and physical survey of far greater thoroughness than any previously undertaken. He was convinced that the first step toward a comprehensive knowledge of the conditions of greatest productiveness of the fisheries is an understanding of the primary food supply—the "aquatic pasturage," he called it. This he hoped to gain by an accurate qualitative and quantitative analysis of the unicellular plankton and littoral life, which, in turn, involves the chemico-biological and physico-biological questions concerning the ultimate relation existing between land waste and sea utilization, and incidentally a study of the life-histories and interrelations of myriads of animals and plants.

While busily engaged in thus establishing the foundations for the pisciculture of the future, he was ever alert to secure methods of immediate practical utility, and searched the scientific literature for facts and suggestions, and it was thus often through him that important biological work, which had else been barren of practical results, became the basis of inventions of much economic importance. His mechanical ingenuity was remarkable, as his numerous inventions of apparatus will testify; nor until ill-health forced him to relax his efforts did he neglect the minutest details of construction.

It is, of course, impossible, in such a short sketch, to give any adequate idea of the scope and importance of Col. McDonald's work, completed or contemplated, but I am sure that all who have a scientific grasp of the questions involved in the labors of the U. S. Fish Commission toward the maintainance and betterment of our extensive fisheries will feel the immense loss which these interests have sustained in the death of Col. McDonald, especially following so shortly upon that of his lamented co-worker and frequent scientific adviser, Dr. John A. Ryder.

Col. McDonald was born in Romney, Hamshire Co., W. Va., Oct. 18, 1836. His early education was had at a local academy. He entered the Virginia Military Institute in 1855 and graduated in 1860, having interrupted his course to attend the University of Virginia during the college year of 1858–59. After graduation he was appointed assistant at the Institute to Prof. "Stonewall" Jackson, serving until the outbreak of the war, when he was appointed Inspector-General on that General's staff. He saw much active service, particularly while serving as an officer of the Engineer Corps. From 1866 to 1879 he was a professor at his alma mater, occupying the chair of chemistry, geology and mineralogy, and later that of geology and mining engineering. He served as Commissioner of Fisheries of Virginia from 1875 to 1888, when he was appointed U. S. Commissioner by President Cleveland, to succeed Dr. G. Brown Goode, who had temporarily filled the position left vacant by the death of Prof. Baird. Col. McDonald had previously held responsible positions in the U. S. Fish Commission under Prof. Baird, first, in 1879, as special agent on the fisheries statistics for the Tenth Census, then as superintendent of the shad hatcheries of the Potomac River, and subsequently as chief of the Division of Distribution of Food-fishes. He died Sept. 1, 1895.

—J. Percy Moore.

Luigi Ferri, Professor of Philosophy in the University of Rome, Italy, died in Rome, March 17, 1895. He was born in Bologna in 1826, was educated in France under Suisset and Simon, among his fellow pupils being E. Curo and Paul Janet. In 1862 he was made Professor of the History of Philosophy in the University of Florence and remained there until 1871, when he assumed the title of Professor of Theoretical Philosophy at Rome. His most important works were "Histoire de la Philosophie en Italie au XIX^e^ siècle," 1869, and "Psychologie de l'Association de Hobbes à nos jouès," but he was best known as the editor of Italy's chief philosophical journal, the "Revista Italiana di Filosofia."

Charles Secrétan, a pupil of the philosopher Schelling and for many years Professor of Philosophy in the University of Lausanne, died January 22, 1895.

G. G. Glogan, Professor in the University of Kiel and author of many psychological and philosophical works, died early in this year.

Dr. D. Hack Tuke, the distinguished alienist, author of many works on psychological medicine, died in London March 5, 1895.

Georg von Gicycki, Associate Professor of Philosophy in the University of Berlin, died March 4, 1895, at the age of 46. Professor von Gicycki was the leader of the Utilitarian school in Germany, was a warm personal friend of Felix Adler and Stanton Coit and was much interested in the introduction of the "Ethical Culture" movement into Germany. His most important work appeared in 1888 under the title "Moralphilosophie."

Appointments of the past year. Professor O. Külps, who has been one of Wundt's assistants at Leipzig has gone to the University of Würzburg.

Dr. S. Mezes, a graduate of Harvard, has been appointed Professor of Philosophy in the University of Texas.

Dr. Margaret Washburn to be Professor of Philosophy and Psychology at Wells College.

W. B. Elkin to be Professor of Philosophy in Colgate University.

A. H. Lloyd to be Assistant Professor of Philosophy, and J. Bigham Ph. D. (Harvard) and Geo. Rebec Ph. B. (Mich.) Instructors in Philosophy in the University of Michigan.

J. S. Mackenzie M. A. to be Professor of Philosophy in University College, Cardiff, Wales.

W. L. Bryan Ph. D. (Clarke) to be Professor of Philosophy and Vice-President, University of Indiana. Dr. John A. Bergstrom to be Assistant Professor of Psychology and Pedagogy; E. H. Lindley to be Instructor in Philosophy.

Warner Fite Ph. D. (Penna.) to be Instructor in Philosophy, Williams College.

J. H. Hyslop Ph. D. (Johns Hopkins) to be Professor of Logic and Ethics, Columbia College.

Dr. J. Allen Gilbert of Yale to be Assistant Professor of Psychology in the University of Iowa.

Drs. E. B. Titchenor and J. E. Creighton have been made full Professors in the Sage School of Philosophy at Cornell.

Dr. Hillebrand has been made Assistant Professor of Experimental Psychology in the University of Vienna.

Dr. Hugo Münsterberg, Professor of Experimental Psychology in Harvard University for the past three years, has returned to Germany. He has not yet decided whether he will make his home permanently in the United States or in Germany.

Report of the Committee Appointed by the Smithsonian Institution to Award the Hodgkins Fund Prizes.—The Committee of Award for the Hodgkins prizes of the Smithsonian Institution has completed its examination of the two hundred and eighteen papers submitted in competition by contestants.

The Committee is composed of the following members:

Dr. S. P. Langley, Chairman, *ex-officio;* Dr. G. Brown Goode, appointed by the Secretary of the Smithsonian Institution; Assistant Surgeon-General John S. Billings, by the President of the National Academy of Sciences; Professor M. W. Harrington, by the President of the American Association for the Advancement of Science.

The Foreign Advisory Committee, as first constituted, was represented by Monsieur J. Jansen, Professor T. H. Huxley, and Professor von Helmholtz; and after the recent loss of the latter, Dr. W. von Bezold was added. After consultation with these eminent men, the Committee decided as follows:

First prize, of ten thousand dollars, for a treatise embodying some new and important discoveries in regard to the nature or properties of atmospheric air, to Lord Rayleigh, of London, and Professor Wm. Ramsay, of the University College, London, for the discovery of *Argon*, a new element of the atmosphere.

The second prize, of two thousand dollars, is not awarded, owing to the failure of any contestant to comply strictly with the terms of the offer.

The third prize, of one thousand dollars, to Dr. Henry de Varigny, of Paris, for the best popular treatise upon atmospheric air, its properties and relationships. Dr. de Varginy's essay is entitled "L'Air et la Vie."

August 9, 1895. (Signed) S. P. Langley,
G. Brown Goode,
John S. Billings,
M. W. Harrington.

"Post-Darwinian Questions," the second part of the late Prof. George J. Romanes' work, "Darwin, and After Darwin," is announced for publication by the Open Court Publishing Company, of Chicago, on October 15th next. With the exception of the concluding chapters, the present volume was ready for publication over two years ago, but the severe and protracted illness of Professor Romanes prevented its speedy completion. On his death, in 1894, the manuscript was placed in the hands of his friend, Prof. C. Lloyd Morgan, the distinguished biologist and Principal of University College, Bristol, England, who has successfully edited the work. This volume, with the first on "The Darwinian Theory," and the booklet on "Weismannism," constitutes, in the opinion of all competent critics, the most complete and authoritative *general* treatise on evolution in the English language. (Pages, 334. Price, $1.50.)

The same publishing house has also recently issued a second edition of Professor Romanes' "Thoughts on Religion," declared, by a prominent writer in the Chicago *Tribune*, to be "one of the most valuable books the century has produced." (Pages, 184. Price, $1.25.)

The Open Court Publishing Co., of Chicago, will issue, late in October, one of the most important books on the theory of evolution which America, perhaps, has yet produced. Its author is Prof. E. D. Cope, of Philadelphia, a well-known representative of the Neo-Lamarckian school of America, and represents the opposite extreme to Weismannism in evolution. In this book, which is entitled "The Primary Factors of Organic Evolution," Professor Cope will seek to show, principally by an examination of the paleontological records (in which he has done his main original work), and secondarily by a review of the general results of embryology and comparative anatomy, what the *efficient causes* are that are concerned in the progressive development and perfection of the organic forms of the world. One of the most noteworthy features of the book will be Professor Cope's attempt to show that every variation of organic beings has been produced by a direct efficient cause, and is not the result of chance—a consideration which Darwin overlooked. Professor Cope also discusses the part which consciousness has played in the evolution of living forms. His book will be a storehouse of evolutionary facts and discussions, especially from the paleontological point of view and undoubtedly the most complete handbook of the *purely mechanical* theory of evolution which exists. The original illustrations will be numerous and valuable. (Pages, *circa* 550. Price, $2.00.)

Course in Embryology.—Professor Charles S. Minot will give, at the Harvard Medical School, Boston, a course intended for persons who wish to make a special study of vertebrate or human embryology. This course is open to registered students of the graduate department of the Faculty of Arts and Sciences, and will be offered hereafter also as a special course to graduate students of the medical school.

This course will extend through the entire year, but in two parts of one term each. The resources of the Embryological Laboratory in apparatus and material render it possible to offer unusually favorable opportunities for both general study and special research. The course is arranged for those who, as morphologists, anatomists and practitioners, wish to give the principal part of their time for one or more school terms to the subject. It will cover the whole field of embryology, including the genital products, the theories of heredity and sex, the formation of the germ-layers, differentiation of the organs, the history of the placenta and the general morphology of vertebrates and of man. Most of the work will be done by the student in the laboratory, but there will also be formal lectures. Students taking this course will be expected to devote to it not less than eighteen hours a week.

Persons wishing to take this course should enter the university as graduate students under the Faculty of Arts and Sciences, but those who have a medical degree may enter as graduate students of the medical school. In the latter case, the fee for one term is $75.00, for two terms $125.00.

Applications should be addressed to Dr. Charles S. Minot, Harvard Medical School, Boston, Mass.

Prizes of the Belgian Academy of Sciences, Letters and Fine Arts.—The following announcement in regard to the prizes offered by the *Academie Royale des Sciences, des Lettres et des Beaux-*

Arts de Belgique has recently been made. In Natural Science the subjects for discussion are: (1). Original researches on the intervention of the phagocytes in the development of the invertebrates. (2). A description of the phosphates and carbonates of Belgian soil. The description must include the strata and locality of each mineral to which the writer refer. (3). Original researches concerning the peripheral nervous system of the Amphioxus, and, in particular, the constitution and genesis of the roots of the sensory nerves. (4). Original researches concerning the mechanism of the cicatrization of plants.

The prize for each of the four divisions will be a gold medal, valued at six hundred francs.

The memoirs must be written legibly, either in French or Flemish, and addressed post-paid to *M. le secretaire perpétual, au palais des Académies,* before the first of August, 1896.

The Academy insists upon exact citations; the authors must give the editions and pages of the works cited. Only manuscript copy will be accepted.

The competitors are requested not to use a pseudonym, but to adopt a device, which must be repeated on a card containing the name and address of the author and sent with the manuscript in a sealed envelope A prize cannot be awarded to any one who fails to comply with this formality.

All memoirs sent after the limit of time has expired, or those whose authorship is made known in any way whatever, are excluded from the competition.

The Academy reminds the competitors that when the memoirs are submitted for judgment, they must remain among its archives. However, the authors may have copies made at their own expense, by addressing a note to that effect to the permanent secretary.

The Jean Servais Stas prize is in the form of one thousand francs, to be awarded to the best work on the following subject:

To determine, by original research, the atomic weight of one or more elements for which the physical constant is now uncertain.

The memoirs must be legibly written in French or Flemish. They must be addressed, post-paid, to *M. le secrétaire perpétual, au palais des Académies,* before the first of August, 1896.

The competitors will, in other respects, conform with the usual conditions of the annual contest.

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THE AMERICAN NATURALIST

A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

Vol. XXIX. **DECEMBER, 1895.** **No. 348**

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PHILADELPHIA, U. S. A.

THE EDWARDS & DOCKER CO.,

518 AND 520 MINOR STREET.

THE

AMERICAN NATURALIST

Vol. XXIX. December, 1895. 348

SARGENT'S STUDIES OF THE FORESTS OF JAPAN.

By Charles E. Bessey.

Within a few years we have had a most valuable contribution to our knowledge of the forest trees of Japan from the hand of Professor Charles S. Sargent, who first published a series of papers in *Garden and Forest*, now collected into a volume entitled the "Forest Flora of Japan." Some of the results of these studies are so at variance with the common statements in papers and books on the geographical distribution of plants as to be quite startling. Thus it is shown that many of the trees usually regarded as Japanese are not actually natives of the islands, but have been introduced from China and other adjacent regions. In discussing this point, reference is made to Dr. Gray's paper on "Forest Geography and Archæology," in which it was shown that Japan is remarkable for the number of species of its forest trees (one hundred and sixty-eight).

"In the Japanese enumeration were included, however, a number of trees which are not indigenous to Japan, but which, as we know, were long ago brought into the Empire from China and Corea, like most of the plants cultivated by the

Japanese. Early European travellers in Japan, like Thunberg and Siebold, who were unable to penetrate far into the interior, finding a number of plants common in cultivation, naturally believed them to be indigenous, and several Chinese plants were first described from individuals cultivated in Japanese gardens. Later writers on the Japanese flora have generally followed the example of the early travellers, and included these plants in the flora of Japan. Indeed, it is only very recently that it has been possible to travel freely in all parts of the Empire, and to study satisfactorily the character and distribution of its flora."

"The list of Chinese and Corean trees cultivated in Japan, and usually enumerated in floras of the Empire, includes *Magnolia conspicua*, *Magnolia parviflora*, *Magnolia watsonii*, *Sterculia platanifolia*, *Cedrela sinensis*, *Zizyphus vulgaris*, *Koelreuteria paniculata*, *Sapindus mukorosi*, *Acer trifidum*, *Rhus vernicifera*, *Sophora japonica*, *Liquidambar formosana* (*maximowiczii*), *Cornus officinalis*, *Diospyros kaki*, and probably *Diospyros lotus*, *Chionanthus retusa*, *Paulownia imperialis*, *Catalpa ovata*, *Lindera strychnifolia*, *Ulmus parvifolia*, *Thuya orientalis*, *Gingko biloba*, *Podocarpus nageia*, *Podocarpus macrophylla* and *Pinus koraiensis*."

In comparing the forests of Japan with those of other countries, after deducting the foregoing, it is still found that "the Japanese region for its area is unsurpassed in the number of trees which inhabit its forests." Comparing the Japanese forests with those of eastern North America, there are 139 species in 53 genera in the former, and 155 species in 66 genera in the latter. If now we take larger areas in each region, the comparison is equally instructive.

"In eastern North America, that is, in the whole region north of Mexico and east of the treeless plateau of the centre of the Continent, but exclusive of south Florida, 225 species of trees, divided among 134 genera, are now known. The Japan-Manchurian region includes eastern Manchuria, the Kurile Islands, Saghalin, and the four great Japanese islands, but, for our purpose, does not include the Loochoo group, which, although it forms a part of the Japanese Empire politically, is tropical and subtropical in the character of its vegetation, which, moreover, is still imperfectly understood. In this narrow eastern border of Asia, there are now known 241 trees, divided among 99 genera. The extra Japanese portion of the region contributes but little to the enumeration. In Saghalin, Fr. Schmidt found only three trees which do not inhabit Yezo, and in Manchuria, according to Maximowicz and Schmidt, there are only eighteen trees which do not also occur in Saghalin or the northern Japanese islands. In the four islands of Yezo, Hondo, Shikoku, and Kyūshū, therefore, we now find 220 trees divided among ninety-nine genera, or only five less than occur in the immense territory which extends from Labrador to the Rio Grande, and from the shores of the Atlantic to the eastern base of the Rocky Mountains. Neither *Cycas revoluta* nor *Trachycarpus* (*Chamaerops*) *excelsa* is included in the Japanese list, as the best observers appear to agree in thinking that these two familiar plants are not indigenous to Japan proper. I have omitted, moreover, a few doubtful species from the Japan enumeration, like *Fagus japonica* Maximowicz and *Abies umbellata* Mayr, of which I could learn nothing in Japan, so that it is more probable that the number of Japanese trees will be increased than that any addition will be made to the silva of eastern America."

That the moist and equable climate of Japan is favorable to the growth of woody plants, is shown by the fact that very nearly ten per cent. of the species of Anthophytes and Pteridophytes are trees. If we consider the shrubs also, the proportion of ligneous species is still more remarkable, being almost exactly twenty-two per cent.

"The aggregation of arborescent species in Japan is, however, the most striking feature in the silva of that country. This is most noticeable in Yezo, where probably more species of trees are growing naturally in a small area than in any other one place outside the tropics, with the exception of the lower basin of the Ohio River, where, on a few acres in southern Indiana, Professor Robert Ridgway has counted no less than seventy-five arborescent species in thirty-six genera. Near Sapporo, the capital of the island, in ascending a hill which rises only 500 feet above the level of the ocean, I noticed forty-six species and varieties of trees. Within five miles of this hill also grow sixty-two species and varieties, or more than a quarter of all the trees of the Empire, which are crowded into an area a few miles square, in the latitude of northern New England, in which, north of Cape Cod, there are only about the same number of trees."

Upon the question of the similarity of the flora of Japan to that of eastern North America, Professor Sargent makes a full discussion, and it is not too much to say that it will compel a change in some of the prevalent notions as to the vegetation of these regions.

"Travellers in Japan have often insisted on the resemblance between that country and eastern America in the general features of vegetation. But, with the exception of Yezo, which is still mostly uninhabited and in a state of nature, and those portions of the other islands which are over 5,000 feet above the level of the ocean, it is difficult to form a sufficiently accurate idea of the general appearance of the original forest-covering of Japan to be able to compare the aspects of its vegetation with those of any other country, for every foot of the lowlands and mountain valleys of the three southern islands has been cultivated for centuries. And the foothills and low mountains which were once clothed with forests, and could be again, are now covered with coarse herbage, principally Eulalia, and are destitute of trees, except such as have sprung up in sheltered ravines, and have succeeded in escaping the fires which are set every year to burn off the dry grasses. Remoteness, bad roads, and the impossibility of bringing down their timber into the valleys, have saved the mountain forests of Japan, which may still be seen, especially between 5,000 and 8,000 feet above the level of the sea, in their natural condition. But these elevated forests are composed of comparatively few species, and if it were not for the plantations of conifers, which the Japanese for at least twelve centuries, it is said, have been making to supply their workers in wood with material, and for the trees preserved or planted in the temple grounds in the neighborhood of towns, it would be impossible to obtain any idea at all of many of the Japanese trees. But, fortunately, for nearly two thousand years the priests of Buddha have planted and replanted trees about their temples, which are often surrounded by what now appear to be natural woods, as no tree is ever cut and no attempt is made to clear up the undergrowth. These groves are sometimes of considerable extent, and contain noble trees, Japanese and Chinese, which give some idea of what the inhabitants of the forests of Japan were before the land was cleared for agriculture.

The floras of Japan and eastern America have, it is true, some curious features in common, and the presence in the two regions of certain types not found elsewhere shows their relationship. But these plants are usually small, and are rare or grow only on the high mountains. Diphylleia, Buckleya, Epigaea, and Shortia show the common origin of the two floras; but these are rare plants in Japan, as they are in America, with the exception of Epigaea, and probably not one traveller in ten thousand has ever seen them, while the chief elements of the forest flora of northern Japan, the only part of the Empire where, as has already been said, comparison is possible—those which all travellers notice—do not recall America so much, perhaps, as they do Siberia and Europe."

On making a close comparison of the forests of Japan and eastern North America, it is found that in the former region there is no Black Oak, Chestnut Oak, Tulip-tree, Pawpaw, Gordonia, Plum-tree, Locust, Gymnocladus, Liquidambar, Tupelo, Osage Orange, Sassafrass, Plane-tree or Hickory. Moreover, in many instances where a genus has representatives in both regions, the species are rather of the European than the North American type. The Japanese forests contain species of many genera which have no North American representatives, as Euptelea, Cercidiphyllum, Trochodendron, Idesia, Ternstroemia, Cleyera, Eurya, Camellia, Phellodendron, Hovenia, Euscaphis, Maackia, Albizzia, Distylium, Acanthopanax, Syringa, Cinnamomum, Machilus, Actinodaphne, etc., etc. Magnolia and Aesculus occur in both regions, as also Rhus, Hamamelis, Aralia, Cornus, Juglans, Thuya, Chamæcyparis, Picea, Abies and Tumion (*Torreya*).

Other interesting comparisons are made by Professor Sargent showing that in other ways the forests of the two regions are quite unlike, as in the greater number of broad-leaved evergreen trees and shrubs in Japan, the small number of pines, and more striking still, the dense bamboo undergrowth which covers the forest floor, even on the mountains and in the extreme north.

Of the studies of the families of forest trees taken up by the author, it is impossible here to give more than a brief outline, and the reader must be referred to the work itself for the details. Of the Magnolia family there are, in Japan, five genera, while in the United States there are but four; nor are there any evergreen species of the genus Magnolia, resembling those of our southern States. In this family the most important tree is the *Cercidiphyllum japonicum*, which is said to be the largest tree in Japan. It is often one hundred feet high, and its usually clustered stems are often eight or ten feet in diameter at their common base.

Of *Ilex latifolia*, one of the eight arboreal species of hollies, Professor Sargent says that it is "probably the handsomest broad-leaved evergreen tree that grows in the forests of Japan, not only on account of its brillant, abundant fruit, but also on account of the size and character of its foliage." We are told that it will certainly succeed in our southern States, and may be hardy as far north as Washington.

There are twenty species of Japanese Maples, more than twice as many as occur in North America. Two of these belong to the section Negundo. In marked contrast to the Maple family is the Pea family, represented by but three arborescent species, viz.: *Albizzia julibrissin*, *Maackia amurensis* and *Gleditschia japonica*; the latter closely resembles our Honey Locust, even to the appearance of the branches, which are "horribly armed with flattened spines, two or three inches in length." *Fraxinus manchurica*, the Japanese Ash, attains a height of one hundred feet, with a diameter of from three to four feet. It has been grown for many years in the Arnold Arboretum, where it is quite hardy. The Japanese Elms are of minor importance, the principal species being identical with the Elm of Europe (*Ulmus campestris*), although of much smaller growth. Related to the Elm is the Zelkova, "perhaps the largest deciduous-leaved tree of Japan," as well as "its most valuable timber tree." It attains a height of one hundred feet, and a diameter of eight to ten feet. The best known of the Japanese Oaks is *Quercus dentata*, a tall but irregular tree, "remarkable for the great size of its leaves, which are often a foot long and eight inches broad." *Quercus crispula* and *Quercus grosseserrata* are excellent timber trees, eighty to a hundred feet in height, with a diameter of three to four feet. The Chestnut and Beech are identical specifically with the European trees, but show varietal differences, the former being a more precocious tree, often bearing fruit when but ten or twelve feet in height. Professor Sargent suggests this tree for introduction into the northern United States.

Japan is richer than eastern North America in conifers, and they "are more planted for shade and ornament than they are in America, or, perhaps, in any other country." The great number of Japanese conifers prevents more than a mere mention in this paper of the most important species. *Chamæcyparis obtusa* and *Cryptomeria japonica* are largely planted as timber trees, the former also being one of the sacred trees planted about the temples. *Cephalotaxus drupacea* and *Ginkgo biloba* are common, although it is now agreed that the latter is not a native of Japan, where, however, it grows to a great height (100 feet) in the groves about the Buddhist temples. *Tumion* (*Torreya*) *nuciferum* is the "largest and most beautiful representative" of a curious genus. The Umbrella Pine—*Sciadopitys verticillata*—well-known to us as a small tree in cultivation, is, in its native region, a tall pyramidal tree a hundred feet or so in height. But two pines, *Pinus densiflora* and *Pinus thunbergii* are valuable timber trees. There are also important species of Picea, Tsuga, Abies and Larix, some of which have long been in cultivation in America and Europe.

In closing his interesting account of the Japanese forests, Professor Sargent remarks upon their lack of economic or scientific management, and the imperative need of adopting an intelligent system of reforesting and cultivation. It appears, however, that "the forests of Yezo are still intact, except where here and there a struggling settlement has broken into the forest blanket which covers this noble island. Here are great supplies of oak and ash of the best quality, of cercidiphyllum, walnut, fir, acanthopanax, cherry and birch—a storehouse of forest wealth, which, if properly managed, could be drawn upon for all time, and which, if the timber is not needed in Japan, may become, when the trans-Asiatic railroad is finished, an important factor in the development of southern Siberia and some of the treeless countries of central Asia."

THE BIRDS OF NEW GUINEA. (MISCELLANEOUS).

BY G. S. MEAD.

In considering the birds of the tropics or of any portion of the tropics, one is apt to suppose that the birds which are seen therein at any time may be seen at all times. In other words that they are as much fixtures as the trees, that they never migrate. While this may be true of a large number of species, it is not by any means true of every species, even of land birds.

Our own birds are with us a few months only; most of them at the approach of winter go south where, in tropical lands or in low temperate latitudes, they may be found during a longer period. The mere migrants—those that pause on their way north or south for days only—are not taken into account.

It is well then to bear in mind two facts: First, that in every country migratory birds whose period of stay covers a large proportion of the year, are to be met with besides permanent residents; second, that all birds found by travellers are not necessarily permanent residents, but in many instances transient vistors only.

Birds of Paradise are said to move from one island of the Papuan Archipelago to another, in order to avoid storms or stress of weather at certain times of the year. The Nicobar pigeon also, a heavy flyer, has been seen many miles distant from the mainland.

Probably therefore, in New Guinea, although we find a very large resident population, we also discover many birds that have come from Australia or the Asian Continent to remain but a partial period. Mr. Jukes illustrates this view in his valuable narrative " The Voyage of the Fly."

" While we were in this neighborhood (in Torres Straits, Turtle-back Island) about the end of February, (1845), great flocks of the bee-eater which is common in Australia (*Merops ornatus*) were continually passing to the northward. The white pigeons also (*Caropophaga luctuosa*) were going in the same direction in numerous small flocks, and in March all the pigeons left in the islands were young ones. The bee-eaters go as far to the southward as Sydney during the summer of New South Wales, but we never saw the white pigeons much to the southward of Torres Straits. In September, 1844, they were coming thickly from the northward to Endeavour Strait, and they seem to return in March. What can be the reason of the migration? In these latitudes it is evident that mere temperature cannot be the cause of it, although the variation of the seasons for different fruits or insects may. I had afterwards strong reasons for suspecting, that even on the opposite sides of so small a space as Torres Strait, not more than 120 miles, the seasons are totally different; that the wet season prevails in New Guinea between March and October, which on the north of Australia is the driest part of the year; while from October to March, when most rain falls in Australia, it is probable that the south coast of New Guinea has its driest weather."—J. B. Jukes' Voyage of the Fly, Vol. I, p. 157.

Rich as the entire archipelago is in bird life, many as are the species peculiar to this or that island and found no where else, it would nevertheless be an unjust limitation to enumerate only such forms as are confined to the one region and cannot without the compulsion of some extraneous force pass beyond the barriers of their island home, to the total exclusion of the many additional species of birds that while they may not in all cases breed, yet linger for a longer or shorter period in the places of their choosing. A large number of species of swallows, king-fishers, raptorial birds, range so widely as to make it impossible to say that they really belong to one island or group of islands rather than to another. In some instances, therefore, we find an interchange of habitat.

The pigeons form a very large chapter in the Natural History of New Guinea. They are many in number and species, (more than 80 are known) of all sizes and characteristics, and are found pretty generally throughout the vast island. Many of the kinds distributed in different quarters in Australia are to be seen in Papua, while several are peculiar to the latter and never found in Australia at all. Almost all phases of columbar development, therefore, may be studied in this region, which ornithologically speaking, is, as has been shown in divers instances, singularly favored. Foremost among the pigeons is the splendid *Goura coronata*, whose stately form is now not uncommon in zoological gardens. It is very large for a pigeon, as large oftentimes as the domestic turkey, very slow in its movements and quiet in its disposition. Its lovely dark blue plumage and the peculiar but beautiful crown, are its chief claims to renown among the many other wonders of its habitat, while its great size distinguishes it among its own kind. The crest is certainly very remarkable, imparting to its wearer a look that no other species of its tribe, indeed no other bird, possesses. It has the appearance of a bunch of long, delicate leaves from which all the pulpy matter has been removed. There appears to be rather individual than specific differences in the crests. The crest of *Goura victoriae* may be thicker towards the top, the thin feathers spreading out into little fans, but this appearance is not invariable. On the other hand *Goura albertisi* boasts a crest fully as large and tall, but the spatulas instead of flowering out as it were, remain of an even texture throughout their length. Yet in this case also, the distinction is not certain. A surer mark of difference between the two species is the white on the wings, this color being particularly noticeable in the *albertisi*.

A dark gray-blue is the dominating color; this becomes paler on the tail, and finally makes a bluish-white band. Whitish marks appear on some of the feathers, while on the shoulders a fine maroon is visible and again on the under parts. The total length of the bird is fully two and a half feet.

Another species, *Goura sclaterii*, says D'Albertis "is like the crested Goura, but differs from it in having an ashen colored instead of an iron-gray black." Wallace mentions still another species, *Goura steursii* from Jobie, brought from there by the naturalist Rosenberg.

The genus *Eutrygon* of New Guinea is represented by a single species namely, *E. terrestris*. This pigeon is a handsome dark leaden-gray bird with a whitish spot on the forehead. The wings, tail, back and rump are a shining light olive, the sides and under tail coverts rufous. A white collar encircles the neck and throat; bill small and bony. The smallest of the genus *Ptilopus*, *Ptilopus nanus*, is clothed in bronzy-green, set off by a strip of gray on either side the neck, by a patch of purple in the very middle of the abdomen, and yellow touches on the wing coverts. Tail deep green; bright corn-yellow on under tail coverts. Female has no purple spot. The Tiny fruit pigeon it is called.

Another pretty little pigeon is *Ptilopus iozonus*, purple-banded; this dainty miniature of its family is about 8 inches in length. The general color is green, becoming black along the extremities of the long wings. The tail beneath is yellow, buff and white; legs yellow.

The *Chalcophaps margaritae* (*Philogoenas jobiensis*) or white-chested pigeon strikes one at first as being brown or bronze in color, but further observation will show a greater variety of tint. Moreover, as with almost all pigeons, the fundamental color is rich with its reflected lights. The tail is black intermixed with blue, the head black and gray, the neck, breast and throat white. Elsewhere violet, blue, even pink are reflected from the uniform metallic brown surface. This pigeon is small in size, timid and suspicious, and keeps to the ground, rarely perching upon trees.

A fine, large bird, nearly two feet in length, is *Macropygia reinwardtii*, widely distributed over the archipelago. The under parts including the neck and head are pure white or ashy. Above, over the back, wings and two middle feathers of the long and shapely tail, the color is a warm chestnut. Black occurs also on the primaries, and in lines and edgings along some of the tail feathers, mixed with gray. The feet are red; around the eye runs a circlet of bare skin.

Otidiphaps nobilis, a ground pigeon, is rich in color. On the long feathers of the head a dark green lies; around the neck runs a collar of green rippling with light. A rich brown darkens the metallic surface of the back, while the wings are coffee colored. The curiously rounded tail is a dark blue-black and contains twenty feathers. The note of this bird is strenuous and persistent, lacking perhaps, the volume of certain species, but making up the deficiency by iteration and reiteration. The bill is like a small bone.

To D'Albertis we are indebted for a brief description of *Gymnophaps albertisii, novum genus et nova species.* "The form of their beaks, the nostrils surrounded by a circle of the brightest scarlet, and a large bare space around the eyes of the same brilliant color, give these birds a most curious appearance. The back is generally ash colored, speckled with black at the ends of the feathers."

Among pigeons, indeed among all the feathered folk, there are few more curious looking birds than the species *Caloenas nicobarica*, Nicobar pigeon, representing a genus by itself, scattered more or less abundantly throughout the Malayan Archipelago. It possesses considerable power of flight, although not an easy bird upon the wing, hence its general diffusion over the numberless islands of the Australasian seas. Mr. Guppy records its appearance in the Solomon Islands. The anomalous feature causing the peculiar appearance is the spread of long individualized feathers over the neck, shoulders and back. Thus is formed a kind of disparted mantle in which the lanceolate plumes seem to have been thrust after the subjacent layer was grown. The reflections from this singular covering are a blending of bronze and green. A still brighter reflection is turned from the metallic surface of the wings, a livelier green here meeting the eye. One notices with some surprise, as if it were an incongruous appearance, that the terminations of the tail feathers are a pure white. Everywhere else we find a uniformity of bronzy coloring, intense indeed with reflections, but without contrasts.

Many of these pigeons, especially of the crowned species, are most delicious eating. The flesh surpasses in flavor, richness and other edible qualities that of almost all game birds. According to the taste of some travellers turkeys, ducks, geese, all must hang their heads in the presence of *Goura coronata.*

The *Talegallus* or Brush turkey is frequently seen in New Guinea, his mound being one of the characteristics features of the country. He is a small bird to accomplish such a task as gathering together in a compact mass, material—brush, dirt, leaves, etc.—in sufficient abundance to fill 20 or 30 large carts. No two travellers seem to make the same measurements. In this, which he treads down firm, the eggs are deposited and then left for the incubation the heat of decaying matter is sure to bring about. Several nests are placed in the same mound and do service for successive seasons. It is very much as if one of our barnyard fowls were transported into the depths of the forest, since the general aspect of the domestic hen and the wild bird is almost identical, and the cackling equally serious and obdurate.

The muscular effort necessary to the heaping up of the mounds must of course be very great; most of the work, if not all, is done by means of the foot, which is of large size and terminates a long, stout leg. While the bird stands on one foot, with the other he grasps the materials to be used and thrusts or kicks them back to the place he wishes. In this way the huge nest is gradually formed until it becomes a very respectable hillock in its dimensions, in some instances 20 to 30 feet through and 15 in height; all this is accomplished by birds (several combining together to perform the task) scarcely larger than a barnyard fowl. This Megapode (not using the term in its strict scientific limitation) is not addicted to flight nor are its wings of sufficient strength to keep it long in the air even were the bird disposed to entrust itself to that element Accordingly when disturbed, if it takes to its wings at all, it is with hurried and laborious strokes usually terminating at some convenient bough not far away, where it stands with outstretched neck somewhat after the manner of our wild turkey, anxious as to the cause of alarm below. It is a shy timid bird, attentive to its own business solely, yet, like all such creatures, frequently carried away by curiosity.

Its enemies are many, for the flesh is sweet and the eggs nutritious. It would seem, therefore, as if for this defenseless, inoffensive creature, Nature would have provided some special protection. So indeed she has, since in the dusky hue, that blends readily with the forest surroundings, the *Talegallus* is furnished with the best possible protective coloring, but Nature oftentimes appears to delight in being capricious or inconsistent; she here gives an invisible cloak but as if to neutralize the gift, she bestows also a loud, dissonant voice that invites everything within hearing to come and see to what it belongs; and, as if this were not enough, the poor creature is obliged by hapless fate to call public attention to the depository in which its treasures are laid, by the vast size of the structure erected for their concealment.

The general color of the birds is a sober brown, unrelieved by any touch of brightness, unless it be in the pale yellow of the legs. The neck of one species is flushed with red, while in another a warm dark gray reaches as far as the abdomen. In some cases a delicate shading of browns produces a pleasing effect on the body and wings. The bill is dark, short and compact.

Four species are known, namely, *Talegallus lathamii* of Australia and New Guinea, *T. jobiensis*, *T. cuvierii* and *T. fuscirostris.* D'Albertis calls the last *nova species.* It would seem as if some or all of these might be domesticated. The first mentioned is a large bird, in shape and size the counterpart of the female turkey, of a uniformly dark brown plumage and long neck denuded of a compact covering of feathers, but having instead a coarse dull-red skin scantily-clothed with short, stiff feathered shafts. The head presents a similar appearance. The tail is long and keel shaped, and like the wings dull of hue. There is a slight interfusion of gray on the under parts, imparting a mottled appearance to the thighs and abdomen.

Yellow brightens the wattles. The female is like her mate but somewhat smaller. The eggs are pure white, laid in a wide circle, and about 3½ inches long.

Talegallus cuvierii is also a very dark brown with yellow legs and feet. It is not nearly so large a bird as the preceding and is better put together. While the larger bird looks not unlike a loosely set, shambling turkey, the smaller might pass for a trim, plump pullet. The sexes present no special differences. The color throughout is a sooty-brown excepting on the abdomen, which is mottled. The back and hinder parts are covered with a thick bed of the softest down; like the feathers a dark brown.

Talegallus fuscirostrii has been assigned a separate species of its own on account of its dark-colored bill.

T. jobiensis from the Island of Jobie is a variation probably differing but slightly from the species enumerated.

In *Dasyptilus pesquetii* we see a bird which must be classed among the parrots, yet one which possesses a curious resemblance in that most distinctive feature of the parrot family, viz., the head, to hawks and eagles; the eye also is small and fierce, and the beak that of a bird of prey. The feathers too, what feathers there are, for the head is almost bare except the occiput, stand out stiffly as at times of anger those on the head of the eagle. But in all other points the parrot is evident enough. The colors are strongly laid in, although few in number. Black of a greenish tinge covers most of the upper parts, from which the red of the wings stands out vividly; a similar tint scarcely less brilliant appears on the thighs, abdomen and rump; a grayish hue is apparent on the breast, combined with pale yellow, giving a peculiar cast to that part of the body. In length, taking in the somewhat long tail, this anomalous member of his tribe, is about twenty inches.

If the parrot just described is something of a nondescript, the Black Cockatoo, *Aterrimus*, is exceptional because of his great size, for he is the largest of his family. He is also the only member of the genus *Microglossus*. He is to be found pretty generally throughout the archipelago and is always in evidence because of his size, color and eccentricity of looks and conduct. He measures sometimes 32 inches and is entirely black from his absurd head, which is finely crested, to the long, rounded tail. The only relief to this funereal garb is the bright red of the bare cheeks. The bill is extremely powerful and is used with as much dexterity by its proud possessor as if it were not the most awkward looking thing in the world.

A splendid species of the Gardener, splendid by reason of its crest, for in other features it resembles the *Inornata*, is *Amblyornis subalaris* found in the Astrolabe and Horseshoe Mountains, Southeast New Guinea. One noteworthy fact should not be omitted; its cabin boasts of two entrances, for what special purpose, if any, is a matter of surmise. There is considerable olivaceous on the body of this species and bright, fine stripes on the throat. The beautiful erectile fire-orange crest, tall and spreading, grows dark of hue near the crown, and is also shaded here and there along the sides. The bill lacks the size of the other species. The total length of the bird is only about eight inches. The female is like the male with the exception of the crest. She is without this distinguishing ornament, but the uniform dark brown of the back and the mottled brown-yellow below are the same.

The bower of this species is said to surpass that of any other bird in ingenuity and quaintness. The same general design as we have seen in the case of the *Inornata* is followed by the *Subalaris*. Around a central post or tree-stem the construction is reared; at its foot is a bank of moss into which is thrust flower or twig or other ornament. The running or chasing ring encircles the bank, and over all there is erected a sort of roof probably as a shelter and concealment. Surely instinct or sagacity has not further gone than in this little pleasure house built as it were after a plan, out of material as serviceable and durable as the special purposes required. Easily removable, they are at the same time fitted in the entire work so artistically as to give the appearance of solidity to the fabric.

Ten years ago there was discovered in the Horseshoe Mountains, Eastern New Guinea, a fine Paradise bird, regarded as a new species of a new genus and so classified by the distinguished German naturalists Drs. Finsch and Meyer, whose personal knowledge of the great island and its feathered population is so widely appreciated. They named the acquisition *Astrarchia stephaniae* after the Crown Princess of Austria. It is like the brilliant *Astrapia nigra* but differs in some particulars so important, especially in the form of the tail, as to justify its relegation to a genus of its own. The general color is black with violet, green, bronze and blue reflections. There are two, if not three bands, athwart the breast, the one glinting out all the reflections, the other just below, less broad, glowing with a coppery refulgence, while a third so evanescent as to scarcely admit of specification, is of a bluish shade. The under parts do not fail from their dark surfaces to send forth gleams of changing colors—green, golden and brown. The tail is black also, upper and under tail coverts blue-black. From the side of the head proceed velvety-black, shining feathers somewhat lengthened; so too are the loose feathers on the neck. The metallic wings—black and glistening—are of a violet-purplish cast. The bill, feet and irides are black. As in the *Astrapia* the exterior upper tail feathers are curved back at their ends and are of a roseate dye, perceptible but elusive. But it is not in the tints but in the arched shape of the tail feathers, that one essential difference between the *Astrapia nigra*—the Paradise Pie—and *Astrarchia* lies. In the first "the tail is regularly graduated," in the second "the graduation is irregular." Again the head of the latter is less profusely plumaged, nor are the feathers of adornment as long as in the allied genus. On the neck the plumes of *Astrarchia* are not free and upturned, but laid close upon the underlying feathers.

THE CLASSIFICATION OF THE LEPIDOPTERA ON LARVAL CHARACTERS.

By Harrison G. Dyar.

Several articles[1] have appeared in the American Naturalist, presenting different views of the classification of the Lepidoptera. Certain studies on the larvæ have tended to show that there are characters of classificatory importance in this immature stage, and it may be interesting to compare the evidence furnished by them with that deduced from the mature structures.

Prof. V. L. Kellogg, accepting the division of the Lepidoptera into the suborders Jugatæ and Frenatæ, finds in the families of the former certain generalized characters in the mouth parts; but the Hepialidæ exhibit an atrophied condition. In the larvæ these conditions are reversed. The Hepialid larvæ present distinctly the characters of classificatory importance, while the leaf-mining Micropterygidæ are considerably atrophied. In the view advocated by Dr. A. S. Packard, the Hepialidæ are placed, not in a separate suborder, but low in the scale, near the Tortricidæ. Therefore, these larvæ will serve as something of a test between the two views advanced. Dr. Packard has discussed the larvæ of the Hepialidæ and quotes their characters as supporting his views, saying that the hairs are arranged in the same way as in normal Tortricid and Tineid larvæ "the four dorsal hairs arising from minute warts arranged in a low or short trapezoid." He has also given figures of several species (Journ. N. Y. Ent. Soc., iii, 70, pls. iii and iv). This article is, however, open to criticism in two essential points. In the first place, the differential characters of the families of Lepidopterous larvæ do not reside in the dorsal warts. By this argument, Hepialus could equally well be proved to be a Noctuid or a Butterfly. In the second place, the figures of Hepialus larvæ do not show all of the

[1] Am. Nat., March, June and August, 1895.

setæ, often not half of them. Probably they had become lost by attrition in the specimens drawn or possibly they were overlooked; but it is evident that any conclusions founded on these figures will require revision. Dr. Packard's figure of the first stage of *Hepialus mustelinus* is drawn in such a position that the lateral setæ do not show. I have, however, received some of these larvæ from Dr. Packard (who has very kindly furnished me with valuable specimens of larvæ which I should not otherwise have seen); I am able, therefore to present a more detailed drawing. (Fig. 1.)

I have shown in other publications[2] the general arrangement of the setæ common to all Tineids, Tortricids and and other Microlepidoptera, and that the higher families, including the Noctuidæ, Sphingidæ and Butterflies are founded on the same type. The arrangement on the two last thoracic segments and on the abdomen is shown in Figure 5. This type includes what I call the subprimary setæ, certain ones common to all the Microlepidoptera and the Noctuids and their allies, but absent in the newly hatched larva and also in the highest families. They are marked by an asterisk in the figure. Now, clearly, if Hepialus belongs where placed in the view advocated by Dr. Packard, that is to say among the lower "Neolepidoptera," it should possess the subprimary setæ in the normal position. If, however, it belongs to a separate suborder, as the Jugatæ in the view supported by Prof. Kellogg, it should not have them, and for this reason: the subprimary setæ are not universal in the Frenatæ, but exist in two of the superfamilies (of my arrangement), not in the three others. Now Hepialus, if of the rank of a suborder. should show the generalized characters of the other suborder without its special acquired characters which might appear in some of the superfamilies. Therefore, the subprimary setæ should be absent, though this argument does not preclude the presence of other different subprimary setæ, or of other primary ones, not present in the Frenatæ.

Figures 1 and 2 show Hepialus in Stage I and mature. The subprimary setæ are absent but on the thorax are a set of

[2] Ann. N. Y. Acad. Sci., viii, 198; Trans. of the Same, xiv, 50, 1894–5.

setæ quite different from those of the Frenatæ marked + in Fig. 2a (mesothoracic segment), and also the primary setæ, which correspond to those of all other Lepidoptera. Thus Hepialus larva is not only a generalized form, but has pursued a line of development different from all Micros and Noctuids, the only larvæ in any way comparable with it in simplicity. With the three higher groups no one has recently thought of allying it, though formerly it was included among the "Bombyces." This evidence seems to me to be best interpreted as supporting the view that Hepialus represents a group of Lepidoptera (Jugatæ) as generalized as the lowest Micros and of subordinal rank.

However, let us see how favorable an interpretation to the other view can be put on the structures of Hepialus larvæ. That is to say, can the setæ be homologized with the Tineidæ? We recognize at once that no Tineid or related family has such a structure. They are remarkably uniform, for, when not degenerate, the arrangement of Figure 5 obtains, gradually modified in the higher forms by the approximation of iv and v on abdomen, then of i and ii also; on thorax ia and ib, iia and iib, iv and v, respectively, approximate. Therefore, Hepialus is neither typical nor does it represent a high development in the normal line. Still, on the abdomen, the fourth primary seta above the spiracle may correspond to the seta in Cossus hereinafter mentioned, but we must suppose this seta in Cossus to be primary; iv is out of line with v, more as in the Noctuina. Of the secondary setæ, the lower may correspond to vi, the upper is unexplained. On the thorax the upper anterior primary seta is unexplained; the two subprimaries may correspond to iii and v but moved up out of all association with iv. Thus by some violent movements we have homologized a part of the subprimary setæ of Hepialus with those of the Tineidæ. It is true that considerable movements may occur; I was deceived by such in my first explanation of the Psychidæ. Granting the possibility then, it could be argued that Hepialus may really belong with the Tineidæ, were it not for the two unexplained setæ; but the whole explanation is too forced to pursue further.

To turn now to the Protolepidoptera (Packard's suborder I). Aside from the generalized condition of the mouth parts and the body as a whole, no characters appear to prove that Eriocephala is entitled to subordinal rank. The possession of generalized characters is also called for in placing this genus in the Jugatæ. It is true that if the external lobe of the maxillæ corresponds to the tongue and not the inner (galea) in Eriocephala as Dr. Packard implies in his article, quoting Dr. Walter, we would have a real difference, indicating a dichotomous division. But Dr. Walter homologizes the true tongue of his "höheren Micropteryginen" (the Paleolepidoptera of Packard), also with the outer lobe, stating "Die Innenlade der Maxille ist indes völlig geschwunden. Als einzige Maxillarlade ziegt sich hier ein zwar noch kurzes, aber typisch entwickeltes und leicht rollbares Rüsselchen" (Jena. zeit. fur Naturwissenschaft, xviii, 761) and Prof. Kellogg thinks that it is the inner lobe in all cases that corresponds to the tongue (Am. Nat., June, 1895, p. 547), finding a rudiment of the outer lobe in the true Micropterygidæ.

The larva of Eriocephala is admittedly a specialized one. Not much is to be gained in discussing it, as it is in the interest of both views to show it different from most larvæ. Still I will show that the arrangement of the setæ may be derived from the Micropteryx type. Their form is unique and most interesting, but not valuable in classification.

I will briefly discuss, but in more detail, the characters of the larvæ of the several families of the Jugatæ, as far as they are known to me.

Suborder JUGATÆ.

Superfamily HEPIALIDES.[3]

Family *Hepialidæ.*

Hepialus mustelinus. Stage I (Fig. 1). The prothoracic segment is normal for all generalized Lepidoptera. On the two posterior thoracic segments the primary setæ are present with

[3] Grote, Syst. Lep. Hildesiæ, 1895.

an additional primary seta (marked + in the diagram Fig. 1c). On the abdomen, the primary setæ are present with a small additional one behind tubercle iii (+ in Fig. 1d). I am indebted to Dr. Packard for the specimen.

Hepialus humuli. Mature larva (Fig. 2). On the prothorax the cervical shield extends down to include the setæ before the spiracle. No setæ added to those in the first stage. On the last two segments the setæ are as in Stage I, without any of the true subprimary setæ (associated with iv and marked * in Fig. 5), but two different ones are present (marked * in Fig. 2a), associated with iib. On the abdomen there are present, besides the primary setæ, two subprimary ones (marked * in Fig. 2b). There are four primary setæ above the spiracle, which is unknown in any other Lepidoptera except in the Microlepidopterous genus Cossus, where the fourth seta is probably secondary (I have not seen Stage I of Cossus) and in the butterfly Danais, where it occupies a different position. The upper subprimary seta is without an analogue so far as I know. The lower one I have formerly interpreted as being the subprimary tubercle vi of the Micros (Ann. N. Y. Acad. Sci., viii, 198), but this was before I had examined considerable material. This interpretation is still possible, but in view of the fact that the tubercle is associated with vii as vi never is, and in view of the condition on the thorax, we cannot regard it as the homologue of vi.

Hepialus lupinulus. Mature larva. The structure is the same. I cite the species to show that the characters described above are generic and not individual. In my example (a blown specimen) a number of the setæ have been lost during the journey from Europe but the tubercles from which they arose can be distinguished plainly under a half inch objective in the proper positions.

Superfamily Micropterygides.

Family *Micropterygidæ.*

Micropteryx purpurella. Mature larva (Fig. 3). The rudimentary setæ are difficult to distinguish. On the thorax I discover but one seta to represent ia and ib; the rest are present, but without any subprimary ones. On the abdomen the primitive arrangement prevails. I take the two lower setæ to represent vii and viii (the latter corresponding to one on the inside of the leg in Hepialus, which could not be shown in the figure) and consequently subprimary vi is absent. There is nothing here to contradict placing this genus with Hepialus in the suborder Jugatæ, but I do not emphasize the point, on account of the extreme reduction of the setæ. Larvæ kindly sent me by Dr. T. A. Chapman.

Family *Eriocephalidæ.*

Eriocephala calthella. Stage I (Fig. 4). Dr. Packard has kindly loaned me a slide of these larvæ prepared and given him by Dr. Chapman. Dr. Chapman has recorded many interesting observations on these larvæ (Trans. Ent. Soc. Lond., 1894, 337–344), but only the arrangement of the setæ concerns us here. Dr. Chapman's dorsal view (l. c. pl. vi, Fig. 1) corresponds with my own observations. His lateral views, however, are on a smaller scale and the lowest row of setæ has been omitted. It was apparently not seen, as it is stated in the text that there are "8 rows of globular appendages" or setæ, that is four on each side, whereas, in reality there are are five rows, The two lower setæ on the prothorax also escaped observation. These corrections should be made to Dr. Chapman's account.

The setæ are highly modified and their arrangement has been much specialized as shown by the fact that the last two thoracic segments are like the abdomen. This is the case in no generalized type and has only been so perfectly attained in some of the highest lines of development in the Frenatæ. Nevertheless, by omitting seta iv on the thorax and iii on the abdomen, the arrangement could easily be derived from that of Micropteryx. I do not wish to suggest that this is the actual homology, for my material is too limited, but there seems nothing to preclude a derivation of Eriocephala from Micropteryx.

The curious abdominal legs are unique in the Lepidoptera. Probably they have been derived secondarily and have no homologues elsewhere. Dr. Chapman has endeavored to ally Eriocephala with the Limacodidæ (Eucleidæ). Certainly there are several curious and striking analogies,[4] but I believe that these families really have no affinity. This is not the place for a discussion of the reasons for this view and I will only remark that the arrangement of the setæ is clearly not homologous.

Explanation of Plate.

Fig. 1. *Hepialus mustelinus*, Stage I, side view. *a*, head and thorax; *b*, one segment of abdomen; *c*, a thoracic segment made diagrammatic and the leg setæ omitted; *d*, an abdominal segment made diagrammatic.

Fig. 2. *Hepialus humuli*, mature, a diagram of the setæ. *a*, thorax; *b*, an abdominal segment.

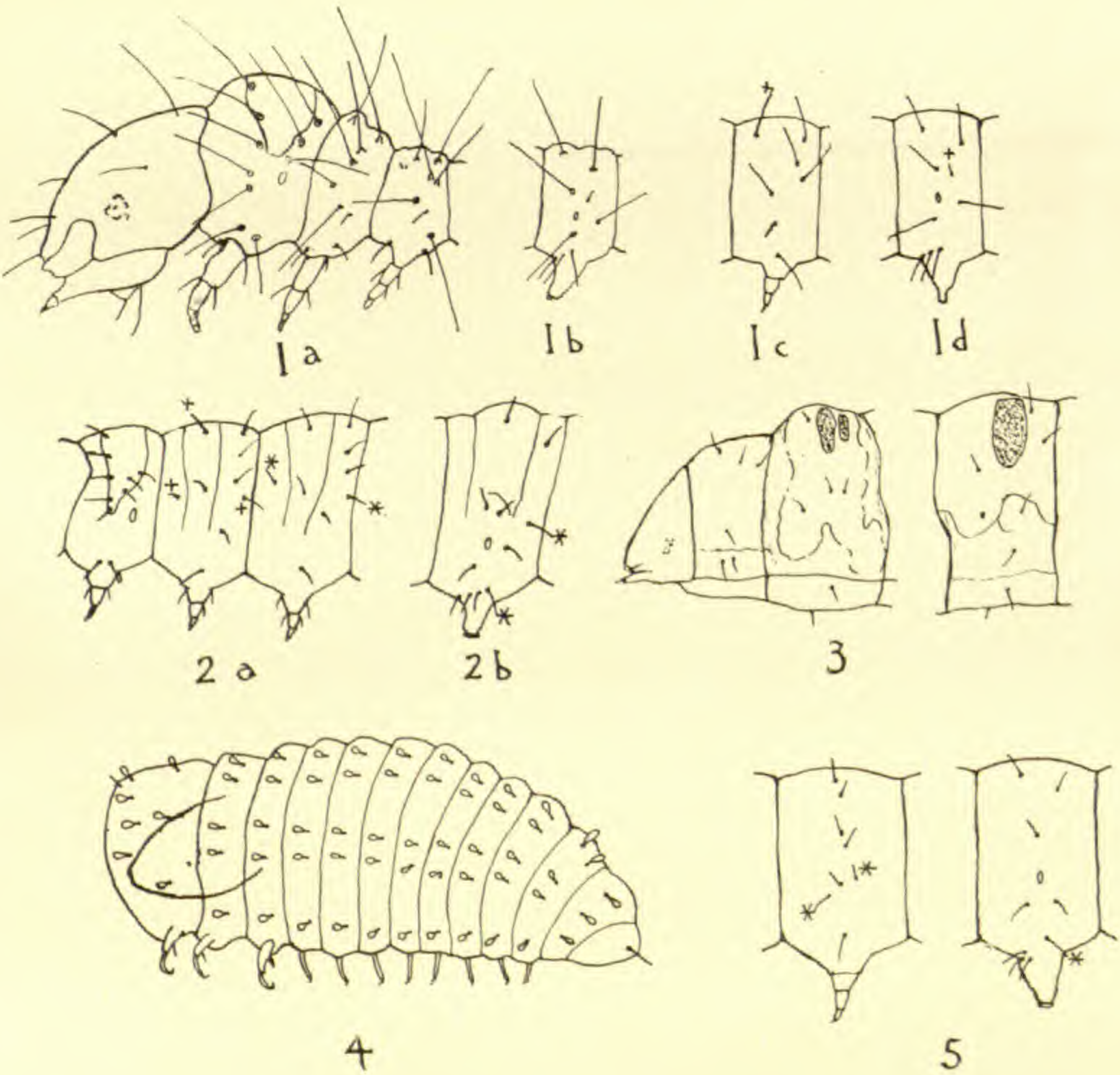
Fig. 3. *Micropteryx purpurella*, mature, first two thoracic and an abdominal segment.

Fig. 4. *Eriocephala calthella*, Stage I. The whole larva is represented, side view, but only the setæ are shown. The head is retracted and its outline appears by transparency.

Fig. 5. A diagram of the metathoracic and abdominal setæ of the primitive Microlepidoptera (Tineides).

[4] These are (1) the retractile head, (2) the angular outline of the body section, ridged subdorsally and laterally and bearing setæ on the ridges, (3) the presence of a series of dorsal and lateral intersegmental areas corresponding in position to to the largest of the depressed spaces of the Eucleidæ, (4) the unusual number of abdominal legs, on the same segments as the suckers of the Eucleidæ, especially in the presence of a foot on joint 5 (first abdominal segment), which bears no appendage in any other Lepidopterous family than these two, and is also apodal in the phytophagic Hymenoptera, (5) the tendency to have the thoracic setæ arranged like the abdominal ones.

PLATE XXXVII.



Dyar on Lepidoptera.

RECENT LITERATURE.

Flora of Denver.[1]—The author of this little book states in her prefaces that "this Flora was written with the sole aim of helping students to learn the names of the plants that grow around Denver." She has accordingly made a simple book, in which, however, she has striven to secure a reasonable amount of scientific accuracy. In this she has succeeded very well. She has descriptions, (sometimes very short, and in sedges and grasses a mere list of names) of about 500 flowering plants, which must prove useful for the young people who study the plants of the vicinity of Denver. We understand that this is a prodrome of a more complete work to appear in the future. In it doubtless the nomenclature will be modernized and characters supplied to the families and genera.—CHARLES E. BESSEY.

Two Plant Catalogues.—In 1868 the Portland Society of Natural History published a Catalogue of the plants of Maine, which has been a standard list for a quarter of a century. We now have a new Catalogue[2] in which the results of much recent work have been incorporated. In the Catalogue proper issued in 1892 we find 1509 species and varieties of Phanerogams and 69 Pteridophytes. In the supplement these numbers are increased by 149 Phanerogams and 6 Pteridophytes. Seventy-seven names must be dropped from the original list, leaving at present a total of 1656 species and varieties. This is in truth a very good beginning toward the acccomplishment of the final catalogue, of which this is but the forerunner.

The arrangement and nomenclature are ultra-conservative, and this in spite of the fact that the author recognized the propriety of changes in both. Such a course is not scientific, nor do we think it is wise. What defense can be made of this—which we find on p. 42? "While in the case of the class *Gymnorpermæ* it would perhaps have been well to follow the more natural system of placing it between the *Monocotyledoneæ* and the *Pteridophyta*, yet it has been thought better to follow closely the sequence adopted by Gray;" or of this in the next para-

[1] *A Popular Flora of Denver, Colorado*, by Alice Eastwood. San Francisco. Zoe Publishing Company. 1895, 57pp.

[2] *The Portland Catalogue of Maine Plants*, Second edition extracted from the Proceedings of the Portland Society of Natural History, 1892, and *Supplement to the Portland Catalogue of Maine Plants*, extracted from the Proceedings of the Portland Society of Natural History, 1895, by Mr. L. Fernald.

graph? "So also the names in some cases might have been changed with advantage, but it was decided to follow the nomenclature of the 6th edition of Gray's Manual of the Botany of the Northern United States." It used to be the boast of Science that her votaries had the courage of their convictions; let us hope that this may continue.

As a list, however, the catalogue speaks well for the activity of the botanists of Maine. We note in the supplement the unlooked for occurrences of several far-western plants, viz., *Oxytropis lamberti sericea, Glycyrrhiza lepidota, Artemisia biennis, Cenchrus tribuloides.*

In the "Flora of Pasadena,"[3]—In a pamphlet of 45 pages Professor McClatchie has catalogued 1056 plants which he has found upon an area about ten miles north and south and six miles east and west, lying about the city of Pasadena, California. The southern edge of this tract is 500 feet above sea level while the northern edge rises to 5000 or 6000 feet upon the San Gabriel Mountains; at its western edge is a deep cañon traversed by a swift stream, and numerous small streams flow from the interior of the tracts.

Upon this small, but varied region have been found of Protophyta 40 species; Phycophyta, 50; Carpophyta, 350; Bryophyta, 53; Pteridophyta, 21; Spermaphyta, 542. The catalogue is therefore a list of the *plants* of the region, not of "the flowering plants and vascular cryptogams," as is so commonly the case in similar undertakings. Several things about the catalogue are especially commendable; thus, the place of publication of the new species (sixty-two) is given in all cases, a most helpful feature. This sentence, also, is significant, and hopeful; "being opposed to the naming of new species after collectors. I have attempted to prevent any being given my name, and have succeeded in all cases except one." Another commendable feature is that the author has "attempted to follow the Rochester rules for nomenclature." If we compare the two catalogues, we find that both show excellent work as their basis, but the western author is shown to have a broader conception of systematic botany, and to be less trammeled by the traditions of conservatism than the eastern one.—CHARLES E. BESSEY.

Frank's Diseases of Plants.[4]—The first volume the new edition of this useful work has recently appeared from the hand of Dr. Frank,

[3] Flora of Pasadena and Vicinity, by Alfred J. McClatchie. Reprinted from Ried's History of Pasadena. Los Angeles, California, 1895.

[4] *Die Krankheiten der Pflanzen*, Dr. A. B. Frank. Erster Band, Zwiete Auflage, Breslau, Verlag von Edward Trewendt, 1895, pp. 344.

of the Royal Agricultural High School of Berlin. The present volume deals solely with the those "diseases" which are due to inorganic agencies, those due to the attacks of parasitic animals and plants being deferred to the second volume. Thus we have nearly one-half of the book devoted to wounds, somewhat less than a third to atmospheric influences, about a sixth to the influence of the soil, while in remaining pages various other agents are discussed. A few woodcuts help to illustrate the text. An English work of this kind would be useful.—CHARLES E. BESSEY.

Wilson's Atlas of Karyokinesis.[4]—It is the object to this altas to place before students and teachers of biology a practically continuous series of figures photographed directly from nature, to illustrate the the principal phenomena in the fertilization and early development of the animal egg. The new science of cytology has in the course of the past two decades brought forward discoveries relating to the fertilization of the egg and the closely-related subject of cell-division (karyokinesis) that have called forth on the part of Weismann and others some of the most important and suggestive discussions of the post-Darwinian biology. These discoveries must in some measure be dealt with by every modern text-book of morphology or physiology, yet they belong to a region of observation inaccessible to the general reader or student, since it can only be approached by means of a refined histological technique applied to special objects not ordinarily available for practical study or demonstration. A knowledge of the subject must therefore, in most cases, be acquired from text-books in which drawings are made to take the place of the real object. But no drawing, however excellent, can convey an accurate mental picture of the real object. It is extremely difficult for even the most skilful draughtsman to represent in a drawing the exact appearance of protoplasm and the delicate and complicated apparatus of the cell. It is impossible adequately to reproduce the drawing in a black-and-white text-book figure. Every such figure must necessarily be in some measure schematic and embodies a considerable subjective element of interpretation.

The photograph, whatever be its shortcomings (and no photograph can do full justice to nature), at least gives an absolutely faithful representation of what appears under the microscope; it contains no subjective element save that involved in the focussing of the instrument, and hence conveys a true mental picture. The present work, therefore,

[4] An atlas of the Fertilization and Karyokinesis of the ovum. By Edmund B. Wilson, Ph. D., Professor of Invertebrate Zoology in Columbia College, New York. Columbia University Press McMillan & Co., 1895.

serves a useful purpose, especially by enabling teachers of biology to place before their students a series of illustrations whose fidelity is beyond question, and which may serve as a basis for either elementary or advanced work in this direction.

The photographs have been taken from the eggs of the sea-urchin, *Toxopneustes variegatus* Ag. (a classical object for the study of these phenomena), taken as a type. The eggs having been cut into extremely thin sections $\frac{1}{8000}$ to $\frac{1}{5000}$ inch.) were stained in iron-hæmotoxylin, and projected by means of the Zeiss apochromatic oil-immersion objective, 2 mm. focus, at an enlargement varying from 950 to 1000 diameters. They have been reproduced *absolutely without retouching* or modification of any kind.

Following is a partial list of the points clearly shown in the present series:—The ovarian egg, with germinal vesicle, germinal spot and chromatin-network; the polar amphiaster with the "Vierergruppen" or quadruple chromosome-groups; the unfertilized egg, after extrusion of the polar bodies; entrance of the spermatozoon, the entrance-cone; rotation of the sperm-head, origin of the sperm-aster from the middle-piece, growth of the astral rays; conjugation of the germ-nuclei, extension and division of the sperm-aster; formation of the cleavage-nucleus; the attraction-spheres in the resting-cell; formation of the cleavage-amphiaster, origin of the spindle-fibres and chromosomes; division of the chromosomes, separation of the daughter-chromosomes; structure and growth of the astrosphere; degeneration of the spindle; formation of the "Zwischenkörper;" origin of the chromatic vesicles from the chromosomes; reconstruction of the daughter-nuclei; cleavage of the ovum; the two-celled stage at several periods showing division of the archoplasm-mass, "attraction-spheres" in the resting-cell, formation of the second cleavage-amphiasters.

The explanatory text comprises a simple introductory account of the general history of the subject (for the use of students and general readers), with a number of figures, mostly original, but a few copied from Boveri. In the descriptive part a more critical description of the photographs is given, with drawings illustrating every stage shown.

The atlas will be of great utility to embryologists and biologists in general, and the execution will satisfy the student, as worthily illustrating the text. The reputation of the author guarantees the accurracy of the work.

A Delightful Book on Butterflies.[5]—In these excursions into

[5] Frail Children of the Air. By Samuel Hubbard Scudder. Houghton, Mifflin & Co., Boston, 1895. Price $1.50.

the world of butterflies, Dr. Scudder has treated of some of the most fascinating phases of biological science in an extremely interesting manner. The comparatively few who had read these essays as they originally appeared in the author's classic Butterflies of New England —a work so expensive that it could only be accessible to a limited number of readers—will rejoice that they are now available to every seeker after biological knowledge. In the thirty-one chapters which the book contains there are discussions of such subjects as these: Butterflies in Disguise; a Study of Mimicry; Deceptive Devices Among Caterpillars; Butterflies as Botanists; Color-relations of Chrysalids to their Surroundings; Butterfly Sounds; Nests made by Caterpillars: The Eggs of Butterflies; The Oldest Butterfly Inhabitants of New England; The Procession of the Seasons; Lethargy of Caterpillars; Fossil Butterflies. Each of these subjects is discussed with the fullness of knowledge and excellence of style which characterize the authors writings. The book is certain of a hearty welcome from lovers of nature-knowledge.—CLARENCE M. WEED.

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General Notes.

PETROGRAPHY.[1]

The Lherzolites of the Pyrenees and their Contact Action.—The contact action of the lherzolites of the Pyrenees upon the lower Jurassic rocks through which they cut has been studied carefully by Lacroix,[2] who publishes his conclusions in a volume illustrated

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

[2] Comptes Rendus, Feb. 11, 1895. Nouv. Archiv. D'hist. Nat., III, Sér. vi, p. 209.

by six plates containing fifty figures. The intensity of the metamorphism varies widely. At 500 meters from the contact the limestones are filled with metamorphic minerals, and even at 1.5 kilos from the nearest visible contact with the eruptive the limestomes still contain many of these. The altered sedimentary rocks are limestones, calcareous marls and occasionally sandstones. In the limestones the principal new minerals found are dipyr, micas, feldspars, tourmaline, rutile, sphene, magnetite, hematite, pyrite, apatite, quartz, graphite and rarely spinel, epidote and garnet. The calcareous marls have been changed to aggregates of silicates with four types of structure, the honestone, the micaceous schist and the amphibolitic and dioritic. Near the contact the organic coloring matter of the marls has disappeared. A little further away it is changed to graphite and at a greater distance it remains intact. The fissures cutting through the metamorphic rocks are lined with zeolites, which, however, the author does not think are connected in any way with the metamorphic processes. The sandstones, at the only contact seen, were changed into quartzites rich in needles of rutile, and a lusite, sillimanite and a few flakes of mica. A close similarity exists between the contact action of lherzolites and granites. The difference in the two cases consists in a corrosion of the metamorphic rocks by the granite and a great production of feldspar, while in the case of the lherzolites there is no transition between the metamorphosing and the metamorphosed rocks. The conditions determining the nature of the contact rock formed are: 1, the original composition of the sedimentary beds; 2, the quantity of the volatile and soluble substance accompanying the eruptive; and 3, the conditions under which the rock was erupted.

Nepheline Rocks from the Kola Peninsula.—A full account of the nepheline syenite region of the Kola Peninsula, Finland, by Ramsey[3] and Harkman has recently appeared. The main results of the senior author's study of the region have already been given in these notes. Other results can only be referred to, as they are two numerous to be described in detail. The authors define a new rock type—imandrite. It is a rock composed of quartz, plagioclase, chlorite, biotite and several accessory components. The first two minerals occur in isometric grains separated from each other by seams of chlorite or biotite. The rock has a half clastic structure, since the quartz and feldspar appear often as fragments in the interstitial chlorite. The quartz is largely secondary, and is supposed to be due to a silicification

[3] Fennia, 11, No. 2, 1894. Also American Naturalist, 1892, p. 334.

of the original rock. A second type of imandrite resembles a silicified porphyritic rock. A hypersthene-cordierite-hornfels, with handsome cordierite crystals, an oliving-actinolite schist, containing cordierite, and several contact metamorphosed sediments are described in detail. The major portion of the article deals with the nepheline syenites and the related rocks—theralites, augite,-porphyrites, iolites, monchiquites, tinguaites, etc., and the new rocks, lujavrite and tawaite. The theralite agrees exactly with Rosenbusch's definition of the type. It is a medium grained aggregate of idiomorphic pyroxene, and granitic plagioclase and nepheline, with the accessories brown hornblende, biotite, sphene, magnetite, apatite, sodalite and secondary zeolites. Lujavrite is a trachytic nepheline-syenite with its components largely idiomorphic. Tawaite is a coarse-grained mixture of sodalite and pyroxene.

Around the periphery of the nepheline syenite the rock is different from its main mass and it has produced contact effects with surrounding rocks. A nepheline syenite with a trachytic structure is described among the peripheral phases of the syenite, and a rock resembling pulaskite, but containing no porphyritic crystals. This rock, which the authors call umptekite, is a nepheline syenite, poor in nepheline. It differs from the nepheline syenite in containing a calcium-feldspar, from augite-syenite in possessing hornblende instead of augite, from laurvikite in its structure, and from akerite in its lack of quartz. Its structure is granitic. Arfvedsonite is its principal amphiboloid, and besides, it possesses aegerine. The characteristic minerals of the nepheline syenite are also present in it. The aegerine is frequently associated with sodalite or with feldspar in pegmatitic intergrowths. A sillimanite gneiss is mentioned as possibly being a metamorphized sediment.

The Matrix of Naxos Corundum.—The corundum[4] of Naxos occurs in an iron gray foliated or massive granular rock composed almost exclusively of corundum and magnetite. The first mentioned mineral is in largest quantity. Associated with these two components are limonitic and hematitic alteration forms of magnetite, margarite, tourmaline, muscovite, cyanite, staurolite, biotite, rutile and occasionally spinel, vesuvianite and pyrite. The corundum is in rounded grains or in well defined crystals surrounded by magnetite. Most of the other constituents, with the exception of the magnetite, appear to be the results of shearing. An analysis of the rock gave: Corundum

[4] Tschermak, Min. u. Petrog. Mitth., xiv, p. 311.

=64.2% ; Magnetite=26.8% ; Iron oxides=6.9% ; Siliceous products =2.00%.

Miscellaneous.—In the abstract of a paper read before the Geological Society of America, E. B. Mathews[5] gives a brief account of several distinct types of granite, covering an area of 900 square miles, in the Pike's Peak district, Colo. All are believed to be portions of a single magma, erupted at different times, with the later portions cutting through the earlier ones.

Bayley[6] records the existence of a series of acid and basic tuffts, amygdaloids, glassy and crystalline lavas, and spherulitic phases of volcanic rocks on North and Vinal Haven, Maine.

Darton and Kemp,[7] in the same brochure describe a dyke near Dewitt centre, three miles east of Syracuse, N. Y. It is a peridotite similar to that described by Williams from Syracuse. Its composition is represented by the following figures:

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	Nio	CaO	BaO	SrO	Mgo	K_2O	Na_2O	P_2O_5	CO_2	SO_3	S	H_2O	Total	— O = S
36.80	1.26	4.16	.20	8.33	.13	.09	8.63	.12	tr	25.98	2.48	.17	.47	2.95	.06	.95	7.44	=100.22	—.47=99.75

Lepsius[8] divides gneisses into meta-gneisses—those formed by the metamorphism of sedimentary rocks, pro-gneisses—those constituting portions of the original earth crust, gneiss-granites—those produced from granite by fluidal movements of a liquid rock magma—and clasto-gneisses, those formed by the crushing of a solid granite.

Hornung[9] has examined a series of rocks associated with the melaphyres in the South Harz, and has shown that some of those that have been called clay slates are in reality volcanic tuffs. Their material was erupted in two different periods, and both were erupted before the melaphyre. The older tuff is composed essentially of a green basic pumiceous glass, the second of splinters of biotite, zircon, quartz, plagioclase, pyroxene and red garnet. Both have the typical tufaceous structure. The tuffs are interbedded with sediments, and their material is more or less thoroughly intermingled with the material of these latter rocks.

In the District of Columbia granitic rocks[10] have disintegrated into

[5] Bull. Geol. Soc. Amer., Vol. 6, p. 471.

[6] Ib., p. 474.

[7] Ib., p. 477.

[8] Notizbl. des Ver. f. Erdk. iv Folge. 15 Hft., p. 1.

[9] Min. u. Petrog Mitth., xiv, p. 283.

[10] Merrill, Bull. Geol. Soc. Amer., Vol. 6, p. 321.

sandy soils, whose composition is almost identical with that of the compact rock from which they were derived.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	P_2O_5	Ign	Total
Rock	69.33		14.33		3.60	3.21	2.44	2.70	2.67	.10	1.22	=99.60
Soil	65.69	.31	15.23	4.39		2.63	2.64	2.12	2.00	.05	4.70	=99.76

The disintegration processes are not chemical except in so far as hydration is chemical, but they are mainly mechanical.

Formation of Dolomite.—A most important contribution to the study of the formation of dolomite is made by M. C. Klement in the Bull. Soc. Belge Géol. Paléontol. et Hydrol. After describing the history of the theories of dolomite the author calls attention to the frequent occurrence of dolomite in the form of coral reefs, as observed by Dupont in the Devonian, by Richthofen and Mojsisovics in the Trias, and by Dana in the recent raised reefs of Metia in the Pacific. He points out that while in the chemical experiments that have been made with a view of dolomitizing carbonate of lime, *calcite* has always been operated on, the substance of coral has been shown by Sorby to be probably *aragonite.* The author has, therefore, carried out a large series of experiments on the action of the constituents of sea-water (particularly magnesium sulphate) upon aragonite, the results of which are given at full length. From these he finds (1) that a solution of magnesium sulphate, in the presence of sodium chloride, and at a temperature of 60° C. or more, decomposes aragonite with formation of a magnesium carbonate, the exact composition of which is difficult to determine, owing to the impossibility of isolating it from the residual aragonite; (2) that this action increases with the *rise of temperature,* and with the *concentration* of the solution, and is greatly diminished by the absence of sodium chloride; (3) that recent coral is attacked by magnesium sulphate just as mineral aragonite is; and (4) that the lagoons of modern coral reefs offered all the conditions of temperature, saturation, etc., necessary for the production of magnesium carbonate in the manner of experiments, while recognizing therefore, that dolomites may have been formed in more ways than one, M. Klement concludes that one of the most usual ways in nature has been the action of heated and concentrated sea-water in coral lagoons on the aragonite of coral and other skeletons, with formation of carbonate of magnesium, which is subsequently, perhaps after solidification of the rock, with the remaining carbonate of calcium, converted into massive dolomite. (Nature, June, 1895.)

GEOLOGY AND PALEONTOLOGY.

On a New Species of Diplacodon, with a Discussion of the Relations of that Genus to Telmatotherium.—The material forming the basis of this paper consists of a skull with lower jaw (No. 11242, Princ. Collection) found by the writer near the base of the *Diplacodon elatus beds* of Osborn, in the upper Eocene or *Uinta*, of Marsh. The locality is about eight miles north of White River and twenty-five miles east of Ouray Agency, Utah, and is locally known as Kennedy's Hole. Other remains of Diplacodon were found, some of which are of considerable interest, inasmuch as they establish a lower geological range for that genus than has hitherto been accorded it, and indicate a considerable variety of species. Remains of Diplacodon are among the rarest of all the Uinta mammals, and any material which will increase our knowledge of this morphologically interesting genus is most acceptable.

In referring this skull to Diplacodon, I have been compelled to ignore certain characters ascribed to that genus by Prof. Marsh. That author, in speaking of the relations of this genus to the Titanotheriidæ (Brontotheridæ), in his original description of the type specimen, says:[1] "From this family Diplacodon differs widely in its dentition and the absence of horns." In describing Diplacodon as hornless, it would seem that Prof. Marsh's conclusion is entirely conjectural, since his material does not show whether there were horns or not. The present skull has a well-developed pair of frontonasal horns, and, since it agrees in all the characters *known* to that genus, I have preferred to refer it to that genus rather than to propose for it a new one on the strength of this purely conjectural character ascribed to Diplacodon by Prof. Marsh. Should future discoveries show that there are hornless forms with the same dental characters as Diplacodon, it will then be necessary to establish for the present specimen a new genus which may be called *Protitanotherium*.

Diplacodon emarginatus sp. nov.

The type of the present species is the skull and lower jaw above referred to (11242). The posterior region had already weathered out when found and was badly injured, but many of the pieces have been fitted together and show some of the more important characters of this

[1] Am. Journ. Sci. & Arts, March, 1875, p. 247.

region of the skull. Anteriorly both the skull and lower jaw are well preserved, and supplement admirably Prof. Marsh's type of this genus which consists only of the palate and premolar and molar teeth.

The present species is at once distinguished from *D. elatus* by its greater size, as is shown by a comparison of the length of the premolar and molar series, which is 310 mm. in the former and 242 in the latter.

The Cranium:—In general appearance the cranium of *D. emarginatus* is remarkably like some of the smaller forms of Titanotherium. The dorsal surface is slightly concave antero-posteriorly? and is further characterized by the absence of a sagittal crest. The nasal openings are high and deeply incised. The horns are composed of both the frontals and nasals; they are placed transversely and directed upward, outward and forward; they are elliptical in cross-section with the antero-posterior diameter the longer. The nasals are broad, strong and rather short, they are firmly coössified, concave inferiorly, emarginate anteriorly and with their external lateral borders considerably thickened, they do not extend as far forward as the premaxillaries and are slightly constricted just in front of the base of the horns. The premaxillaries are well-developed, are separated anteriorly by a deep median notch back of which they are firmly coössified, they extend considerably in front of the maxillaries. The maxillaries are expanded at the base of the canines and decidedly constricted between this tooth and pm. 2, back of which they expand rapidly in order to accommodate the large posterior premolars and molars. The infraorbital foramen is situated just above pm. 4.

The Lower Jaw:—The rami are closely united at the symphysis which is very long and oblique, its posterior border is just below pm. $_3$. The anterior mental foramen is situated directly below pm. $_2$, between it and the premolars there is a slightly excavated and fluted area. The rami gradually deepen from before backwards.

The Superior Dentition:—The superior incisors are placed considerably forward of the canines, and are arranged in the arc of a circle instead of in a nearly straight line as in Titanotherium; they show a remarkable transition from the Paleosyops to the Titanotherium type of incisor. The external, lateral incisors are large, pointed teeth, with strong, internal basal cingula and rather sharp external, lateral cutting edges. The median incisors are much smaller than those just described, but are larger and better developed teeth than the internal lateral incisors which are assuming the rudimentary, spherical form seen in Titanotherium. Both the median incisors and the internal laterals have posterior, basal cingula and a posterior ridge connecting the apices of these teeth with the cingula. The different degrees of development noticed in the superior incisors would seem to indicate the order of disappearance of these teeth in the Titanotheridæ. The superior canines are large, pointed, conical teeth, nearly circular in cross-section ; they are directed almost straight downward, only slightly forward, and scarcely any if at all outward. There is a diastema between the superior canines and pm. 1, which is a very simple tooth fixed in the jaw by two roots, and consisting of a single cone with a posterior heel. The remaining superior premolars and molars are wanting in the present specimen.

The Inferior Dentition :—Of the inferior incisors the median ones are much the larger, while the external and internal laterals are about equal in size ; they all have internal basal cingula. The crowns of these teeth are somewhat wedge-shaped, with an anterior and a posterior inclined plane. The inferior canines are very much like the superior, and are directed upward, outward and forward ; they are separated from premolar one by a considerable diastema. The latter is a very simple tooth, consisting of a single median cone with anterior and posterior ridges. In the present specimen pm. $_{\overline{1}}$ on the right side is a much smaller tooth than the one on the left. Pms. $_{\overline{2}}$, $_{\overline{3}}$, are becoming molariform, and pm. $_{\overline{4}}$ has already assumed the molar pattern. The inferior molars are identical in character with the same teeth in Titanotherium and need no further description ; m. $_{\overline{3}}$ in the type specimen is injured.

The figures in Plate XXXVIII accompanying this paper, were drawn by Mr. Rudolph Weber, and represent accurately the more important characters of the skull and lower jaw of the type specimen. Figs. 5 and 6 are introduced for comparison.

MEASUREMENTS :

The Cranium.

	mm.
Length of nasals from base of horns, ...	114
Breadth of nasals anteriorly, . . . , . .	123
Breadth of nasals at point of greatest constriction in front of horns, ...	112
Distance between top of horns at middle of their apices, .	151
Transverse diameter of horns at a point midway between base and summit, ...	40
Antero-posterior diameter of horns at a point midway between base and summit, . , ...	66
Length of diastema, ...	27

The Lower Jaw.

Distance from front of symphisis to anterior border of ascending rami,	385
Depth of ramus below pm. $_{\overline{1}}$,	63
Depth of ramus below m. $_{\overline{2}}$,	110
Length of symphisis,	152
Length of diastema,	26
Distance from base of pm. $_{\overline{2}}$ to anterior mental foramen,	42

The Dentition.

Length of crowns of sup. internal, lateral incisors,	10
Length of crowns of sup. median incisors,	13
Length of crowns of sup. external, lateral incisors,	21
Transverse diameter of sup. canine at base,	26
Length of inf. premolar-molar dentitions,	310
Length of inf. premolar dentition,	107
Length of inf. molar dentition,	203

The Phylogeny of Diplacodon.

Marsh,[2] Osborn[3] and Earle[4] have all agreed in considering *Diplacodon* as ancestral to *Titanotherium*, and the present material only emphasizes the correctness of their views. This is evidenced not only by the structure of the teeth which, as was first pointed out by Marsh, is intermediate between *Paleosyops* and *Titanotherium*, but also by the general appearance of the skull which is strikingly like that of the latter genus, as will be seen by referring to the figures in Plates XXXVIII and XXXIX. This likeness is shown in the great depth of the cranium above the premolars and molars, in the absence of a sagittal crest, presence, shape and position of the horns, breadth of nasals, etc.

Earle, in his very excellent memoir on Paleosyops just cited, has attempted to indicate the phylogenetic positions of the various genera and species of the earlier Titanotheres. In this paper he derives *Diplacodon* from *Telmatotherium*. Later, Osborn,[5] in describing two

[2] New Tertiary Mammals, Am. Jour. Sci. & Arts, March, 1875, p. 246–247.

[3] The Mammalia of the Uinta Formation. Trans. Amer. Phil. Soc., Vol. XVI, pp. 461–572.

[4] A Memoir upon the Genus Paleosyops Leidy, and its Allies. Jour. Acad. Nat. Sci. Phil., Vol. IX, pp. 267–388.

[5] Fossil Nammals of the Uinta Basin. Expedition of 1894. Bull. Amer. Mus. Natl. Hist., Vol. VII, pp. 71–105.

new and several little-known species of *Telmatotherium* from most excellent material secured by Mr. O. A. Peterson, chiefly from the Uinta beds of Utah, has considered *Telmatotherium cornutum* as directly ancestral to *Diplacodon.* He says, on page 72 of the article just cited, "*Telmatotherium cornutum* is in one of the direct ancestral lines leading to the Titanotheres." In a recent paper by Earle,[6] he suggests a polyphyletic origin of the genus *Titanotherium* as had already been intimated by Osborn. Earle, in this last paper, points out very clearly two distinct lines of species of *Paleosyops* and *Telmatotherium* which he considers persistent series and probable ancestors of *Diplacodon* and *Titanotherium.*

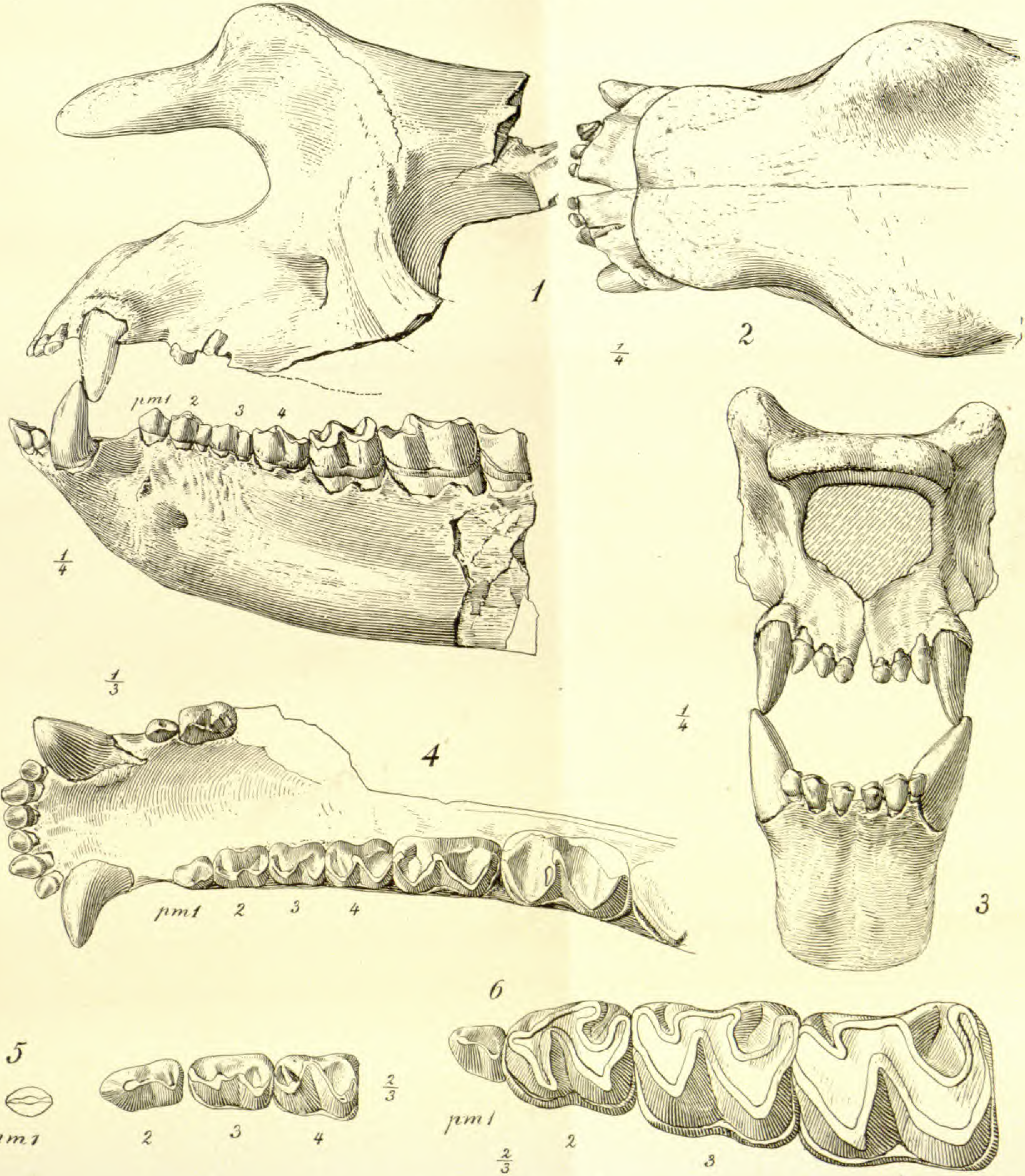
After studying *Diplacodon* in connection with what is already known of *Telmatotherium cornutum,* it seems impossible to accept Osborn's views in regard to the ancestral relations of the latter to any of the later Titanotheres. The *character* of the dentition and the presence of incipient frontonasal horns would, at first, seem to lead to such a conclusion, but a closer study of the material seems to indicate that this is simply a case of parallelism, since, in nearly every other character, *T. coruntum* exhibits features not at all in accordance with what we should expect to find in the immediate ancestors of the Titanotheres; as examples of such features, I would point out, 1, The long, narrow nasals; 2, Convex dorsal aspect of skull; 3, Position of posterior nares which, according to Osborn, are in this species moved backward until they now open far back behind the last molar; 4, The slender and almost parallel zygomata; 5, The presence of an infraorbital shelf; 6, The reduction in the number of inferior incisors to two on either side, while *Diplacodon* still retains three well-developed ones on a side; and Marsh[7] has shown that some of the later forms from near the base of the White River beds still retain three on a side, although quite rudimentary as would be expected. These are all characters of importance, and the position of the posterior nares and reduction of the number of incisors in *T. cornutum* would seem to absolutely prohibit the placing of that species in the direct line leading to the genera *Diplacodon* and *Titanotherium.*

There seems to be little doubt that *Diplacodon* had an earlier ancestry than has heretofore been referred to it, for remains of it are found in the *T. cornutum beds* of Osborn associated with remains of that

[6] On a Supposed Case of Parallelism in the Genus Paleosyops. Am. Nat., July, 1895, pp. 612-626.

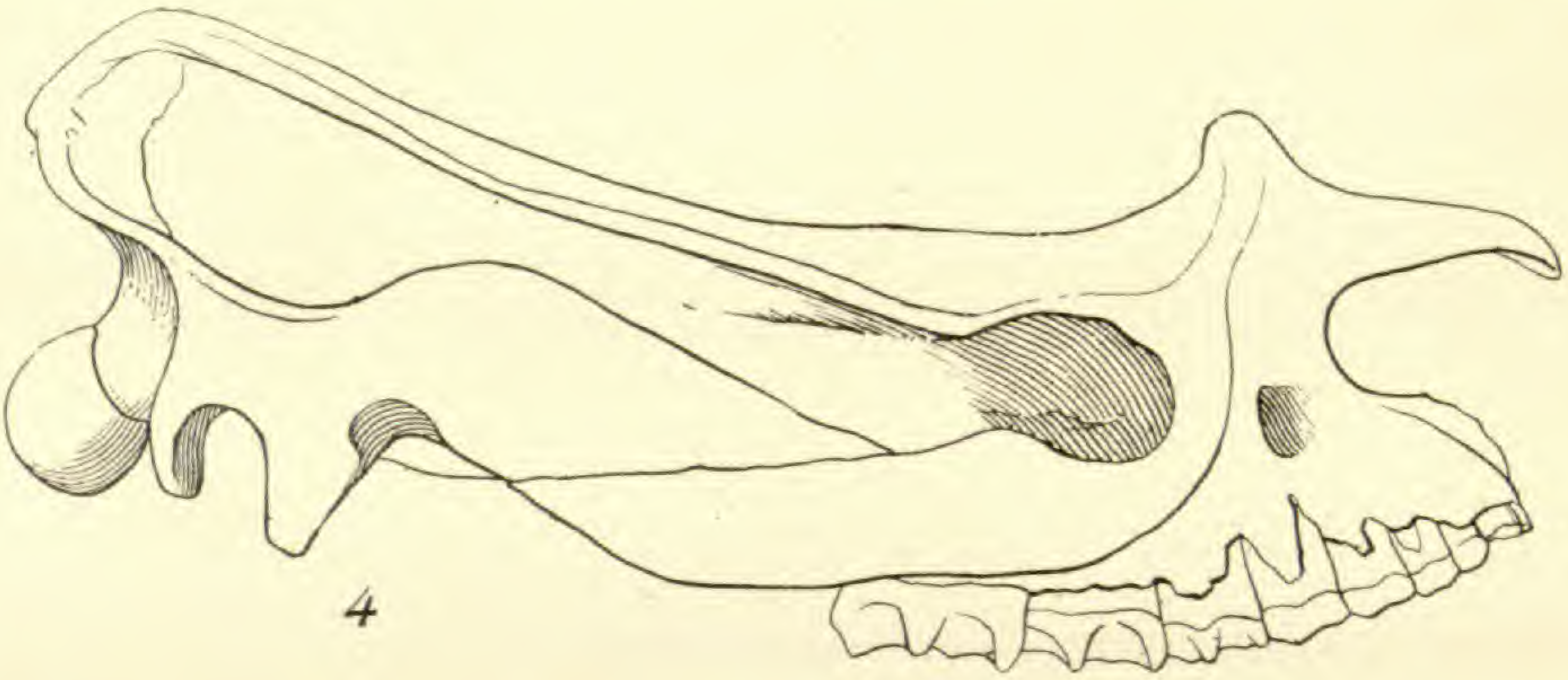
[7] Notice of New Tertiary Mammals. Am. Journ. Sci., June, 1890, pp. 523–525.

PLATE XXXVIII.

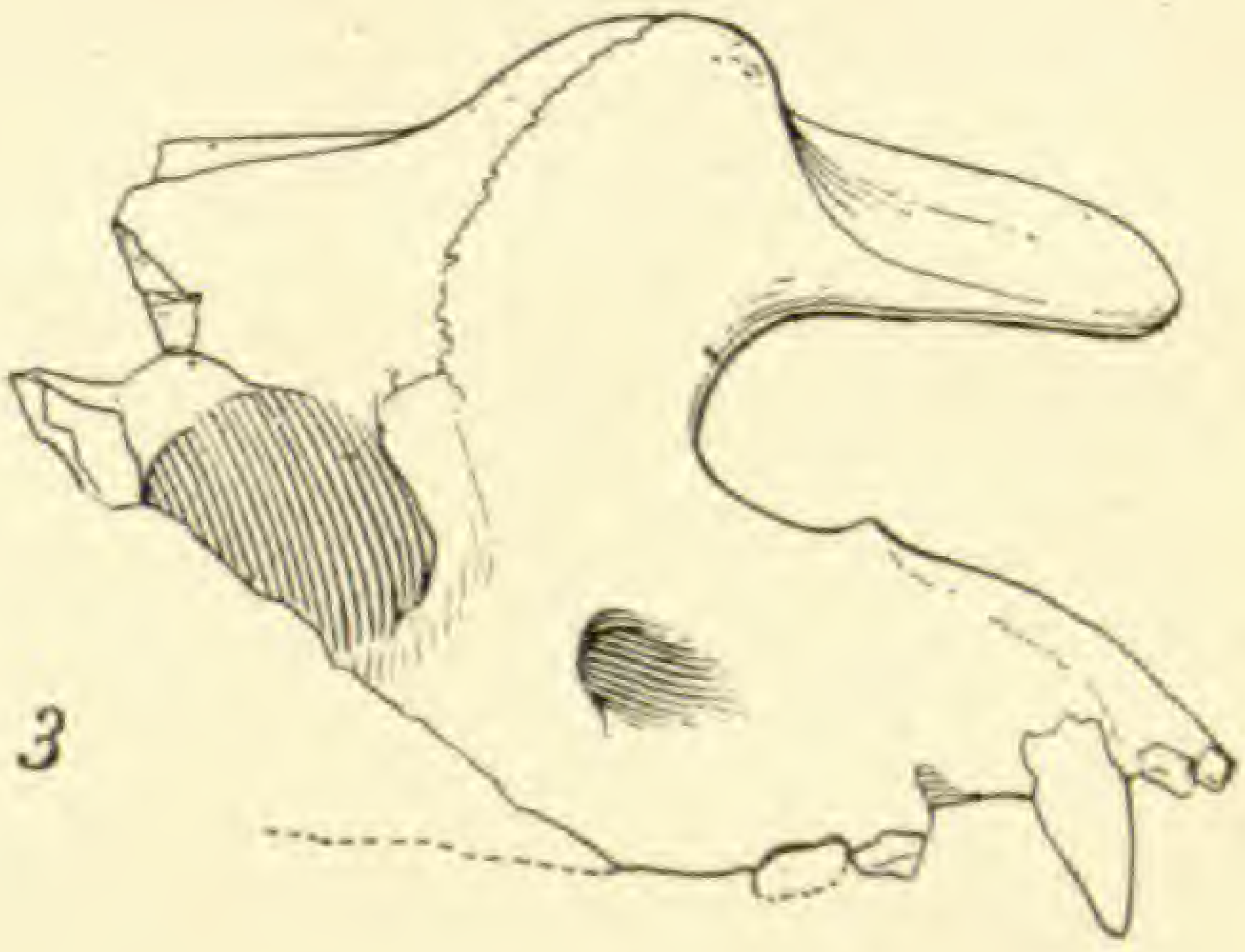


Hatcher on Diplacodon.

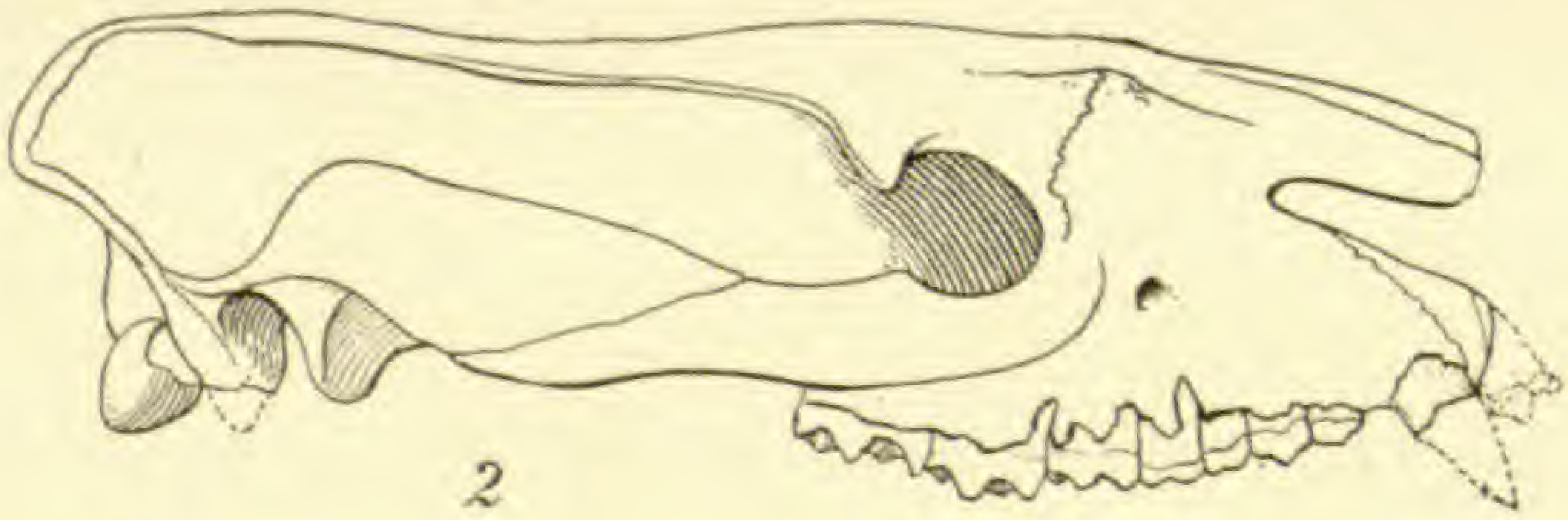
PLATE XXXIX.



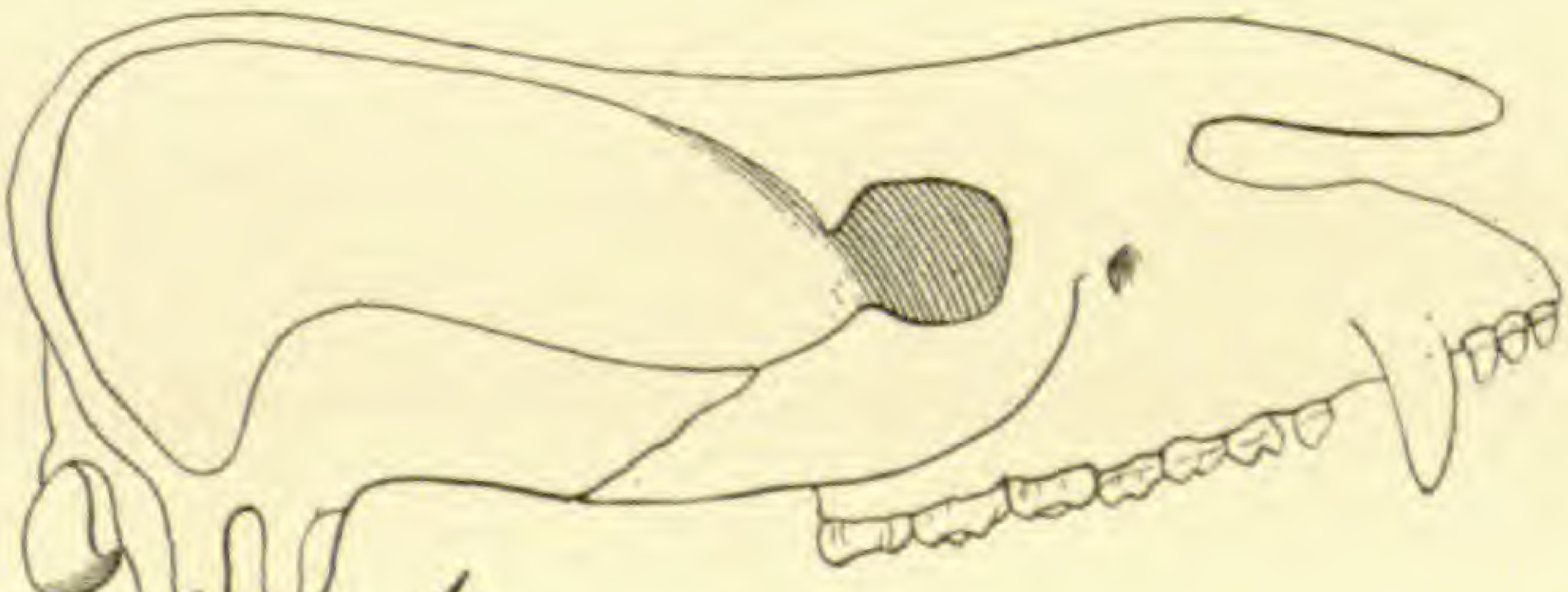
4



3



2



1

Hatcher on Diplacodon.

R. Weber, del.

EUSMILUS DAKOTENSIS, Hatcher.
$\frac{2}{3}$ nat. size.

species, and already at the base of the Uinta proper (*Diplacodon elatus beds* of Osborn) it exhibits a considerable variety of forms. Aside from the two species already known, there are indications of still others, one of which is shown in the pair of nasals (No. 11213) represented in the outline drawing, Fig. 1, with the same portion of *D. emarginatus*, Fig. 2, drawn to the same scale introduced for comparison. Notice the greater absolute and proportional breadth of the former, also the more pronounced medial emargination.

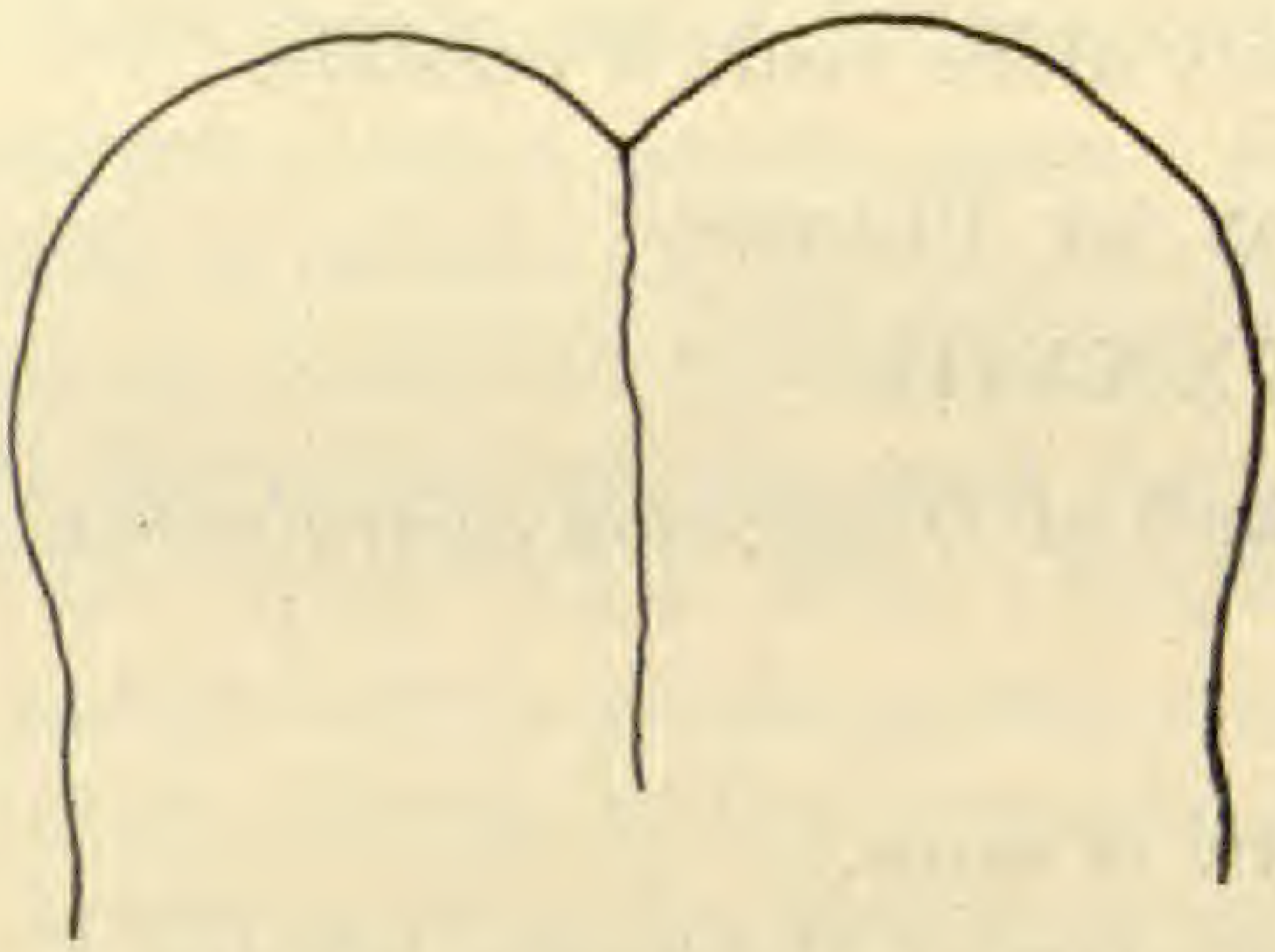


Fig. 1. Sup. view of nasals of *Diplacodon*, sp. ¼ nat. size.

¼

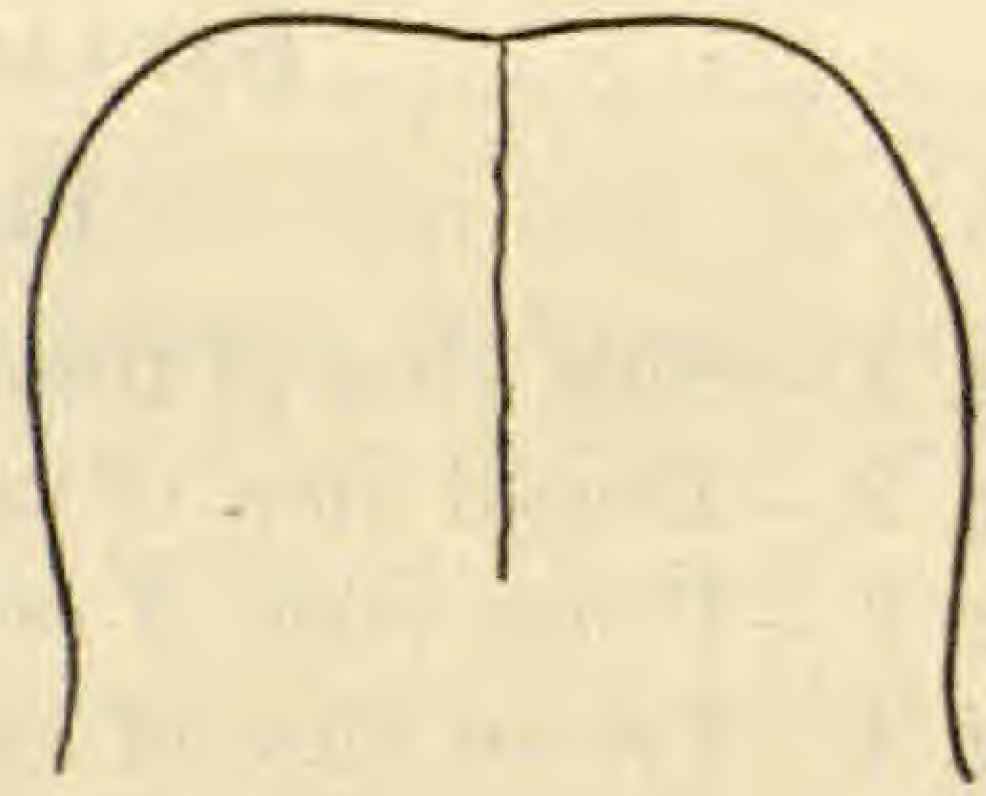


Fig. 2. Sup. view of nasals of *Diplacodon emarginatus*. ¼ nat. size.

If we compare *Diplacodon* with *Telmatotherium vallidens*, we shall meet with much more consistent results, for in this species we have all the conditions which we should expect to find in the ancestor of *Diplacodon* from the Washakie beds. In *T. vallidens* the sagittal crest is already disappearing, the anteroposterior dorsal aspect of the skull is slightly concave, the zygomata are expanding and becoming stronger, the nasals are becoming broader and shorter, there are incipient frontonasal horns, and there are none of those inconsistent characters so numerous in *T. cornutum*. The Bridger representative of this series was doubtless *Paleosyops laticeps*, which has the concave dorsal aspect of the skull, broad zygomata and short nasals, all characters indicative of *T. vallidens*.

In conclusion, there seems little doubt that the Parallel Series, I and II, established by Earle in his late paper, were differentiated early in the Bridger, and that Series I, of that author, was terminated in the Uinta, most likely by *T. cornutum*; while Series II was continued on up into the White River and terminated in the genus *Titanotherium*. Figures 1, 2, 3 and 4, Plate XXXIX, are introduced to show the successive stages of development from the Bridger to the base of the White River beds. Future discoveries will doubtless close the gaps between 2 and 3, and 3 and 4, but there would seem to be little doubt that the genus *Titanotherium* has been evolved from the earlier Bridger forms of *Paleosyops* through *P. laticeps* and the intermediate forms *Telmatotherium vallidens* from the Washakie and *Diplacodon* from the Uinta. Vertebrate paleontology rarely shows a more complete series of the stages of development than are to be seen here.

I wish here to thank Prof. Scott for his kindness in placing at my disposal the material upon which this paper is based. My thanks are also due to the various undergraduate and graduate members of the expedition of 1895, whose generosity alone made it possible.

Explanation of Plates.

Plate XXXVIII.

Fig. 1.—Side view of front of skull of *Diplacodon emarginatus.*
Fig. 2.—Dorsal view of same.
Fig. 3.—Front view of same.
Fig. 4.—Crown view of lower jaw of same.
Fig. 5.—Crown view of inf. premolars of *Paleosyops laticeps.*
Fig. 6.—Crown view of inf. premolars of *Titanotherium* sp.

Plate XXXIX. All figures ¼ natural size.

Fig. 1.—Side view of *Paleosyops laticeps* (after Earle).
Fig. 2.—Side view of *Telmatotherium vallidens* (after Osborne).
Fig. 3.—Side view of *Diplacodon emarginatus.*
Fig. 4.—Side view of *Titanotherium varians* (after Marsh).

—J. B. Hatcher.

Princeton, N. J., Oct. 29, 1895.

Postscript.

The genus *Telmatotherium* as it now stands should be divided, since it embraces at least three quite distinct forms. The type of *T. vallidens* should be removed from that genus and made the type of a new genus. This new genus may be called *Manteoceras* as suggested by Wortman from the field, it would be distinguished from *Telmatotherium* by the absence of the infraorbital shelf, the stronger and more expanded zygomata and the concave superior aspect of skull and incipient fronto-nasal horns. The type of *T. cornutum* should also be made the type of a new genus which may be called *Dolichorhinus*, it would be distinguished from *Manteoceras* and *Telmatotherium* by the reduced number of inferior incisors, presence of incipient horns, presence of infraorbital shelf and position of posterior nares.—J. B. Hatcher.

Discovery, in the Oligocene of South Dakota, of Eusmilus, a Genus of Sabre-toothed Cats New to North America.—In 1873, Filhol[8] described and figured under the name of *Machaerodus bidentatus*, portions of the mandibles and superior canines of a sabre-toothed cat from the phosphorites of Quercy. Two years later, Gervais[9] described similar remains from the same beds under the name of *Eusmilus perarmatus*. There seems to be little doubt that *E. perarmatus* is identical with *M. bidentatus;* but since the material shows characters which at once distinguish it from the genus Machærodus, Cope has accepted the genus Eusmilus, proposed by Gervais, and retained Filhol's specific name. *Eusmilus bidentatus* may then be considered to include all the known remains of this remarkable feline. Hitherto no American representative of this genus has been reported. In 1894 the writer had the good fortune to discover in the *Protoceras beds* of the upper *White River* (*Oligocene*) deposits a complete ramus which agrees fully in all the generic characters known to *Eusmilus*, and is of interest as being the first American representative of that genus. It differs, however, from the European species in several important characters, and may be called *E. dakotensis*.

Eusmilus dakotensis sp. nov.

The type of *Eusmilus dakotensis* consists of a right ramus (No. 11079, Princ. Coll.). It is in a splendid state of preservation, and all the teeth except the canine are entire. Most of the characters are well shown in plate XL, accompanying this paper, which has been produced from very accurate drawings of the specimen made and placed at my disposal through the kindness of Mr. Rudolph Weber.

Dentition:—$\mathrm{I}_{\overline{2}}$, C. $_{\overline{1}}$, Pm. $_{\overline{1}}$, M. $_{\overline{1}}$. The incisors are recurved, about equal in size, and have rather sharp lateral edges. The crown of the canine is gone, but the root of this tooth indicates that it was rather weak, the antero-posterior diameter is about twice the transverse. The alveolar border between the canine and pm. $_{\overline{4}}$ consists of a sharp ridge of bone; it is complete, and demonstrates conclusively the absence of pms. $_{\overline{1}, \overline{2}, \overline{3}}$. Premolar$_{\overline{4}}$ is well-developed and fixed in the jaw by two roots; it is directed upward and backward. The protoconid is high and sharp, the paraconid and metaconid are much smaller and about equal in size, the former has a somewhat internal position and is out of line with the other two cusps. There is only a faint indication of a basal cingulum. The sectorial is quite simple, consisting only of a

[8] Bull. Soc. Phys. et Nat. Toulouse, 1873, t. I, p. 205.

[9] Journal de Zoologie, 1875, t. XVIII, p. 419.

protoconid and paraconid. The slight prominence on the posterior edge of the protoconid seen in Figs. 1 and 2, is due to wear by the opposing superior tooth. The protoconid is larger than the paraconid.

The Ramus:—The most striking feature of the jaw is the extreme downward projection of its anterior angle or flange, which is about equal to the depth of the jaw proper. The flange is deeply concave exteriorly, its lateral surface is separated from the anterior by a sharp ridge of bone. The mental foramen opens far down, almost on a line with the inferior border of the ramus. Near the middle of the jaw, and just in front of pm. $_{\overline{4}}$, there is a small foramen directed forward and upward. The exterior surface below the molars is convex longitudinally. The masseteric fossa is deep, and is not enclosed posteriorly. The posterior angle is very strong, it is but slightly deflected, and is directed outward and backward. The condyle is low, being placed a little beneath the line of the alveolar border, it decreases in strength from within outward, and its articular surface describes accurately a reclining semi-cone. The coronoid process is strong, low and rounded. The inner side of the jaw is a nearly plane surface. The dental foramen is situated just back of the sectorial and a little below the middle of the jaw. The symphysis is very characteristic, it extends far down on the flange, and is greatly expanded superiorly and inferiorly, and much constricted medially. The chin was broad and *very* deep. About one-third the distance from the incisive alveolar border to the bottom of the anterior angle of the jaw there is a large foramen.

Eusmilus dakotensis is easily distinguished from *E. bidentatus*, 1, By its size, which is about two-fifths greater than that of the European species; 2, By the structure of the sectorial, which is without the posterior cusp seen in *bidentatus;* 3, By the structure of pm. $_{\overline{4}}$, in this tooth—in *E. bidentatus* the posterior cusp is much smaller than the anterior, while in *dakotensis* these cusps are about equal in size. Compare Figs. 141 and 142, Filhol's Phosphorites du Quercy, with Figs. 1 and 2 in the plate accompanying this paper.

The discovery of *Eusmilus* in the White River beds is additional evidence in favor of referring those deposits to the Oligocene as proposed by Cope and Scott.

MEASUREMENTS:

	mm.
Longitudinal diameter of m. $_{\overline{1}}$, ...	23
Transverse diameter of m. $_{\overline{1}}$, ...	10.5
Longitudinal diameter of pm. $_{\overline{4}}$, ...	16
Transverse diameter of pm. $_{\overline{4}}$, ...	8

Length of diastema,	54
Greatest length or ramus,	173
Distance from top of coronoid process to bottom of jaw,	56
Depth of jaw below sectorial,	33
Width of jaw below sectorial,	16
Distance from bottom of flange to incisive alveolar border,	89
Depth of symphisis,	71
Length of symphisis superiorly,	27
Length of symphisis inferiorly,	21
Length of symphisis medially,	10

—J. B. Hatcher.

Princeton, Nov. 1, 1895.

BOTANY.[1]

The Vienna Propositions.—In the January number of the *Oesterreichische Botanische Zeitschrift* Ascherson and Engler publish six propositions embodying their views upon nomenclature, accompanied by an explanation of the work of the international committee appointed by the Genoa Congress. The propositions themselves have been published quite extensively, but their explanation has not received much notice in this country. The explanation is of some interest to American botanists because it evidently furnished a part at least of the inspiration and even of the language of the recent " protest " of certain botanists against the Rochester Rules. It is also interesting as showing that the committee appointed by the Genoa Congress has practically dwindled down to Ascherson and Engler.

Following is a translation of the " explanation " and of the six propositions.

" Following the appearance of O. Kuntze's Revisio Generum Plantarum in the spring of 1891, a deep movement made itself visible among botanical systematists of all lands. In Germany it led to the inquiry set on foot by the Berlin botanists, in the course of which the four theses sent to over 700 colleagues were answered, for the most part favorably, by more than half of the addressees; by the Scandinavian

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

botanists investigation of the question was recommended to the meeting of Naturalists at Copenhagen ; in North America the Botanical Club of the American Association for the Advancement of Science at Rochester adopted a resolution agreeing for the most part with the Berlin explanation. This movement reached its culmination at the International Congress held at Genoa in September, 1892, at which the three first points of the Berlin explanation were agreed to almost with unanimity, and for the settlement of the still controverted questions, namely, the fourth Berlin thesis, as well as the doubt over the naming of species, an international committee of thirty members was chosen to prepare the decision of a future congress by a carefully elaborated statement which should impartially consider all the material at hand.

"Since then the actual interest in the nomenclature controversy seems to have cooled considerably. But the organization of the committee encountered unexpected difficulties. Only a bare majority advocated carrying forward the management of the undersigned. Of the other members of the committee, to our regret, two of the three British members, the representatives of Kew, Sir Joseph Hooker and Mr. Baker, declined election in the committee. Two votes fell to Sir Joseph Hooker as manager. One member, indeed, accepted the choice, but thought that he must abstain from all discord over the management. Some colleagues have left the questions addressed to them unanswered. Discouraging as this result was, yet the undersigned held themselves pledged to undertake the management, as otherwise nothing would be accomplished. By this time it became necessary to produce the requisite means for defraying expenses, which lately was made possible by the munificence of the Prussian Academy of Sciences. If, therefore, O. Kuntze in one of his latest publications accuses us of hiding the questions out of sight in order to neglect them, that is one of the cheap insinuations which we are accustomed to from this gentleman, and which, indeed, is not worthy a thorough refutation. This seasoning of scientific polemic, for him indispensable it seems, and just as insipid as undeserved aspersion of opponents, is employed in profuse quantity in the controversial pamphlet appearing in the last twelve months which O. Kuntze has published as the first part of the third volume of the Revisio Generum Plantarum. In this pamphlet the author has collected all the accessible observations upon the reform in nomenclature undertaken by him and answered them in his manner according to his use of foreign languages. The pamphlet contains also a series of further propositions relating to the reform of nomenclature, among others concerning the constitution of a future congress, and culminates in the proposal of a compromise in that the author explains he will agree to 1737 or even 1753 as the starting point of priority in genera, provided the congress take up his other propositions en bloc.

"Of the other more important observations published in Europe we mention also the memoir of Pfitzer, in which O. Kuntze's nomenclature reform in the region of the orchids is critically examined ; O. Kuntze's reply thereto, and a study by J. Briquet of the current nomenclature questions.

"We would meet with little contradiction were we to state as the common mark of these discussions and publications the opinion that the endeavor of O. K. (sic) to replace a considerable portion of the generic names hitherto in use by others and to provide 30,000 species with his mark of authorship, has found little response with the great majority of thoughtful botanists, who hold the reform worse than the alleged evil. The Kuntzean attempts found enthusiastic approval only in certain circles of American systematists who had already inscribed priority *a l'outrance* upon their banners. This tendency seems to have been in the majority at the Botanical Congress held at Madison in 1893, which, on account of the slender representation of Europe, renounced internationality, since this gathering concluded its transactions with a vote of thanks to O. Kuntze.

"But one would err very much if one thought that these gentlemen adopt the Kuntzean nomenclature unexamined. There the specifically American rule 'once a synonym always a synonym' (which is energetically opposed by O. Kuntze, but by Briquet interpolated into the Parisian *lois de la nomenclature* of 1867) has opened up a new source of rebaptisms, through which the number of needless renamings may soon be increased by several more thousands. So we see that the Kuntzean exertions, so far from bringing into the world the harmony striven for by him, have opened the gates wide to dissension and confusion.

"We believe that before we approach the special questions, two closely interdependent fundamental errors must be met, which run through the argumentation of Kuntze and his American friends. The first is the notion that the principle of priority in questions of nomenclature, on account of its intrinsic justice, should be established for the vindication of the spiritual property of the first discoverer or describer. In our opinion this consideration can in no wise hold the first rank in importance. Much more have we established the rule of priority only for this purpose, in order to have an objective standard, since as a rule it is much easier to determine which name was first published for a certain form than which is the most convenient and suitable. The sense of subjective justice is naturally different with each critic; let one consider only the bitter discussion over the so called Kew Rule or 'objective priority' and the closely connected questions of designations of authority. The one thinks that he who first described a species, or much more he who first named it, has unquestionably rendered the greatest service in connection with it, the other puts the work of the author who first placed a species in the proper genus so high that his name must stand under all circumstances. This cult of priority as a postulate of inherent justice takes on a truly grotesque form with the American theologist Greene; he resembles to a hair the political legitimism over which history has long since passed to the order of the day.

"O. Kuntze appears not to share this romantic conception, although he seems to hold the not less strange illusion of his position over other botanists. He will sacrifice a portion of his 'well earned rights,' but only for the concession that the new congress lay aside its dictatorship. He thinks that he possesses a source of power by which to bring the whole botanical world, present and future, under his yoke.

"The second fundamental error has clearly arisen out of a mistaken conception of the juristic form in which the late illustrious A. deCandolle edited the rules of nomenclature in the form of a statute book. Here also there can be no doubt that only an agreement for reasons of expediency was submitted, which has been followed by the majority of describing botanists by common consent. With what right can Kuntze reproach the Kew botanists who have never recognized the laws with non-observance of these rules?[2] But on no account can the resolutions stand as a law for the enforcement of which the community of botanists must lend their strong hand without refusal, as the state to civil laws. Still less can the defects of this statute book, its silence concerning questions which then were not on the order of the day, be misused for advocates-tricks as, for example, O. Kuntze has done in the matter of beginning priority of genera with 1735. The law says, as we know, that in nomenclature one shall not go back of Linne. Standard works of the master are not specially named. A. deCandolle in his remarks

[2] In this place, as in many others in the article, Messrs. Ascherson and Engler misrepresent Kuntze's attitude. Dr. Kuntze reproaches the Kew botanists because they persist in following their own personal inclinations and refuse to consider themselves bound by any rules—not because having recognized the Paris Code, they violate it. He compares their obstinacy with that of the English people who persist in measuring by yards, feet and inches, after every one else has adopted an international and rational system.—R. P.

of 1883 makes the observation that the terms Phanerogamae and Cryptogamae are to date from 1735, the Linnaean genera from 1737, and the species from 1753. He means this in the purely historical bibliographical sense. In this state of affairs Kuntze now maintains that he has acted in accordance with the laws because he has transferred the species names of 1753 to the generic names of 1737–1752 (we will leave undiscussed the shoving back to 1735 which was so fruitful in new names), and accuses us of revolutionary procedure because we will not allow priority of generic names to be put back of 1753. We can here call upon the most competent testimony that can be adduced upon this question, that of the late A. deCandolle, who prepared the laws, directed the conference over them, and edited the conclusions for the press. If this father of the Paris rules of 1867 has rejected the Kuntzean interpretation, then the question is certainly put at rest. Not less does the Kuntzean position that the rules which were there established concerning the division of genera and like matters, be given retroactive force in interpretation, so that now, for example, the species of *Helianthemum*, because they form the majority of the Linnaean genus *Cistus* must bear that name, and the Miller-Gartnerian species of *Cistus* be rebaptized, conflict, if not with the letter of the Paris resolves, at least with the uninterrupted interpretation of them for nearly a quarter of a century. Here also we hold it self evident that historical development is to be respected—quieta non movere. But these rules of 1867 are to hold when a new monographer reforms the present generic boundaries. So all thoughtful systematists have held from 1867 to 1891, and so will they do also in the future.

"With good foresight, then, did we fix upon the year 1753 as the starting point for genera also in the first Berlin thesis. The American resolution does the same, and both propositions are in full accord with the present practice. As the Genoese congress assented to this decision by a large majority, it is scarcely intelligible how Kuntze sees in this proposition a rash action into which one of the undersigned 'irritated' the congress. Briquet lately opposes these conclusions in a pitiable way in order to argue for 1737. He calls to his aid the Kuntzean argument that 1753 will necessitate the rebaptism of about 6000 species, while by beginning with 1737 a much smaller number would be required. Naturally alterations of the Kuntzean nomenclature are meant. But a comparison can only be made with the nomenclature current before the appearance of the Revisio, and thus it appears that 1737 makes a greater number of alterations necessary than standing upon the starting point hitherto commonly adopted, at least de facto.

"Already two years ago we called attention to the fact that the establishment of 1753 did not suffice to restrain a large number of disagreeable rebaptisms of the best known and most numerous in species of genera. We then as a fourth thesis made a list of 80 (81) genera, the current names of which we wished to retain in spite of priority. This thesis was not adopted at Genoa. It had previously found opposition among the Vienna botanists, and had united against itself the greater number of opponents in the Berlin inquiry. We believe that this opposition is directed against the arbitrary selection; while the purpose, the protection of current names against alterations in majorem gloriam of an abstract principle, as inconvenient as unnecessary, has met with the approval of many of the dissenters. Who can wish sincerely that the abstruse word-buildings of an Adanson, the doctrinaire creations of a Neckar (who strove to obscure the conception of a genus as it had stood well-defined since Tournefort and Rivinus) and the hasty improvisations of a Rafinesque should replace names some of them current for more than one hundred years? We believe that in this case the narrowing of the rule of priority for genera by introducing a year limitation will lead to our goal. One can see an inconsistency here, namely, that we do not propose this year limitation for specific names also. Yet we believe that here also, considerations of convenience must take precedence of abstract symmetry. For half a century men have labored zealously to determine the meaning of Linnaean species and of the species of the older authors by a careful study of their writings and of their collections. These studies were only made possible by the most exact knowledge of the forms concerned; which one certainly cannot assert of the efforts of Kuntze and his imitators which are for the most part based only on bibliographic researches. The result of all these labors which has already met with abundant general acceptation, would be lost, and long vanquished errors would resume sway if we were to introduce the year limitation (naturally with retroactive force) for species also. The inconvenience of such a rectification of priority affects only as a rule a single name, sometimes two, more seldom a larger number. In the case of genera a similar 'correction,' which in no way concerns the scientific knowledge of the types in question, may often lead to the rebaptism of two hundred names.

"Moreover, theoretical reasons can be adduced why genera should not receive precisely the same treatment in nomenclature as species. Only a few would defend the absolute application of the principle of priority to the naming of families, orders and classes. Now, since in these cases, the considerations for priority fail, it is an entirely reasonable distinction to hold that while with genera priority shall rule, nevertheless where reason would become unreason and benefit vexation it be restrained by a year limitation, and yet in the case of species rule unrestrained.

"A different treatment of priority for genera recommends itself also with respect to the debated starting point of the same. We have already mentioned the important considerations of convenience which speak for 1753; nevertheless, there are numerous adherents of 1737; there have been and will be some for 1735, 1694, 1690, and, perhaps, for still other dates. Each of these starting points would naturally require a special generic nomenclature.

"It is also to be noticed that the conception of the genus is much less defined and, therefore, more inconstant than that of the species. What alterations have the ideas of genera in the Cryptogams, excluding the ferns, in the *Gramineæ*, *Orchidaceæ*, *Umbelliferæ*, *Compositæ*, *Cruciferæ*, etc., undergone since Linné. For these groups, therefore, our proposition comes to the same result as the proposals which would have the priority of groups begin with this and that monograph. Also the disagreeable double-namings in the *Proteaceæ*, in which by Kuntze's own statement Knight and Salisbury, the authors he has raised upon his shield, do not seem at all free from the suspicion of plagiarism, would be put out of the world.

"Moreover, by the adoption of a period of limitation, the addition to the second Berlin thesis resolved upon at Genoa at Prantl's suggestion will become superfluous. This, as it must be confessed, somewhat improvised proposal directed its point against Adanson; but it affected as well Haller, Scopoli (in part), and many other authors whose names are well known.

"Besides, even O. Kuntze has nothing to oppose to a limitation principle, provided only his restorations are excepted from it!

"It is self evident that the endeavor to alter the current nomenclature of genera as little as possible, which has moved us to propose a period of limitation, must not fall into opposition with itself. Such an opposition would occur if a name for a long time in common use should be rejected by reason of the rule, since, perhaps, after it had remained unobserved for a long time it might be restored once more. It is necessary, therefore, to fix a limitation for this and analogous cases.

"By fixing both periods at fifty years, the greatest number of the names applied in DeCandolle's Prodromus will be allowed to stand, and most of the 6000 rebaptisms calculated by O. Kuntze as required by 1753 will fail.

"We summarize the results of the foregoing discussion in the following rules:

"1. The rule that a name once applied but later becoming invalid must not be used again is to be recommended for observance in the future; but retroactive force is to be denied to this rule (once a synonym always a synonym) and alterations of names based upon it are to be rejected.

"2. On the transfer of a species out of the original genus into another genus, the original specific name is to be retained.

"3. The year 1753 is to be retained as the starting point of priority for both species and genera.

"4. In the nomenclature of species the principle of priority is imperative; only a more certain name must not be replaced by a doubtful one.

"5. In the nomenclature of genera a name which has remained unnoticed for at least fifty years, cannot later be established in the place of one which has become current.

"6. This rule allows an exception where the name in question, since its restoration, has remained in use at least fifty years.

"These rules as well as all other proposals proceeding from the committee after they have been passed upon by the committee, require the approval of a future congress.

"It is much to be desired that botanical nomenclature be placed in the closest possible accord with the system of nomenclature now under deliberation by the zoologists.

"P. ASCHERSON,
"A. ENGLER."

"Vienna, September 21, 1894."

(*To be continued.*)

VEGETABLE PHYSIOLOGY.[1]

Macfarlane on Paraheliotropism.—As the result of a series of interesting experiments, described in *Botanisches Centralblatt*, Bd. 61, 1895, under the title of "The Sensitive Movements of some Flowering Plants under Colored Screens," Dr. J. M. Macfarlane, of the Univer-

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

sity of Pennsylvania, finds that the hot sun position assumed by sensitive plants is not due to the action of solar heat rays, as a number of observers have stated, and as he was himself formerly inclined to believe, but to the more refractive rays of the solar spectrum. His studies were made upon *Cassia nictitans, C. chamæcrista, C. tora* and *Oxalis stricta,* and some of his conclusions are as follows :

" In all cases it has been found that Sachs' statement is so far correct, viz. : that when sensitive plants are placed under colored screens the leaflets fold as in the nyctitropic state, most powerfully under red, less so under yellow, only feebly or not at all under green, and that under blue screens the leaflets remain open as in ordinary daylight. But expansion under the red and yellow screens soon takes place, the rapidity of the expansion varying according to the brightness of the light and the species experimented on." " If the light be diffuse, and thus of moderate intensity, the flat morning position of the leaves is retained throughout the entire day, or part of it if the sun ultimately shines out." " If the light becomes more intense, no alteration, or it may be slight deflection in *Cassia* or inflection in *Oxalis,* occurs to leaflets of plants under the red and yellow screens. When plants are under a green screen and exposed to intense illumination. the leaflets either remain flat or assume a more or less paraheliotropic position, the angular change at times amounting to 25°. In all cases under the blue screens the leaflets become paraheliotropic more or less powerfully, the amount of angular movement being proportioned to the intensity of the light. It is impossible at present to say whether the blue or violet rays are the more powerful. In all cases, normal nyctitropic movement is accelerated a half to one and a half hours under a red screen, but the movements of the leaves and leaflets then are very peculiar." " Under a yellow screen nyctitropism is not quite so accelerated as under red, but the closing movements are nearly or quite regular in sequence, and in Cassias are first visible at the leaf extremity. Under a green screen the time movement practically coincides with that of exposed plants, and is beautifully regular in sequence." " Under the blue light there is always a distinct retardation of the normal nyctitropic period to the extent of from ½ to 2½ hours, the variations seeming to depend on temperature, on length of exposure to the blue light, and on relative intensity of the light for the day." " These observations seem further to warrant us in concluding that up to 38° C., or even 43° C. in some species, heat rays either fail to stimulate the tissues, or if they do that, their action is interrupted aud antagonized by some other form of energy, though this is scarcely likely. The same is true of the less refrangible light rays, and of these the orange-yellow, yellow and yellow-green seem to give the most uniform results, for so long as plants were exposed to intense light the leaflets remained either quite flat or became slightly reflexed. Under the green screen the leaflets of *Cassia nictitans* and *C. chamœcrista*, when strongly illuminated remained flat or became inflexed in some cases to 25°, but those of *C. Tora* under equal illumination inflexed through an angle of 15° ; those of *Oxalis stricta* remained flat. The paraheliotropic movement thus started under the green screen in some species became greatly more pronounced under the blue in all, and during intense illumination in *Oxalis* almost amounted to the nyctitropic position. Grouping the above facts, the conclusion is reached that the heat rays, the less refrangible rays, and the more refrangible rays are all trophic up to a certain point. When that point is crossed the heat rays and less refrangible rays continue to be trophic up to a much higher point, but the more refrangible rays (from green-blue to violet) act as a stimulant or irritant." "It may be worth emphasizing here that sensitive movements are most pronounced in tropical plants, are less so in subtropical and warm-temperate species, and are rare or feebly expressed in temperate and sub-arctic plants. But, as is well known, leaves that are exposed to an intense light show more rapid metabolic changes than those that are shaded. Any change, therefore, in the tissues of a plant which would insure protection of the lamina from the intense blue-violet rays, and its exposure again when these rays become subdued, would have every likelihood of perpetuation in sub-tropical and tropical regions, and such is the state of matters as we find them. We do not know accurately, as yet, the mechanism involved in a sensitive pulvinus, or the changes effected on stimulation of it, but anyone can readily prove that every gradation from non-sensitive to highly sensitive leaves is met with in such groups as the Oxalideæ and Leguminosæ, and that, broadly speaking, the sensitiveness increases as we pass from regions where the sun's rays are of minor intensity to others where the rays are of increased intensity. The writer, therefore, regards the action of the more refrangible rays, when of a definite intensity, as one of stimulus, because (1) the angular inflection of leaflets is proportionate to the intensity of the stimulating rays ; (2) the movement is not due to indirect action from the green laminar substance to the pulvinus cells, but is wholly centered in the latter ; (3) if the inflection movement is considerable, the white cushion of the pulvinus shows a visible change from white to a dull leaden green color ; (4) when the more refrangible rays are cut off by a color screen the stimulus is removed, and then neither the heat rays nor the less refrangible light rays cause closure. The above experiments then indicate that by the paraheliotropic movement leaflets are protected from the intense action of the blue-violet rays, and for this end all the leaflets on any one leaf need not move through the same angle." "These observations emphasize the view already expressed by several investigators that orange, yellow, and green screens to the protoplasm, whether in the form of pigmented walls, of pigmented cell sap, or of chlorophyll are of a protective character, and permit the normal functions to be carried on unimpeded by the action of the more intense blue-violet rays. But while such pigments are specially effective, the writer would suggest a similar function for the thick, highly cuticularized epidermis that covers so many desertic plants, or plants that grow in places exposed to intense sunlight. One can easily prove by experiment that on a hot day a thin sheet of white paper considerably reduces the light intensity. A piece of *Opuntia* epidermis similarly obstructs the light rays, and even though the heat rays pass, we have seen that up to 40–43° C. no injurious effect follows to many plants. It might further be pointed out, as Wiesner has already done, that the hair covering on the leaves of certain plants will contribute to the same end." The location of the movement in the pulvinus was determined by shading this organ from the direct action of the sun by narrow strips cut from an oak leaf. When the pulvini were thus shaded, leaflets that were inflexed 45 to 50° re-expanded in a few minutes so as to form an angle of only 5 to 10°. The time required to effect this change of position was only 1⅝ minutes in *Cassia nictitans* and 2¼ to 2⅝ minutes in *C. chamæcrista*, depending on the age of the leaf. Strips of mica of like weight caused no movement."—ERWIN F. SMITH.

Chalazogamy in Juglans regia.—Some years ago in *Casuarina* a peculiar genus of Australian and East Indian trees, diœcious, bearing aments, having the foliage reduced to scales, and superficially resembling Equisetaceæ, Dr. Treub discovered that the pollen tube does not enter the ovule by way of the micropyle but finally reaches the egg-cell by growing through the chalaza. This peculiar and altogether anomalous method of fertilization led him to found a distinct group of Angiosperms, sub-division *Chalazogamia* equal in rank with subdivision *Porogamia*, including the rest of the Dicotyledons and Monocotyledons. Subsequently, Dr. Nawaschin, of Kiew, Russia, discovered that the same thing occurs in the Betulaceæ, and now in Ein neues Beispeil der Chalazogamie (*Botanisches Centralblatt*, Bd. 63, 1895, pp. 353–357) the same author states that he has found chalazogamy in *Juglans regia*. The large ovule is anatropous. The placenta fills the ovary and frequently fuses with it. From the sides of the placenta develop two peculiar wing-like growths projecting somewhat above the base of the ovule. The pollen tube is strictly intercellular in its growth as in the other Chalazogamia. After the tube has penetrated the stigma and grown through the style, it enters the tissue of the ovary near the canal of the style but without entering its cleft or penetrating the micropyle. During its further growth, in the wall of the ovary, the tube turns to right or left and passing through the wing-like placental growths enters the top of the placenta and from here grows through the chalaza into the nucellus and to the embryo sack. During nearly its entire growth the tube sends out projections and in the chalazal region these become branches which give to the nucellus a veined appearance as if penetrated by a number of distinct pollen tubes. Several of these branches finally reach the embryo sack and surround it on all sides. The author detected the male nucleus, not only in the pollen tube, but also inside the embryo sack. At this time there was in the embryo sack neither an egg apparatus nor a differentiated egg. Besides the antipodal cells, separated from each other by a cellulose membrane, there were only some free nuclei on which devolved the rôle of the female apparatus. These appearances can hardly be explained otherwise than by supposing that the male nucleus fuses with one of the female nuclei to form the egg-cell. In these particulars *Juglans* (also *Corylus*) appears to be related to *Gnetum*, the developmental history of which has been studied critically of late by Geo. Karsten (Cohœn's *Beiträge*, VI). The author now attributes chalazogamy to the inability of the pollen tube to grow through empty spaces, and regards these plants as standing on the threshhold of the angiospermous world. To him they represent transition forms between Gymnosperms in which the pollen tube has an intercellular growth and Angiosperms in which it grows through the mycropyle.—ERWIN F. SMITH.

ZOOLOGY.

Variation in Halicystus octoradiatus.—Among 154 specimens, according to a recent paper in the *Quarterly Journal of Microscopical Science*,[1] Mr. E. T. Brown found 120 normal and 34 abnormal

[1] Vol. XXXVIII, pp. 1–9, Pl. I.

specimens, the normal individual being understood to be one with eight tentacle groups, eight genital bands, eight colleto-cystophores and four well-formed septa. The variations occur in the tentacle groups, the genital bands, and in the number and position of the colleto cystophores. In some cases there is an extra collecto-cystophore, which may be on the edge of the arm of the tentacle group, or within the margin the inner surface of the bell, or even outside the margin. A peculiar variation occurs in the collecto-cystophorus, themselves some of them sometimes bearing a small capitate tentacle. The variation in the genital bands may be due to an apparent splitting of a band or even to a fusion of one band with a ninth or supernumerary one. Two variations in the tentacle groups are interesting. In one individual figured there are seven perfectly normal groups, and one abnormal rather small group occupying a position within the margin upon the inner surface of the bell. Its normal position on the margin is occupied by a large colleto-cystophore with a capitate tentacle. In the other case there are likewise seven normal groups. The eighth is normally placed, but is small. Somewhat outside of it there arises a supernumerary arm bearing an apical group of tentacles and another or proximal group. On each margin of the arm is a colleto-cystophore, thus raising the number of these to ten. It may also be said that the eighth genital band corresponding to the abnormal tentacle group is double.

The author adds that mutilated individuals may reproduce a part that is or is not like the original, and that in some cases these mutilated forms bears a close resemblance to others that are congenitally abnormal. This being the case, it may be said that his observations show that there is considerable room for experiment to determine why the reproduced part is not like the original, and to what extent it may differ.

—F. C. K.

The Role of the Liver in the Anti-coagulating Action of Peptone.[2]—E. Gley and V. Pachon have performed certain experiments that not only demonstrate the correctness of the earlier conclusions of G. Fano, that the anti-coagulating action of peptone injected into the blood of an animal is indirect, but also localize the intermediate agent. The experiments consisted in ligaturing the lymphatic vessels leaving the liver in a dog previously morphined and chloroformed, and then at intervals drawing blood from the left carotid and from the sphenal vein.

[2] Comptes-Rendus de l'Acad. Sci., CXXI, pp. 383–5.

At 3.42 (p. m.), 6 c.c. of blood from the carotid coagulated at 3.43.

At 3.50 to 4 (p. m.) the lymphatics were ligatured.

At 4.09, 8 c.c. of blood coagulated at 4.10.

At 4.22, 5 c.c. of blood coagulated at 4.23.

Then from 4.23–4.26 a solution of 6.5 gr. of peptone was injected into the sphenal vein. At the end of this time blood was drawn at intervals.

7 c.c. drawn at 4.33 coagulated in 1 minute.

8 c.c. drawn at 4.40 coagulated in 1 minute.

8 c.c. drawn at 4.55½ coagulated in 1½ minute.

This clearly shows that by thus preventing the intrahepatic circulation of the lymph, the peptone loses its power of preventing the coagulation of the blood, and consequently that peptone has its usual effect only after having passed through the lymphatics leaving the liver.

—F. C. K.

The Neoformation of Nerve-cells in the Brain of the Ape after a Complete Removal of the Occipital Lobes.[3]—It has commonly been supposed that nerve-cells are not regenerated, and such was the conclusion of G. Marinescu presented to the Société de Biologie in 1894. But physiololgists have observed that animals deprived of the occipital lobes gradually regain the power of coördination of movements and of the recognition of surrounding objects to a degree, at least.

The author, on Aug. 24th, 1895, observed this phenomena, and, upon repeating the operation, was surprised to find the orifices of trepanation closed with a somewhat resisting tissue, and that the space formerly occupied by the occipital lobes had been refilled with a tissue that, upon examination with the rapid Ramon y Cajal Golgi method and by the Erlich hæmatoxylin eosin method, proved to be made of pyramidal nerve-cells and nerve-fibres and neuralgia. The latter was very abundant, while the former were less numerous than in the normal lobes. The growth was not due to the hypertrophy of the anterior lobes, for there was no clear microscopical demarkation between the two parts, and must therefore have been due to neoformation.

He adds that this explains, somewhat, the conflicting results of different observers in cases of incomplete removal of the lobes.

The operation of removal was repeated on the animal, and some three and a half months later the same phenomenon of reviving recognition reappeared.—F. C. K.

The Æstivation of Snails in Southern California.—Like the human genus, snails require rest, days and weeks of solitude, in fact, the land snail (Helix) withdraws so completely from social intercourse that months are spent in voluntary confinement. So secluded does this little householder become that his door or aperture is closed with one white curtain after another until sometimes one half a dozen membranous curtains in succession are draped when he has entered into his Nirvanic rest. In this condition his aperture, or outer door, is securely glued to the under surface of a stone, a board, or any substance under which he seeks shelter. In the eastern states he takes his annual *siesta* in winter, this being the period of hibernation.

But in Southern California snails (Helix) differ from their congeners presenting an illustration of the power of environment over natural ininstincts. Instead of going into winter quarters in October and remaining asleep all the winter months, the season of greatest activity of the Southern California snail is during those months.

The reason for this is that the food supply is plentiful in the winter when the warm rains prevail; but, during the summer months the arid condition of the foot-hills, the habitat of these quiet creatures, makes makes the æstivation of snails a necessity, a question of domestic economy, an adjustment of demand and supply. In process of time the necessity for æstivation, rather than hibernation, became a habit. During this period his functions are in a state of coma; digestion, respiration and circulation are imperceptable; he sleeps with all his powers, and his waking is not a voluntary action. Without moisture a snail will rest for years! Dr. R. E. C. Stearns, of the U. S. National Museum, records a rest of six years of one snail from Lower California, *Helix veatchii.*

On March 21, 1890, a few land snails (*Helix traskii* Newcombe), were collected from some of the low foot hills in Los Angeles. These were left in a glass jar on a stand and in the morning the snails had crawled up the wall of the room and were esconsced in one corner of the ceiling, another one had travelled farther in the night and had pre-empted his claim in one corner of the hall ceiling. They were allowed to remain undisturbed in order to study developments. One soon fell down upon the carpet, but the other two remained intact. The household orders were that *Helix traskii* were to be left undis turbed by brush or broom. The summer came and went, autumn followed, winter came on, and still the hermaphrodites remained asleep. No sound of music nor mirth aroused them.

But the rains came on, heavy drenching showers that rushed down the mountains, washed the foot hills, overflowed the zanjas, and all nature was in a dripping condition. During one of these storms, in

January, 1891, the rain made invidious incursions into the hall during the night, and in the morning the snail was found on the carpet. In an hour afterward he was as willing as ever to struggle for existence. He ate heartily of celery, with his little rasping tongue (radula) beset with multitudes of tiny siliceous teeth.

It was not until February 23, that the other snail had been sufficiently overcome by the forces of nature to loosen his epigram enough to descend to the floor. He was then placed in a shallow saucer of water and he assumed his functions as though there had been no state of torpor.

While the house snails were glued to the ceilings, their relatives in a "snailery" in the garden had been aroused to activity by the first rain as it pattered through the screen cover of the snailery, and had been busy housekeeping. As the result, a number of tiny pellucid looking balls were, on January 21, 1891, carefully hidden in the moist earth in the box. These were the eggs of the snails. Time had been lost by the house snails, their siesta, extended beyond the requirements of Nature, had gained them nothing. It was the intention to study all these forms and see if the "house snails" lived any longer for their protracted æstivation, but, alas! for the rapacity of the animal kingdom, slugs, sow bugs, ants and insects from the rosebushes, made war upon the whole snail colony, adults, babies and eggs, and by summer time, the little houses were empty, the tenants were dead.—MRS. BURTON WILLIAMSON.

A Careless Writer on Amphiuma.—I have recently read an article in the last number (October, 1895) of the American Journal of Morphology by Mr. Alvin Davison on Amphiuma, which contains such evidence of haste and carelessness as to require early notice. At present I refer principally to his references to my work and my conclusions, but as the errors here are so numerous I cannot suppose that I am the only author favored by misrepresentation,

On page 378 he says, "the number of premaxillo-maxillary teeth is never less than fifty. The number is wrongly stated by Cope as thirty-one." I have recounted the teeth on the specimen which I had in hand when this assertion was written, and I find the number to be exactly as I have stated. Mr. Davison has probably counted the teeth on *both sides* of the skull. One would think that a little scientific imagination would have suggested this explanation of the discrepancy to Mr. Davison.

Our author next describes the squamosal bone of Amphiuma, putting his discoveries as to its shape in italics, as though it had not been often described and figured before, and then goes on to say that "the bone which Cope has called squamosal in the Cœcilians is quite differently located, being directed forwards and inwards in such a manner as to form part of the orbit, and, therefore, deserves the name of quadrato-jugal, as some authors have already called it." It is at least amusing to learn that to contribute to the orbit is characteristic of the quadrato-jugal bone. That is exactly what it never does; and, moreover, the squamosal does not do so in Cœcilia. That the element in question is the bone which is called in Batrachia generally by modern authors the squamosal, there can be no doubt; I prefer however, at present, to call it supratemporal. Mr. Davison's osteology is here seriously at fault.

On page 383 the author states that "doing the past six months I have searched carefully for a description, or even a few words of introduction to the muscular system of this strange animal, but have been able to find only a very terse discussion of the subject." He then refers to Bronn, who gives he says "only a few words to the muscles of the head." It is evident that this search was not very careful, or Mr. Davison would not have missed so important a work as Fischer's Anatomische Abhandlungen ueber die Peremibranchiaten und Derotremen 1864, where much space is devoted to the muscular system.

On p. 390 we read "Cope has greatly erred in saying that the lungs are subequal." I find on reexamination of adult specimens that the left lung is only one-tenth shorter than the right.

On p. 395 is another error, which would suggest animus, were not the author's capacity for blundering so exceptionally developed. He says "Cope has asserted that Amphiuma has only one testis, but I find paired testes extending half way from the liver to the vent." It does not appear to have occurred to Mr. Davison that I was describing one side only, and that I stated it to be single in order to distinguish it from that of Siren, where there are two on each side.

On page 403 we have a discussion of the phylogeny of Amphiuma. He gives my table of the Urodela from the "Batrachia of N. America," and then remarks. "It is evident to all phylogenists that this table presents an absurdity, since representatives of each of the five families in the direct line of descent are existing at the present time." On the contrary this naïve observation shows that Mr. Davison is a tyro in phylogeny. He does not seem to be aware that families of many vertebrata, and especially of the lower classes, often have had a long duration in geologic time. Thus in the American Oligocene occur genera of the existing families of lizards, Gerrhonotidæ and Amphisbaenidæ, and existing families of Batrachia are known from the Miocene. But when Mr. Davison wishes to derive the immediate descent of Cœcilians from the Stegocephalia, he goes to an opposite extreme of antiquity, and, moreover, there is no resemblance whatever between the two groups. Even if the Cœcilians possess a basisphenoid as he alleges, but which I greatly doubt, this character would constitute a ground of difference from the Stegocephalia, and not resemblance.

Finally our author, in order to set forth his views of the phylogeny of the class Batrachia, copies bodily, p. 407, my diagram as published in the Batrachia of N. America, without credit, only introducing the two absurdities of deriving the Amphiumidæ and the Cœciliidæ from the Stegocephalia direct.

Mr. Davision has, in fact, adduced some new reasons in support of the proposition which I was the first to formulate, that Amphiuma is nearly related to the Cœciliidœ. So certainly have his researches with those of the Sarasins and Hay confirmed this view, that it is quite worth while to reëxamine the supposed ethmoid of the Cœcilians, and see whether there is not an agreement in this point also.

At the close of the article the author states that Dr. Scott has pointed out parallelisms in evolution of different lines of Mammalia. Dr. Scott has never claimed that his observation was original with himself, and if Mr. Davison had asked the distinguished Professor of Princeton as to this, he would have learned where and by whom this fact of phylogeny was first set forth.

Finally, the plates attached to this paper are quite unworthy of the American Journal of Morphology.—E. D. Cope.

Zoological News.—Those interested in the anatomy of the frog will find Gaupp's account of the hand and foot muscles of that animal (Anat. Anzeiger, Bd. XI, No. 7, Oct., 1895) extremely valuable, and the illustrations which accompany it are very clear. No abstract is possible.

P. J. White adds[4] *Hexanchus griseus* to the list of Selachians (*Notidanus indicus*) in which a median cartilage is inserted in the shoulder girdle. Like Haswell and Parker, he regards it as sternal in nature, and consisting of pre- and post-omosternal elements.

[3] Vitzon, Alex. N. Compte-Rend. Acad. des Sci., CXXI, 1895, p. 445.
[4] Anat. Anz., XI, 222, 1895.

ENTOMOLOGY.[1]

Stemmatoiulus as an Ordinal Type.—The genus Stemmiulus[2] was established by Gervais in 1844. The type species was collected in the mountains of the United States of Colombia. The genus was supposed to differ from Iulus in the possession of a single large ocellus on each side, instead of a cluster of small ocelli, but to subsequent writers this seemed a rather slender basis of generic distinction. Latzel placed Stemmiulus as a doubtful subgenus under Iulus.

Other species with two large ocelli have been described from Jamaica and Ceylon by Karsch and Pocock, but no dissections seem to have been attempted. Mr. Pocock has given me credit for having pointed out to him the fact that the pleural sutures are open, and he has established a separate family for the accommodation of the genus, having previously referred it to the Callipodiæ (Lysiopetalidæ) because the ventral plates are free and the segments striate in a manner resembling that of some of the European Lysiopetalidæ. Mr. Pocock also established[3] a suborder Callipodoidea to contain the Callipodidæ and Stemmiulidæ, but seems later on to have abandoned this arrangement, for we find both families referred back to the Iuloidea.[4]

During the past four year I have had the opportunity of accumulating in Liberia abundant material in this group, and have accomplished several dissections which reveal a series of remarkable characters, and make possible camera drawings of the interesting parts.

The living animals strikingly resemble in form, size, coloration, habits and movements the Iuliform Craspedosomatidæ, such as Cryptotrichus and Underwoodia. No Craspedosomatidæ are, however, found in tropical Africa, so that mimicry will hardly explain the apparent similarity of these really diverse forms. The movements, indeed, are even more vigorous than those of Craspedosomatidæ, and the creatures frequently throw themselves several inches when disturbed. Mr.

[1] Edited by Clarence M. Weed, Durham, N. H.

[2] This is the original name, and the derivation from *στέμμα* is evident, but the form seems to be incorrect. A similar carelessness in derivation is that of the names "Craspedosomidæ" and "Chordeumidæ," which classical usage would compel us to write "Craspedosomatidæ" and "Chordeumatidæ."

[3] Journ. Linn. Soc. Zool., XXIV, p. 447.

[4] Zool. Erg. einer Reise in Niederl. Ost-Indian, Herausg. von Dr. Max Weber, p. 376. As this reference cites the former one (Journ. Linn. Soc., XXIV, p. 447) it would seem to be a later publication.

Pocock informed me that the collector of the Ceylon species reported that the animals were saltatory. This apparent jumping motion, is caused by vigorous wriggling of the body. At other times they crawl or run after the manner of other Diplopoda, but are more fleet. Strangely enough, one of several genera of Spirostreptidæ found in Liberia is also very fleet and has the habit of throwing itself by vigorous wriggling in the same way as Stemmatoiulus. In Liberia I collected three well-defined species, here referred to Stemmatoiulus, but noticed no differences in habitat or habits. All were found among fallen leaves and decaying vegetable debris in deep forests or other moist and deeply shaded localities, or rarely in heaps of rubbish in open places.

Structurally considered, these Liberian species show many characters or combinations unique among recent Diplopoda. It will not be possible to separate satisfactorily the ordinal, family, generic and specific characters in this group until the American and Indian forms are better known, and the following subordinal description will probably need modification when further investigation has been made.

STEMMATOIULOIDEA, new Suborder.

Body fusiform, distinctly compressed laterally.

Labrum tridentate, with a median tooth.

Eyes of one or two very large ocelli.

Mandibulary stipe with cardo distinct, subequal in size with the stipe.

Hypostoma present, large.

Mentum entire, very short.

Promentum broad, longer than the mentum.

Lingual laminæ distinct, very large, transversely striate; lingual lobes provided with sense-cones.

Median lobe well-developed, without styliform processes.

Segments not divided by a constriction into anterior and posterior subsegments; the suture inconspicuous or wanting; dorsally with a distinct median suture and four pairs of setiferous punctations; surface divided by longitudinally oblique impressed lines into narrow areas.

Repugnatorial pores present, subdorsal, located in the anterior part of the segments.

Pleuræ incompletely adnate or nearly free from the tergites.

Pedigerous laminæ all free, of two different shapes.

Legs eight-jointed, except the first two pairs.

Seminal opening of males through an unpaired two-jointed, external duct inserted behind the second pair of legs, which are greatly modified.

Both pairs of legs of seventh segment of males replaced by copulatory organs.

Segments of adults 40–50.

Among these characters some are especially noteworthy:

The ocelli are many times larger than those of other Diplopoda, and the small number should not be looked upon as an indication that any reduction or coalescence has taken place, such as sometimes occurs in cave or subterranean forms.

The lingual laminæ of males are as large and as long as the stipes of the gnathochilarium, and are transversely striate. To accommodate these large laminæ the promentum is greatly reduced, but in the female the promentum is larger and the laminæ correspondingly shortened.

The eight-jointed legs are quite different in form from those of any other group of Diplopoda. Seven joints is the number in the other suborders, although the second joint is always very short and in some case is nearly or quite obsolete. The second joint in Stemmatoiulus is also small, though larger than in any other Diplopod, and the additional joint is probably the result of an articulation in last tarsal joint which in other forms is undivided.

In males the second pair of legs is conspicuously reduced and transformed into a pair of hooks probably of use in copulation,

Behind this second pair of legs is inserted an attenuate, apparently two-jointed, external seminal duct which lies back between the coxæ of the third and fourth pairs of legs, which are medianly hollowed out to receive it, as the drawings show. No such structure has been found in other recent Diplopoda, but the Carboniferous Archipolypoda as described and figured by Scudder show a probably homologous feature described by Scudder as an "intromittent organ." The copulation of Stemmatoiulus has not been observed, but as the creatures have the usual copulatory legs on the seventh segment it seems more reasonable to suppose that in Stemmatoiulus, at least, the function of the structure in question is to convey the seminal matter to the copulatory organs.

The pleuræ are neither free after the manner of Glomeris and Siphonotus, nor coalesced and obsolete as in Iulus and Polydesmus, but are anteriorly more or less adnate to the scuta, and posteriorly separated by a deep incision. Compared with those of the Oniscomorpha and Colobognatha the pleuræ of Stemmatoiulus are very small, which suggests the possibility that the pleuræ of Iulus have been lost, and have not so completely disappeared by mere coalescence.

The segments are provided with eight setæ each, instead of six as in Craspedosomatidæ, and they rise from punctations instead of tubercles, though in the Iuliform Craspedosomatidæ the setæ sometimes rise from punctations, e. g. Caseya. The last segment is rudimentary and has four conic processes like those of the last segment of Craspedosomatidæ. The appearance of setæ on the last segment in these diverse forms accords with the known fact of their great constancy in the other suborders in supporting the view that they are primitive characters and hence of great importance in classification and the estimation of affinities.

The repugnatorial pores are subdorsal, located in the anterior part of the segment and occur in an uninterrupted series from the fifth segment. The occurrence of setæ and pores on the same animal indicates that closer affinity may prove to be possible between the Craspedosomatidæ and Callipodidæ than would be indicated by arranging them in separate suborders.

This combination of characters indicates a wide divergence in developmental history from the other recent Diplopod types. This divergence is also indicated by the fact that the affinities of Stemmatoiulus are evidently with the carboniferous forms known as Xylobius. The segments of Xylobius, according to Scudder's diagrams, are divided into so-called "*frusta*" by longitudinal impressed lines not apparently comparable to the striæ of Iulidæ nor to the carinæ of Callipodidæ or Cambalidæ. Hence I have arranged Stemmatoiulus and Xylobius as representatives of suborders[5] under a new ordinal name, Monocheta, coördinate with the Oniscomorpha, Limacomorpha, Colobognatha and other groups noticed below. The comparative study of the Diplopoda necessary in examining the question of the proper systematic value of the characters presented by Stemmatoiulus has led me to look upon the Helminthomorpha of Pocock as a composite group, the different members of which are not necessarily more related to each other than to the Oniscomorpha or Limacomorpha.

An apparently satisfactory means of division into groups the members of which have more evident affinity among themselves, is to be found in the location of seminal opening and the structure of the external seminal ducts when present. Without known exception the characters drawn from these organs are accompanied by a definite complex of other features so that there appears to be ample ground for

[5] Suborder Xyloiuloidea, to contain the family Xyloiulidæ, genus Xyloiulus fossils from the Sigillarian stumps of Nova Scotia. Xylobius Dawson is preoccupied, and is replaced by Pyloiulus.

the claim that the proposed groups[6] are natural ones. The nature of the differences by which the Monocheta are maintained as distinct may be shown by briefly indicating the most important diagnostic features of the different orders with which they have been confused. Complete parallel descriptions are in preparation.

Order MEROCHETA.

Median lobe of gnathochilarium with styliform processes.

Seminal openings of males appearing as perforations of the coxæ of the second pair of legs.

Suborders Polydesmoidea, Craspedosomatoidea, Callipodoidea.

Order MONOCHETA.

As defined above. The affinities, as far as these can be indicated, seem to place this order between the Merocheta and the Diplocheta.

Suborders Stemmatoiuloidea, Xyloiuloidea.

Order DIPLOCHETA.

Seminal openings through paired ducts inserted at the base of the second legs.

Suborders Spirostreptoidea, Cambaloidea, Iuloidea.

Order ANOCHETA.

Labrum with a median sinus and an even number of teeth.

Segments 1–5 with one pair of legs each.

Seminal opening single, median, located at the base of the second legs; external seminal ducts entirely wanting.

Suborder Spiroboloidea.

Family STEMMATOIULIDÆ Pocock.

Stemmiulidæ Pocock, Journ. Linn. Soc., XXIV, p. 477.

Genus STEMMATOIULUS Gervais.

Stemmiulus Gervais, Ann. d. Soc. Entom. d. France; 2 series, II, 1844; 3 series, II, p. 70, Pl. V, fig. 11 (1844).

Type *St. bioculatus* (Gervais and Goudot) ibid.

Locality.—Columbia, temperate regions.

[6] Annals N. Y. Acad. Sci., Vol. IX, p. 8, 1895. There seems to be no good reason why the groups in question may not be looked upon as orders, as Mr. Pocock has proposed in the case of the Oniscomorpha and Limacomorpha. The characters which separate them are both fundamental and constant.

The type species had but a single ocellus on each side of the head, and may prove to represent a genus distinct from the forms with two ocelli. For the present, however we have no means of estimating the value of this character and the new Liberian species are provisionally described under Stemmatoiulus.[7]

Stemmatoiulus bellus sp. n.

Plates XLI, and XLII, figs. 1–31.

Body distinctly fusiform, especially narrowed caudad.

Vertex even, smooth and shining, very finely striate longitudinally, with a trace of a median suture; no hairs except one on each side rising from a punctation.

Clypeus even, smooth and shining with a few scattered piliferous punctations; immediately above the labrum with a row of peculiar clavate, decurved hairs.

Labrum with a rather deep emargination and three teeth separated by deep incisions.

Eyes of two very large ocelli, the superior of which is larger; a small punctiform sense-organ mesad from between the ocelli.

Antennæ clavate, the second and fifth joints longest.

Gnathochilarium and mandibles, see plates.

First segment semi-elliptical the inferior corners rounded; surface evenly convex, the margins not raised; two or three short striations near the posterior corners; surface apparently smooth and shining; under a lens of sufficient strength it is seen to be very finely striate longitudinally over the entire surface, as are all the other segments; no trace of a median line or suture; eight setæ rising from punctations near the posterior margin.

Subsequent segments with a very distinct median dorsal sulcus; on posterior segments this is gradually more deeply notched posteriorly; the whole surface of the segments is very finely and closely striate longitudinally; in addition to these there are numerous distinct oblique impressed line or striations, higher in front and at subequal distances apart, though closer together laterally than dorsally and closer on the posterior segments than on the anterior; there are about 26 of these oblique lines, 5–7 above the pores. The impressed lines are finely

[7] I have seen the types of *St. bioculatus* (Gervais and Goudot) and of *St. compressus* Karsch. The latter is a dried female in the Berlin Museum There seem to be six conic setiferous processes on the last segment; the pore is located in the third area from the median line; the striæ are wider apart than in the African animals; the legs shorter; the body strongly compressed, short and robust.

beaded or crossed by minute ridges, something after the manner in which the transverse sutures of certain Polydesmoidea are ornamented. The effect of these impressed striations is to give the body a peculiar satiny sheen. The striations do not appear on the dorsal surface of the first few segments, but come farther up gradually to about the tenth.

Repugnatorial pores beginning on the fifth segment; located subdorsally and on the anterior part of the segments, so far in front that they are frequently concealed by the posterior edges of the adjoining segment. The pores are below the second seta from the middle, though the setæ are near the posterior margin of the segment; the pores are usually just below one of the oblique lines which is then sinuate upward around the pores; sometimes the pore is midway between two lines which are then not sinuate, but are always wider apart than any other lines, for their whole length.

Setæ in four pairs; the lowest pair small and inconspicuous, but always present.

Last segment rudimentary, with four setiferous conic processes.

Anal valves not strongly convex, the margins not compressed or raised; surface moderately hirsute with hairs of different lengths, especially caudad.

Preanal scale nearly semicircular, with the two setæ usual in Diplopoda.

Pleuræ striate in the same manner as the scuta.

Pedigerous laminæ of two sorts, those of the anterior pair of legs of each segment subtrapezoidal, those of the posterior pairs with the posterior corners produced. The spiracles are large and distinct.

First pair of legs six-jointed in both sexes, the three distal joints fringed with long hairs.

Second legs of male modified into hooks; four joints are distinguishable, the two lower nearly coalesced. Second legs of female reduced, five-jointed, the joints fringed with long hairs, as are those of the first pair.

Legs 3–5 of males distinctly crassate, the others slender. The distal joints of the anterior male legs have peculiar stout spines or chitinous processes in addition to the usual and ordinary hairs.

Copulatory legs of male, see figures.

Color a dark though bright, horn-brown; a narrow yellow median stripe; a row of light (whitish) spots in which the pores are located. The dark color stops at the middle line of side, and below this the animal is colored a bright orange or light brownish-yellow; legs and ventral surface pale yellowish or nearly white. Head and antennæ dark. Second and third segments bright yellow, and forming a conspicuous collar.

Length 25–30 mm., width 2·5 mm., dorso-ventral diameter 3 mm. Segments 48–50.

Locality: Not rare in Western Liberia; Monrovia, Muhlenburg Mission, and Mt. Coffee. I have examined about 40 mature specimens. The females seem to be somewhat more numerous than the males.

The above description may be taken as somewhat generic, at least for the Liberian species. In the remaining two only characters differing from those of *St. bellus* are given.

Stemmatoiulus pencillatus sp. n.

Plate XLIII, figs. 32–46.

Body slender, not so distinctly fusiform as in the last species.

.Segments with setiferous punctations inconspicuous; dorsal suture and sulcus more distinct and notched posteriorly; the impressed lines more distinct and the surface of the segment between somewhat more convex than in *St. bellus.*

Second male legs with a pencil of long hairs rising from the third joint, where in *St. bellus* there is a cluster of shorter hairs. On the fourth joint is a pectinate row of curved spines in, *St. bellus* represented by a cluster at apex.

Legs 3–5 of males more strongly crassate than in *St. bellus.*

Copulatory legs quite distinct in form, see figures.

Colors in general similar to that of *St. bellus,* but not so bright, mottled horn-brown. Median stripe broader, but rather indistinct, reddish-brown; spots about the pores very indistinct, horn-color, lighter than the surrounding surface. The dark color ceases at about the middle of the side, but not very constantly or abruptly. Immediately below there may be a row of dull orange spots, or the whole lower lateral surface may be a mottled light horn-brown. Feet whitish, antennæ dark, except the last joint. Second and third segments not yellow, but rather darker than the others; the first segment is occasionally yellowish.

Length of male 19 mm., width, 1·25 mm.; female 22 mm. and 1·75 mm., there being a much more noticeable disparity in size than in the preceeding species. Segments 50–53.

Locality: A rare species in Western Liberia; Mt. Coffee and Muhlenburg Mission.

Stemmatoiulus calvus sp. n.

Plate XLIV, figs. 47–57.

Body smaller and less fusiform than in *St. bellus*, but more robust than in *St. pencillatus* ; lateral compression not so strong.

Segments with the minute longitudinal striations less distinct than on *St. bellus* ; the coarser striations less oblique and less distinct ; the pores seem to be slightly more dorsal.

Second male legs almost without hairs on the two distal joints, which are also much more slender than in the two preceeding species.

Length 3–5 distinctly crassate, but less so than in the other Liberian species.

Copulatory legs of characteristic form, see figures. A notable difference is shown in the basal lamina of the anterior face. In both other species this is broad and distally emarginate ; in *St. calvus* it runs out into an attenuate process.

Color : In life this species appears to be banded with black and white alternately, as the posterior part of each segment is subhyaline and appears white. In alcohol the color is dark horn-brown, nearly black, somewhat mottled ; median dorsal line very narrow orange, sometimes nearly or quite obsolete. A row of lighter horn-brown spots along the pores and another similar row at an equal interval below ; the dark color is not interrupted at the median line of side as in the other species, but extends down nearly to the pleural suture. Under surface, legs, and apical joint of antennæ whitish.

Length 22 mm., width 2 mm. ; number of segments, 44–47.

Locality.—A rare species in Western Liberia. Found only in the region of the Mangrove Swamps in vicinity of Monrovia ; I have collected a few specimens on Bushrod Island and along the Mesurado River, of which two are mature males.

A considerable quantity of young specimens were collected, but they are difficult of determination and have not been given much study. In young individuals of all the species the color is a uniform grayish. I have also collected forms congeneric with the Liberian at Sierra Leone and at Conakry, French Gambia, but no mature males were secured.

The drawings of the Liberian species here submitted are supposed to show, in addition to the specific characters, the apparent constancy of the more fundamental and important features on which the higher divisions have been based. On this account figures of the same structures have been repeated for each species, even when the specific differences were not important.—O. F. Cook.

Explanation of Plates.

Plate XLI.

Stemmatoiulus bellus.—Fig. 1. Gnathochilarium of male; 2. Part of same, more magnified; 3. Gnathochilarium of female; 4. Antenna of male; 5. First pair of legs of male, posterior view; 6. Second pair of male legs, anterior view; 7. Same, posterior view, showing also the external seminal duct; 8. One of the second male legs, lateral view, more magnified; 9. Same, posterior view; 10. Third leg of male, posterior view; 11. Fourth leg of male, posterior view; 12. Fifth leg of male, anterior view; 13. Sixth leg of male, anterior view; 14. Tenth leg of male, anterior view; 15. Male genitalia, anterior view; 16. Same, posterior view.

Plate XLII.

Stemmatoiulus bellus.—Figs. 17. Anterior pair of legs of a segment from the middle of the body, anterior view; 18. Posterior view of basal portion of same; 19. Posterior pair of legs from same segment; 20. First four segments, ventral face; 21. Lateral and ventral portion of a segment from the middle of the body, showing the pleural suture; 22. Mandible; 23. Head, lateral view, showing antennal socket, two large ocelli, mandibulary stipes and gnathochilarium; 24. Dorso-lateral part of a segment, showing the median line at the left, the sculpture, repugnatorial pores, and three setæ; 25. Last three segments, dorsal view; 26. Same, ventral view; 27. Same, lateral view; 28. First pair of legs of female, posterior view; 29. Second pair of legs of female, posterior view; 30. Third pair of legs of female, posterior view; 31. Fourth pair of legs of male, anterior view.

Plate XLIII.

Stemmatoiulus pencillatus.—Figs. 32. Antenna of male; 33. Gnathochilarium of male; 34. Leg of first pair of male; 35. Second male leg, anterior-lateral view; 36. Second pair of male legs, posterior view, showing also the exterior seminal duct; 37. Third pair of male legs, posterior view; 38. Apical joints of same, more magnified; 39. Fourth pair of male legs, basal joints, posterior view; 40. Fifth pair of male legs, anterior view; 41. Sixth male leg, anterior view; 42. Seventh male leg, anterior view; 43. Male genitalia, anterior view; 44. Same, posterior view; 45. Labrum, exterior view; 46. Same, interior view.

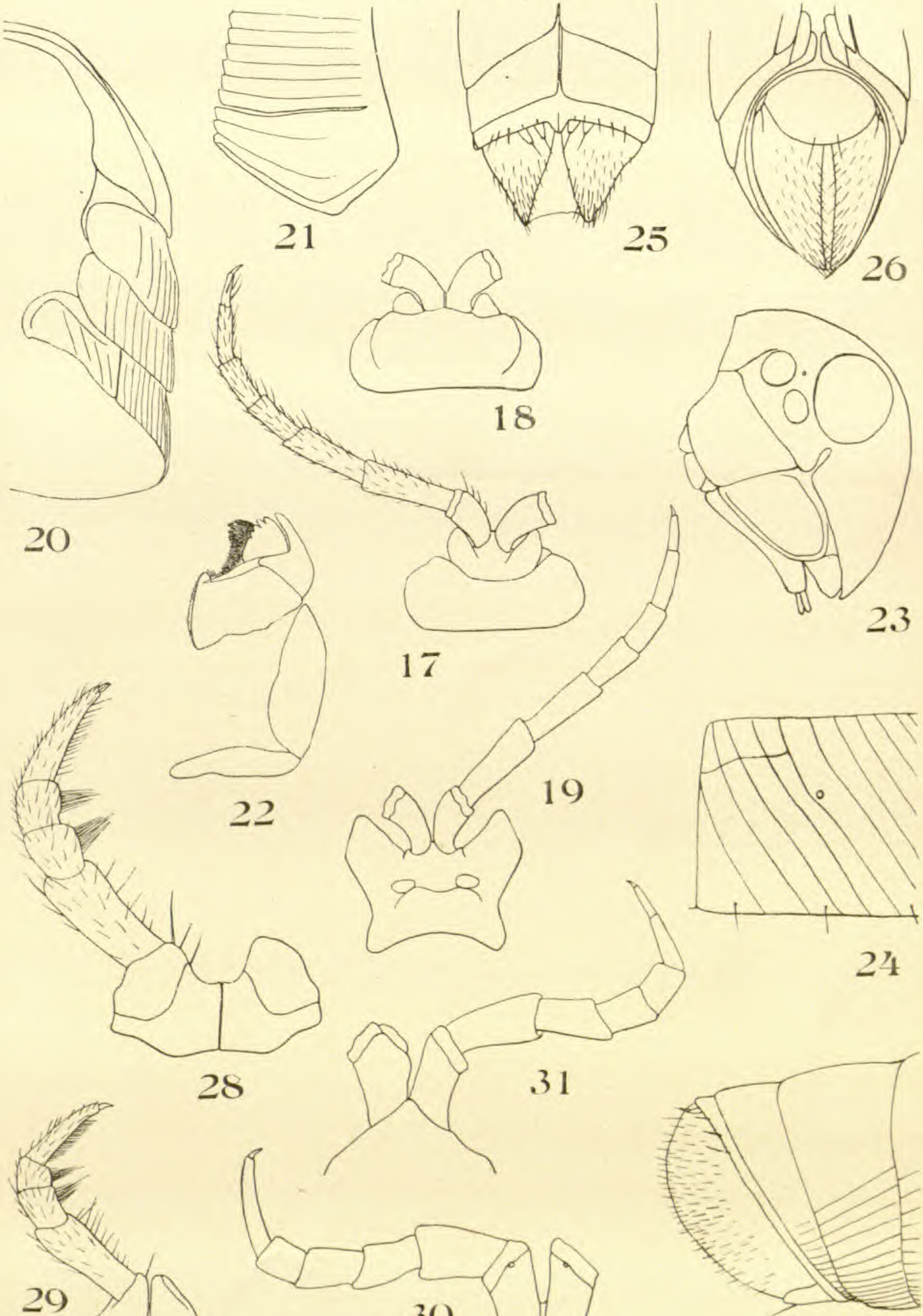
Plate XLIV.

Stemmatoiulus calvus.—Figs. 47. Gnathochilarium of male; 48. Antenna; 49. First male leg; 50. Second male leg, anterior face; 51.

PLATE XLI.

Cook on Myriapoda.

PLATE XLII.



Cook on Myriapoda.

PLATE XLIII.

Cook on Myriapoda.

PLATE XLIV.

Cook on Myriapoda.

Second pair of male legs and external seminal duct, posterior view; 52; Third legs of male, posterior view; 53; Fourth legs of male, posterior view; 54, Fifth legs of male, posterior view; 55; Sixth legs of male, posterior view; 56. Male genitalia, anterior view; 57. Same, posterior view.

EMBRYOLOGY.[1]

Conjugation of the Brandling (continued from page 1027).—It is an error to suppose that there is any great accuracy of adjustment of ring to ring in this process of conjugation; there are no openings of one to be brought opposite to openings in the other but only the long girdle to be applied to the region of the sperm receptacles which open between the ninth and tenth and the tenth and eleventh rings. When the girdle envelopes this region, as seen in the two-constricted parts of the figure, the enlarged intermediate region with the openings of the male ducts may be drawn backwards or forwards without need of accurate coincidence with certain rings on the other worm.

Having hardened conjugating brandlings after killing in boiling water we may cut sections of the two and obtain some insight into the anatomical relations of various parts during, or at least at any given stage of the process of sexual interchange. In longitudinal median sections we find such conditions as are indicated in figure 2 which represents the true relative size and positions of the organs although small details are omitted and the organs are represented in a conventional way. We see the somewhat free head end of the upper worm then the constricted region, the long swollen region, the second constricted part and the head end of the lower worm.

Examining the upper worm from the head backward we see that in the first-eight rings the digestive tract has a large muscular and glandular thickening of its dorsal wall, that the brain lies in the cavity of the third ring while the nerve cord is shown ventrally just as in the normal worm at ordinary times. The ninth and tenth rings form a small swelling sharply cut off by very deep constrictions of the body wall from the regions in front and behind. In these two rings the diges-

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

tive tract is reduced to a more slender tubule with scarcely any lumen. The main bulk of this region is made up by the seminal receptacles two of which are shown as swollen bags full of fresh sperm. There are in all four such bags two opening between the 9th and 10th and two between the 10th and 11th ; as indicated in this figure the openings of those bags are tubules that run out through the body wall on the dorsal side, not on the median line but some distance right and left.

Immediately after the region of the sperm receptacles follows the long enlargment that reaches from the 12th to 25th rings inclusive. Here the digestive tract enlarges as the soft-walled crop in the fifteenth and sixteenth rings and then narrows as the gizzard with very thick walls. Then from about the eighteenth ring the intestine runs back as a much distended tube full of liquid. The great accumulation of liquid in this swollen part of the body between the two constricted areas is a marked feature ; the same congested state pertains to the dorsal blood vessel which is seen as a very thick tube dorsal to the intestine though in the constricted sperm-receptacle region it is reduced to a scarcely observable and collapsed state.

What gives this long intermediate region its excessive plumpness and distended appearance at the anterior end, where it seems to overhang the first constriction as seen in fig. 1, is the presence of the huge sperm vesicles, or as they are sometimes called testes, which are quite full of sperm is various stages of development. They are roughly indicated in figure 2 as large dorsal bags in the 12th to 16th rings. The body wall in this region is thin from distension and the diameter of the section is great from the presence of these seminal receptacles, the gorged intestine and blood vessel and the accumulated liquid of the body cavity.

The following region, from the 26th to 33rd rings is the girdle. It has a much thickened glandular wall and is contracted so that the section is small, the intestine, body cavity and blood-vessel all compressed. Just posterior to this the section enlarges and the organs take on a more normal state of expansion.

Looking now at the lower worm we find the anterior part essentially as in the first case but the next region is even more powerfully constricted so that these 9th and 10th rings make but a very small showing in the entire section.

One of the sperm receptacles is crowded back out of this region into the greatly enlarged part that follows. The constriction between the two regions has here taken place in the middle of the eleventh ring and the pressure has forced the posterior seminal receptacle of the small contracted region into the large mass that holds the seminal vesicles.

In the elongated region from the twelfth to the twenty-sixth rings the distension of the intestine and the great protuberance caused by the large crowded lobes of the seminal vesicles are even more pronounced than in the other worm.

The girdle is much contracted and constricted towards the ends in such a way that its thickened glandular wall extends both forward and backward beyond the constrictions into the neighboring regions.

From such sections we learn that the girdle and the region opposite it and containing the seminal receptacles are much contracted while the long intermediate region between the girdle is correspondingly distended. The ends of the girdle contractions are markedly constricted as deep annular grooves in which coagulated mucous serves as a cord to bind the two worms firmly together. The distended region is the one that contains the seminal vesicles full of sperm and the openings of their ducts on the fifth ring.

In a series of transverse sections of the anterior portions of two conjugating brandlings the condition of affairs at the contracted girdle region is especially striking. As shown in figure 5 one worm more than half envelopes the other. The upper part of the figure is the girdle region with its thick glandular and thinner muscular parts of the body-wall on the dorsal and lateral sides but with a much attenuated body-wall on the ventral side, which is pushed in so that the lateral parts hang down and form a deep trough for the reception of the other worm. The other worm, below in the figure, is so much contracted that the muscular part of its body wall is very thick and it is moreover thrown into folds that farther increase its extreme diminution in diameter. Its body cavity is very small and the digestive tract in it reduced to a minute tube as compared with the intestine in the other half of the section, in the girdle region of the other worm. In this shrivelled part of the worm enveloped by the girdle we see the ducts or outlets of two of the seminal receptacles, full of ripe sperm that stains deeply and is indicated in black.

This section passes nearly between the ninth and tenth or tenth and eleventh rings of the worm enclosed below by the girdle of the worm above which is cut across about the twenty-eighth to thirtieth ring.

The figure also indicates a cuticle like membrane passing from the girdle completely over the dorsal side of the other worm ; this is hardened mucous that lies close to the worms and binds them together. At the same time there is a small space left between the epidermis and this mucous cuticle and in this we find ripe sperm, especially, as indicated in the figure, in the angles where the surfaces of the two worms separate.

As the sperm stains very darkly it may be easily recognized in sections. It is found in the sperm ducts of both worms as well as in the sperm receptacles, where some of it is not even now ripe. It is also seen issuing out of the openings of the sperm ducts onto the outside of the body in both animals. There it may be traced for some distance as it is held beneath the pseudo-cuticle of mucous that envelopes the worms. Especially abundant along lateral lines it rises up onto the dorsal side of the worm enclosed by the girdle and may there be seen collected about the openings of the seminal receptacles and traced into the short ducts of these organs to the mass that more or less fills up these four bags in all the conjugating brandlings as yet studied.

The anatomical evidence thus shows that in the conjugation of brandlings the girdles form grasping organs that envelope the part of the other worm containing the seminal receptacles and that a secretion, probably from the girdles, binds the two worms firmly together at these two regions. It also demonstrates that both worms pour out sperm onto the outside of the body and that this passes some distance backwards and not forwards along the sides of the worms and is finally taken into the seminal receptacles. We cannot, however, decide from these sections whether none of the sperm of one animal enters its own receptacles, but there is nothing to militate against the facts observed on the live Lumbricus, by Hering, that is the passing of two currents of sperm, each backward from its orifice to the girdle and so into the other animal and the sections indicate that no sperm passes forward to the animals own receptacles.

In the main the process of conjugation in the brandling as deduced from the anatomical relations of preserved pairs harmonizes exactly with the observations made upon the live Lumbricus and as we have seen by sectioning conjugating Lumbricus that the anatomical relations are almost the same as in the brandling we have little doubt that direct observation upon the brandling when they are made, will be largely a confirmation of Hering's account.

Yet the action of the girdle may be somewhat different since the dorsal opening of the seminal receptacles in the brandling as compared with the ventral opening in Lumbricus makes it difficult to understand how such movements of the girdle as described above by Hering can collect the sperm about the openings of the receptacles though they might bring it to the lateral positions shown in fig. 5. In the brandling even more than in the large Lumbricus we may suppose with Hering that same sucking action of the receptacles may be concerned in taking in the sperm.

We are probably not far wrong in concluding that conjugation is essentially the same in *Allolobophora fœtida* and *Lumbricus terrestris.*

In addition to filling the sperm receptacles of the other worm conjugation commonly leaves a trace in the form of the so-called spermatophores, or penis of Hering and older writers, which may here receive attention less from their intrinsic value than from their bearing, though it be slight, upon the important suggestion advanced by Professor Whitman namely that spermatophores might have been the original means of transferring sperm and only later superceded, in most animals, by localized organs for transmission. Though in the earthworms the foreign sperm is discharged from the receptacles when the eggs are laid and fertilizes them outside the body it might be supposed that these spermatophores in question were remnants of a formerly useful apparatus for putting sperm from one animal into the other, such as is found in some leeches. In the brandling, however, the indications seem rather to favor the idea that the spermatophore here is in a sense accidental and of no historical value so that it cannot be relied upon in extending the condition found amongst leeches to other groups, even if related.

When conjugating brandlings are separated we often find upon one or the other or both such spermatophores as are indicated in fig. 3. They are conspicuous white specks that soon turn yellow-brown though preserving a milk-white central elevation.

When pulled off from the epidermis, to which it adheres quite firmly at first, each is a homogeneous membrane or hardened secretion with a central cavity full of ripe sperm that moves when crushed out.

In a section of such a spermatophore attached between two rings we see, in figure 4, that it is very closely attached to the epidermis and that it ends abruptly, in fig. 3 it is seen to have a ragged edge and may also present outlying bits separately attached to the skin. The contained sperm lies in layered masses as if ejected into a stiffening jelly; moreover this mass is not entirely closed in as the section, fig. 4, would indicate but lies in a pit or pouch that opens at the top, in other sections, so that the sperm may be squeezed out in a fresh specimen. The spermatophore is thus a mass of sperm lying in an irregular cup of some tough secretion that is spread out on the skin and stuck to it.

Of 220 live brandlings taken at the conjugating season of the year 84 had spermatophores attached at about the 22nd ring of the body. Generally there are two sometimes but one, generally they are attached so as to cover the groove between two rings as in fig. 4 but often they are on the face of a ring as in fig. 3.

Of fifteen pairs taken in conjugation May 8th, 1892, five had spermatophores as follows: two symmetrically placed, between rings 22 and 23; one on the right side of the 23rd; two symmetrically placed on the 23rd; one on the left between the 23rd and 24th; two symmetrically placed on the 24th.

The region in which these bodies are found, the 22nd to 24th rings is opposite to the openings of the male organs of the other animal during conjugation, as already emphasized and indicated in figs. 1 and 2, and as the distance between the bodies, when there are two, is equal to that between the two male openings we are led to infer that these spermatophores are formed where the male openings are pressed against the other animal.

In serial transverse sections we find where the sperm is issuing from the male openings a condition of things such as is indicated in fig. 6. In the angle between the sides of the two worms just exterior to the closely applied ventral surfaces there is a considerable accumulation of sperm which is continuous with that issuing from the male opening. This extends backwards along the side of the worm that is ejecting it and is covered over by a dense, mucous, cuticle-like membrane as indicated in the figure. The glands near the male opening are evidently active and pouring out a dense secretion which fills up most of the space between the two worms and partly envelopes the large sperm mass. We have here what seems to be, with little doubt, a spermatophore in process of formation; the secretion of the glands about the male opening forms a dense mass adhering to the other worm and receiving in its substance a considerable collection of sperm as it issues forth. When the worms separate the secretion should adhere to the worm opposite to the male opening and leave in it a little mass of sperm; thus might arise spermatophores as are shown in fig. 3.

If the spermatophores are formed in this way as entangling of some sperm in a local secretion about the male opening and are stuck to the other worm they might still be of use in fertilizing the eggs of that worm when they pass into the egg capsule for the egg capsule would glide forward from the girdle over the region where the spermatophores are stuck and perhaps carry them off. But it is very doubtful if the spermatophores remain attached till the eggs are laid. Of twenty-two worms bearing spermatophores not one had them after forty-eight hours when kept in confinement, nor were any eggs laid in that time.

Though we regard the spermatophore as an accidental or at least useless structure as far as it has to do with any preservation of sperm we would not deny that the secretion about the male opening has a use whether sperm sticks in it or not.

Possibly this dense mass may serve to check the spreading of sperm in a forward direction and make more certain its passage backward towards the region where it can reach the receptacles of the other worm.

The balance of evidence seem to be that the spermatophores of the brandling, and by inference those of other earthworms too, are of no use after the process of conjugation is finished, that they do not serve to convey sperm and hence are not spermatophores at all in any proper sense of the word.—E. A. ANDREWS.

PSYCHOLOGY.[1]

Criminology.—In a series of articles on *Les Régles de la Méthode Sociologique,* recently contributed to the *Revue Philosophique* (May, June, July and Aug., 1894), Prof. Emile Durkheim, of Bordeaux, has taken occasion to advance a somewhat novel theory of crime and its relation to the normal social organism. This he restates and reaffirms in the May number, 1895, in reply to a rather intemperate attack made by M. G. Tarde in February. The whole controversy is of interest as showing how easily familiar facts assume a new and even paradoxical guise when put in ambiguous language.

Prof. Durkheim finds his point of departure in the impossibility of getting from the subjective or the teleological points of view any satisfactory definition of the concepts *normal* and *pathological.* The morbid is not necessarily painful *e. g.*, hysterical anæsthesia and, *vice-versa,* the painful is sometimes normal, *e. g.*, menstruation, parturition. The normal cannot be defined as that which is adapted to its environment, for it is not proved that every state of the organism must be adapted to some external state, and, in any case, we lack a criterion to judge between greater and less degrees of adaptation. Nor is the normal that which is fitted to survive, since, *e. g.*, infancy and old age are normal, and, on the other hand, many morbid states do not appreciably shorten life. There remains, then, only one suitable meaning which we can give these words. The normal is the general, the usual, the average. The abnormal, morbid or pathological is the exceptional and unusual. It follows then that the conception of a healthy organism is practically identical with that of the organism as such. Health will also be

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

desirable, for the normal or average traits which constitute it are grouped together chiefly by reason of their common utility to the species.

The importance of the above analysis, Prof. Durkheim continues, will become evident if we apply it to a single problem. All criminologists are agreed that crime is a pathological phenomenon. Yet, in the light of the foregoing, the error of this view is at once apparent. Crime is found in all societies of all types, and is indissolubly connected with the conditions of social life; it must therefore be regarded as a normal phenomenon. By this admission we do not merely mean that it is inevittable, although regrettable; we mean "that it is a factor of the public health, an integral part of every healthy society." Good reasons can be given for this conclusion. In the first place, crime can never be abolished. It consists in the offence of certain collective sentiments If those sentiments could be made strong enough to suppress the present forms of crime, they would, by reason of their greater sensitiveness, take fresh offence at acts now regarded as venial, and crime would be as far from extinction as ever. In the second place, since it depends upon conditions which are essential to life, it must itself be regarded as advantageous. In the third place, this occasional clash of the individual with the collective sentiment of the community is an essential condition of progress. The abolition of crime would be the abolition of progress. " Thus we see the fundamental facts of criminology in a quite new aspect. Contrary to current notions, the criminal no longer appears a radically unsocial being, a parasitic element as it were, a foreign and unassimilable body introduced into the midst of society; he is a legitimate instrument of social life. Crime should no longer be conceived as an evil that cannot be contained within too narrow bounds; but, so far from congratulating ourselves when it chances to fall too noticeably below its usual level, we should feel confident that our apparant progress is accompanied by, and is even organically continuous with, some social disturbance." . . . . " Since crime is not morbid, its cure cannot be the end of punishment, and that end must be sought elsewhere." To these startling deductions Prof. Durkheim adds some even more startling reflections upon the practical advantages of this truly and only scientific method of investigation. No longer need human effort be wasted in the pursuit of fantastic and indefinable ideals. The desired and desirable end, that is, social health, is something definite and known; we need only labor to maintain the normal state of affairs, to reëstablish it if it is disturbed, to reconstruct its conditions if they tend to change.

To this argument M. Tarde replies by reaffirming the prevalent view that crime is hurtful to society, and therefore a menace to progress, contests Prof. Durkheim's attempt to exclude from the definition of the normal the teleological element and concludes, most unhappily, as I think, with a protest against the admission of "science," reason's offspring, as the supreme guide of life to the exclusion of "the heart, the soul, the imagination." To which Prof. Durkheim calmly replies by admitting all his opponent can say as to the evil effect of crime; his sole point is that crime is an inevitable outcome of the laws of life, must therefore be regarded as normal, and is both indirectly and directly advantageous, in spite of its disadvantages.

Although surrendering no one of his original arguments, the tone of this reply is very different from that of his first statement. The enthusiasm of the iconoclast has given way to the determination of one convinced of his point, although apparently anxious to overlook its practical consequences.

The fallacies in Prof. Durkheim's argument are evident enough, although M. Tarde fails to see them. They lie in the ambiguity of the words *normal* and *crime*. "Normal" properly means "conformable to type," or "conformable to the standard." The type is primarily determined by the average of instances, and has no direct reference to the end subserved. We may thus regard a given scrap of stone, a case of typhoid fever as normal, *i. e.*, as types of their kind, without any covert teleological reference. But, when, in any given class, conduciveness to a given end is a relatively constant feature, it necessarily becomes embedded in the type-concept and the latter becomes teleological. It would thus be impossible to define a normal knife without explicitly or implicitly including fitness for cutting as one of its elements. When the end subserved is generally advantageous, a tendency manifests itself to enforce upon individuals conformity to the type and the latter thus assumes to the consciousness of the community the form of a standard to which one *ought* to conform. Again, since in the realm of nature constant features are usually due to the operation of fixed laws, the normal in the first sense is frequently necessary. But the normal is not always necessary, as it is not necessary that a human adult be above three feet in height, although the normal adult is. The word "abnormal" is not the simple negative of "normal," but is properly the negative of its second sense only. "Morbid" and "pathological" are used in yet narrower sense. When we endeavor to discover the concept "normal" in the phenomena of life, we meet with a new difficulty. The phenomena of life are always manifested by individuals, but their function is two-fold. At first glance it appears to be the preservation of the individual, but a closer examination shows that they can subserve that end only in so far as it conduces to the preservation of the race. Thus phenomena may be found which conduce to the preservation of the race, or which are absolutely in harmony with it, while endangering that of the individual. The words "morbid" and "pathological" primarily denote that which tends to the destruction of the individual; secondarily, they are used of that which tends to the destruction of the race. They are not antithetical to "normal" in its first sense of "typical," but in its second sense only. Their proper antithesis is "healthful."

A similar ambiguity lurks in the word *crime*. Prof. Durkheim would define it as an act which is repressed by the sense of the community. This is not its common meaning. As ordinarily used, it denotes an act which is not *condemned*, but *condemnable*; the latter word involves reference to a standard, and that standard may be defined in various ways. The standard which is more or less explicitly recognized by most of us who are accustomed to the biological way of thinking, is "conduciveness to preservation," and this is implicitly acknowledged by Prof. Durkheim himself.

If we follow his reasonings with these distinctions in mind, the paradoxical character of the conclusions vanishes. Let us quote his words and bring to view in italics the ambiguity of the thought:

"To class crime among the phenomena of normal sociology, *as we are justified in doing because it is found in every society* (*1st sense of "normal"*), is equivalent, *since that which is normal is also conducive to preservation* (*2d sense of "normal"*), to affirming that it is a factor of public health, an integral part of every sound society." P. 591.

Evidently this depends upon a confusion between the first and second uses of "normal."

The second argument would prove that crime is necessary and therefore useful. The paradox depends upon the double sense of "crime." If we remember that Prof. Durkheim means no more than individnal transgression of the majority's will, the paradox vanishes. We may also admit that such transgression is occasionally useful. The question as to its necessity is more difficult. Prof. Durkheim conceives of progress as the resultant of two opposing factors, the tendency to innovation on the part of individuals, and the tendency of society to suppress innovations, hence those innovations only survive which are found to be advantageous. He tacitly assumes that the innovations of individuals must be as much disadvantageous as advantageous, and infers that any increase in the intensity of the repressive factor must tend to the suppression of all forms of innovations alike, and hence must extinguish progress. For this conclusion I can see no warrant. The tendency of individuals to disadvantageous variation is not, in fact, proportioned to the tendency to advantageous, and as the latter gains ground upon the former, the necessity for stringent suppression on the part of the community diminishes. In ethical terms, with the moralization of the individual, laws and penalties become superfluous. With the increase in average intelligence also goes an increase in the intelligence with which the repressive instinct is exercised and a greater freedom in choice is allowed the individual than was found in earlier stages of development.

Thus Prof. Durkheim's startling paradox dissolves upon examination. Crime, in the narrower sense of the word, *i. e.*, conduct disadvantageous to the community, is not shown to be essential to the existence of variations in conduct which may prove advantageous to the community, since we have reason to believe that continuous decrease in the former is entirely compatible with continuous increase of the latter.

The Habits of Nestor.—Mr. Taylor White gives, in the last number of the *Zoologist*, an interesting account of the Kea or *Nestor notabilis*, the parroquet of New Zealand, which is so often cited as an example of a gramnivorous bird becoming, on occasion, carnivorous, and which is reputed to attack sheep and devour the delicate fat which envelops the kidneys. Mr. White lives in New Zealand, and can observe the bird close at hand.

According to him, the Kea subsists principally on lichens and not on fruits or grain, for it is found at some distance from the forest, among rocks and on bare ground. Like other animals unaccustomed to man, the Kea exhibits no fear at first sight. It allows itself to be approached, and Mr. White speaks of some of the birds playing about him, even becoming familiar enough to peck the buttons on his boots. Others would perch on his hand and allow themselves to be caressed. In captivity, they eat both bread and meat. Their powerful beaks enable them to break the bars of strong wooden cages.

As to the carnivorous habits of these birds, Mr. White speaks as follows: About the year 1861, sheep were introduced, and after some years it was noticed that a certain number of them died, and on the backs of these, behind the shoulder, in the neighborhood of the kidneys, was found a peculiar wound. About this time it was discovered that the Kea was the enemy of the sheep. In selecting a victim the

Kea prefers an animal with long fleece to which it can cling. It would seem, moreover, that the bird is after the fat rather than the flesh. A Kea has never been seen on a dead body, and the probabilities are that it also feeds on the blood. The various stories told of the Kea are then true in part—it does attack sheep. But it is naturally carnivorous, for, in addition to fruits and grains, it feeds on insects. It has, then, not changed its régime in adding mutton to its ménu; it has simply extended its depredations. Revue Scientif., Aug., 1895, p. 248.)

ANTHROPOLOGY.[1]

A preliminary examination of aboriginal remains near Pine Island, Marco, West Florida.—The significance of Colonel Durnford's able and interesting communication to the AMERICAN NATURALIST for November, 1895, descriptive of his discoveries in South West Florida last Spring, may gain force, it is thought by the courteous Editor of this Department, if I add a few comments in regard to my own later observations in the same field, and in regard to the relation this find seems to bear to Eastern American Archeology in general.

It was my good fortune to be under the care of Doctor William Pepper and at the Hospital of the University of Pennsylvania when Colonel Durnford called at the Museum of the University and exhibited a few of his valuable specimens to its Director, Mr. Stewart Culin. It was also my good fortune both to meet Colonel Durnford and see his specimens at the time, and to receive from him then a full account of, and later, a series of detailed notes upon, his exploration.

From these communications and from examination of the articles he brought, I inferred that probably Colonel Durnford had investigated not an isolated place of the sort he so well describes, but a typical deposit such as might, by further search, be discovered in connection with other shell settlements in the same region. I therefore did not hesitate to pronounce this find of his one of the most important yet made on our southern coasts, and with a view to ascertaining more relative to its nature and to learning whether my inference in regard to its typical character was tenable or not, I gladly seized the opportunity afforded by the suggestion of Doctor Pepper, (whose views coincided with mine) that I extend a health-trip in the South, to the scenes of Colonel Durn-

[1] The department is edited by Henry C. Mercer, University of Penna, Phila.

ford's excavation, and, in the interest of the Archæological Association of the University of Pennsylvania, make examinations and, so far as might be collections there.

On reaching Florida, I found that it was impracticable to proceed beyond Punta Gorda, directly to the place Colonel Durnford and Mr. Wilkins had excavated. Procuring at this place a little sloop and two men, I therefore followed a somewhat round about course, exploring the greater number of keys or little islands lying along the way thence southward to the point in question, namely Collier's, near Marco. At the first key examined, some fifteen miles south of Punta Gorda, I found to my astonishment, that all its heights had resulted from artificial accumulations of shells, not irregularly piled up, like mere refuse heaps, but more or less structurally and regularly reared on a shallow reef in relatively shoal waters, to serve apparently as the core or central foundation of a village of enormous extent. These heights were fringed interruptedly by lower platforms and long, out-reaching winrows, so to say, of additional shell accumulations, some several feet high, others scarcely elevated above the level of high tide. Penetrating portions alike of these low shell embankments and of the central tumuli or cores, were openings long, narrow, and measurably straight through which the waters of the bay still to some extent ebbed and flowed. When seen from the highest points (for every portion of the key was covered with a tangled jungle of trees, vines and tropical plants, agaves and cacti, and when looked at from below was hidden by the dark, dense margin of mangoes) these openings seemed all to tend toward some central point or points; and on descending and following one of them I was led into a veritable water-plaza around which clustered the gigantic mounds of shell—each set of them between its channel-like openings. I then realized that this central space—which had an irregular extent of more than an acre—was the filled up basin of a shallow lake formed rather by the rearing of structures around it than by other artificial means, and now filled to high tide level by washings from these heights and by growths of aquatic plants. I further realized that the openings leading into this place were actual canals, preserved or kept clear between the shell mounds or platforms, etc., for the passage in and out of the canoes of the dwellers on and around the heights. An examination of the sides of the highest of the central shell mounds or cores surrounding this water-plaza or lake court, revealed ere long a fairly well preserved road-way leading up to near the summit of the mound, and with eyes thus opened, I soon found other, though less distinct roadways or trails on the shell slopes, leading up to lesser heights around. Following these trails down to what was once the water's edge of the lake (which was even now so marshy that I could not excavate it with so limited a force) I found more than a hundred of the typical pierced busycon shells or conchas, such as had once (I later determined) served as the armatures or heads of hammers, clubs, picks, hoes and chisels or celts, etc., as was even then manifest to me in the various forms (pecked or ground) of their more tapering portions or whorl ends.[1] Thus I was at once convinced that this was another such place,—shell heaps, canals, central lagoon and all, as Colonel Durnford had described, yet on a scale so vast that I could scarcely believe it to have been artificial, wholly the work of human hands. What I have here described was more or less typical of no fewer than eleven others of these shell settlements later examined on various keys or on out-lying reefs of Pine Island, and the mainland below Punta Rassa. In the lagoon of one of the lower keys (off Pine Island), I was able to excavate sufficiently to determine that it too, contained the remains of objects of arts as was evidenced by a wattling plummet, a hammer stone (rare indeed in those parts where shell and bone seem to have replaced to a great extent the stone so common in other ancient camp sites) and a busycon shell pick *still mounted on its original handle of mango wood!* With this find I was convinced of the typical nature of the original Collier muck-bed as described in Colonel Durnford's notes, even ere I saw it, and the discovery here, and later in the edge of one of the great canals of the contiguous island, of the remains of pile work, suggested that these great shell settlements had been surrounded inside and out by post-supported platforms, from which alike implements, etc., now found in the mud as described by Colonel Durnford, and the shell rows or heaps alongside, which I have designated winrows, had been dropped. This, eked out by many later observations, solved the problem of the origin, as well as of the structural character of these great shell settlements. On reaching Collier's, I was most courteously received by Mr. and Mrs. Collier. Excavations alongside the diggings of Mr. Wilkins and Colonel Durnford, and still further in toward the center and one side of the muck bed, although made under water mostly (for the rainy season had set in) revealed within the few hours I could devote to the work other relics of the kind Colonel Durnford has described—net-pins, seine-

[1] I find, and it gives me pleasure to state here that in some of his earliest admirable communications to this Magazine relative to the Mounds of St. John's River, Florida, Mr. Clarence Moore arrives at almost identical conclusions regarding the uses of these pierced shells, and that my later finds in the mucks beds of old lagoons on Demorest's key and at Collier's fully confirm these conclusions.

stays, small fragments of netting, and the like, as well as rope made of palmetto and agave fibre, burnt thatch, a long and beautifully finished spar or post, fragments of a burnt mud hearth and of pottery, some highly finished, wattling plummets and sinkers, two beautifully shaped fish clubs, five mounted busycon shells, one of which was edged to serve as a celt, several of the shell funnels (which proved to have been mounted on handles as spoons) many necklace pendants, gourds, seeds, etc., etc. Some of the art remains found here and on the surrounding low, but very extensive shell mounds, as well as at other settlements, strongly indicated, as did skulls later dug from a shell burial place to the northward on Sanybal Island, a far southern origin of the builders of these works, at least of the oldest of them. Moreover, the study of these shell settlements and of their art remains, has been found by me to have a most important and explicit bearing on the archeology of at least the Mississippi and contiguous regions, in other words on the Mound Builder question ; points which it is believed the expedition I am hoping soon to conduct to Florida under the joint auspices of the University Association and the Bureau of American Ethnology will clear up and to some extent demonstrate or establish. But even if these indications of a hasty reconnissance be not all borne out by more careful examination of the field, still, this find of Colonel Durnford's seems to have been typical, to relate at least to a hitherto unthought of phase of aboriginal life, to relate also to a period indefinitely antedating the time of Columbian Discovery, and hence giving us, as have the cliff dwellings—so opposite in character—well preserved remains of the perishable work of prehistoric stone-age (or, in this case, shell-age) men, and is thus the most important of Archeologic finds recently brought to notice. The Archeological Association of the University of Pennsylvania is therefore to be congratulated on the uuique opportunity far research in a comparatively new field which Colonel Durnford's scientific disinterestedness and generosity has made possible.—Frank Hamilton Cushing.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The National Academy of Sciences.—A scientific session of the Academy was held at Philadelphia, in the Laboratory of Hygiene of the University of Pennsylvania, beginning Tuesday, October 29, 1895, at 11 o'clock A. M. and continuing through the following day. The papers presented were as follows :

(Oct. 29th) On the Paleozoic Reptilian Order of the Cotylosauria, E. D. Cope; On a New Variable of Peculiar Character, S. C. Chandler; On a Bone Cave at Port Kennedy, Pa., E. D. Cope; On Borings through the Coral Reef in Florida, A. Agassiz; On the Alkali Uranates, Wolcott Gibbs; (Oct. 30th) The Olindiadae, W. K. Brooks; The New Campanularian Medusae (read by title), W. K. Brooks; The Filar Anemometer, Carl Barus; The Counter-twisted Curl Aneroid, Carl Barus; On the Broadening of Spectral Lines by Temperature and Pressure; A. A. Michelson; On the Asteroids (read by title), A. Hall; The Early Segregation of Freshwater Types, Th. Gill.

Boston Society of Natural History.—Nov. 6, 1895.—The following paper was read: Prof. George Lincoln Goodale, "Some Peculiarities of Australasian Vegetation." Illustrated by stereopticon views of Australia and New Zealand.

November 20.—The following paper was read: Dr. J. Walter Fewkes, "Some Newly Discovered Cliff Ruins in Arizona. Stereopticon views were shown.—SAMUEL HENSHAW, *Secretary.*

American Philosophical Society.—November 15, 1895.—Prof. Cope read a paper "On the Ancestral Type of Amniote Vertebrata." Dr. Brinton presented a new vocabulary from South America, with remarks. Mr. H. C. Mercer made observations on Indian work in the Wyandotte Cave, Indiana.

The Biological Society of Washington.—October 19.—The following communications were made: S. D. Judd, "The Food of the Catbird, Thrushes and Wrens;" L. O. Howard, "An Enemy of the Hellgramite Fly;" W. H. Dall, "Exhibition of the Remains of the Mammoth;" C. Wardell Stiles, "The Rudolph Leuckart Memorial;" "The Third International Zoological Congress;" C. Hart Merriam, "North American Shrews."

November 5.—The following communications were made: F. V. Coville, "The Botanical Explorations of Thomas Coulter in Mexico and California;" William Palmer, "Albinistic Birds' Feet;" F. A. Lucas, "The Extinct Gigantic Birds of Patagonia."

November 16.—The following communications were made: Barton W. Evermann, "The Fishes of the Missouri River Basin;" Frank Baker, "Nomenclature of Nerve Cells;" Edw. L. Greene, "Some Fundamentals of Nomenclature."—FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

Bibliographical Reform.—At the Baltimore meeting of the American Society of Naturalists (Dec., 1894), a committee was appointed to consider Dr. H. H. Field's plans for bibliographical reform, the committee to report in print. That committee would report as follows:

Dr. H. H. Field, in view of the well-known imperfections and shortcomings of all existing records of zoological literature, has formulated plans which will give the zoological world an approximately complete index of all literature as promptly as possible. This record will be issued in the form of bulletins, each number of which will be distributed as soon as sufficient material has been acumulated to make a "signature." The same bulletin will also be issued printed only on one side of the page to allow for cutting up for special bibliographies. Lastly, the separate titles will be issued upon cards of the standard "index" size. Each title will be followed by a few words giving the subject and scope of the article, when this is not sufficiently indicated by the title, while the cards will have, in addition, catch numbers, so that any library assistant can readily incorporate them in the card catalogue.

The plan contemplates a union of existing bibliographies with this one. In the case of the Naples Jahresbericht, this will consist in co-operation, this series continuing as the yearly morphological analysis of the bibliography. It is to be hoped that the Zoological Record will co-operate in a similar way, devoting itself to the systematic side, and, by aid of the new facilities of co-operation, increase its present usefulness to students. Arrangements have now progressed so far that it seems probable that the records of literature in the Zoologischer and Anatomischer Anzeigers will be merged in the new scheme, and, it is hoped, that the one in the Archiv für Naturgeschichte will take the same course. If sufficient encouragement be given, it is proposed to include physiology in the scope of the new plan. The net gain will be fewer bibliographies, wider scope, nearer approximation to completeness, and more prompt publication.

The central office of the work will be established at Zürich, Switzerland, and it may be said that the cantonal government has already appropriated 2000 francs annually to its support, and will supply suitable quarters for its work. France has promised a similar sum, and aid is expected from Germany, from the International Congress of Zoologists, and from the British Association for the Advancement of Science. Committees have been appointed in France, Germany and Russia to co-operate in making the record as complete as possible. Lastly, publishers stand ready to undertake the publications of the bulletins, cards, etc., without expense to the central office, since the sales are estimated to fully cover all cost of manufacture. The only matter unprovided for is that of preparing the record for the printer, and this is already so far provided for that if America can give $500, the beginning of the work with the year 1896 can be assured.

Your committee, having examined the matter in detail, would therefore report that they regard the plan as one worthy the fullest support of the American scientific world. They recommend it as worthy of financial support, and would urge all publishers and publishing institutions to send all periodicals and other works, or, in the case of books, at least the correct title and a summary of contents prepared by the author, promptly to the central bureau. They would finally recommend the appointment of a permanent committee of ten, to co-operate with similar committees in other countries in forwarding the movement.

Signed: Samuel H. Scudder,
H. P. Bowditch,
Henry F. Osborn,
E. A. Andrews,
J. S. Kingsley,
Committee.

In this connection it is well to state that the funds desired from America have been obtained: $250 from the Elizabeth Thompson fund, $250 from the American Association for the Advancement of Science, and $50 from the American Society of Microscopists. Arrangements have been concluded for the publication, by Englemann, of Leipzig, of a "Bibliographica Zoologica," as a continuation of the "Litteratur" of the Zoologischer Anzeiger, and by Fischer of Jena, of a "Bibliographica Anatomica" to contain the morphological titles. The price for the first will be 15 marks a year, that of the Anatomica has not yet been fixed. Cards containing the titles will be issued at from $2.00 to $3.00, according to the number taken. Arrangements are now in progress for the inclusion of physiology in the plan, and steps have already been taken looking to the later incorporation of botanical literature.

Botanical readers will be pleased to hear that another part of Gray's Synoptical Flora of North America, beginning with Ranunculaceæ, is now in press. Every encouragement should be given for the completion of this magnificent work.

Dr. J. P. Lotsy, formerly at Johns Hopkins University, has accepted a position with Dr. Treub, at Buitensorg, Java. It is said that the Macmillans will shortly issue an important work by him on the Morphology of Reproduction in Cryptogams.

Dr. James Ellis Humphrey will be instructor in Botany at Johns Hopkins the coming year. It is much to be regretted that this great university cannot see its way clear to the founding of a chair of Botany.

W. T. Swingle, of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, has secured leave of absence, and will spend a year or two at German Universities. He goes first to Strasburger at Bonn, and will subsequently study with Göbel at Munich.

President and Mrs. Fairchild, of the State Agriculture College, Manhattan, Kansas, spent the summer travelling in Great Britain and on the Continent. Mrs. Kedzie accompanied them.

David G. Fairchild, formerly of the Division of Vegetable Physiology and Pathology, in the U. S. Department of Agriculture, has spent the last two years studying botany at various European centers—Naples, Breslau, Berlin, Münster. He is now studying fungi with Brefeld, and contemplates spending the winter at the great tropical botanic garden at Buitensorg in Java.

During the summer there were several changes in the personelle of the Division of Animal Pathology, in the Bureau of Animal Industry, U. S. Department of Agriculture, Dr. Theobald Smith, for a long time Chief of Division and widely known on account of his bacteriological researches, has become Bacteriologist to the Massachusetts State Board of Health and Lecturer at Harvard ; Dr. V. A. Moore takes his place, and Dr. P. A. Fish, of Cornell Univ., becomes Dr. Moore's assistant.

Dr. C. W. Stiles, of the Bureau of Animal Industry, U. S. Department of Agriculture, has returned from a two months trip to Europe, made partly for the sake of attending the International Zoological Congress at Leiden.

Dr. Volney M. Spalding has resumed his duties as Professor of Botany in the University of Michigan, having recently returned from a two years' sojourn at German Universities, most of which time was spent with Pfeffer in Leipsic, at the British Museum, and with Brefeld in Münster.

Dr. Lucien M. Underwood has been called to the chair of Botany in the Agricultural and Mechanical College at Auburn, Alabama.

Dr. Engler, of Berlin, in conjunction with other distinguished botanists, has, in preparation, a new edition of Grisebach's famous treatise, *Die Vegetation der Erde*, which has been out of print some time. Mr. Th. Holm, of the Division of Vegetable Physiology and Pathology in the U. S. Department of Agriculture, has been asked to contribute the portion on North American Gramineæ and Cyperaceæ.

Mr. F. S. Earle, of Ocean Springs, Miss., has been appointed Assistant in the Division of Vegetable Physiology and Pathology in the U. S. Department of Agriculture, Vice Joseph F. James, resigned. Mr. Earle will have charge of the herbarium.

Mr. O. F. Cook is contemplating a third trip to the west coast of Africa. Mrs. Cook will accompany him. The next volume of the Transactions of the New York Academy of Science will contain an important systematic paper on Myriapods, from his pen.

The Entomological Society of Washington will devote the next number of its Proceedings to a memorial of Prof. C. V. Riley, who was the founder of the Society and always an active member.

The Australian Museum, at Sydney, still suffers from small appropriations by Parliament, and during the year 1894 it was working with a reduced staff and with practically no money for increase or publication. Dr. Ramsay, owing to ill-heatlh, has resigned his position as Curator after 20 years' service, but still retains a connection with the museum. Mr. Robert Etheridge, Jr., has been appointed as his successor. The total income for the year 1895 was about £6,000, and 120,000 persons visited the museum during the year, 34,000 of these coming on Sundays. Among the most interesting additions to the museum were a number of relics of Capt. Cook, the list of which would seem to indicate that this antipodial museum has about as large a collection of specimens collected by Capt. Cook and of memorials of him as has the museum at Oxford. The museum has also received a considerable collection of aboriginal pottery from Arkansas.

Dr. A. I. Vernenil, the well-known anatomist and surgeon, of Paris, died June 12.

Dr. A. Froriep has been made Ordinary Professor of Anatomy, at Tübingen.

Dr. W. C. Williamson, the botanist and paleobotanist of Owens College, Manchester, England, died June 23, aged 79.

Dr. J. Strahl, of Marburg, has been appointed Ordinary Professor of Anatomy, in Giessen.

The American Association for the Advancement of Science appropriated $250, and the American Society of Microscopists $25.00 towards Dr. Field's Bibliographical Bureau.

Dr. Karl Müller, of Berlin, goes as Professor of Technical Botany to the Technical School of Carlottenburg.

Dr. N. V. Ussing becomes Professor of Mineralogy in the University of Copenhagen, in place of Dr. von Johnstrup.

George Murray has been appointed Custodian of Botany in the British Museum, in place of Dr. Carruthers.

Dr. L. Plate is Privat-docent in Zoology in the University of Berlin.

Dr. Max Verworn has been appointed Extraordinary Professor of Physiology in Jena.

Dr. Albert Günther has retired from his position as Director of the Zoological Department of the British Museum, having reached the age-limit of the British Civil Service.

Count Angelo Manzoni, geologist and paleontologist, died in Ravenna, Italy, July 14, 1895.

Dr. W. Roux, of Innsbruck, goes to the University of Halle as Professor of Anatomy.

Sir John Tomes, well-known for his researches on the teeth, is dead at the age of 80 years.

Dr. E. Ihne has been appointed Professor of Botany in the Technical School at Darmstadt.

Rev. J. G. Morris for many years recognized as an eminent student of American Lepidoptera died at his home near Baltimore, October 10. Dr. Morris was born in 1803 and has long been considered one of the fathers of American entomology. His catalogue of the Lepidoptera published in 1860 by the Smithsonian Institution and his Synopsis of Diurnal and Crepuscular Lepidoptera are the publications by which he was best known to entomologists.

Dr. Albert E. Eoote, of Philadelphia, died recently in Atlanta, Georgia. Dr. Foote was born in Hamilton, N. Y., Feb. 6, 1846. After graduating at Cortland Academy, Homer, N. Y., he entered the class of 1867 in the University of the State of Michigan, where he took the degree of Doctor of Medicine. After some time spent as an instructor at Ann Arbor, he was appointed Assistant Professor of Chemistry and Mineralogy in the Iowa State College.

In 1875, Dr. Foote removed to Philadelphia. He was a life member of the Academy of Natural Sciences, of the New York Lyceum of Natural History, and of the American Association for the Advancement of Science. Dr. Foote's extended travels, both in this country and in Europe, made him particularly well known in scientific circles. His chief interest was in mineralogy.

He was well known as one of the few professional dealers in objects of nature in the United States, and he made a financial success of it, leaving a competency to his family. As an antiquarian repository of works on natural history, Dr. Foote's establishment is without a rival in America.

EDITOR'S TABLE.

—Some cultivators of the sciences occasionally complain that the meetings of scientific bodies are not well attended, and that they read papers to too many empty benches. Moreover, even when they have a scientific audience they allege that very few of those present understand what they have to say. And they speculate on measures to be adopted to remedy this state of affairs.

As the scientific investigator acquires years and experience, he recognizes that in the present state of human society he has no right to expect that the situation can be very different. The number of serious cultivators of science in any community is not large, and the number of men engaged in original research in any given field is still smaller. Like the landed aristocracy of the old nations, the producers in each department of science are well scattered over a country, and it is only on national occasions that they gather in any considerable force. The situation as to the audiences who assemble to listen to papers of original value in pure science is therefore not likely to change for some years. In fact, the size of audiences may be set down as inversely as the rationality, and directly as the emotionality of the matter set before them. Such is the present state of the civilized nations of the earth, and it is not peculiar to any one of them.

Most of the large cities of the United States have an "Academy of Sciences," or its equivalent, and it is largely with reference to the prosperity of those bodies that discussions such as we have referred to above is heard. Many of the members want them to be what they call popular, which, in its best sense, means that they wish for large audiences at the meetings. Now, if what we have said above is true, this object cannot be attained, unless the Academy abandons its real object, the advancement of scientific knowledge by original research. This is the primary object of Academies of Science in all countries, and if they neglect it, they lose their identity, since the facilities for the distribution of knowledge are everywhere relatively abundant. When the Academy of Science becomes a distributor of knowledge only, it abandons its important proper function, and becomes comparatively a nonentity. Let us hope that Academies of Science in America will not follow the course of the Academies of Music, which are, in Europe, educational and critical, in America, mere theaters.

The measures adopted by Academies of Science in the United States to make themselves popular and therefore "successful," are often highly amusing. The usual method is to elect some man president who is rich but unknown to science; since, in the minds of some people, money is the source of the sciences and the arts. Men of the same type are also often elected to other responsible positions in these societies for similar reasons. We have watched this mode of attacking the problem for many years, and have never known it to be successful. In the case of the Philadelphia Academy, it did, on one occasion, entail a loss of over $12,000 cash capital to the Society. In fact, the reasons why this method should not prove successful are not far to seek. The only way to make it successful would be to have a bill of sale of the office legally executed, so that the sum agreed on could be collected by process of law in case of failure to produce the "consideration" after the election. This the business world understands, whereas it does not perceive the cash value of original research. In fact, the election of an outsider to rule over them by a body of experts for a supposed financial equivalent, is a proceeding not calculated to excite the respect of a rich man or any other kind of man.

A society is, however, fortunate if it escapes without more serious injury than a financial disappointment. Men not habituated to the ways and means of research frequently apply nostrums which do more harm than good, and bring the society into deserved contempt. Thus in one city the President, who was of the type mentioned, succeeded in incorporating into the society a body of photographers, with the result of simply developing the photographic society. The men by whom the original society was known to the world were locally quite lost sight of. In another city a number of local amateur astronomical clubs were taken into the Academy. These consisted of ladies and gentlemen whose devotion to science consisted in viewing the stars in each others pleasant society. Another Academy adopted popular lectures as a device for filling empty benches. The selection of the lectures being in the hands of incompetent officers, cranky and ignorant persons, and those who had apparatus to sell, occupied the time of the Academy, to the great scandal of the really scientific men of the city.

The appointment of amateurs and unscientific persons to positions in scientific bodies, often has ludicrous results. One Academy of Science discussed an ancient bone dredged up in salt water. It was perforated with fossæ in series, and it was concluded that it was a mouth bone of a fossil fish. It turned out to be the head of and ancient tooth-brush. An exhibition of foot-tracks on ancient rocks before the same Academy, brought to his feet a dancing master, who illustrated the formation of the impressions terpsichorean fashion.

Another plan for promoting the prosperity of scientific bodies is to have dinners and social receptions. These methods are always successful in drawing together numbers, and if persons are to be elected members of such societies in proportion to their gastronomic capacities, such a system must be eminently successful. To be serious, however, and to repeat what should be self-evident to every person, this plan tends only to an increase of non-expert membership, which is really at the bottom of all the evils which have befallen scientific societies. Hence, unless some measures to protect the membership be adopted, this method of "promotion" should be always rejected.

The result, both of our observations and cogitations on this subject is, that the only method by which Academies of Science can advance themselves in the public esteem, is to continue in their work of original research. If they cannot acquire public confidence in this way, they cannot acquire it at all. There is no short cut to this so-called "success." As in all other human endeavors to wrest advantage from Nature, labor and labor only "omnia vincit." As with the agriculturist, the machinist, or the accumulator of money, devotion to work and this only, brings the rewards which we seek. The visible products of labor are what men respect, and if the scientific man wishes to inspire the respect of wealth, he must show results, rather than bestow on men of wealth what are to them empty honors.

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