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THE BLIND CAVE FISHES AND THEIR ALLIES.

BY S. A. FORBES.

AN unusual interest attaches to everything relating to the blind fishes of the caves, partly because of their peculiar deprivation and the compensation for it afforded by the development of special sensory structures more useful to them in their subterranean situation than eyes would be, and partly because the origin of their peculiarities has proved an inviting subject of speculation and discussion with reference to the doctrine of natural selection. In the careful papers of Mr. F. W. Putnam,[1] especially, we find accurate descriptions of the genera and species, and a clear statement of opposing views respecting the derivation of these little fishes.

A strict evolutionist passes, perhaps too easily, from the idea of the unbroken, rayless night in which the blind fishes live and seem to have lived for ages, to that of their atrophied eyes and highly developed epidermal organs of sense—connecting these at once as cause and effect on the strength of his general theory. In papers written, one nine and the other seven years ago, Mr. Putnam presented, partly in criticism of previously published explanations of Mr. Cope,[2] facts and considerations which seemed to him to break the force of the argument based by evolutionists upon the peculiar adaptation of the blind fishes to their surroundings, and even to compel the conclusion that the darkness of their situ-

[1] AMERICAN NATURALIST, January, 1872. Annual Report of the Peabody Academy of Science for 1871. Proceedings of the Boston Society of Natural History, Vol. XVII, 1874, pp. 222–225.

[2] Ann. Mag. Nat. Hist., Nov., 1871.

ation did not bring about the atrophy of their eyes, the development of their special organs of sense, or the bleaching of their skins.

The discussion seems not to have been carried further; and I now revive the subject because the study of a new species closely allied to the blind fishes, which has recently been discovered in Illinois, enables me to contribute a few facts which throw additional light upon it.

In the papers cited, it is argued, in brief, that the conclusions as to adaptation based upon the absence of functional eyes and the extraordinary development of tactile organs in Amblyopsis and Typhlichthys are negatived by the fact that in Chologaster, an equally subterranean genus, tactile organs are wanting, and eyes are fully developed. If genera without eyes, and another genus with them, are found living under the same conditions, the inference is obvious that the conditions cannot have caused this difference.

The possible rejoinder that Chologaster may still retain its eyes because it has had a shorter subterranean history, and has not yet become so thoroughly adapted to cave life as its predecessors, is forestalled by the argument that we have no right to assume that Chologaster is a later inhabitant of underground retreats than the blind fishes, until at least one specimen of the former has been found in the outer waters in the vicinity of the caves. The same reasoning is applied to the difference of color—Amblyopsis being colorless and Chologaster brown.

On page 232 of the NATURALIST for March, 1881, I briefly described a single specimen of Chologaster obtained by Mr. F. S. Earle from a spring in Southern Illinois; but did not undertake to decide, from a single example, whether it belonged to a distinct species or not. Seven additional specimens obtained by the same gentleman from the same place, agree so closely with the one previously found that it is evident that all belong to one species, and I have no longer any doubt that this is distinct from the two previously described.[1]

[1] *Chologaster papilliferus*, n. s. The head is broad and flat; contained three and a-half times in the body (without caudal), widest posteriorly and broadly rounded in front. Its width between the eyes is half its length. The eye is contained about six times in the length of the head, and is placed above and behind the tip of the maxillaries. The greatest depth of the body is contained five times in its length to caudal. The pectoral fins reach only half way to the anal; and the caudal is broadly

The most important and interesting peculiarity of this species indicates a more advanced stage of adaptation to a subterranean life than that of its congeners. On all the surfaces of the head appear short rows of peculiar tubercles, relatively wider than the papillæ of Amblyopsis, but also apparently shorter. They are much the largest about the anterior nostril and on the lower jaw, and are larger on the side of the head than on its upper surface. While the papillæ of Amblyopsis are set on ridges of the skin, those of this Chologaster are somewhat sunken within it, and often placed in grooves; and it is not until they are freed from the adjacent epidermis by dissection, that their full height is seen. When thus exposed they closely resemble the papillæ of Amblyopsis in form and size, and are similarly cupped at the tip. Aver-

rounded and almost truncate. The color is brown above, paler below, with three narrow longitudinal stripes, the upper and lower black, the middle one pale with narrow black edging above and below. With a glass the ground color is seen to be everywhere minutely mottled black and white. The fins are all nearly or quite concolorous, except the caudal, which is minutely marked with rows of white specks on a dusky ground. These specks indicate the articulations of the fin rays. There is usually a dusky vertical bar at base of tail. The dorsal and anal fins are thick and fleshy, their height about equal to their length, the former with six and the latter with five rays.

On all surfaces of the head, peculiar tubercles or papillæ occur in short rows, much the largest on the lower jaw and about the anterior nostril, where they are sunken in grooves of the skin. They are also larger on the side of the head than above. An irregular double row surrounds the anterior nostril, except externally, and behind this appear four short, transverse rows on each side, the last of these being a little behind and within the eye. Then follow about eight short, irregularly placed, oblique and transverse rows, accompanied posteriorly by a longitudinal row. On each side of the middle of the back part of the head is a short longitudinal row, each with a small patch not far from its tip. At the upper end of the gill-slit is a conical tubercle with an apical perforation; and traces of a series of vertical rows of tubercles appear on the anterior part of the side of the body. The side of the head bears many short vertical rows, with some longitudinal and oblique rows also. On the under side of the lower jaw, a double or triple row of large papillæ is set in a groove just within the jaw, and a small, triangular, sunken patch is found a little within the anterior end of this row. Another longer row of smaller papillæ runs parallel to the former, between it and the hyoid arch. Average specimens measure 37mm. in total length.

This species presents the internal characters of the genus, as defined by Mr. Putnam in his "Synopsis of the family Heteropygii," published in the Annual Report of the Peabody Academy of Science for the year 1871. The description of the genus should be amended, however, by the omission of the statement concerning papillary ridges and an opercular papilla.

Taken from a spring at the base of a limestone bluff, in Union county, in Southern Illinois.

age examples from the largest sub-maxillary row measured .01 in height by half that width. I found no projecting filament, however, in any of the cups, such as is described and figured by Professor Wyman in the papers of Mr. Putnam already cited. The interior structure of the papillæ also differs greatly from that of Amblyopsis, as the latter is represented by Professor Wyman. In Amblyopsis, according to that eminent anatomist, each papilla is supplied with a nerve fiber which terminates in a short, flexible filament springing from the middle of the concavity in the tip of the papilla. In the Chologaster each papilla is likewise penetrated by a nerve fiber, which is very easily traced, even without the help of reägents, because of the black pigment in the neurilemma, but this nerve passes to an epidermal "end organ" precisely similar in structure to those minute bodies found abundantly embedded in the skin of the head of young fishes, and belonging to the same general class as those sensory structures which occupy the lateral line.

This "end organ," or "nerve button," which fills the interior of the distal third or half of the papilla, is a nearly globular mass of cells, partly various modifications of the columnar, and partly spindle-shaped or spherical, each of the latter with a filamentous prolongation at one or both ends. The nerve fiber of the papilla passes, without division, to the inner end of the cell-cluster, where its fibrils appear to continue into the filamentous processes of the cells. Having no fresh material for the osmic acid treatment, I could not positively demonstrate the terminations of the fibrils. These are evidently simple examples of that class of structures to which a supposed "sixth sense" of fishes and amphibians has been assigned, and by which these animals are believed to appreciate motions of the water and wave lengths longer than those of sound.

The importance of well developed structures of this character to fishes without the use of the sense of sight, is very manifest. The close general resemblance between these organs and those described for the blind fishes, taken in connection with their similar situation, arrangement and apparent use, is probably sufficient evidence that the two kinds are homologous.[1]

[1] Is it not possible that the specimens of Amblyopsis studied by Professor Wyman were not perfectly preserved, and had lost more or less of their superficial epithelium, and with this the "nerve buttons" from the tips of their papillæ? Some color

Recurring now to the argument of Mr. Putnam, we note that the discovery of a species of Chologaster which frequents external waters of an immediately subterranean origin, supplies all needed proof that the genus either has a shorter subterranean history than Amblyopsis, or, at any rate, has remained less closely confined to subterranean situations; and that in either case the occurrence of eyes, partial absence of sensory papillæ and persistence of color, are thus accounted for consistently with the doctrine of "descent with modification."

The extraordinary development, in only a part of the genus, of a special sensory apparatus peculiarly useful to a fish unable, for any cause, to see, points the same way, and gives evidence of a *progressing* adaptation of these fishes to their unusual abode.

The intermediate relation of the sensory tubercles of Chologaster to the much smaller ones of young fishes and the permanent papillæ of Amblyopsis, points out the evident origin of the last through the permanency and higher evolution of structures commonly evanescent in the young.

is given to this surmise by the statement, in the papers cited, that his fishes were provided with only a single layer of delicate epithelium; whereas most fishes, and especially the naked and nearly naked kinds, are usually covered with an epidermis several layers deep, and by the further fact that the papillæ of Chologaster would accurately resemble those figured in Mr. Putnam's paper (except for the filament), if the former were denuded, as supposed.

After the above was sent to the printers, Mr. Putnam kindly sent me an alcoholic specimen of Amblyopsis with the epidermis intact over considerable areas of the head. An examination of the sensory structures of these regions at once showed the correctness of my surmise, that they are in Amblyopsis, as in the new Chologaster, to be definitely classed with the so-called "organs of the sixth sense," and are simply more highly developed examples of the structures found in the heads of young fishes. Each papilla bears at its tip a cluster of sensory cells in all respects similar to those above described; and I have little doubt that the figures of Prof. Wyman were made from denuded papillæ which had accidentally lost their sensory cells. The "filaments" seen by him on two or three of the papillæ were probably remnants of the cell clusters. The epidermis of the head is not composed of a single layer of delicate cells, as described by him, but of at least three layers—a deeper, columnar one, a median layer of large spherical or oval cells, with granular contents, and a superficial layer of thin, flat cells. The epidermis is, in fact, so thick that it almost or quite conceals the folds of the true skin upon which the papillæ are borne.

A fuller account of these structures will be given in another article.

A SINGULAR PARASITIC ISOPOD CRUSTACEAN AND SOME OF ITS DEVELOPMENTAL STAGES.[1]

BY CARL F. GISSLER, PH.D.

THE material for the present paper[2] was obtained from the common prawn of our shores,[3] *Palæmonetes vulgaris* Stimpson,[4] about ten per cent. of which I found infested, in June, 1881, with a Bopyrus (*Bopyrus palæmoneticola* Packard[5]), probably the same species which Professor Joseph Leidy mentioned as occurring near Atlantic city, N. J.[6] The female of our Bopyrus averages in size from 3.50 to 4.50^{mm} in length, and 3 to 4^{mm} in width. Its ventral side is invariably turned toward the carapace of the prawn and its marsupium or breeding cavity is usually filled

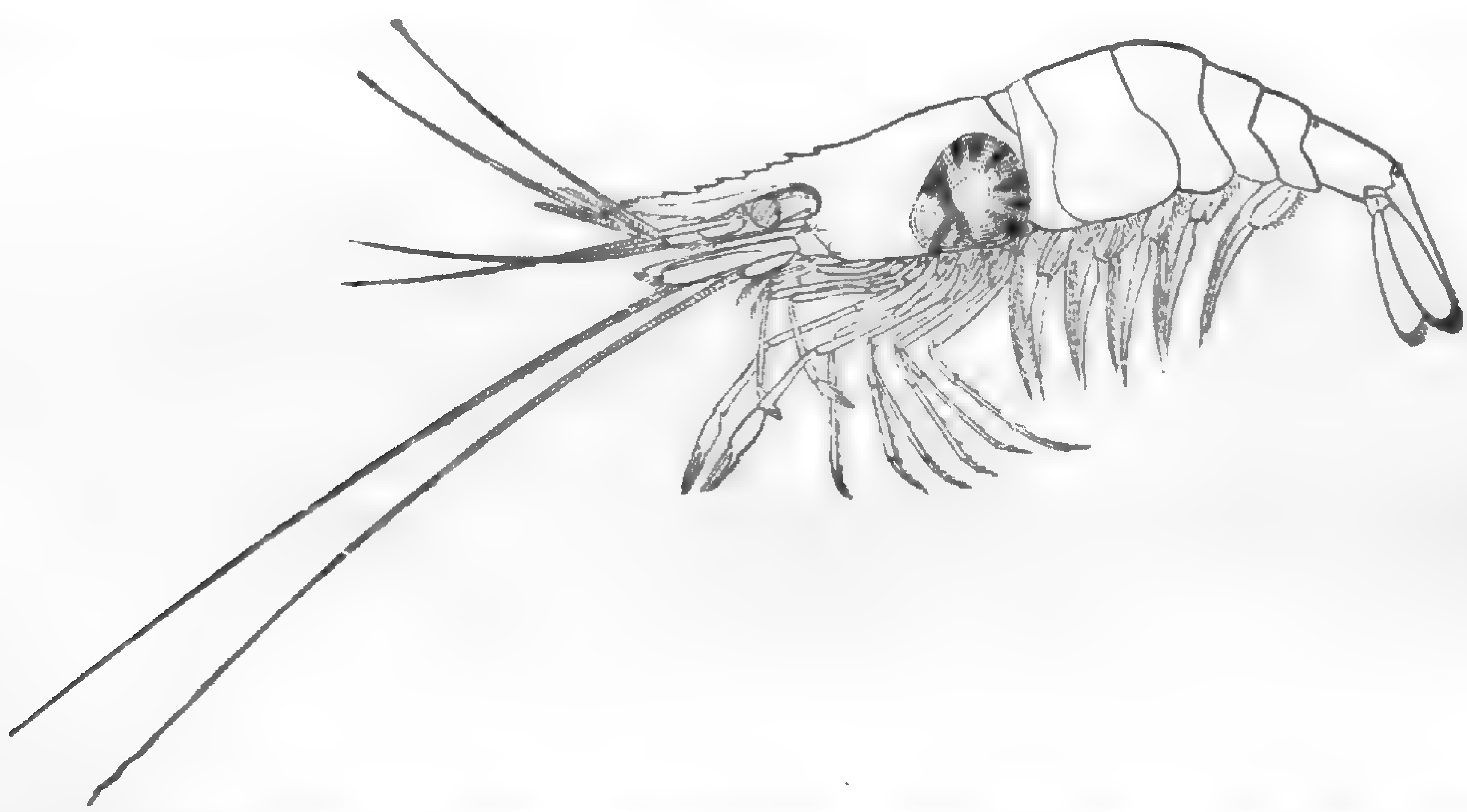

FIG. 1.—The common prawn (*Palæmonetes vulgaris* Stm.) with its parasite. Natural size.

with minute yellowish eggs of a nearly spherical form. From three hundred to three hundred and fifty eggs are contained in this cavity; the latter being formed by the prolonged lamellate margins of the thoracic segments.

The body of the female is of a whitish color, and as in all

[1] Jenaische Zeitschrift für Medicin und Naturwissenschaften, Vol. VI, 1, p. 53, 1870. Dr. Fritz Müller. (Bopyrus and Cryptoniscus.)

[2] Read before the 30th meeting of the A. A. A. S., August, 1881. In this paper the Bopyrus was provisionally called *B. manhattensis*.

[3] See also my note in *Scientific American*, Vol. XLI, No. 10, September 3d, 1881.

[4] Annals Lyceum Nat. Hist. N. York, Vol. X, p. 129, 1871.

[5] Zoology for High Schools and Colleges. By A. S. Packard, Jr., M.D., Ph.D. 1881, 3d ed.

[6] Proceedings Academy of Nat. Sciences, 1879. See also Report on the marine Isopoda of New England. By Professor Oscar Harger. p. 312.

members of this family, is somewhat distorted and unsymmetrical, one side having narrower segments than the other, and is therefore of a triangular shape.

Degeneration as a result of parasitism is manifested in the absence of eyes as well as antennæ proper, in the clumsy form of the feet and the much reduced mouth-parts. The head evidently consists of two unequal fleshy lobes. The dorsal cephalic lobe is triangular and somewhat unsymmetrically placed, the ventral lobe is of subquadrate shape, anterior angles produced, posterior angles rounded, with the middle of its posterior part prolonged and rounded.

Of the mouth parts I was unable to find more than one pair of maxillæ inserted at the sides of the ventral cephalic lobe. They constitute a flat, roundish, terminal piece, the palpus, with nine marginal hyaline tentacles;[1] the basal joint is connate with and obliquely inserted into the median lobe. A number of muscle-nerves (muscle and nerve together) run to the tip of the basal maxillary joint, some of which enter the palpus, others (three) distribute themselves along the outer tip of the former, entering three longer and stouter marginal tentacles. A beautiful dendritic arrangement of black pigment is found near the base of the palpus.

From underneath the body of the ventral cephalic lobe arise a number of narrow, ligulate, gill-like appendages, which are, in the live animal, kept in constant rapid paddling motion.[2] Viewed under higher microscopic power, they exhibit a granular structure with longitudinal, hyaline, evidently lacunary canals. If it was not for their abnormal position near the anterior part of the body and their structure, I should regard them as gills, but to be consistent, am obliged to see in them paddling organs for the purpose of aërating the eggs or embryos contained in the marsupium.

The seven pair of feet are curved forward and downward, and terminate in an indistinct hook-like knob. The black pigment is very irregularly distributed in the feet, some are all yellowish, others but slightly pigmented, and again others are nearly all black. This I have observed in live specimens, and it seemed to

[1] Compare with C. Spence Bate and J. O. Westwood's History of the British sessile-eyed Crustacea, Vol. II, p. 218, fig. 9.

[2] C. Spence Bate and J. O. Westwood, op. citat. p. 220. * * * furnished with two or three membraneous, flattened, pointed appendages.

me that, when black, the pigment is centrally located in the legs. The thoracic segments have, as apparently in all Bopyridæ, their margins prolonged into more or less lanceolate pigmented lamellæ. To these lamellæ the feet are attached. The lamellæ attached to the first pair of feet is a small, beautifully pigmented oval lobe, and its entire margin is fringed with delicate tentacles. The second and third pair of feet have very broad lamellæ, with forward directed sub-ovate tip, and with their anterior margins fringed. The fourth, fifth and sixth pair of foot-lamellæ are short, broad and irregularly triangular pieces; seventh lamella very long, narrow, lanceolate.

The marsupium is an open, roundish cavity, surrounded by the above-mentioned lamellæ, and covered by the carapace of the prawn.

The abdomen is deeply segmented, and ventrally provided with roundish appendages overlapping each other in the median line. I have closely observed the live females, and doubt that those abdominal appendages functionate as gills. They consist of a larger thick fleshy lobe, and a smaller, still thicker roundish piece. They are the degenerate postabdominal legs, characteristic of the order of Isopoda. Usually four, but sometimes six pairs of the thoracic epimera are more or less black pigmented.

The male averages about 1^{mm} in length by 0.25^{mm} in width. Head with a pair of lateral pigment eyes. Head and seven thoracic segments black pigmented, the pigment exhibiting, beside the ordinary form, a pretty stellar arrangement.

Anterior angles of thoracic segments oblique, abdominal segments four, pale, their margins perfectly round, segments gradually becoming narrower toward the terminal median piece, which is minute, and, on treating with acetic acid, is seen to consist of two lobes.

The last of the thoracic segments, not being as fully pigmented as all the preceding, exhibits dorsally a twisted, serpentiform (bretzel-shaped) marginal ornamentation.[1] Eight pairs of legs with powerful claws. Antennæ apparently two-jointed, first joint club-shaped, with five minute bacilli on its tip, second joint much narrower, about one-quarter as long as the first, with six bacilli at its tip.

[1] Similar to the male of *Cepon distortus* Leidy, Journ. Acad. Nat. Sc. Phila., Vol. III, 2d series, 1855 to 1858, Plate XI, Figs. 26 to 32.

PLATE I.

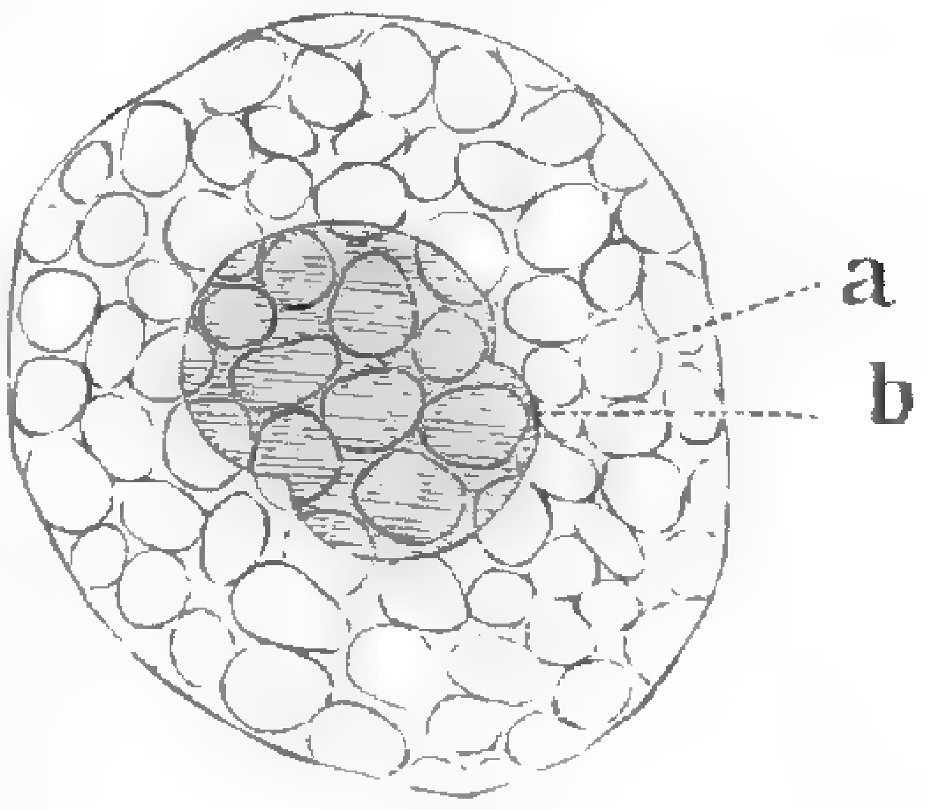

Fig. 1

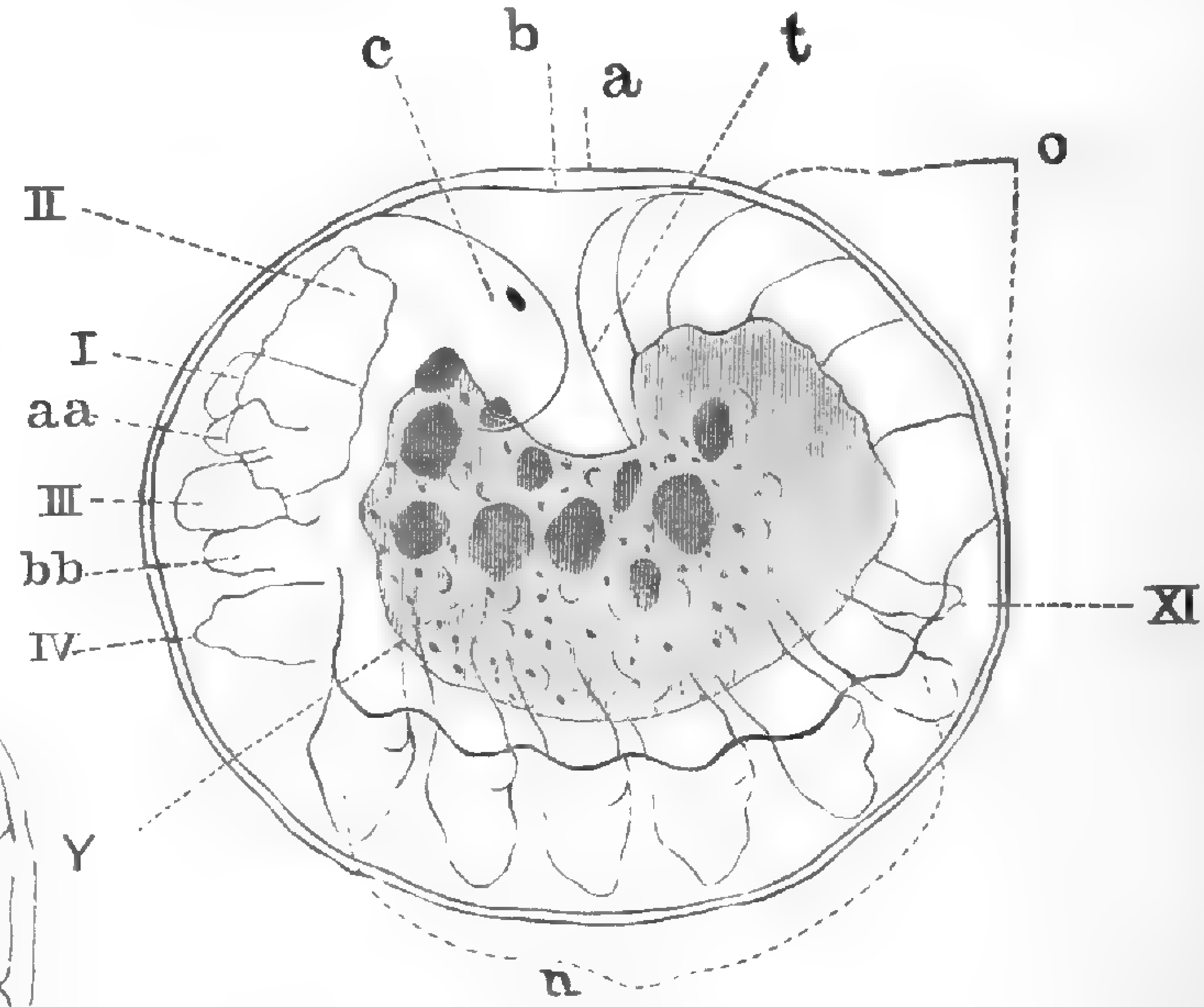

Fig. 2.

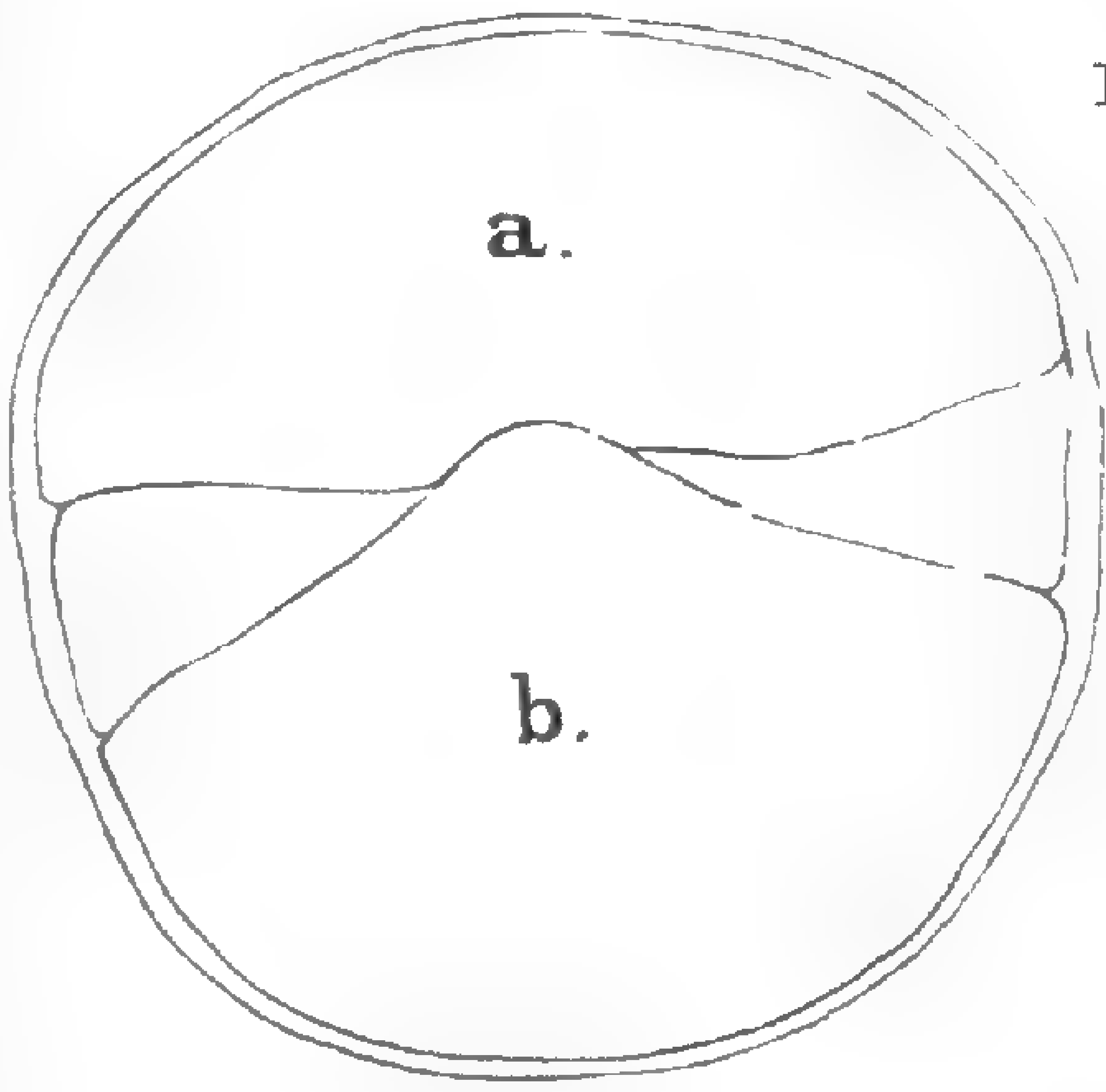

Fig. 3.

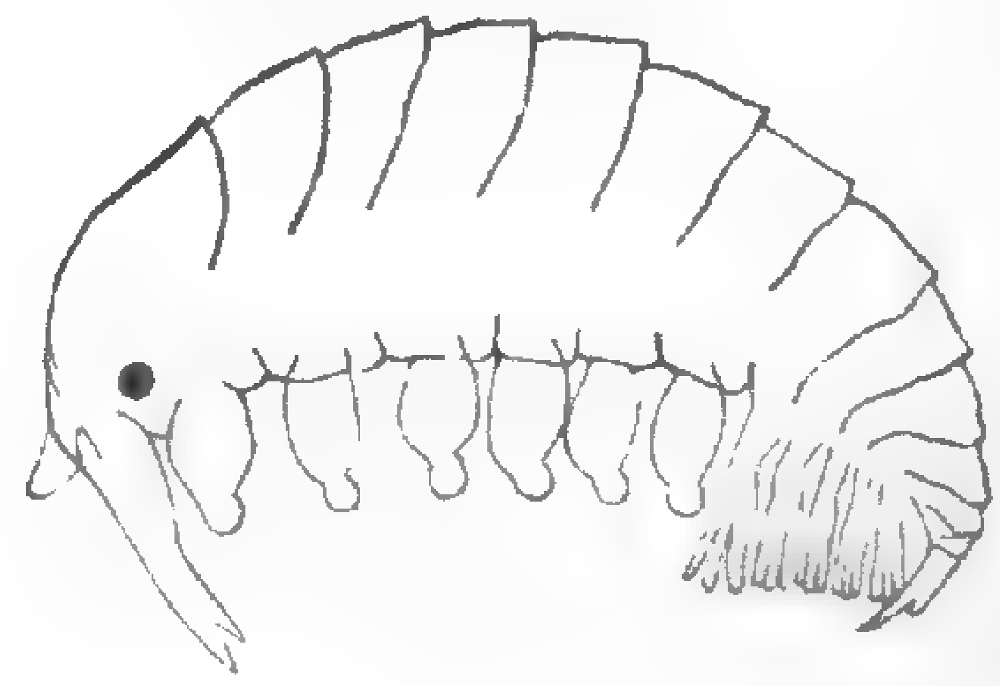

Fig. 4.

Fig. 4 *a*.

Fig. 4 *b*.

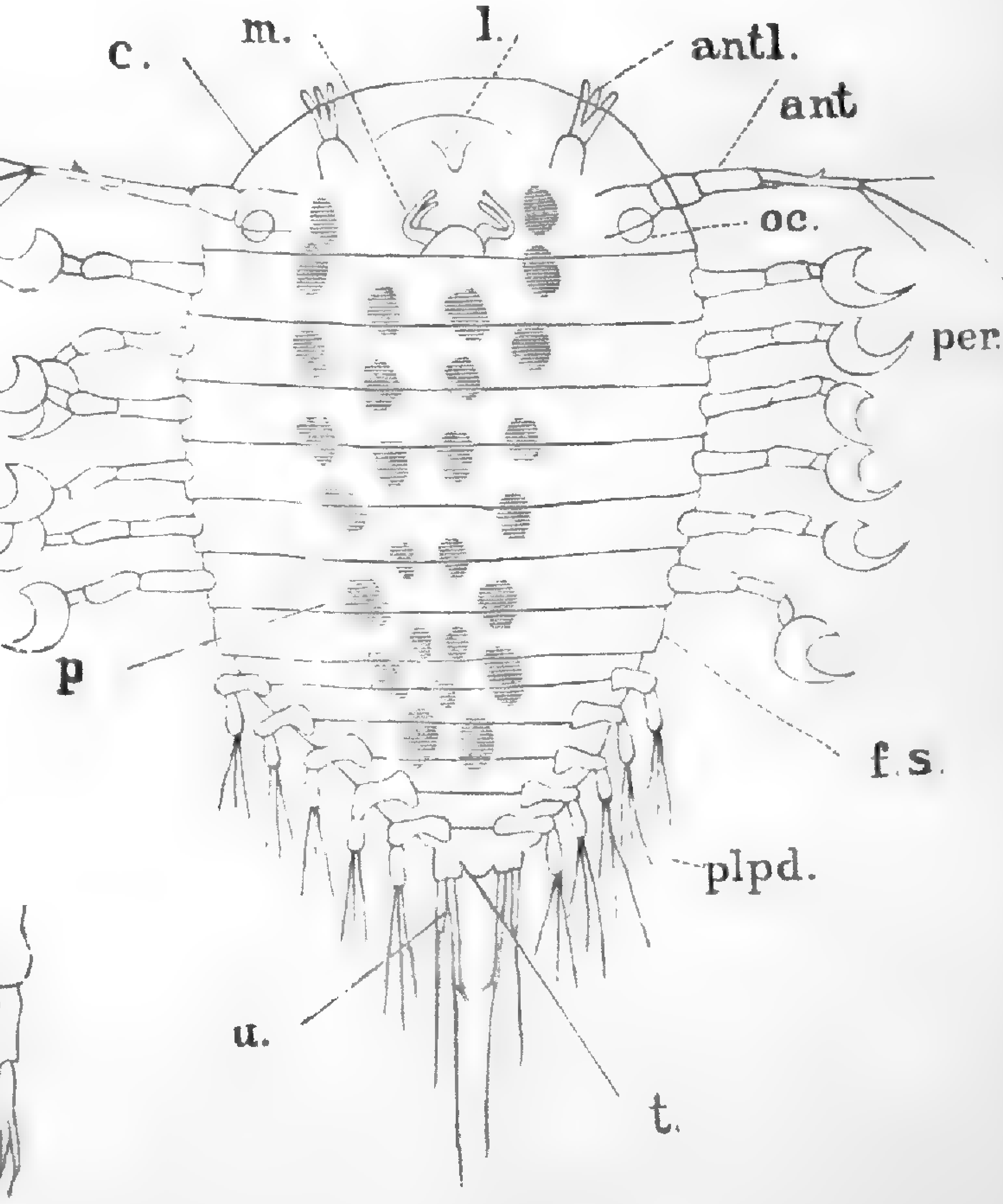

Fig. 4 *d*.

Fig. 4 *c*.

Fig. 5.

Bopyrus palæmoneticola.

The live males were removed from under the lobes of the abdomens of the females (one male in each female, and always on the same spot) and placed on paper wetted with salt water, where they slowly walked about in a sideways direction. The females moved their legs to and fro, and contracted their abdomen only on touching the ventral appendages. They kept rapidly paddling with their gill-like cephalic appendages as mentioned above. I presume that the male and female get their necessary aëration through the motions of the gills of the prawn, and as the embryos are laterally covered by the marsupial lobes of the females, and exteriorly by the carapace of the prawn, the additional fanning of the female cephalic appendages is intended for aërating the eggs or the embryos only. The functions of the gills in the carapace of the prawn infected with the Bopyrus, are undoubtedly impaired through the presence of the latter, thus shortening the life of the former; the lessened aëration conditions but one brood of the Bopyrus; both adults of the latter gradually die off *in ratio* with the prawn.[2] The embryos after quitting their larval skin,

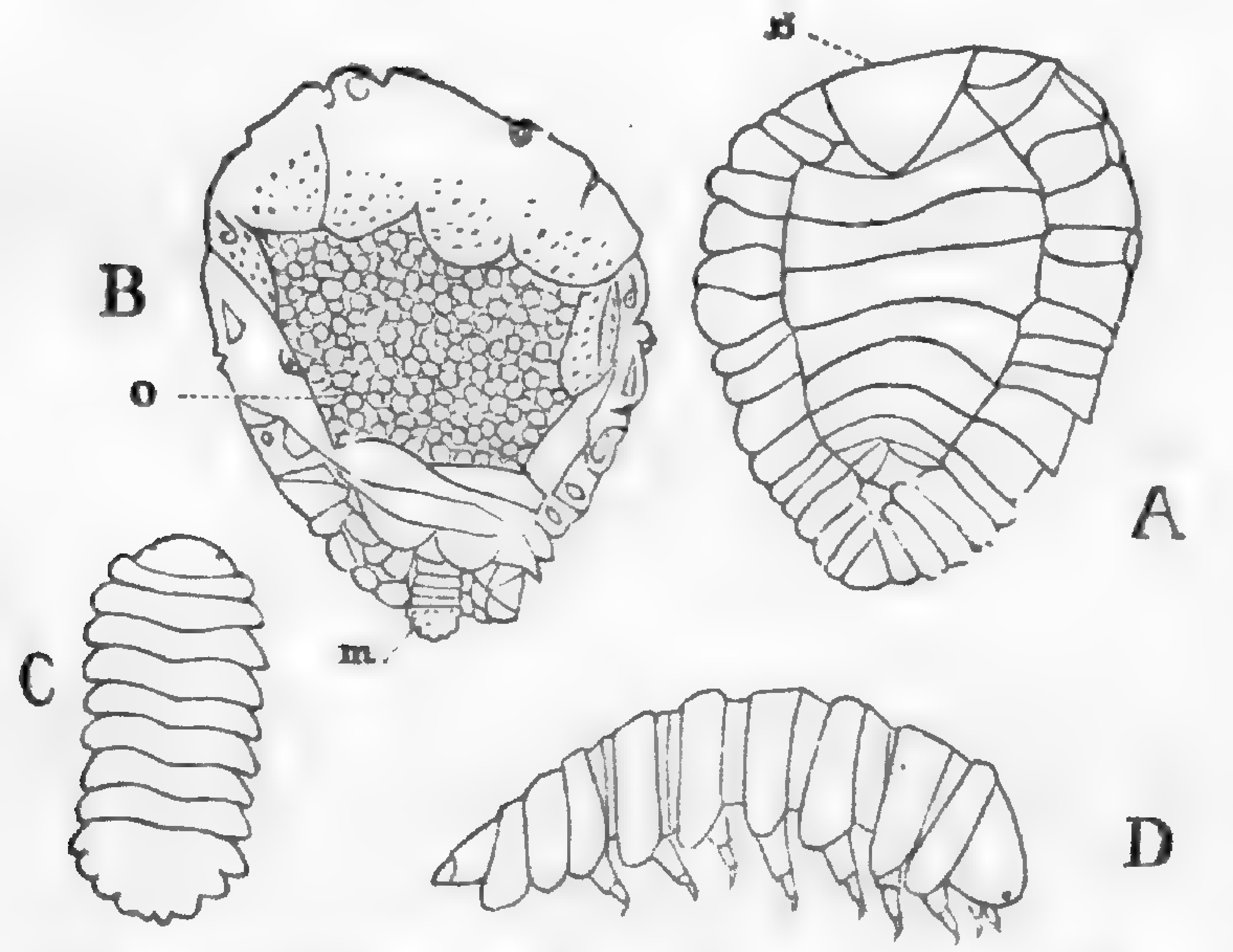

FIG. 2.—*Bopyrus palæmoneticola* Pack., much enlarged. (From *Scient. Amer.*, Sept. 3, 1881). *A*, female Bopyrus, dorsal view; *B*,ventral view of same, *C*, dorsal view of male; *D*, male, side view; (*B*) *c*, eggs; *m*, male.

[1] This is also the case with Cymothoa, according to Professor J. C. Schiödte in Annals Mag. Nat. History, Ser. v, Vol. 2, 1878, p. 195. On the Propagation and Metamorphosis of the suctorial Crustacea of the family Cymothoidæ.

[2] The suggestion that the Bopyrus and its host die "in ratio" together, was supported by several experiments, by placing separately about half a dozen of both infected and healthy prawns into quart jars full of marine water, wherein in every instance the infected prawns died several hours before the non-infected ones.

are, what Bate and Westwood have already hinted at, in their highest and most advanced stage; the organs of sense and motion being proportionately larger and better developed at that period of their existence than ever after. In this free stage the young get their aëration through the entire integument. I suppose that after the brood of larvæ have left the marsupium of the female, they will actively swim about in the sea, attaching themselves, if possible, to egg-clusters of female prawns;[1] with the young of the latter they simultaneously grow up, and enter their branchial cavity in pairs at an early period of life.

In June, 1881, I found a few (out of several hundred) live females with males, the former with empty marsupia, which fact led me to believe that this Bopyrus may produce more than one brood, but the few cases may either be exceptions or, what is more likely, the broods had just left their marsupia, leaving the parents to their fate.

The following observations were made on the eggs and embryos taken from the marsupium of live female specimens. The specimens were obtained during May, June and July this year (1881), and the number of more advanced developmental stages was not at all augmented in the latter month, nor was this the case with a lot received late in August. By far the greater number of prawns, regardless of sex,[2] exhibited through their transparent carapace the yellowish eggs of the female Bopyrus, nearly all, with but a few exceptions, showing under the microscope the peripheric blastoderm cells within which a larger or smaller, entire or subdivided yolk-mass could be distinguished (see Pl. 1, fig. 1). The few exceptions just mentioned showed, when viewed from the side, the budding limbs and segments very indistinctly, the two body-ends however, head and tail (pleon) being more distinct, exhibiting the form seen in Pl. 1, fig. 3. Those prawns which showed through their swollen carapace a more grayish mass, contained the Bopyrus embryos invariably in their larval skin, a drawing of which is seen in Pl. 1, fig. 2.

These embryos contained a central undifferentiated yolk-mass, with a few yellow oil-globules and some larger orange-colored

[1] Bate and Westwood, p. 217.

[2] Dr. Heinrich Rathke (I quote from Bate and Westwood, p. 217) found the female Bopyri upon female prawns, of which he had observed several hundreds thus infected, whilst quite as many male prawns were found to be free from their attacks.

pigment masses, the latter being nearer the dorsal line. It must be understood that the embryo in Isopod crustaceans is bent backward, head and tail nearly touching each other, the limbs, on the other hand, being in the peripheric layer. In Fig. 4 an embryo is shown freed from the egg-skin or chorion, thereby turned into its opposite direction, concave ventral and convex dorsal side. A pereiopod or thoracic leg; the end of the abdomen (telson) with the last pair of legs (uropods), a pleopod, one of the second pair of antennæ with *dd*—? remnants of earlier embryonic bristles—are shown respectively in Figs. 4, 4 *a*, 4 *b*, 4 *c*, and 4 *d*. By working with the dissecting needles, the embryo (in Fig. 4 freed from the chorion, but still enclosed in its larval skin) with some difficulty could also be freed, limb after limb, from its larval skin (amnion), then appearing as in the much enlarged Fig. 5. This, as has already been said, is the highest and most advanced stage of the Bopyrus, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will deform into the abdominal lobes and from the seventh free segment will bud a pair of legs. But if a male, where does the eighth pair of thoracic legs originate from? From the first pair of pleopods? I should rather infer that the pair of uropods will yield the eighth pair of legs in the male. The fact that the male has no abdominal appendages (so-called gills of the female) gives strength to the assumption that the eighth pair of legs in the male are derived from one pair of the pleopods, since the former (female) have the same origin.

EXPLANATION OF PLATE I.

FIG. 1.—Egg after segmentation.

a. Blastoderm-cells.

b. Subdivided central yolk ball.

FIG. 2.—Later stage. Lateral view.

c. Head.

a. Chorion.

b. Larval skin—amnion.

aa. Mandibles.

bb. Maxilla.

I. Antennula.

II. Labrum.

III. Antenna.

IV. Maxilla?

y. Yolk with orange pigment balls.

n. The six thoracic legs (Pereiopoda).

XI. Seventh free thoracic segment.
o. Twelfth to sixteenth segment (abdominal segments, pleopods concealed).
t. Telson, uropods covered beneath the dorsal bent.

FIG. 3.—Profile view of embryo; dorso-ventral.
a. Head.
b. Pleon.

FIG. 4.—Older embryo in larval skin. Lateral view.

FIG. 4 *a.*—Telson or fourteenth segment with the uropods of Fig. 4 in larval skin. Highly magnified. Showing pigment.

FIG. 4 *b.*—One of the pereiopods of larva (Fig. 4) in larval skin.

FIG. 4 *c.*—A pleopod of larva (Fig. 4) in larval skin.

FIG. 4 *d.*—Second antenna of the same stage.
dd. Remnants of earlier embryonic bristles ?

FIG. 5.—Latest larval stage.
c. Head.
l. Labrum.
m. Mandibles (?) with labium.
antl. Antennula.
ant. Antennæ.
oc. Eye.
per. The six pereiopods.
f. s. Seventh free segment.
plpd. The five pleopods.
t. Telson, bearing the
u. Uropods.
p. Orange pigment spots.

EXPLANATION OF PLATE II.

FIG. 6.—Stellar form of pigment of adult male; from dorsal side.

FIG. 7.—Leg of adult male Bopyrus.

FIG. 8.—Antenna of male B. magnified 500 ×.

FIG. 9.—One of the maxillæ with palpus of the female.
arthr. Original joint.
mn. Muscle-nerves.
p. Dentritic pigmentation.
t. Maxillary palpus with nine tentacles.
l. Disconnected part (from the other half).
β. Anterior free lobe.

FIG. 10.—First thoracic lobe of female.
p. Pigment.
t. Tentacles.

FIG. 11.—Outline of one of the abdominal appendages (gills) of female.
l. Smaller, thicker lobe, put aside.

FIG. 12.—Schematic figure showing position of the two maxillæ underneath the cephalon.

PLATE II.

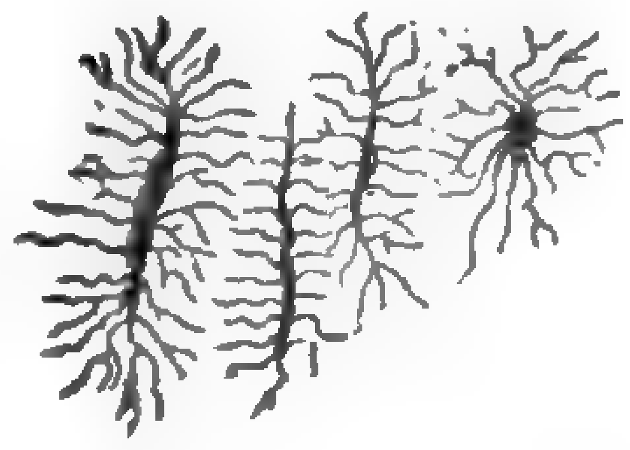

FIG. 6.

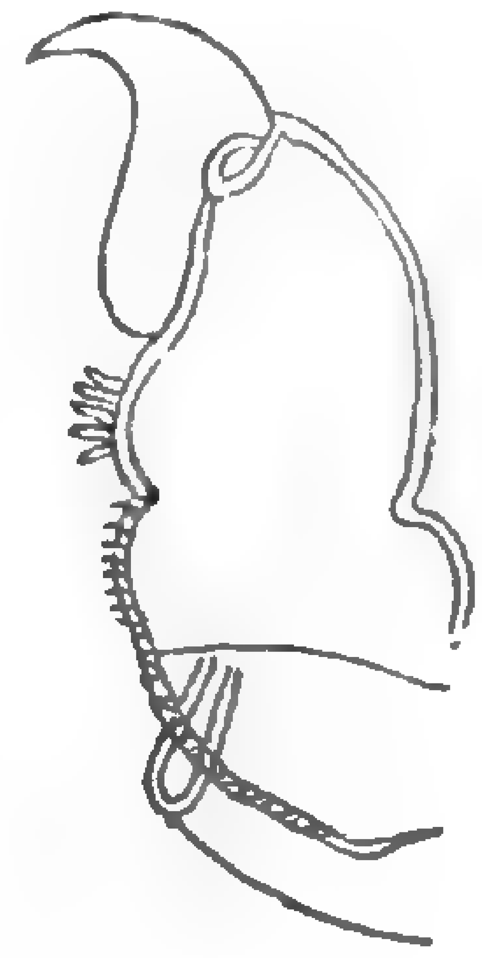

FIG. 7.

FIG. 8.

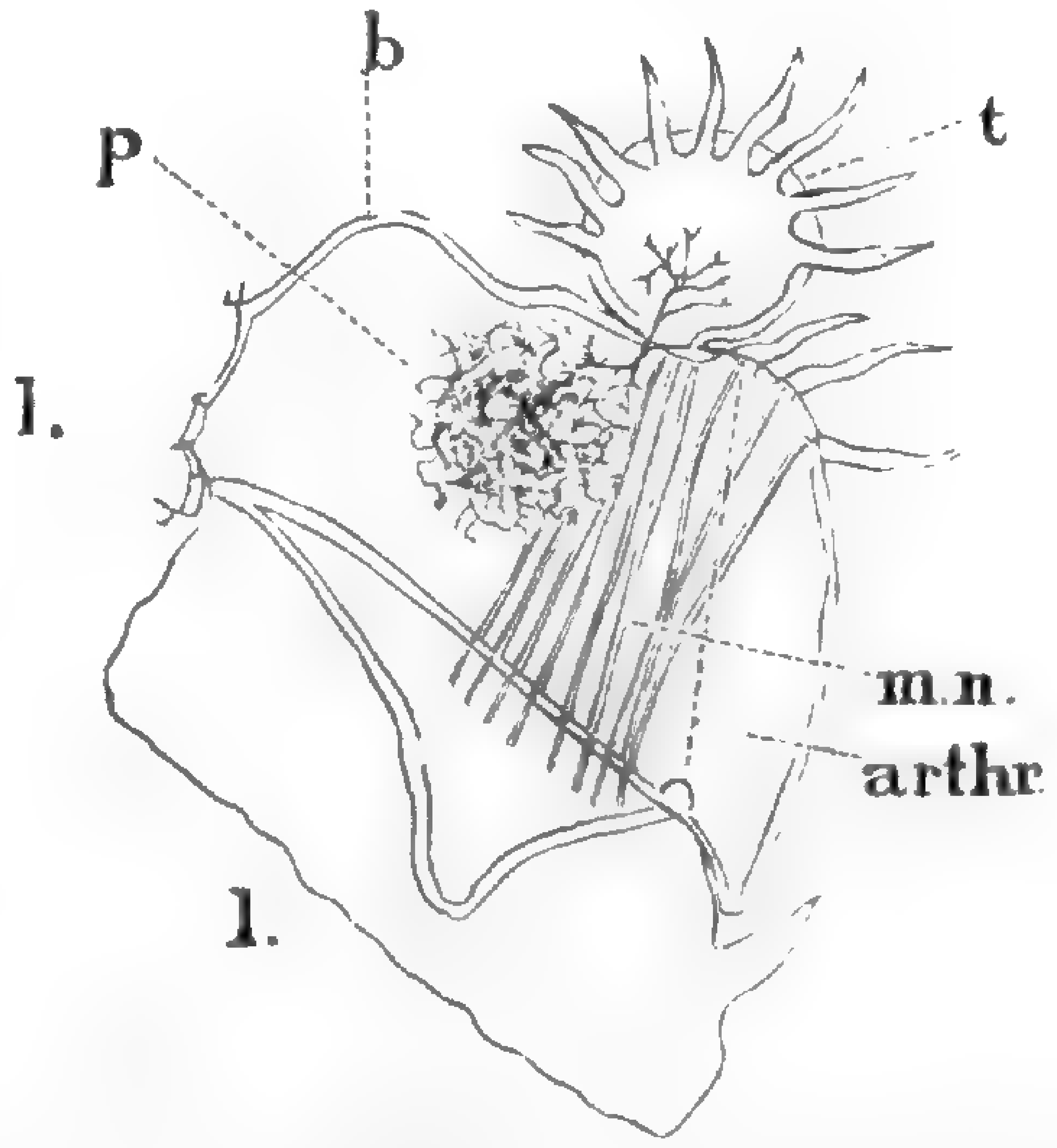

FIG. 9.

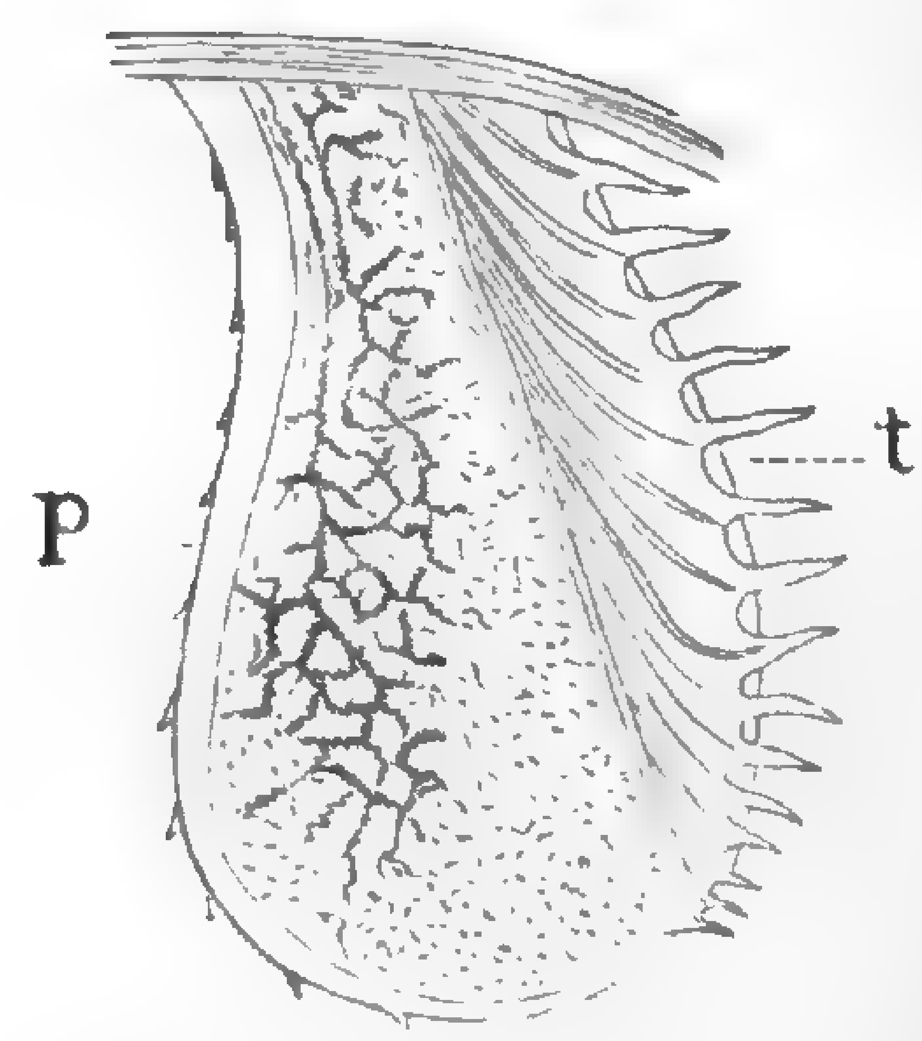

FIG. 10.

FIG. 11.

FIG. 12.

BOPYRUS PALÆMONETICOLA.

THE HETEROGONY OF OXALIS VIOLACEA.

BY WILLIAM TRELEASE.

IN May of the present year, after collecting specimens of the violet wood-sorrel about Madison, Wis., I noticed that I had succeeded in getting two well-marked forms of flowers, in one of which the pistils were considerably longer than the stamens, which were in two sets of slightly different length, while in the other the pistils were shorter than either set of stamens. On the supposition that these were respectively the long-styled and short-styled forms of a trimorphic species, careful search was made for the mid-styled form. In a class exercise in analysis, something over one hundred plants were studied, but only the two forms above mentioned were found, and in nearly equal num-

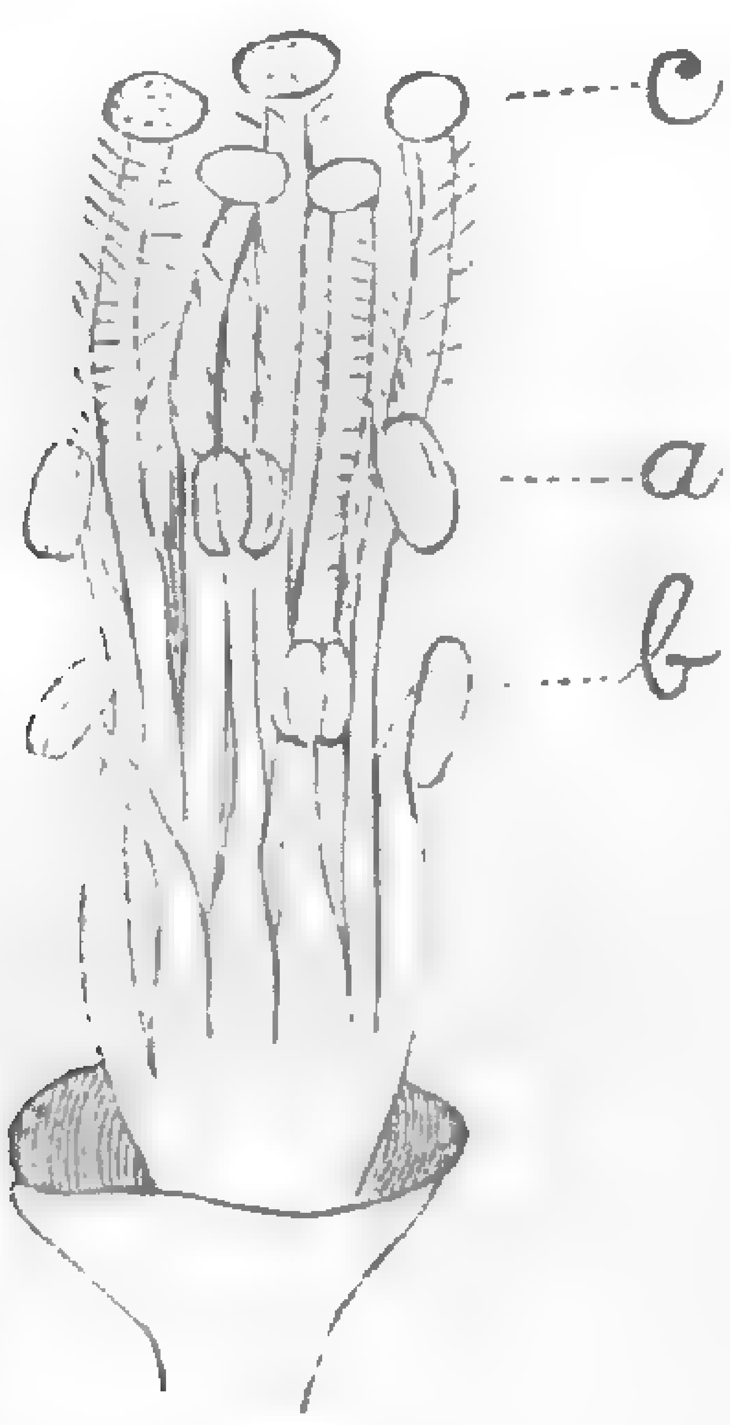

FIG. 1.

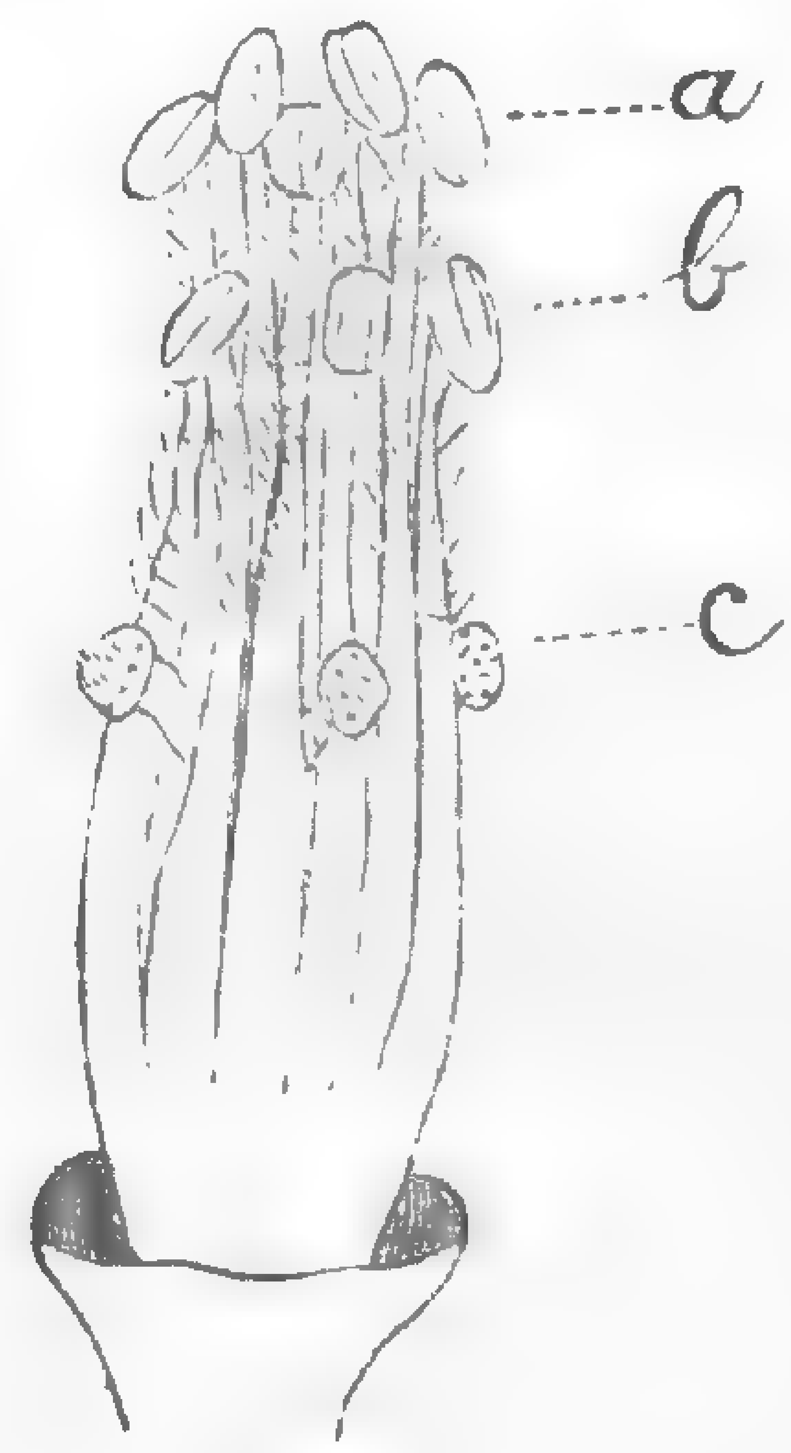

FIG. 2.

FIG. 1.—Long-styled flower of *Oxalis violacea*. FIG. 2.—Short-styled flower of the same species. Magnified eight diameters.

bers. An examination, made by myself, of the flowers of about a hundred additional plants, from different localities within an area of a few miles, gave a similar result.

Up to this time no accurate record of the number of plants of either form, or of the absolute lengths of stamens and pistils had been made, attention having been given only to the presence or absence of mid-styled flowers, and, in a general way, to the relative abundance of the two forms which were found. After this eighty-one flowers, gathered at random from as many plants, were carefully examined, and it was found that in fifty-one the styles were nearly twice as long as the average of both sets of stamens, while the styles of the remaining thirty were shorter than either set of stamens, the latter being about equal to the pistils of the long-styled flowers. These forms are represented in Figs. 1 and 2. The measurements of the flowers referred to, are given in the following tables:

TABLE I.—OXALIS VIOLACEA.

Measurements of Stamens and Pistils from Long styled Flowers.

Flower Numbers.	Pistils.	Long Stamens.	Short Stamens.
1	5. mm.	3.2 mm.	2.5 mm.
2	4.5 "	2.8 "	2. "
3	4.6 "	3. "	2.2 "
4	4.8 "	2.8 "	2. "
5	4.4 "	3. "	2. "
6	4. "	2.8 "	2. "
7	5.6 "	3.5 "	2.6 "
8	4.8 "	2.6 "	1.8 "
9	4.8 "	3. "	2.5 "
10	4.5 "	3. "	2. "
11	5. "	3. "	2. "
12	4. "	2.4 "	1.8 "
13	4.6 "	3. "	2. "
14	4.6 "	2.5 "	2. "
15	4.8 "	3. "	2. "
16	4.2 "	3. "	2. "
17	4.6 "	2.8 "	2. "
18	4. "	2.2 "	1.6 "
19	5. "	3. "	2. "
20	4. "	2.8 "	2. "
21	4.4 "	2.3 "	1.6 "
22	4.4 "	2.5 "	2. "
23	4.2 "	2.4 "	1.8 "
24	4.2 "	2.5 "	2. "
25	4.8 "	2.8 "	2. "
26	5. "	3. "	2. "
27	4.6 "	2.8 "	2. "
28	5. "	3. "	2.5 "
29	4. "	3. "	2. "
30	4.8 "	3. "	2. "
31	4.6 "	3. "	2. "
32	5. "	3. "	2. "
33	5. "	3. "	2. "
34	4.8 "	2.8 "	2. "
35	4.8 "	3. "	2. "
36	4.4 "	2.8 "	2. "
37	5.1 "	3. "	2. "
38	4.4 "	2.5 "	2. "
39	5. "	3. "	2. "
40	5. "	3.2 "	2.4 "
41	4. "	2.5 "	2. "
42	4. "	2.8 "	2 "
43	4. "	2.8 "	2. "
44	4.8 "	2.8 "	2. "
45	4.5 "	3. "	2. "
46	4.2 "	2.8 "	2, "
47	4.5 "	3. "	2. "
48	4.6 "	2.6 "	2. "
49	4.8 "	3. "	2. "
50	5. "	3. "	2. "
51	4. "	2.5 "	2. "

TABLE II.—OXALIS VIOLACEA.

Measurements of Stamens and Pistils from Short styled Flowers.

Flower Numbers.	Pistils.	Long Stamens.	Short Stamens.
1	3. mm.	5.1 mm.	4. mm.
2	3. "	5.1 "	4. "
3	2.4 "	5. "	4. "
4	2.3 "	5. "	4. "
5	2.5 "	4.2 "	3. "
6	2.5 "	5. "	4. "
7	2.5 "	5. "	4. "
8	2.5 "	4.8 "	3.6 "
9	2.4 "	5. "	4. "
10	2.5 "	5.4 "	4. "
11	2.4 "	5.4 "	4. "
12	2.4 "	5. "	4. "
13	2.8 "	5.1 "	4. "
14	2. "	4.5 "	3.2 "
15	3. "	5. "	4. "
16	2.5 "	4.8 "	3.8 "
17	2. "	5. "	3.8 "
18	2.5 "	5. "	4. "
19	2.5 "	4.8 "	3.5 "
20	2.5 "	5. "	4. "
21	3. "	5.5 "	4.5 "
22	2. "	4.6 "	3.2 "
23	2.4 "	4.6 "	3.8 "
24	2.6 "	5. "	4. "
25	2. "	5.5 "	4.2 "
26	2.4 "	5. "	4. "
27	2.5 "	5. "	4. "
28	2.5 "	5. "	4. "
29	2. "	4. "	3. "
30	2.4 "	5. "	4. "

Though both stamens and pistils vary in length, as might, indeed, be expected from the fact that the flowers are by no means of uniform size, a glance at the tables and appended diagram shows that, as a rule, the styles of either form are intermediate in length between the two sets of stamens belonging to the other form; while the difference between the stigmas and the nearest set of anthers is, in either, greater than that between the stamens themselves, both differences being nearly constant for both long and short-styled flowers.

This is slightly different from the usual arrangement of the parts in trimorphic species, as may be seen by comparing Figs. 1 and 2, representing the species under consideration, with Figs. 3, 4 and 5, after Hildebrand, representing the trimorphic *O. gracilis*. That the long stamens of the long-styled flowers, and the short stamens of the short-styled flowers stand at different heights—as may be most clearly seen by comparing the lines *a* and *b′* in the diagram—and not at the same height, is, it seems to me, of some importance. In trimorphic plants too, the pollen grains from the two sets of stamens of a given flower commonly differ

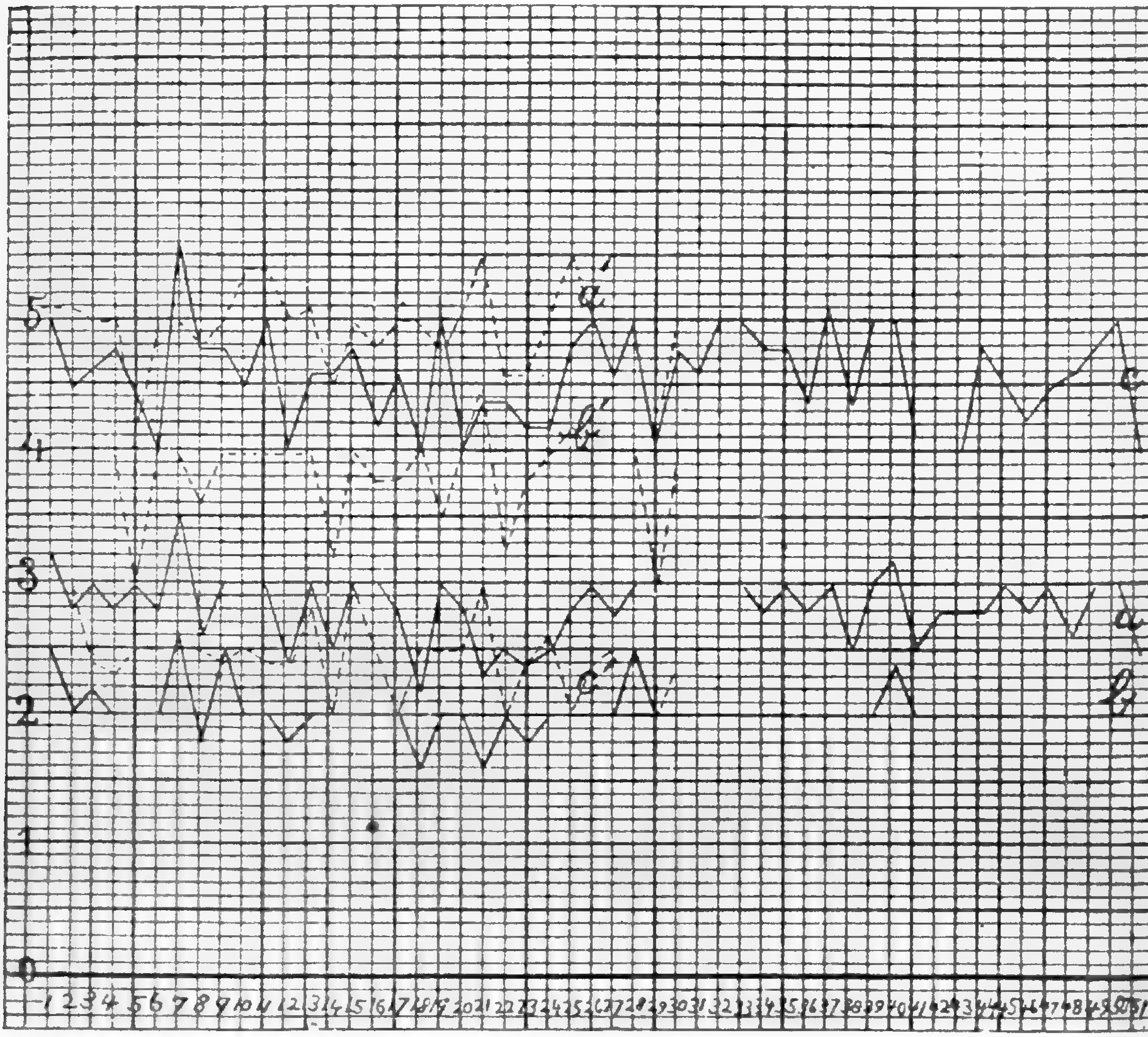

Diagram showing the relative lengths of stamens and pistils in eighty-one flowers of *Oxalis violacea;* from Tables I and II. The unbroken lines connect coördinates representing measurements of long-styled flowers; the dotted lines connect those for short-styled flowers. *a*, the long stamens; *b*, the short stamens; *c*, the styles. The heavy line marked *o* represents the base of the corolla; the other transverse lines representing millemeters and fractions.

noticeably in size, but the following measurements of pollen from three flowers of each sort do not show this difference:

TABLE III.—OXALIS VIOLACEA.

Measurements of Pollen from Long-styled Flowers.

Flower Numbers.	Long Stamens.	Short Stamens.
1.	44 μ. × 24 μ.	44 μ. × 24 μ.
2.	44 " × 24 "	44 " × 24 "
3.	44 " × 24 "	40 " × 24 "

TABLE IV.—OXALIS VIOLACEA.

Measurements of Pollen from Short-styled Flowers.

Flower Numbers.	Long Stamens.	Short Stamens.
1........................	50 μ. × 28 μ.	48 μ. × 27 μ.
2........................	50 " × 28 "	52 " × 34 "
3........................	52 " × 32 "	48 " × 28 "

These grains were measured dry, immediately after removal from newly gathered flowers. It will be seen that those from both sets of stamens in any flower, are nearly equal in diameter; while, as is usual in heterogonous plants, those from the short-styled flowers are larger than those from the long-styled.

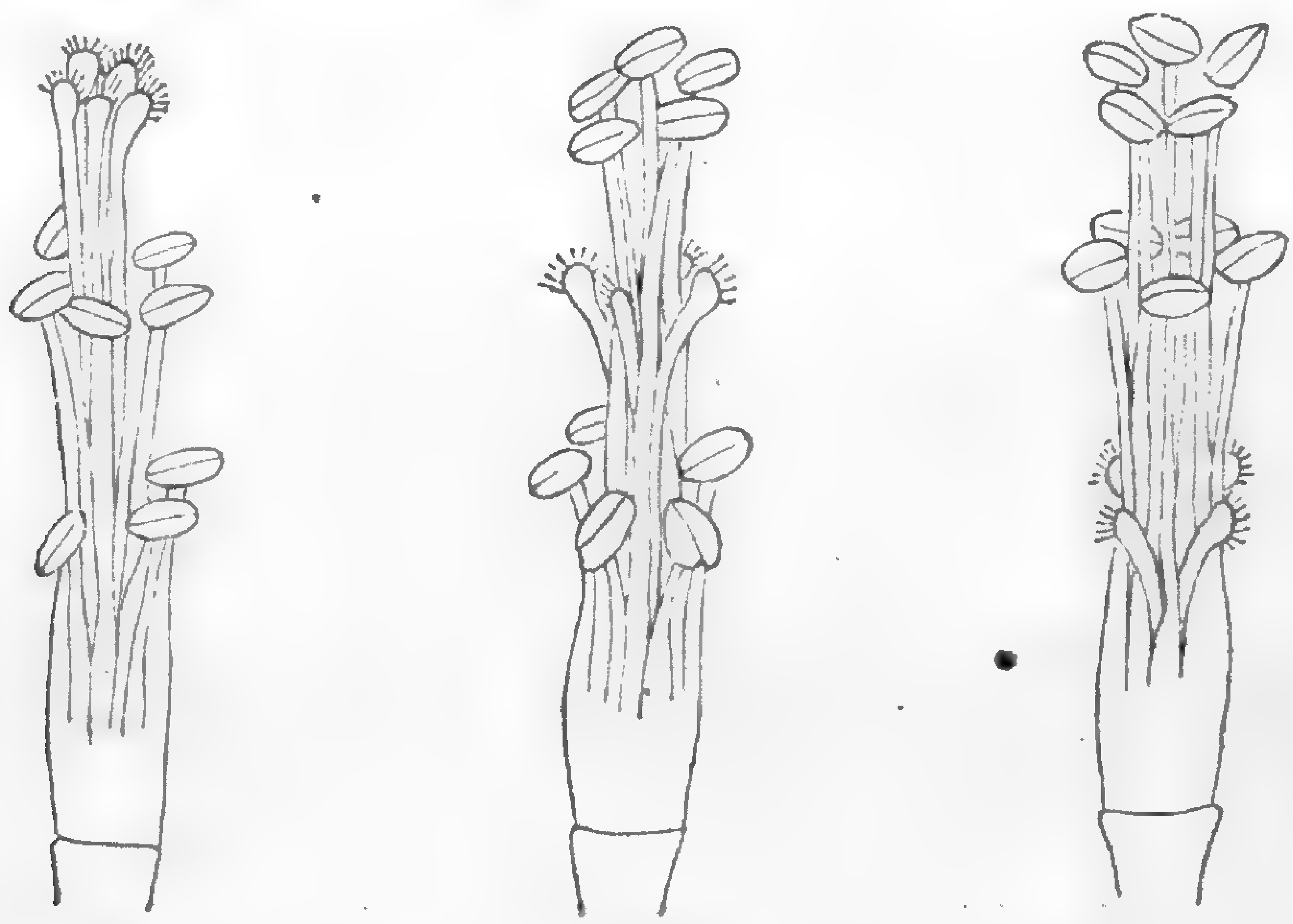

FIG. 3. FIG. 4. FIG. 5.

FIG. 3.—Long-styled flower of *O. gracilis.* FIG. 4.—Mid-styled flower of the same. FIG. 5.—Short-styled flower of the same. The calyx and corolla have been removed in every case.

The facts indicated appear, so far as they go, to point to dimorphism rather than trimorphism in this species; although with truly trimorphic plants, one or even two of the forms may occasionally be absent from a given district. Concerning the local occurrence of but two forms of trimorphic plants, Mr. Darwin[1] says: "Fritz Müller formerly believed that a species of Oxalis, which is so abundant in St. Catharina that it borders the roads for miles, was dimorphic instead of trimorphic. Although the pistils and stamens vary greatly in length, as was evident in some specimens sent to me, yet the plants can be divided into two sets, according to the lengths of these organs. A large pro-

[1] Different Forms of Flowers on Plants of the same Species, p. 180.

portion of the anthers are of a white color and quite destitute of pollen; others which are pale yellow contain many bad with some good grains; and others again which are bright yellow have apparently sound pollen; but he has never succeeded in finding any fruit on this species. The stamens in some of the flowers are partially converted into petals. Fritz Müller after reading my description * * * of the illegitimate offspring of various heterostyled species, suspects that these plants of Oxalis may be the variable and sterile offspring of a single form of some trimorphic species, perhaps accidentally introduced into the district, which has since been propagated asexually." A case somewhat similar to that of *Oxalis violacea* about Madison, is afforded by a Brazilian species of Pontederia, of which Fritz Müller[1] found only long and short-styled flowers. An important difference, however, is found in the measurements of the pollen from the different sets of stamens of a given flower; for "the pollen grains distended with water from the longer stamens of the short-styled form are to those from the shorter stamens of the same form as 100 to 87 in diameter, as deduced from ten measurements of each kind. * * * Moreover, the longer stamens of the long-styled form of Pontederia, and the shorter ones of the short-styled form are placed in a proper position for fertilizing the stigma of a mid-styled form."

"With respect to the absence of the mid-styled form in the case of the Pontederia which grows wild in Southern Brazil," Mr. Darwin adds, "this would probably follow if only two forms had been originally introduced there; for, as we shall hereafter see from the observations of Hildebrand, Fritz Müller and myself, when one form of Oxalis is fertilized exclusively by either of the other two forms, the offspring generally belong to the two parent-forms."[2]

Whether in *O. violacea* we are dealing with a case of this sort, or whether the species is dimorphic, can only be definitely decided by the examination of many specimens collected over as large a range of territory as possible, and it is to be hoped that those who have the opportunity will make observations of this sort. Meantime it seems not improbable that the plant is dimorphic; and although dimorphic species are as yet unknown in this genus,

[1] Jenaische Zeitschr., VI, 1871, p. 74, fide Darwin. l. c., p. 184.

[2] l. c., p. 185. cf., also p. 212.

so far as I am aware, the occurrence of both homogone and trimorphic species gives some reason for looking for still others which are dimorphic. In writing this I am perfectly aware that Hildebrand[1] has examined a few herbarium specimens of *O. violacea*, finding eight long-styled, three short-styled, and one mid-styled plant in the twelve specimens examined. The constant lack of correspondence in our specimens between the sets of stamens which should correspond, however, leads one to wonder if a mistake may not have been made, especially since a slight discrepancy exists between the numbers cited and the summary, in the paragraph cited.

Both the long and short-styled flowers are visited by small bees in considerable numbers, the more common being *Nomada bisignata*, *Ceratina dupla*, *Augochlora pura*, an Osmia, and several species of Halictus. These insects are attracted by the nectar which is secreted, apparently, by the papillose bases of the petals, and which is protected from rain, &c., by pubescence on the styles in the long-styled flowers, and on the filaments in the other form. As a result of these visits, some flowers of both kinds produce capsules, which are by no means uncommon, although by far the greater number fall away without bearing any fruit.

——:o:——

FORESTS—THEIR INFLUENCE UPON CLIMATE AND RAINFALL.

BY J. M. ANDERS, M.D., PH.D.

THAT there exists some sort of relation betwixt forests and conditions of climate, perhaps most observers would be ready to concede. Many attempts have been made to explain how forests affect atmospheric states, but there is great diversity of opinion on the subject, and, indeed, the question to-day remains somewhat involved in obscurity. As every one knows, there was a time when forests were considered almost inexhaustible. It is also a well-known fact that the destructive hand of man began, centuries ago, to fell rapidly these abundant forests, and changes of climate and fertility of the soil have, in numerous regions, been attributed solely to this denudation of the land. On examining the literature of the subject, it is found that the balance of

[1] Monatsber. Berlin Akad., June 21, 1866, p. 357.

argument and opinion is decidedly on the side of the baneful effects of the destruction of forest growth, the testimony of some of the best scientific minds of different ages being very strong on this point.

It is but fair to say, however, that not a few observers of note deny any effects of woods on the moisture and other conditions of the atmosphere; and even stranger still, it has been declared that the climate of the Western States has, if anything, been improved by the denudation of forests; but this assertion rests, we think, on too slender evidence to be entitled to credence. It may be safely assumed that forests favorably affect the meteorological conditions. Our subject presents many difficulties owing chiefly to the fact that numerous causative elements enter into the question, some of which are of a conflicting tendency, and though a question so confessedly intricate may perhaps never be susceptible of solution, nevertheless any new light on the subject, however faint the ray, must be considered welcome.

One of the ways in which forests are usually considered to exert an influence over the climate, is by obstructing the free passage of wind currents. This is an element of the question which is, perhaps, better established than any other, but is of too great importance to be disposed of in a summary manner. It is evident that trees are well adapted to break the force of the wind; the branches, and particularly the leaves, on account of their immense numbers and close proximity, serve as efficient barriers, and the trunk holds up the bushy top and defies the tempest, while roots in turn are continually extending their grip on mother earth in order to support the trunk. And it can be readily understood that the particles not checked by the first row of trees to the windward, would have their force diminished and be promptly checked by the trees to the rear. In this wise belts or clumps of trees afford shelter to the leeward of them from the chilly, or even frigid blasts, which are known in many localities to be very unfavorable to the maturation of fruit-crops and harvests. Of little less importance, perhaps, is their effect in protecting from the drying winds of summer, which are frequently the cause of blighted crops and other mischief, due to their power to enhance evaporation from vegetation and from the soil during the dry season. For this reason woods are also needed even on our coast. The sea breezes as they strike the land become warmed, their capacity for moisture is thereby increased, and naturally absorb with avidity the earth's moisture and produce a drying effect. It is plain to be seen then, that woods by intercepting cold currents and drying winds, mitigate extremes—rendering summer less sultry and winter less severe, though they may not materially affect the mean temperature. In like manner they must tend to obviate the injurious consequences of cold spring and autumn winds, and thereby relatively lengthen the warm season or term of vegetable development. This is a highly important office, since some crops are slow in maturing.

The experiment has been tried extensively in France of planting trees in belts one hundred meters apart, and with marked benefit to the climate, and there are some good reasons for believing that a similar experiment in various places in our own country, would prove equally advantageous. It has been observed many times that fruit grown in the city surpasses in quality and size that grown in the country, and this is ascribable to the more effectual shelter in the former place.

The wind as it courses over an open country conveys with it a variable quantity of moisture, which, though usually invisible, is always present in the atmosphere, which is likewise arrested by the forest. Now what becomes of this moisture? The air is forced up by the side of the woods to the tops of the trees just as in the case of a low mountainous elevation, and owing to the attraction between its particles and the constant *vis a tergo* caused by fresh currents from behind, the volume does not stop here but rises higher. When the temperature of the air above is lower than that in the forest, as is sometimes the case when storms prevail, then there would also be an upward current from the tree tops. It is usually considered that in this manner forests increase the aggregate general rainfall, viz., by causing ascending currents to sufficiently high regions for the moisture to be condensed into clouds and rain, and this has been held by some to be the only way in which they influence precipitation. Meteorological science has, however, established the fact that rain is generally formed from one to two miles above the surface of the earth, and it would scarce be possible that an obstruction no higher than an ordinary forest could, *per se*, be capable of raising the vapor-laden air to this extent and could not actually increase the rainfall. On the other hand, when forests are situated on elevated ridges or mountains of moderate elevation, they may have the effect of extending the influence of the latter a step further in producing an upward current to the cooler regions, or condensing area, and in this manner greatly assist local precipitation. It is now a settled fact that high mountains augment the rainfall in themselves or even to some little distance from their bases. The Alps of Switzerland are known to modify and greatly influence the course of storms. We repeat it then, that forests resemble high altitudes as regards their *mechanical action* in affecting the rainfall, but owing to their meagre height, can scarce be said to have any influence (mechanically) over this phenomenon except they are situated upon the latter, in which case their action may tell considerably. Forests do, however, affect local precipitation through certain vital functions, as will be seen by and by.

No other influence which forests exert upon atmospheric conditions can claim so large a share of importance as that exercised on its humidity. The explanation of their effect on this meteorological element is to be found mainly in a study of some of the organic processes carried on by trees, but to a slight extent also to a mechanical action. The evaporation from the soil is interfered with by the vegetable canopy above, which prevents, in a great measure, the sun's rays from reaching the earth and heating it so as to facilitate evaporation. Again, by forming a more or less perfect screen interposed between sky and earth, forests in a measure intercept the dew and lighter rains, allowing but a portion of this moisture to reach the earth. *It has been estimated that the evaporation from the soil of the forest is rather more than one-third as great as that from open soil, but this lessened surface evaporation is much more than compensated for by transpiration of the forest, as will be indicated by the results of our investigations.*

The question of the influence of the organic functions of plants on the humidity of the air, is one of paramount importance and great philosophic interest. Whatever effect plants have through these processes must be due either to the exhalations of moisture from the leaves (transpiration) or to the absorption of moisture by the leaves. The latter idea, as formerly taught and until recently held by most authorities, is now most probably shown to be erroneous. According to the researches of Unger[1] the theory of the absorption of the watery vapor by the leaves is untenable.[2] My

[1] Wilhelm der Baden und der wald, p. 19, quoted by Marsh.

[2] The writer regrets that the details of these experiments are not accessible.

own observations tend to confirm the conclusions of Unger. A growing pot plant (geranium) in a thrifty condition was experimented with. The whole of the pot was covered with a double layer of oiled silk, and the free portion accurately adjusted around the base of the stem, on which it was tied with elastic cord. Thus prepared, no evaporation could take place from the soil in the pot, and what is of more importance still, no moisture could be thus supplied to the roots excepting that which was contained in the soil in the pot. The plant was now placed under a glass case which was situated over a shallow box in which there was about four inches of soil which was kept saturated so that the evaporation from it kept the air of the glass chamber quite moist. The whole arrangement was placed near a window with a southern exposure, the plant catching the rays of the sun for about five hours of the day in clear weather. In this situation the plant remained quiescent or dormant so far as any visible growth or development was concerned, for about two weeks, when it began to look languid and the margins of the leaves began to change in color and to show slight signs of failing nutrition. The explanation of this apparently long state of hybernation in the plant is simple. The air in the case being too moist to allow of scarce any transpiration, the plant retained the moisture in the pot for purposes of nutrition only, and since the plant most probably grew but little during that period, there was quite sufficient water in the pot for its uses for so long a time. At the end of the two weeks the plant was taken out of the glass case and placed in a sick chamber with the same exposure, in which three dozen other thrifty plants were situated. The oil silk was allowed to remain on and no water was supplied to the roots of the plant. The atmosphere of the chamber was noticeably moist to the senses, though agreeable. Here the sun's rays had an opportunity of exciting the plant to transpire actively, and, as a consequence, in a few days nutritive change became very decided, leaf after leaf drying until at the end of another fortnight only a couple much withered leaves were left on the plant.

Now this experiment is not sufficiently conclusive to assure us that absorption of moisture by the leaves is *impossible*; but it certainly must show to the satisfaction of every one that not sufficient water can be taken in through them to carry on the normal functions of the plant, and renders it extremely probable the only source of moisture to the plants is through the roots.

On the other hand actual observation has shown that transpiration is carried on with almost incredible activity—the rate at which aqueous vapor is given off by plants being more than one and a quarter ounces per square foot of leaf surface for twelve diurnal hours.[1] Let the reader reflect upon the vast expanse of leaf surface of a single tree giving off vapor at this rate, and then let him consider the number of trees in a forest of only a few acres, the number being variously estimated at from 150 to 600, and multiplying these two factors he will be able to form some approximate idea of the enormous amount of aqueous vapor supplied to our atmosphere in the most acceptable form.

During the past summer I have instituted a series of experiments with the view of determining the amount of water vaporized from known areas of leaf surface, land surface and water under similar circumstances, in order that a more nearly correct estimate of evaporation from these various sources might be made.

A pot plant having one square foot of leaf surface was carefully prepared — in the manner previously described—so as to prevent any evaporation from the pot in which it was growing. Another glazed pot was filled with soil (a light clay loam) so as to expose a surface area of only twenty-four square inches, the pot being about the same size as that containing the plant, and the depths of the pot very nearly six inches. The plant was sufficiently watered to keep it in a thrifty condition, while the earth in the plantless pot was kept generally well saturated. Both were equally exposed to the outer air. The evaporation from earth and plant was now tested simultaneously by weighing the two pots at stated intervals, and it was found that the mean evaporation was, in fair weather, nearly equal for the two sources, with a slight preponderance on the side of the soil. For fourteen consecutive days of clear and partly cloudy weather, the mean transpiration from the plant was a little over one and a quarter ounces, and the evaporation from the soil one and a third ounces. This would place the rates of evaporation of equal areas of leaf and land surface, under like circumstances of exposure, at about six to one in favor of the soil, that is to say, one square foot of soil will evaporate six times as much as one square foot of leaf sur-

[1] "Transpiration of Plants," AMERICAN NATURALIST for March, 1878, by the author.

face. This will appear quite plain when it is remembered that the extent of the leaf surface was six times as great as that of the soil, and that the total diurnal evaporation was so nearly equal from the two sources. These experiments were several times repeated, and with about similar results.

Now if it were known how many times greater the leaf surface of a great forest than the land on which it was situated, it might with ease be computed what is the relative evaporation from a forest and an equal area of open country. From personal observation and computation, we think it safe to assume that the leaf surface of a wood is at least twelve times greater than the ground on which it stands, so that at the above rate the transpiration from the forest would still be nearly twice as great as the evaporation from an equal area of free soil. It should be mentioned also that the evaporation from the earth in this case was under the most favorable circumstances, and the state of the ground as regards moisture was very like that of the open earth directly after a moderate rain. It was found by testing to be nearly equal to that given off by a similar area of water.[1] It would appear certain, then, from these investigations, that more water is emitted to the atmosphere from a forest than from an equal body of water, and in this there is a confirmation of the experiments of Williams who computed that the evaporation from a wood was one-third more than an equal space covered with water.[2] It is well known that at times, during the warm season more particularly, we have no rain for several weeks, so that the mean general surface evaporation is probably not by any means as great as would be indicated by these figures—for it was found that by allowing the soil in the pot to become even moderately dry, the amount evaporated would fall far short of what it was when keeping the soil well watered. On the other hand we have good reasons for believing that the true rate at which forests give out aqueous vapor is, at all events, not over estimated in these researches. In the first place the trees are at all times supplied with a more abundant supply of moisture for transpiration — owing partly to power which the roots have to attract moisture from every direction; partly to the retention of the rainfall in their network to be in due

[1] The same methods were used as in the experiments with the soil and plant.

[2] Agricultural Report for 1865, p. 526. Unfortunately the methods employed by this investigator are not given.

season absorbed by the myriad root hairs, and partly also to the circumstance that the vegetable mold usually carpeting the soil of the forest is well qualified to soak up water and prevent its running off too rapidly through superficial channels.

The humbler specimens of vegetation also have an effect, as is conclusively shown by the following experiment: A pot with artificially prepared soil, similar to that used in the above experiments, was used. Another vessel of the same size and weight in which grass *(Poa annua)* about four inches high was growing, was also employed. Now it was found by repeated testing that from the pot containing the grass the evaporation exceeded that of the pot having only soil. The rates in ounces would be about five to four for the grass and soil respectively.

From all these investigations the writer is able to confirm his former investigations in regard to transpiration,[1] and in these experiments it was particularly observed that while the evaporation from the soil was greatly influenced by temperature and the degree of humidity—for the mean temperature and dew point were both noted in all these experiments—transpiration was excited to a greater degree by the direct rays of the sun.

From the data just obtained it would seem safe to infer that when the percentage of woodland is fair (25 to 30 per cent.) at least twelve inches of water is transpired in the course of a season in mild or temperate climates, or, in other words, twelve inches of the total annual terrestrial evaporation. All this vast amount of water is transpired in about six months, or during the vegetative period. Under these circumstances an equivalent of nearly half the rainfall during the warm season may be accounted for by the transpiration. These are striking facts, and tell in indisputable terms of the happy effect of plant life upon the humidity of our atmosphere, as this substance in due proportion is very essential to an equable and salubrious climate. Were it not that the atmosphere was properly moistened so as to intercept nocturnal radiation from the earth, our cereals and other products of husbandry as well as vegetation generally, would greatly suffer if not be entirely destroyed by the resulting frost.

It is also a noteworthy fact that the exhalation of moisture from the vast surface presented by the leaves is nearly constant even during long droughts; and when streams and shallow waters

[1] Transpiration of Plants, AMERICAN NATURALIST for March, 1878.

have dried up, evaporation from the soil outside the woods has almost ceased, transpiration continues unremittingly to furnish atmospheric moisture in order to keep as nearly as possible a uniform proportion of this important substance in the air. What an harmonious adaptation of means to an end does nature exhibit here—plant life atomizing tons and tons of watery vapor into the surrounding medium, even during time of drought, and this same vapor in turn protecting luxuriant vegetation from the evil consequences of terrestrial radiation. Moist air during winter tends to moderate extreme cold, during the summer, on the contrary, it tends to cool the draughts, hence forests by moistening the air in summer give us cool and delightful breezes; another means by which forests affect extremes of temperature.

This brings us face to face with the old question, do forests, apart from their mechanical action, to any extent affect the rainfall? Be it remembered that the total annual evaporation and rainfall bear a constant relation. We do not claim for forests that they influence in any degree the general course of storms, for the latter are governed by other and more general forces. May not forests, however, influence the local distribution of rains and dews, and within certain limits and periods of time, the amount of precipitation? We have seen that during the spring and summer the amount of water yielded to the atmosphere is very nearly equivalent to half the rainfall, even at Philadelphia. Now, granting that our premises are correct, it will be conceded that a part, at least, of the water atomized to the atmosphere by a wood, is most likely returned to the surrounding country in the form of rain or heavy mists. Where is this moisture given to the air by trees condensed into rain, and how produced? It has already been stated that rain is usually formed from one to two miles above the surface of the earth, hence it follows that forests located on mountain ridges, besides strongly favoring the ascent of vapor-laden currents by a mechanical effect as already pointed out, may also have their own moisture readily condensed, owing to their altitude as well as in the manner to be presently described. It will also be remembered that in considering the mechanical action of forests, it has been stated that when not situated upon mountain ridges they are incapable of raising the vapor-laden currents sufficiently high to be condensed into rain, and this is true, but there is a notable exception to the rule that rain is produced at so great an elevation as above indicated.

The demonstrable variation in temperature of the moist air of the woods and the currents outside, and the mingling of these, doubtless reduce the temperature sufficiently to cause local precipitation. At first sight it might appear impossible that this could result in anything so tangible as rain, but we must examine this question carefully. During the warm season the temperature of the air in the forest is lower than that of the air outside, which is due in a measure to the trees intercepting the rays of the sun, causing shade, which has a cooling effect, and partly also as pointed out by Pettenkofer (*Pop. Sci. Monthly* for Feb., 1878), to the slight draught which is always caused by shade in the open air. Every one who has ever passed from the open air on a hot mid-summer day to within the borders of a forest, must have experienced with a relish the refreshing influence of the shade. Again, the temperature of the trees of a forest, and even their tops, is found to be lower than the air in the forest. This fact is easily explained: the rapid evaporation of watery vapor from the leaves, as shown by our researches, renders the action of the solar rays neutral, and their temperature is somewhat reduced. The observation has been made (according to Pettenkofer) that the trunks of trees breast high, even at the hottest time of day, are 5° Centigrade cooler than the air of the forest. Ebermayer speaks of the temperature of the trees in a forest as being always lower than the air of the forest.

As already indicated by the present researches, forests moisten the air over, in and to some extent around themselves. Now in the light of these facts may we not be pardoned for concluding that warm currents sweeping over a country and striking the cool, moist air in and above the forest, and mingling with it would have a portion, at least, of the contained moisture condensed into gentle showers, extending their beneficent influence to neighboring fields? Again, let some stray current come along of a lower temperature than the air of the forest, and the moist air over the forest would readily be condensed, since it is a well-known fact that a moist air discharges its vapor more readily in the form of rain than a dryer atmosphere. We have now seen how trees can cause local rains; it will also be observed that the rain is formed chiefly above the forest, though it may be through the influence of winds that it falls to the earth for some distance around. *By increasing the frequency of light rains, forests tend to obviate* *drought, which is of ultimate importance to the farmers' crops and vegetation in general.* It will be seen that all our deductions have been drawn largely from the known facts from observations.

The experiments of L. Fantiat and A. Sartiaux (Translation of a communication to the French Academy of Sciences, *Pop. Sci. Monthly* for June, 1875), which have come to the notice of the writer since the above has been written, are of great value as well as interest. Space is wanting to give at any length the experiments of these authors. They say: "We now made the following observations in the heart of the forest of Helatte, which embraces 5000 hectares of land. At the height of about six meters (say twenty feet) above a group of oaks and hornbeans eight or nine meters high, we placed a pluviometer, pscychrometer, maximum and minimum thermometers, and an evaporometer, so as to ascertain at that point the amount of rainfall, the degree of saturation of the air, and the rate of temperature and evaporation. In open air at a distance of only 300 meters from the forest, and at the same height above the ground as in the former case, we placed similar instruments under the same conditions. With regard to the rainfall and degree of saturation, the observations for six months showed the total rainfall to be 192.50^{mm} in the forest and $177.^{mm}$ in the open air, difference in favor of the forest, 15.50^{mm}. The degree of humidity for the open air showed a mean of 61.7, and in the forest 63°, difference in favor of the forest, 1.3°." These investigations are, in a measure confirmatory of my own.

Forests produce abundant dews. The formation of dew is dependent on two conditions, the radiation from objects near the earth and a certain proportion of moisture in the air. Just as in the case of the production of rain, the moister the air the more readily is dew formed, it requiring a less reduction of temperature, hence when the moistened atmosphere in the vicinity of a forest comes in contact with the night air, dew in abundance is the result. Having shown that the temperature of the trees, their leaves and the atmosphere in the woods is several degrees lower than the air without, it may be inferred that dew is frequently formed during the day in the shade, and, perhaps, over the forest, particularly when the atmosphere is tranquil or when there are but slight breezes, shedding its silent enlivening influence to fields and valleys round about. This is another office on the part of forests not by any means to be despised, since heavy dews are often very refreshing in their effect upon vegetation, and doubtless add to the fertility of the soil in many instances. It is an observation worthy of note, too, that in some parts of the globe nearly all the moisture that reaches the earth is in the form of dew, *e. g.*, Egypt and Arabia.

It should be recollected that the action of forests, in every aspect considered, is more or less local in character. It follows, therefore, that the local distribution of woods is of the utmost importance. Our investigations likewise show the necessity for forest culture in regions where a proper proportion (from twenty-five to thirty per cent.) does not exist for their real benefit to the climate, while on the other hand they exhibit with equal force the folly of the ravages of the woodman's axe in destroying our primitive forests.

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GLACIAL MARKS IN LABRADOR.

BY A. S. PACKARD, JR.

THE engraving[1] illustrating this article, brings out clearly some of the characteristic features of the scenery of the coast of Labrador. In the foreground the rocky shore of the Horsechops, as the deep fiord is called, which is situated far up on the eastern coast of Labrador, has been ground down, smoothed and polished by the great mass of land ice which formerly filled Hamilton bay and moved slowly down from the table-land in the interior, and whose ice front must have presented to the sea a wall, perhaps 500 to 1000 feet high, at the end of which was probably a submarine bank or terminal moraine like those known to exist at the present day on the coast of Greenland and Spitzbergen.

Across the fiord on the shores of the bay, which rise abruptly in great rocky terraces—also a characteristic feature of Labrador and Arctic landscapes—may be seen scattered snow banks, which linger on these shores as late as August, while those in the more shaded, protected places may live on until the early snows in September give them a renewal of life, so that their existence may become perennial.

[1] From a photograph kindly presented to the author by William Bradford, Esq. The writer here acknowledges, with pleasure, the many facilities and kindnesses received during a voyage with this enthusiastic artist to the Labrador coast in 1864.

In this inhospitable, rigid climate, where the Arctic current passing out of Baffin's bay presses against the coast, bearing on its surface an almost continuous expanse of floe ice, forming a belt perhaps 500 to 1000 miles long by from fifty to sometimes one hundred miles wide, the temperature of the Labrador coast north of Belle isle is kept down to the average annual of 32° Fahrenheit, so that the climate of the more exposed parts of the coast of Labrador, particularly the capes and islands, is nearly identical with that of Southern Greenland. Indeed, many of the insects, the birds and mammals, as well as the flowers, are the same as those of Greenland.

At the head of the bays and fiords, where the soil is protected from the chilling influences of the damp easterly winds which blow inland over the belt of floe ice fringing the coast, the spruces attain a growth some twenty and thirty feet in height, and the flora and fauna is, in general, more like that of the region lying near the limit of trees in the interior of British America.

On the left side of the foreground is a hut of some squalid fisherman's family, built of hewn spruce logs, banked up on the sides and with the roof partially covered with sods from the wet peaty soil. Judging from the houses of the Labrador fishermen we have entered, the interior is as dark and dismal, as forbidding and comfortless as can well be imagined, though this is not true of many of the homes of the Labrador folk.

Now the question arises, why may not this smooth, polished rock-surface have been made so by the floating ice borne down by the strong Labrador polar current, which flows past the coast at the rate of three or four knots an hour? That it had been done by land ice moving down the bay from the interior, we have been able to prove by our observations at "Indian Tickle," a deep, narrow fiord separated by a point of land from the northern side of Hamilton bay, or Invuctoke inlet. A "tickle," to use the language of the Labradorian, is any deep, narrow bay, just wide enough to admit of a vessel's passing through it. The shores of the Indian tickle presented much the same appearance, for here the Domino quartzite, very smoothly worn and polished, in places capped by trap overflows, runs under the water to the depth of about thirty feet, forming a polished and smooth bottom to the harbor. The marks we observed, and which proved conclusively to our mind the course taken by the ice, occur about twenty-five feet above the water's edge, and below the line of lichens, which are probably kept at a distance by the sea spray.

Here on the polished and smooth shore, somewhat like that represented in Plate III, we observed a number of remarkable lunoid furrows (Fig. 1). These crescent-shaped depressions ran at exactly right angles to the course of the bay, and were from five to fourteen inches broad by three to nine inches long, and the depression was deepened in the hollow of the curve, for

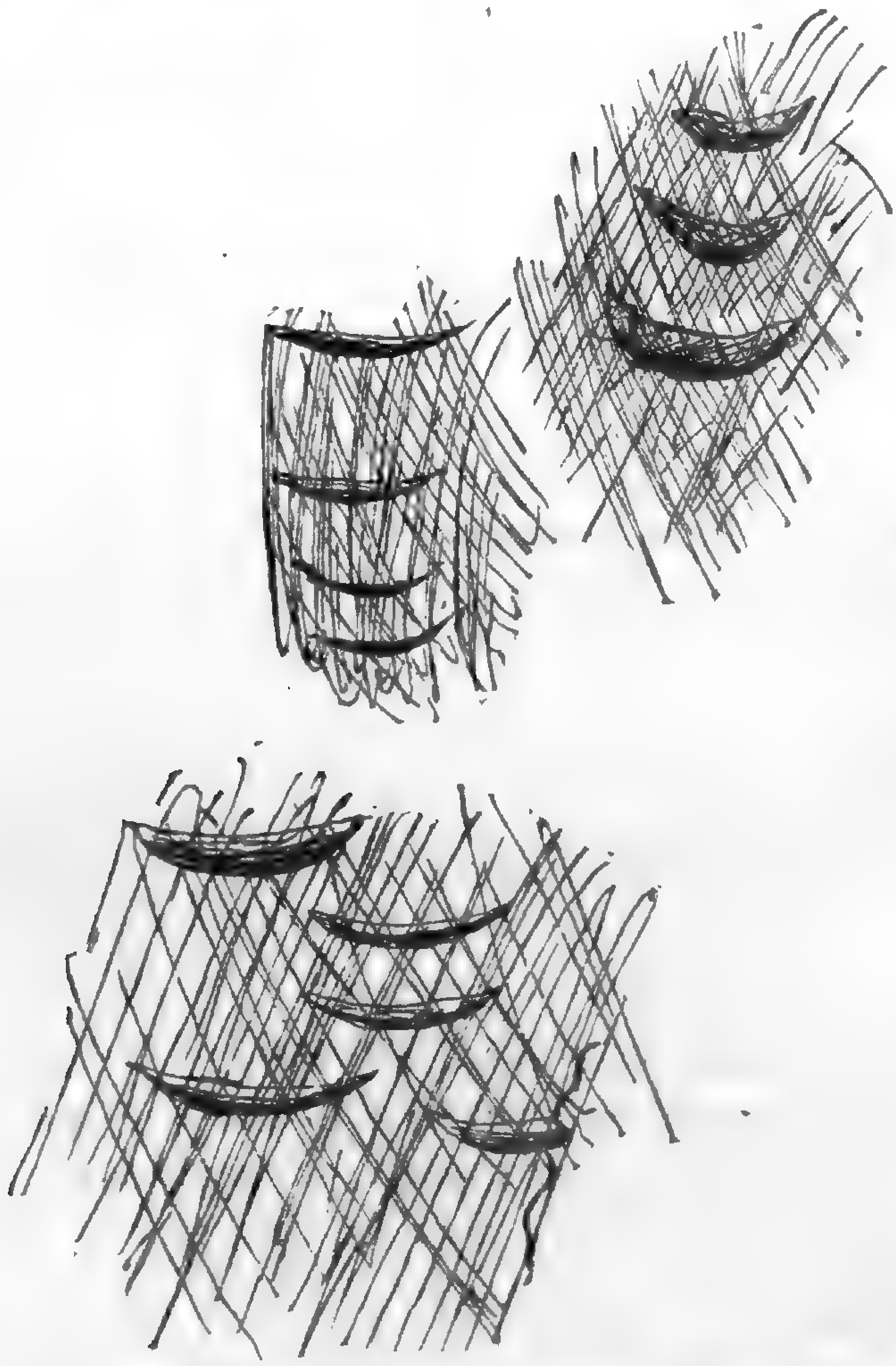

Fig. 1.—Glacial lunoid furrows at Indian Tickle, Labrador.

about an inch. Their inner, or concave, edge pointed south-west, the bay running in a general S. W. and N. E. direction. They were scattered irregularly over a surface twenty feet square. Where several followed in a line, two large ones were often succeeded by a couple one-quarter as large, or *vice versa*. Also at Tub island on the southern side of Hamilton bay, similar markings, though less distinct, occurred about the same distance above the sea, and on a similar polished quartzite.

These marks agree precisely with a number of lunoid furrows which I have observed on a shoulder of rock near the summit of

Mount Baldface, in the White mountains, which is 3600 feet high, and at other points in the White mountains, where I could observe the course of the ancient glaciers by trains of boulders and also by glacial grooves. These peculiar lunoid furrows are evidently made by rounded boulders freezing into the bottom of the glacier; the stone being thus frozen solidly into the ice, serves as a rude gouge, wearing out a crescent-shaped depression. The succession of several such furrows appears to be the result of the stone's slipping from the ice and turning over and becoming frozen in again during the advancing and receding motions of the glacier.

The presence, then, of these furrows is good evidence that the ice moved down the bay seaward. They could not have been made by floe ice, as the polar current flows along the coast at right angles to the direction of the bay, while it also appears that similar marks are abundant on the summits of some of the White mountain peaks. In a future paper I shall have more to say of glacial phenomena in Labrador.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The intelligent press of the country is gradually adopting the position taken by the NATURALIST, in its August number, on the question of the insanity of Guiteau, the murderer of President Garfield. This is, that whether legally insane or not, the mental condition of the prisoner falls within the boundary-line of insanity.

This was simply an adaptation of the well known views of Herbert Spencer and Dr. Maudsley. It is to be hoped that a full investigation of Guiteau's case will lead to an important modification of the legal definition of insanity, and of the laws relative to the treatment of insane criminals. In the first place, the present definition, which only admits insanity where the criminal is unable to judge of the consequences of an act, is certainly erroneous. Persons undoubtedly insane often act with deliberate design, and great forethought. It would be a safe, though not a perfect definition of insanity, to describe it as a state of mind in which acts are committed, which are in direct opposition to the plain and obvious interests, not of persons affected by the act, but of *the actor.* Here the question of the ignorance of consequences is restricted to its legitimate field, the instinct of self-preservation, through which the rational faculty has originated. It is another way of stating that the emotional or sentimental elements of character have so far overcome the rational as to cause the commission of self-destructive acts. Under this definition an act of violence committed in savage society would not indicate insanity, while the same act committed in civilized society, where means of detection and punishment abound, would be properly regarded as that of an insane person.

In such a classification, criminals are those who disregard the rights of person and property with a *reasonable* expectation of advancing their own interests thereby.

Benevolence is not an indication of insanity, for it is only a reflection of self-interest over others, and is often an expression of the most elevated form of self-interest. True reformers are not insane, but religious enthusiasts may easily be so. The former have a definite idea of practicable methods of advancing the true interests of mankind; while the methods, or aims, or both, of the insane enthusiasts, are at best useless and impracticable. But that the one class graduates into the other, is incontestible.

In the imposition of bodily restraint on the insane, reference will of course be had to the quality of the act, precisely as in the case of the sane. The nature of the act being established, the question now standing in the statutes as to the capacity of the criminal to comprehend the consequences of his acts, would well be considered. He who, with deliberate intent, violates the rights of person and property, is more dangerous to the community, than he who does so as an incidental effect of his aberrations.

The punishment of the former, should be like that of the sane criminal, designed to protect society in two ways; firstly by restraining the criminal himself from inflicting further injury; and secondly, by furnishing persons in the community of similar mental constitution with reasons for believing that it is contrary to their interests to commit like acts. In this way the law would furnish such insane with motives which would produce a change in the balance of the mind, the result being sanity. The punishment of death is as proper in such cases as in that of sane criminals of corresponding grade. The death penalty might even be necessary in the case of that lower grade of the insane who do not understand consequences. In this case the only object sought is the protection of the community, for motives are less operative with these than with the higher class of the insane. In either, the question of moral responsibility is omitted from consideration, as being beyond the range of human knowledge.—*C.*

—— The numbers of the AMERICAN NATURALIST for 1881 were issued on the following dates: January, December 31st, 1880;

February, January 25, 1881; March, February 24; April, March 25; May, April 16; June, May 19; July, June 22; August, July 27; September, August 23; October, September 23; November, October 28; December, December 3.

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RECENT LITERATURE.

MIVART'S THE CAT.[1]—The principle underlying the method of modern scientific, particularly biological study, is to examine one animal thoroughly, in order to lay the foundation for further advanced and more comparative studies. So we have books devoted wholly to the anatomy of a few common animals, typical forms, as the frog, the butterfly, or as in the present work, the cat. The tendency is thus to extreme analytical and special views, and such books should be of course used with the understanding that the student will never make a broad, philosophical naturalist unless his studies be made comparative. But it is better to thoroughly know all that can be learned from one kind of cat, than to have a superficial knowledge of cats in general, or mammals at large. Cats are very unequally distributed, and there is always a superfluity of material in our cities, so that the incipient medical student need not lack for material for dissection preliminary to his laboratory practice on the human cadaver. For this class of students this book is all important, while it is also designed for use in colleges and higher schools, or those beginning the study of zoölogy, as an introduction to the study of vertebrate animals.

After describing clearly and simply, with the aid of abundant and most excellent wood engravings, the skeleton, muscles, organs of alimentation, circulation, respiration and secretion, of reproduction, the nervous system, with the physiology of these organs in sufficient detail, a full and adequate account is given of the cat's development.

This important subject appears to be well treated, and is, in part, the result of the author's own observations, a number of the diagrams and illustrations having been prepared for this work.

These chapters occupy about two-thirds of the book, and are succeeded by chapters on the psychology of the cat, and on the different kinds of cats; while the work closes with essays on the cat's place in nature, the cat's "hexicology," or its relations to the world about it and to fossil cats, and finally, Professor Mivart gives us his opinions as to the pedigree and origin of the cat.

In his discussion of the nature of the cat's mind, the young student will be liable to be unduly biassed by Mr. Mivart's dog-

[1] *The Cat.* An introduction to the study of backboned Animals, especially Mammals. By ST. GEORGE MIVART, Ph.D., F.R.S. With 200 Illustrations. New York, Charles Scribner's Sons, 1881. 8vo. p. 557. $3.50.

matic method of teaching a subject which needs great candor and liberality of thought, as there is a great difference of opinion among naturalists concerning the subject of animal psychology, and the student should, at the outset, know that the entire subject is unsettled, and that there are two predominant schools of thought. If he knows this, and that the matter may eventually be somewhat understood by future work, he will, perhaps, be led to make for himself new discoveries and observations on the habits and mental traits of animals, and gain clearer views of the entire field of comparative psychology. To make the *ex cathedra* statement that instinct is a "special faculty," or "a power of blindly performing appropriate complex acts, by seemingly voluntary actions in response to felt stimuli," and then in footnotes to attack what he deems the "very singular views" of Mr. Herbert Spencer and Mr. Lewes, as if they were alone in attempting to reason out the probable origin of instinctive acts; this, we contend, savors of dogmatism and onesidedness, and it seems to us that in an educational book of this sort both the old and the new views should be given to the student, who is supposed to have arrived at years of discretion, and to be able, in a degree, to judge for himself between conflicting theories.

Mr. Mivart also insists, as if it were a matter of course, that an animal "is really the theatre of some unifying power which synthesizes its varied activities, dominates its forces, and is a *principle of individuation.* There would seem to be here present, a vital force or principle which has no organ except that of the entire body within which it resides," etc. Now considering that a large number of biologists do not adhere to the old notion of a "vital force," we think the author should have stated both views fairly, giving in his adherence to whichever he may prefer. With the remaining portions of this chapter we agree, and the discussion concerning the nature of the cat's mind is a clear and interesting one.

Our domestic cat is probably a descendant of the old domestic cat of Egypt, which is mentioned in inscriptions as early as 1684 B.C., and was certainly domesticated in Egypt 1300 years before Christ. From Egypt the cat must have been introduced into Greece, while a fresco painting of a domestic cat was found on the wall of a Pompeiian house; although the late Professor Rolleston has suggested that the domestic cat of the Greeks was the white-breasted marten. The domestic cat is probably the descendant of the Egyptian cat *(Felis maniculata)*, a native of Northern Africa.

It is a pity that among the excellent drawings of different species of cats given us in this book, a good representation of the Egyptian cat should not appear.

In this chapter the different kinds of cats are described, and many of them illustrated in an excellent way, among them the

Figs. 1, 2.—External form of Wild Cat and figure of the Skeleton, showing the relations of the latter to the external form.

wild cat of Europe, and the northern lynx, of which the North American *Felis canadensis*, *F. rufa* and *F. maculata* are considered as varieties.

There are, in Mivart's opinion, fifty species of living cats, but he thinks that some of these may turn out to be mere varieties, and some forms regarded in this book as varieties, may possibly prove to be really distinct species, especially when we consider the South American spotted cats, the ocelots and margays, as well as the smaller cats of China and neighboring regions.

The fossil species are then considered, especially those from the Tertiaries of France and North America, made known to us by Gervais, Filhol, Cope and Leidy.

In the discussion on the cat's place in nature, after a too long

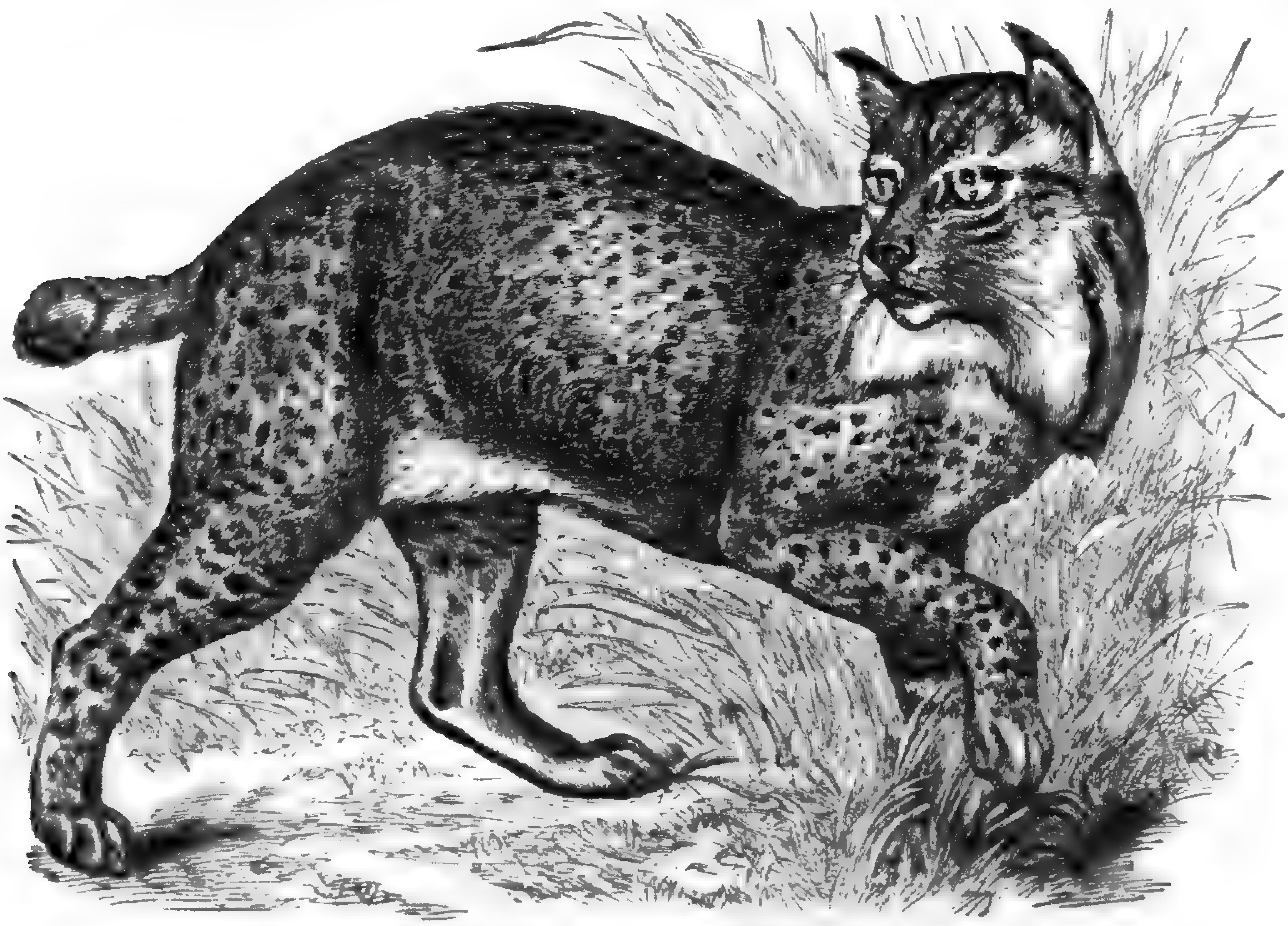

FIG. 3.—The Northern Lynx, var. *Felis maculata*.

effort to show that the cat is not a plant, but an animal and a carnivorous one, the author reasons by exclusion, and shows, what nobody will dispute, that the cat's place in nature is as "a member of the typical genus of the typical family of carnivorous placental mammals," mammals being what our author somewhat clumsily terms "the suck-giving, tied-brained class of back-boned animals."

The fourteenth chapter is on "the cat's hexicology." The gentle reader is here informed that this is not a new organ or quality of the cat, but simply is a word coined by the author and substituted for what seems to us a much better expression, the study of the environment. The study of all the "complex relations to time, space, physical forces, other organisms, and to surrounding conditions generally, constitute the science of *hexicology*." But if the author is so far constrained, from motives of prudence in dealing with scientific names to the uninitiated as to use "back-boned animals" for vertebrates, and the term "suck-giving" for mammalian, why does he take away the layman's breath by proposing the term *hexicology*, when we are only just getting used to the much better term environment?

But notwithstanding the formidable name at the head of the chapter, the essay itself is quite interesting, and serves to introduce us to the more valuable and interesting one on the pedigree and origin of the cat. In this essay all that has been learned of the cat's structure and development, and of cats and carnivora in general, is brought to bear upon the question of the origin of the species, and family, and order. In answer to these questions, the author, adopting the results of French and American palæontologists, states his belief that the cat has originated from the cheetah, and the Felidæ in general from some Viverrine animal, while the carnivora may have descended from *Arctocyon*, the oldest Tertiary mammal, and contrary to the views of some, our author derives the carnivora from the insectivora, rather than the marsupials. As to the method of evolution, Mivart stands out from most other English evolutionists as a believer in sudden or saltatory evolution as well as slow, gradual development of species, his views in a general way agreeing with those of several American writers on this subject. This last chapter is certainly an able and interesting discussion, and the entire volume is the work of an expert comparative anatomist, and of a strong, able, facile writer.

THOMAS' FIFTH REPORT ON THE INJURIOUS INSECTS OF ILLINOIS.[1]—In its typographical appearance, as well as general usefulness to the farmer or gardener, and interest to the entomologist, this report appears to us to be somewhat in advance of its predecessors. The longest article is on the army worm, and is a critical discussion of known facts regarding its natural history, some points of which still remain to be cleared up. Professor Thomas suggests as the result of his meteorological studies in connection with this insect and the chinch bug, that two favorable seasons are necessary to develop these insects in injurious numbers. The time is coming when by a study of climatic changes, we shall be able to predict, with some degree of certainty, the coming of injurious insects. This has already been in part worked out as regards the Rocky Mountain locust, and in this connection the suggestions and facts in the chapter of the present report on "the relation of meteorological conditions to insect development" is timely and valuable. Enough is now known of the periodicity in life of the more injurious insects to indicate that the Hessian

[1] *Tenth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* Fifth Annual Report by CYRUS THOMAS, Ph.D., State Entomologist. Springfield, 1881. 8vo, pp. 244.

fly is most abundant in rather wet and moderately warm seasons; while warmth appears to be the chief element in developing the Aphides or plant lice, some species being more favored by a humid atmosphere, while others develop more rapidly in a dry season. "The cut-worms are developed more abundantly in such seasons as increase the army-worms, which in their normal habits are but cut-worms, massing in armies and migrating being really an abnormal condition in their history. Observation shows, as heretofore stated, that, as a general rule, those species which occasionally develop in such vast numbers require for this purpose two consecutive seasons, though the character of the seasons for the different species differ somewhat. That is to say, those which bring out one species are not the ones which bring out another. As examples of the correctness of this statement I have only to refer to the migratory locusts, the chinch bug, as heretofore shown, the Hessian fly, the army-worm, etc. The locust and the chinch bug require the same kind of seasons, that is, two successive dry years, the latter warm as well as dry; consequently, when two such seasons prevail generally over the Northwest, both species are apt to appear, as was the case in 1874. But the case is different with the army-worm. This requires a dry summer and fall, and I am inclined to believe also a dry winter, followed by a cool and rather damp and cloudy spring. The two most noted years of its appearance in this State were 1861 and 1875, each of which followed a preceding dry year, but in neither case was the year in which it appeared warm, 1861 being one of average temperature, and 1875 rather cold. The latter, which is the only one for which we have the records of the different seasons, was more than usually damp in the spring and summer." Some meteorological tables are given in illustration.

These chapters are followed by a descriptive catalogue of larva; that of the caterpillars of butterflies being compiled by Miss Nettie Middleton, that of the Sphingidæ, Ægeridæ and Bombycidæ by Mr. John Marten, while a chapter giving original notes on caterpillars is contributed by M. D. W. Coquillet. The Report closes with a reprint of Bulletin 4 of the U. S. Entomological Commission on the Hessian fly, by A. S. Packard, Jr.

Walcott on the Organization of Trilobites.[1]—In this essay Mr. Walcott brings together the results of much patient labor in preparing sections and studying them with a view to settle the vexed question as to the nature of the limbs of the trilobite. The results are as follows: No antennæ have been discovered; but "four pairs of manducatory jaws, formed by the basal joints of the four anterior pairs of appendages," which "have a general structure similar to the cephalic legs of Limulus and Eurypterus."

[1] *The Trilobite:* New and old evidence relating to its organization. By C. D. Walcott. Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. VIII, No. 10. Cambridge, March, 1881.

Mr. Walcott also feels "justified in stating that there is a series of jointed legs extending from the cephalic shield beneath the thorax and pygidium to the posterior segment of the latter; that, as far as known, they were ambulatory, and formed of six or seven joints; that to the basal joint there was attached an epipodite and branchia; and that, from the proof we now have, there is little doubt but that the appendages beneath the pygidium did not vary essentially from those of the thoracic region. They may have terminated in a slender filament, or filaments, as but three joints have been seen in any one appendage." We congratulate the author on the success of his long-continued efforts and well-directed labors; he has fully demonstrated that Trilobites have slender jointed limbs on the general plan of those of Limulus, and not phyllopodous ones; while he has also shown that the branchiæ were also attached to certain of these limbs, though we may not be satisfied with his interpretation of the nature of these gills, and wait for further light on this extremely difficult point. His restoration of a Trilobite will be useful, although it does not seem entirely natural, but yet may express the results of Mr. Walcott's work thus far. He has settled, however, in an admirable way, the general nature of the appendages of the Trilobite, and is entitled to the thanks of palæontologists.

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The Honey Ants of the Garden of the Gods, and the Occident Ants of the American plains. By Henry C. McCook, D.D. 8vo, pp. 180, 13 plates, bound. Philadelphia, 1881. From the author.

On certain Cretaceous Fossils from Arkansas and Colorado. By C. A. White. 8vo, pp. 6, 1 plate. Ext. from Proc. Nat. Mus., 1881. Washington 1881. From the author.

Extra Census Bulletin. The areas of the United States, the several States and Territories, and their counties. By Henry Gannett, E. M. 4to, pp. 20, map. Government Printing Office, Washington, 1881. From the author.

Illustrations of a Law of Evolution of Thought. By Joseph LeConte. 8vo, pp. 20. 1881. From the author.

The Kames of Maine. By George H. Stone. 8vo, pp. 38, map. 1880. From the author.

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——.o.——

GENERAL NOTES.

BOTANY.[1]

Mimicry in Fungi.—"Instances of mimicry are not rare amongst fungi. They are more frequently attractive than protective mimicries. They may be of vegetable, of animal, or of excrementitious substances, either as regards external appearance, or as regards odor. The main object of these mimicries is the attraction of insects, the advantages of which to plants are: (1), either fertilization of hymenomycetous spores by co-specific spermatia from other individuals, or by the transportation of spores from the hymenium of one fungus to that of another, or perhaps increased germinative energy to the spores is obtained by the admixture of other co-specific spores without the element of sexuality; (2), the diffusion of the fungus spores by insects as well as by the larger animals."—*Grevillea.*

Simblum rubescens Gerard, in Iowa.—Two years ago W. R. Gerard described and figured a new species of fungus in the *Bulletin of the Torrey Botanical Club.* It was discovered on Long Island, and was found to be a species of Simblum, a genus of the Phalloidei, the Stink-horn family. No species of Simblum had previously been known to exist outside of the tropics, *S. periphragmoides* occurring in the Mauritius islands, *S. gracile* in Ceylon, *S. flavescens* in Java, *S. pilidiatum* and *S. sphærocephalum* in South America. Such being the distribution of the known species, it must be regarded as remarkable that one should be found in North America, and Mr. Gerard was justified in questioning whether his specimens might not have grown from spores or mycelium brought in ballast from the tropics, especially as we understand they were found at no great distance from "ballast dumpings."

This question is settled, however, by its discovery in Central Iowa in October of the past year. A dozen or more plants were found in a field by C. L. Spencer, a student in the Agricultural College. Good specimens were secured and placed in alcohol for study in the laboratory. In only one particular do the Iowa specimens disagree with the description given by Mr. Gerard. To our plant Schlechtendal's remark as to the odor of an allied species *does* apply very forcibly, for it certainly does "stink fürchterlich."

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

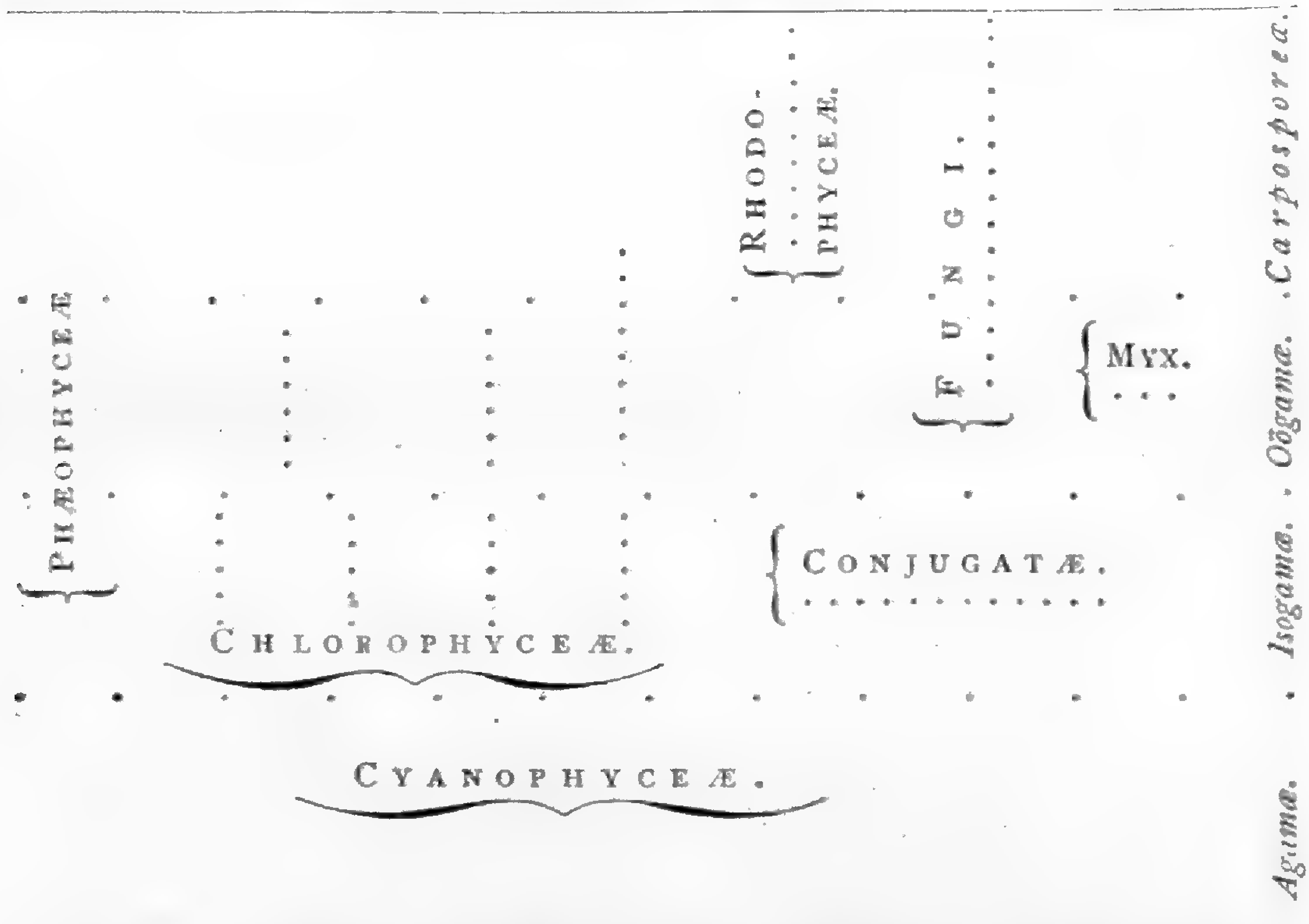
THE ASPARAGUS STEM FOR LABORATORY STUDY.—This plant affords as interesting and instructive an example of the stem of Monocotyledons as the now generally used pumpkin stem does of the Dicotyledons. It is so common that every botanical laboratory can be supplied with it, and its early appearance, and long-continued growth make it possible to secure fresh specimens during many months of the year. The new shoots, such as are sold in the markets, if placed in alcohol afford good material for study, although we have found it a better plan to make all the sections we wanted of fresh stems and then to preserve these sections in alcohol. Thus some cross and longitudinal sections of the very young stems we made early last year are still in most excellent condition for study. Not the least interesting feature of the asparagus stem is its provision for increasing its diameter by the subsequent formation of fibro-vascular bundles in a sub-cortical meristem zone. This will afford material for much careful study on the part of students in the laboratory.

THE ABUNDANCE OF FRESH-WATER ALGÆ.—The excessively wet autumn in Central Iowa caused an unusual growth of fresh-water Algæ. Every pond and ditch was filled with *Spirogyra*, *Zygnema*, *Vaucheria*, etc., until the first of November. Usually our waters are nearly barren of these growths so late in the season, but this year the continued wet weather, instead of the usual drouth, favored their development. The same causes doubtless produced the unusually large amount of autumn blooming of our spring flowers which was noticeable at the same time.

THE SYSTEMATIC ARRANGEMENT OF THE THALLOPHYTES.—If we except England and America, where a morbid conservatism seems to prevail, there has been a great deal of activity recently among botanists with reference to a better arrangement of the plants lying in the great region below the mosses, and to which Endlicher gave the name of the Thallophyta. Thus Cohn, in 1872, published in *Hedwigia*, an outline of a classification, in which the old groups Algæ, Fungi and Lichenes were no longer maintained in their integrity. Shortly afterwards (in 1873) Fischer proposed an arrangement which bears a striking similarity to Sachs'. These two are briefly given in our "Botany for High Schools and Colleges," and need not be repeated here. Sachs' now famous arrangement was published in the fourth edition of his *Lehrbuch*, which appeared in 1874. This has been somewhat modified by various authors, notably by Professor A. W. Bennett, who, in 1880, proposed to restore the groups (classes) Algæ and Fungi, subdividing them, however, into sub-classes by making use of Sachs' structural characters. This was republished in the NATURALIST for January, 1881.

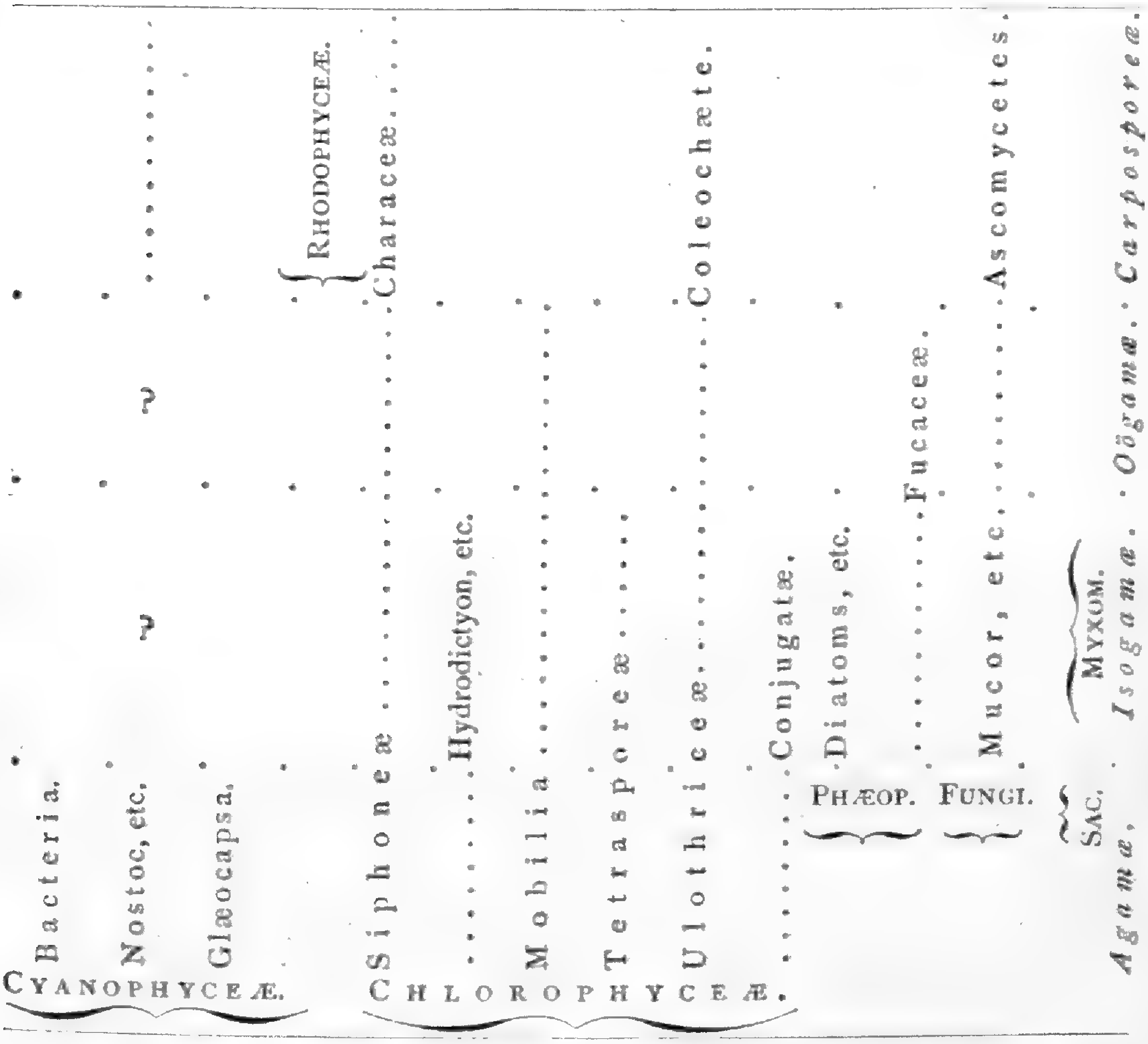
De Bary, in January of the present year, published in the *Botanische Zeitung* a scheme of a systematic arrangement of the

Thallophytes, involving some interesting points. In this seven classes, viz: the Cyanophyceæ, Chlorophyceæ, Conjugatæ, Phæophyceæ, Fungi, Myxomycetes and Rhodophyceæ, are recognized. These classes are regarded as genetic groups, which often include plants of very different structural rank. The Cyanophyceæ are thus all Agamæ, while the Chlorophyceæ are, for the greater part, Isogamæ, with three of its five branches extending into the Oögamæ, and one into the Carposporeæ. Phæophyceæ originating in the Isogamæ, extend into the Oögamæ; similarly the Fungi, which have their origin in the Oögamæ extend into the Carposporæ. The Conjugatæ are all Isogamæ, the Myxomycetes all Oögamæ, and the Rhodophyceæ all Carposporæ. Thus it is seen that De Bary has attempted to retain the integrity of the groups which European algologists have generally recognized, and at the same time to make use of Sachs' structural classification. It may be understood from the following diagram:



Cohn's later attempt was sketched in the June NATURALIST of the past year, and Caruel's in the October number. We have now another (*Bot. Zeitung.* Aug. 12, 1881) by Christoph Gobi, curator of the Herbarium of the University of St. Petersburg. This last bears a close resemblance to De Bary's in that Sachs' system is preserved for indicating structural rank; thus we have the Agamæ (Protophyta of Sachs), Isogamæ (Zygosporeæ of Sachs), Oögamæ (Oösporeæ of Sachs) and the Carposporeæ; further, the genetic series (or classes) include plants of different structural rank, the Cyanophyceæ being mostly Agamæ with a doubtful higher representation, the Rhodophyceæ all Carposporeæ, the

Chlorophyceæ and Fungi, each including the four structural forms, and the Phæophyceæ some Agamæ, Isogamæ and Oögamæ. The Saccharomycetes and Myxomycetes are outlying groups, respectively, of the agamic and isogamic Fungi. The following diagram will serve for comparison with the preceding one:



Gobi, after remarking upon the inappropriateness of the name Thallophyta, and the difficulty of fixing upon such characters as will set off distinctly the plants of this group from those of all others, suggests the new name of Glœophytæ, from the slimy nature of most of the species. We trust that this new name will not be adopted, for while there can be no exception taken to Gobi's criticisms upon the use of the term Thallophyta, the real difficulty lies in the attempt to combine in one great group, plants which have too many structural differences. In our opinion, the Thallophytes include several distinct grand divisions of the vegetable kingdom, just as the Cormophytes do. Old names generally live long after their usefulness has ceased, as witness Cryptogam, Endogen, Exogen, and in zoölogy the term Invertebrata, and doubtless it will be many years before we shall be rid of Thallophyta, but certainly we should not now add another to the long list of those which are to be forgotten.

It is significant that in all these recent attempts at a methodical disposition of these plants, the lichens do not appear as a distinct class, but are placed with the Ascomycetes (fungi), being regarded by most as an order of this class. This indicates the pretty general acceptance of Schwendener's views as to the nature of lichens, or, at the least, of some very considerable modification of the old view.

There are hopeful indications of a gradual settling down upon nearly the lines of demarkation first roughly drawn by Sachs. It may be that Sachs' names will not be retained, and, indeed, it may be questioned whether some of the more recently suggested ones are not preferable. However, we prefer Protophyta to Agamæ, while Isogamæ and Oögamæ are certainly not much preferable to Zygosporeæ and Oösporeæ. Zygophyta, Oöphyta and Carpophyta would be better in many respects than any yet suggested.

The Slime Moulds (Myxomycetes) sadly puzzle the botanists. Their old position near the puff-balls (in the Carposporeæ) they have hopelessly lost, while their right to a place in the Oösporeæ (De Bary) or the Zygosporeæ (Sachs and Gobi) is exceedingly doubtful. We agree with Fischer, Bennet and Caruel in placing them in or near the Protophyta. In view of Saville Kent's recent endeavor to show the animal nature of Slime Moulds, it may not be amiss to repeat here the remark made by us two years ago. "It is by no means an improbable hypothesis that in the Myxomycetes we have the *terrestrial phase* and in the Monera the *aquatic phase* of a common group of organisms. The Myxomycetes are not Monera, but they are moneran in their structure, and probably also in their affinities. All the differences between the Myxomycetes and a Moner like *Protomyxa*, for example, are probably referable to the terrestrial habit of the former as contrasted with the aquatic habit of the latter." ("Botany for High Schools and Colleges," p. 207, foot-note.)

In Bennett, De Bary and Gobi's systems the greatest emphasis is placed upon what may be called genetic relationship, as distinguished from structural relationship. That some account must be taken of genetic relationship in any system of classification needs no argument in these days, but this must not be to the exclusion of structure, and evident structural affinities, lest the prime object of all classification be defeated.—*C. E. Bessey.*

Electric Light and Plant Growth.—Dr. Siemens' interesting experiments with plants grown in electric light promise to be of great value not only to the student of vegetable physiology, but to the farmer and gardener as well. It seems to be pretty certain that in continuous light plants grow much more than when darkness alternates with light. Dr. Siemens is, indeed, led to ask whether the darkness of the night does not present a "difficulty to plant life which had to be met," by a special development, instead of affording a period of needed rest. In fact, it begins to look as if the old notion of the need of rest by a plant would have to be abandoned, or at least very greatly modified. One of the most suggestive things brought out in these experiments is the blighting effect of the light from the naked electric light. Plants so exposed became shriveled and scorched, while those situated nearer to the light, but having a sheet of glass interposed, were not so affected.

BOTANICAL NOTES.—In Professor Parker's lecture on "Biology as an academical study," published in *Nature*, there is a most excellent denunciation of the teaching of botany and zoölogy as mere classificatory sciences, and a strong plea for the "laboratory method," which he properly urges for not only the college but for the high school also. "What," says he, "would be thought of a mathematical teacher who relied entirely on lectures, and never dreamed of insisting that his pupils should apply what he had taught by working out examples for themselves? Or what of a teacher of art who ignored the necessity of making his students draw or paint? Every one sees the necessity of practical, and the uselessness of exclusively theoretical teaching in these instances, yet the fact is generally ignored that the case is precisely the same with scientific subjects."——A good service has been rendered by the editor of the *American Monthly Microscopical Journal* in the publication in his journal of the Rev. W. Johnson's "Introduction to the study of lichens." Several wood-cuts help to make the matter so clear that the beginner need have no trouble in taking up the study of these very interesting plants. ——Mr. W. H. Leggett has seen reasons for suspecting cleistogamy in the common purslane *(Portulaca oleracea)*, and asks in the October *Torrey Bulletin* for confirmation or disproof.——As showing the incomplete state of our knowledge of the plants of the world, it is significant that *seven new species* of British lichens are described in *Grevillea* for September. If species are discoverable at that rate in a country which has been so diligently worked by collectors, what may we not look for in the world at large! ——Wm. Trelease has been studying the nectar glands upon the leaves of Populus, and finds that they appear as a rule only on the first half dozen leaves of each shoot in early spring. After a long series of careful examinations, the results of which he records in the November *Botanical Gazette*, he concludes that these glands are protective indirectly by attracting ants, ichneumonids and lady-birds, which in turn serve to keep off many harmful insects and larger animals.——From a study of the flora of Madagascar. J. G. Baker ventures in the *Journal of Botany* to estimate the number of species of flowering plants alone at from four to five thousand, a remarkably high number when we consider the limited area covered by it, viz: 228,573 square miles, or a little more than three-fourths the size of the State of Texas.——Macchiati in the October *Nuovo Giornale Botanico Italiano* enumerates the orchids of Sardinia, forty-six species in all.——In the same journal, Professor Passerini continues his enumeration of the fungi of Parma. No less than thirty-two species of Peronosporeæ occur in the Parmensian flora.——The re-issue of the third series of the well-known *Botanical Magazine* is announced, by the publishers, L. Reeve & Co , London.——A second edition of Elliott's "Hand-book of Landscape Gardening" has appeared from the house of D. M. Dewey & Co., of Rochester. Botanically, its chief interest lies in the numerous very poor colored plates, the publisher has added. It is to be hoped that no horse-chestnut like the one figured in this book ever existed. There can be no excuse for such wretched plates, and for the numerous typographical blunders, which disfigure the work. However, we do not doubt, that the book may be useful to many who wish to improve their grounds.

ZOÖLOGY.

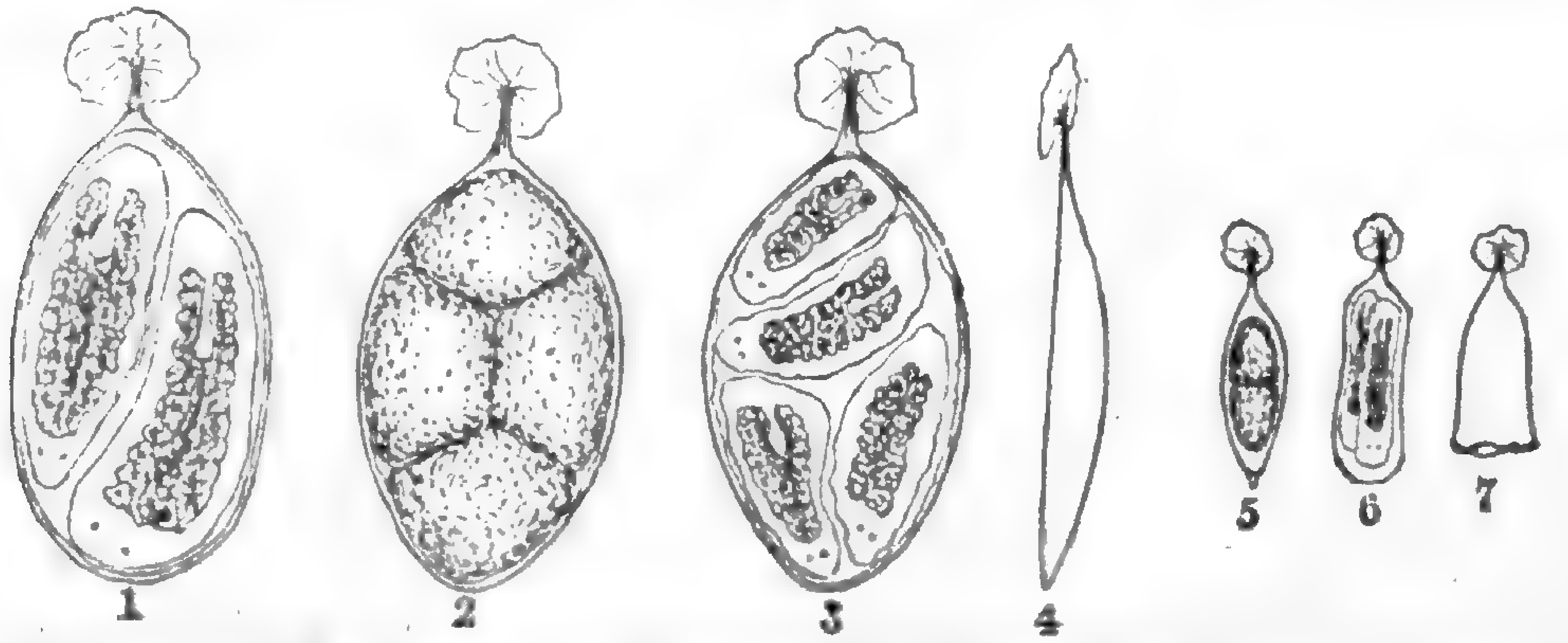
Observations on the species of Planarians parasitic on Limulus.—During the present summer, while engaged in investigating food-fishes under the auspices of the U. S. Fish Commission, near the mouth of the Chesapeake bay, a fine large female specimen of *Limulus polyphemus* was brought to me from one of the pound nets near by, into which it had strayed. Upon making an investigation of the creature's anatomy, I discovered a great number of parasitic planarian worms infesting the gills, and adhering to the leaflets of the latter were many thousands of egg capsules, in which the young worms were undergoing development. From an inspection of a numerous series of these capsules, with the aid of the proper method of sectionizing, it would have been possible to have obtained a full history of the development of the species; for such an investigation the writer was not, however, prepared, nor did he have the time for it, but from the circumstance that there was a great diversity in the size of the capsules, he believes that at least three species of these parasites make the gills of the horse-shoe crabs their nidus. That such parasites infest this animal has apparently been known for a long time. Alexander Agassiz alludes to it under the name of *Planaria angulata* Müller, and Max Schultze in 1873, at Weisbaden, described the animal before the Congress of German Naturalists, but does not appear to have published anything in their transactions. Recently Dr. Ludwig Graff[1] has discussed the subject anew and at greater length and with more thoroughness; but he recognizes but one form, which he calls *Planaria limuli.* Dr. Graff's recognition of but one species is then the excuse for the present notice,

[1] Kurze Mittheilungen über fortgesetzte Turbellarienstudien. Zoolog. Anzeiger, II, Apr., 1879, pp. 202–205.

and I take the opportunity so offered of putting my observations upon record, so as to facilitate future studies by others.

Graff says the capsules observed by him in material supplied from the Frankfurt a. M. Aquarium, by Dr. Schmidt, measured about three millimeters long by one and a half wide, which would correspond pretty nearly with the outline of the largest capsule observed by me and represented in Fig. 9. But according to him these large capsules contained from two to nine embryos, while those observed by me never contained more than one, the presumption, therefore, is, that they belong to distinct species, and that on this specimen of Limulus, *Planaria limuli* was not present.

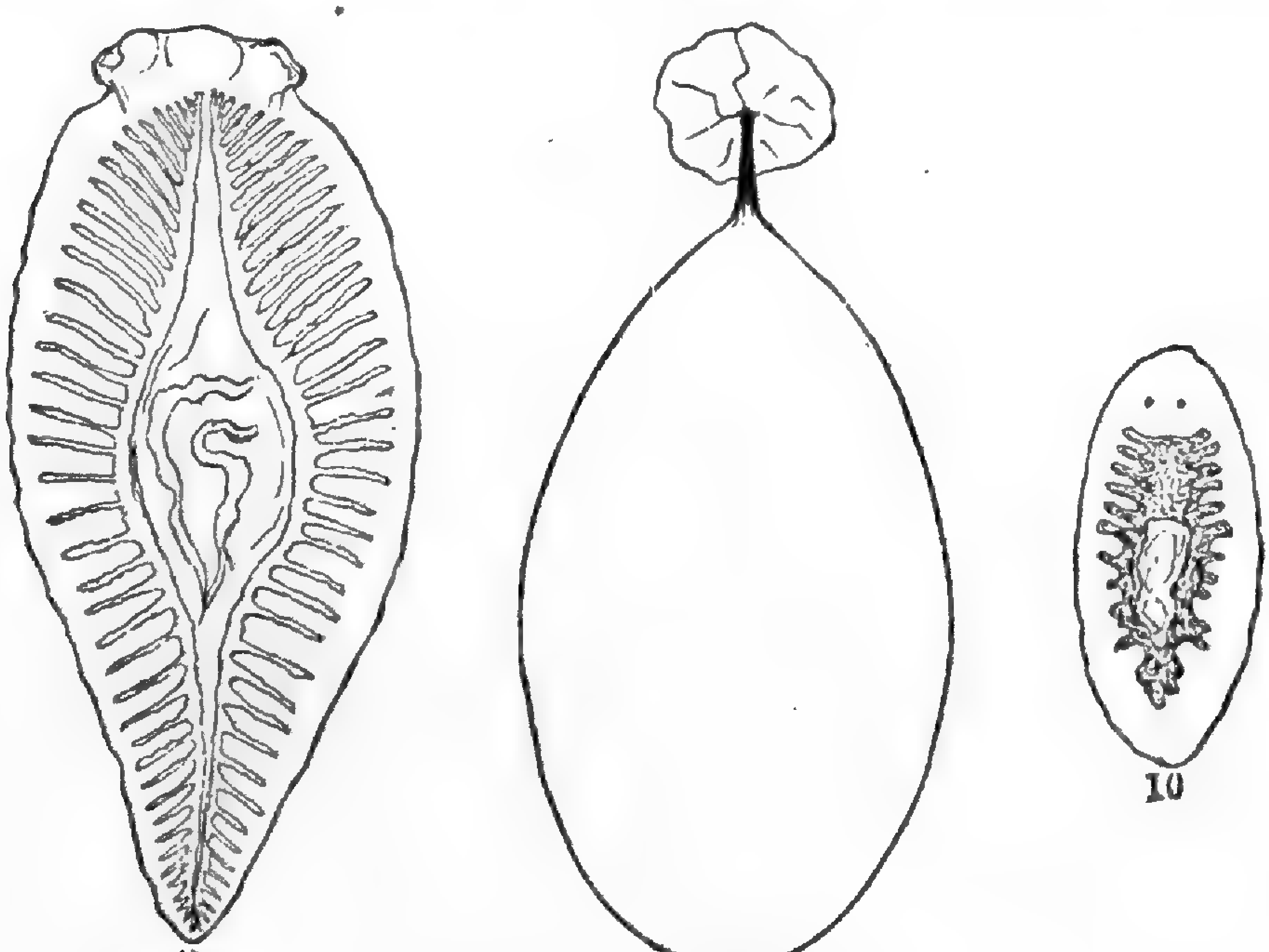
All of the capsules were apparently chitinous, and attached by a cylindrical stalk to the surface of the branchial leaflets by a disk-like expansion of the end of the stalk, as represented in



Capsules and Embryos of the Planaria of the Horse-shoe Crab; enlarged.

Figs. 1–7 and 9. In form the capsules are oval and flattened, lying down flat against the surface of the branchial leaflets with the plane side. The lower side of the capsule is flat, the upper convex, as shown in a side view, Fig. 4. When the young escape they find their way out by the free end of the capsule, which is ruptured as represented in Fig. 7. They are scattered all over the branchial leaflets and on both sides of them. The different sizes were often seen side by side on the same leaflets together with the parent worms, which, as Graff observes, had often eaten through the branchial structures. So extensive was this damage that I suspect they cannot be considered merely as commensals, but rather as true parasites, for it was frequently observed that four or five successive leaflets were eaten through in the vicinity of a large adult worm, so as to produce large irregular perforations with evidences of degeneration of the branchial tissues at the margins of the openings. That they should find it easy to feed off of their host is not to be wondered at, in that the branchial leaflets are composed of two very thin chitinous lamellæ which are kept apart by numerous rounded pillars; in the space between the lamellæ and around the supporting pillars the blood of the host circulates. In consequence of this arrangement, all that our parasites need to do in order to get at the juices of their host, is to cut through the lamella next to them and they have an abundant supply of food always at hand. It appears that Van Beneden, the elder, regards them, on the authority of A. Agassiz, as messmates, but from the foregoing recital it would appear that they are more or less truly parasitic in habit. It appears that other crustaceans are infested by planarians, and Professor Leidy has described a parasitic genus, Bdellura.

On the specimen of Limulus examined by me there were three well-marked types of egg capsules. The first, represented in Figs. 1–4, enlarged sixteen times, measured about a twelfth of an inch, or about a line, in length, and usually contained from two to four embryos. The branches of the gastric cavity are separate posteriorly in the embryos, but afterward become joined, as shown in Fig. 10, supposed to be the adult of this second form This form has a pair of eye spots developed at a very early period



8 4 10

Parasite of the Horse-shoe Crab; enlarged.

which are retained when hatched. The mode of segmentation of the eggs is very difficult to make out in the capsules, as the individual ova are very strongly pigmented, and consequently almost opaque, so that the contours of the cells cannot be discerned.

The second form, represented in Figs. 5–7, enlarged sixteen times, is much smaller but similar in structural features to the preceding. The capsules measure about one-twenty-fifth of an inch in length, and contain usually two eggs or embryos. At first the ova occupy each one of the ends of the capsule, as shown in Fig. 5, but after the young worms have developed somewhat they usually lie along side of each other lengthwise of the capsule. They frequently change positions, however, at this stage, and it sometimes happens that there is but one embryo in a capsule. The ova of this, like the preceding species are nearly opaque, and the walls of the stomach in like manner are composed of very dark granular protoplasm.

The next form of capsule observed, is that represented in Fig. 9, enlarged sixteen times, and is supposed to belong to the adult represented in Fig. 8, enlarged five and a half times. These, as stated before, were never seen to contain more than one embryo, and measure over an eighth of an inch in length. The egg is not so darkly pigmented as in the other forms. The supposed adult of this species, Fig. 8, is apparently without eyes, and the cæcal diverticula of the stomach are arranged in a paired system on either side of the median line independent of each other. The peculiar hood-like cephalic extremity may be of the nature of a sucking disk. This last form is milky white in appearance; the cæcal prolongations of the stomach, yellowish. The stomach in the other forms is dark brown, so that the two types of forms may be at once distinguished.

I do not propose to name the species, as these supposed distinct life histories may, after all our endeavors to separate them, be only phases of the same thing. Sure points of distinction can only be got by a more thorough study of these interesting types than I have been able to bestow upon them, and I leave them here in the hands of such helminthologists as may be disposed to give the subjects of this notice further attention.

I have not seen Dr. Graff's final paper, in which *P. limuli* was to be fully described and illustrated.—*John A. Ryder.*

The Circulation of Sessile-eyed Crustacea. — Dr. Yves Delage has published in the Archives de Zoologie expérimentale et générale, a superbly illustrated and detailed memoir on the circulation of the sessile-eyed Crustacea. The plates are printed in colors, so as to bring out clearly the heart, arteries, venous sinuses and veins; moreover, sections of the body are given, so that the topography of the circulatory system is given in a graphic manner. The memoir is too long for abstract, but it is one of the most valuable contributions of the past year to our knowledge of the Crustacea. The circulation appears to be on much the same plan as in the Decapods.

Viviparous Chirodota.—A Brazilian species of this genus of Holothurians, or sea-cucumbers, has been found by Professor H. Ludwig to be viviparous. The genital tubes appear to give rise to both eggs and spermatozoa, the latter being developed in their blind ends and lateral bunches. The young to the number of sixteen, and all of the same stage of development, were found lying freely in the body-cavity. They had seven tentacles, two of them minute, and in the body-wall were groups of developing or developed calcareous wheels.

A MARINE PLANARIAN AND ITS HABITATION.—In June, 1881, a very large female specimen of the common horse-shoe crab *(Limulus polyphemus)* came into my hands,[1] on the gills of which I observed a number of brown small bodies like seeds of some plant, together with living whitish worms, a dendrocœlous Planarian, the *Bdelloura candida* Girard.[2]

These worms were of various sizes, the largest (Fig. 1; side), measuring 16^{mm} in length and about 6^{mm} in width, by about 1^{mm} in thickness. They moved slowly and snail-like over the large lamellous gills, their body-margin, especially the anterior portion, having undulating motions, these being respiratory movements. On placing them in alcohol they became considerably wrinkled and contracted. The larger ones had neither cephalic notches (which occur in some members of this family), nor eye-dots. The dorsal side showed a faint line running along and close to the entire margin. A large round muscular bag occasionally protruded[3] from a little behind the middle of the ventral surface; this is the pharynx.

In alcoholic specimens a second roundish smaller opening could be seen a little behind the pharynx, the genital orifice. The alimentary system had about ten or eleven lateral sacs.

The seed-like brown bodies found together with the Planarians, I immediately took for their egg-cases, which proved to be correct upon opening some of them whence one or two young Planarians could be taken. They were of a cream color and more transparent than their parents. But strange enough, they had a pair of distinct eye-dots, which, I presume, in the adult have degenerated.

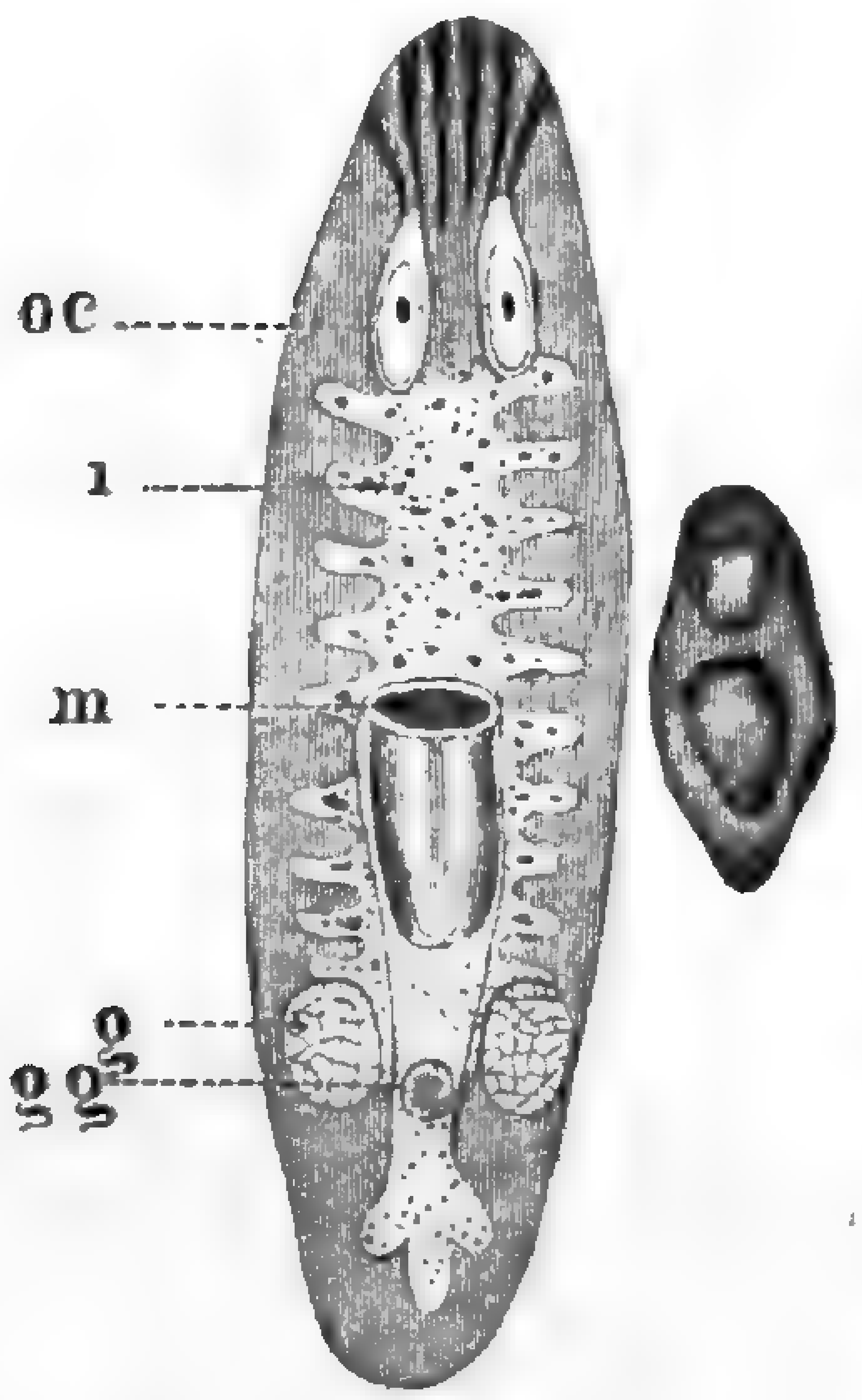


FIG. 1.—Young Planaria, 3mm long, extended. *oc*, eyes; *i*, alimentary system with lateral sacs; *m*, pharynx opening; *g*, male genital glands; *gg*, genital orifice. Figure at the side represents size and form of an adult Planaria.

The pharynx, the genital orifice and even the genital gland (Fig. 1 *g)* could be recognized. From analogy, I infer the latter to be the male organs, the female glands having escaped my observation, since our worm is hermaphroditic. The movements of these young worms were more rapid than in the older ones.

The egg-cases were of various sizes, by far the greatest number, however, being 3.50^{mm} in length (excluding the stem), by 1.50^{mm} in width. They were plano-convex, the latter exteriorly, the former towards the gills. They consisted of a brown, homo-

[1] From Theo. C. Hepp, M.D., Brooklyn, N. Y.
[2] Identified by Professor A. S. Packard, Jr.
[3] In alcoholic specimens in every case.

geneous, thick and leathery mass, either ovoid or cup-shaped, some of them having a sort of a lid on their tip.

Within many of them were the young Planarians, free, moving about, from one to three individuals in each capsule, in others the same were again enclosed within a similar oval case without stem, and again others were found with their tip broken off and empty. The greater number of them were covered around their tip with bluish (colorless in alcoholic specimens) ten-pin-shaped tubes with open tips. As these tubes were invariably on or near the tip of the capsules only, they cannot be taken for parasitic organisms, but may presumably be openings for an exchange of oxygenized water for the enclosed offspring. Those capsules having no such tubes, probably got them rubbed off through the motions of the gills of the Limulus. A few specimens of this Planarian, from three to five millimeters in length, the size usually found only within the capsules, were amongst the larger ones creeping around. These must have just left their protecting homes.—*Carl F. Gissler, Ph.D.*

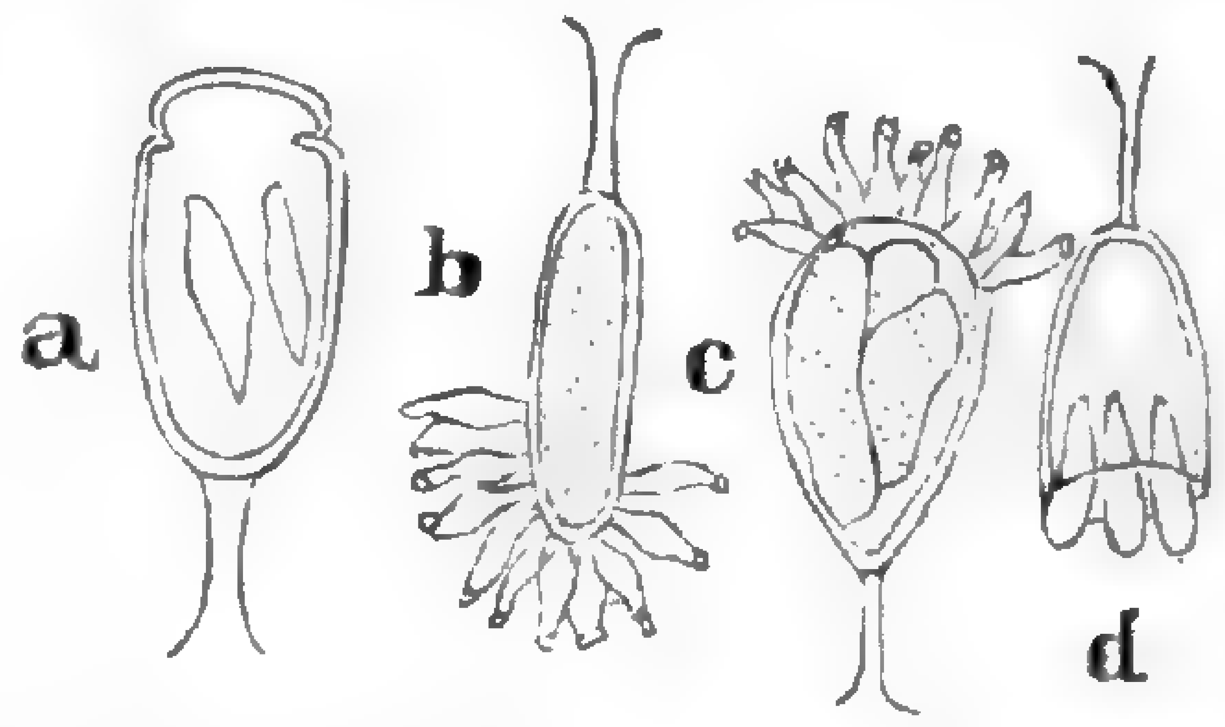


FIG. 2.—*a*, egg capsule with a lid, enclosing two encased embryos; *b*, egg-capsule with one free young enclosed, capsule with air-tubes (?) around tip; *c*, ordinary form of egg-capsule, enclosing three young Planarians; *d*, empty egg-capsule with three empty cases near orifice.

EYE OF PLANARIANS.—Professor R. Hertwig finds that the nervous system of these worms is very primitive in character, and is but slightly separated off from the surrounding tissue; in the eye it is possible to distinguish a black pigmented and a clear colorless portion. The former lies along the animal's axis; the latter is just below the epithelium, and is only separated from it by the basal membrane. The pigmented portion, again, consists of two parts, a transparent nucleus (vitreous body) and a superficial layer of surrounding pigment cells, which are only wanting at the diaphragm-like point at which the retina or colorless part is connected with the rest. The cylindrical fibers of the vitreous body are arranged parallel to one another, the nucleated ends being nearest the pigment. The retina is only formed of optic cells, which are continued at one end into a nerve-fiber, and at the other into a rod-like process. The fibers of the optic nerve traverse the retina in a very irregular manner, so that there is no regular arrangement of the optic cells.

THE STRUCTURE AND AFFINITIES OF THE HIPPOPOTAMUS.—In a recent illustrated paper, entitled "Observations upon the Hippopotamus," by Professor H. C. Chapman, published in the Proceedings of the Academy of Natural Sciences of Philadelphia, the author gives a résumé of what has been published upon the general anatomy of this animal, of which he dissected an adult male and female of the ordinary *Hippopotamus amphibius*, which died during the year past in this country. He figures the brain, alimentary and reproductive systems, and adds much of importance to our knowledge of this great beast. In conclusion, he thus remarks on the natural affinities of the hippopotamus with the Ungulata and other mammals, especially the manatee. "In observing the manatee that lived for several months in the Philadelphia Zoölogical Garden, the manner in which it rose to the surface of the water to breathe reminded me often of the hippopotami that I watched in the Zoölogical Garden of London and the Jardin des Plantes in Paris. The slow way in which the animals rise to the surface, the motionless pose of the almost sunken body, the nostrils often just appearing at the surface, etc., are very much alike in both animals. In speaking of the alimentary canal, I called attention to the stomach of the manatee, which represents that of the hippopotamus in an atrophied condition, while, on the other hand, the stomach of the hippopotamus is intermediate between the peccary and the ruminants. As regards the heart, it will be remembered that in the young hippopotamus, at least, it is bifid, resembling in this respect that of the manatee. The female generative apparatus of the peccary and hippopotamus are almost identical. Again, the sexual vesicles are found in both hippopotamus and manatee. While the placenta does not appear to me to have the importance attached to it by some authors as a guide in determining the affinities of animals, it is proper to mention in this connection that according to Milne Edwards and Garrod the placenta of the hippopotamus is diffuse, and appears to be non-deciduous, and such is the case, according to Harting, in the dugong, and therefore in the manatee, probably, for, as a matter of fact, the placentation of the manatee is unknown.

"While the brain of the hippopotamus appears to be a modification of a type common to the pig, peccary, sheep, ox, giraffe, etc., it has also, it seems to me, affinities with that of the manatee. In a word, then, beginning with the pig, we pass by an easy transition to the peccary, which leads to the hippopotamus, and thence, in diverging lines, to the Ruminantia on the one hand, and the manatee on the other. Palæontologists have not discovered a form which bridges over the gap between the hippopotamus and the manatee, but it will be remembered that certain fossil bones, considered by Cuvier to have belonged to an extinct species of hippopotamus, *H. medius*, are regarded by Gervais as the remains of the *Halitherium fossile*, an extinct Sirenian, of which order the manatee is a living representative. According to Professor Owen, the molar teeth also, both in the Halitherium and the *Felsinotherium*, another Sirenian, are constructed on the same pattern as those of the hippopotamus. It is proper to mention, however, that the same distinguished observer considers the teeth of the manatee and the *Prorastomus*, another extinct Sirenian, to be rather allied to those of the tapir and Lophiodon; but this qualification does not really invalidate the supposed affinities between the Sirenia and the hippopotamus. For the Artiodactyla and the Perissodactyla are probably offshoots of a common stock, and hence we may expect to find in these two groups certain characters common to both, inherited from their Lophiodon and Coryphodon-like ancestors. The affinities of the teeth of the manatee with those of the tapir—the first an embryonic Artiodactyle, the second a generalized Perissodactyle—would be examples of the above view. I do not mean to imply that the manatee has necessarily descended directly from the hippopotamus, though extinct intermediate forms may in the future show this to be so, for possibly they may be the descendants of a common ancestor. To many such speculations may appear mere waste of time, we being unable, from the nature of the case, to experimentally prove or disprove the truth of the hypothesis advanced. It seems to me, however, that the only explanation of the structure of the living forms and of the petrified remains of the animals referred to in these observations, is the hypothesis of there being some generic connection between them."

Verrillia blakei or Halipteris blakei.—In the San Francisco *Mining and Scientific Press*, of August 9th, 1873, I published a "Description of a new species of Alcyonoid Polyp, which I placed in Cuvier's genus Pavonaria, and gave to it the specific name of *blakei*, in recognition of the courtesy of Dr. James Blake, who kindly furnished the specimens to describe. Subsequently, nine days after the publication of the first description as above, at a meeting of the California Academy of Sciences, held on the 18th day of August, I removed the species to a new sub-genus which I called Verrillia, in honor of Professor Verrill, of Yale College.

The characters of this sub-genus were defined as follows: "Polypidon linear-elongate, round or ovate in cross section. Axis round, slender, bony; polyps arranged in two unilateral longitudinal series."

In *Nature* for November 6th, 1873, Dr. J. E. Gray, in an article entitled, "On the stick fish (*Osteocella septentrionalis*), and the habits of the sea pens," endeavored to make it appear that his genus and species, should have precedence, or the names so given by him should stand instead of mine, and gave what he called "the synonyma of these animals," presenting the sequence of dates of publication of the various papers, to show the priority of his own.

To this communication of Dr. Gray's I replied in a paper read before the California Academy of Sciences on the 16th of March, 1874, in which I reviewed the claims of Dr. Gray and his genus and species *Osteocella septentrionalis*, and denied the validity thereof, on the ground that "No description sufficiently accurate to be worthy of consideration can be made of the axial rods or bones alone, of this class of animal forms, nor can species be satisfactorily determined without the fleshy portion; nor in our present state of knowledge can the microscope determine these points."

In the *Zoölogical Record* for 1873, Vol. x (pp. 508–9), Dr. Lutkin, editor of the department Cœlenterata, uses the following language: "Its generic identity with the Australian species (type of Osteocella), cannot be established so long as the latter is known only from the axial skeleton."

It will be seen by the quotation that Dr. Lutken practically sustains my position.

My description, read before the Academy, August 18th, 1873, was soon after reprinted in the *American Journal of Science and Art*, to which Professor Verrill added a foot-note as follows: "A recent examination of a specimen, convinces me that this species is most nearly allied to the *Halipteris christii* Kölliker (Koren and Dar., sp.), and probably ought to be referred to the same genus."

While regretting that the generic title with which I had associated the name of a justly distinguished naturalist, as well as a personal friend, must yield to precedence, I can only accept his suggestion, and place the species in Kölliker's genus Halipterus. The allusions herein to the late Dr. Gray are not intended to revive any differences of opinion as between that eminent authority and myself, but are incidentally introduced, being necessary to the continuity of the record of my own connection with the form which furnishes the title to this paper.

I was not aware until recently that I had not already called the attention of the Academy to Professor Verrill's note, which long-continued sickness in my family, and the pressure, until very recently, of official duties caused me to overlook.—*R. E. C. Stearns, Berkely, California, Nov. 9, 1881.*

Discoveries of the U. S. Fish Commission on the Southern Coast of New England.—In the *American Journal of Science* for October, Professor Verrill records the further discoveries made the past summer over a region about 42 miles wide, north and south, and 105 miles long, along the 100-fathom line off the southern coast of New England. It will be remembered that a remarkably rich fauna inhabits this region, which is near the edge of the Gulf stream, and at the edge of the descent to the ocean bottom. This richness in life seems to be due to the following reasons stated by Verrill: This region is subject to the combined effects of the Gulf stream on one side, and the cold northern current on the other, together with the gradual decrease in temperature in proportion to the depth. It is, therefore, probable that, at any given depth below 50 fathoms, the temperature is nearly the same at all seasons of the year. Moreover, there is, in this region, an active circulation of the water at all times, due to the combined currents and tides. The successive zones of depth represent successively cooler climates, more perfectly here than near the coast. The vast quantities of free-swimming animals continually brought northward by the Gulf stream, and filling the water, both at the surface and bottom, furnish an inexhaustible supply of food for many of the animals inhabiting the bottom, and probably, directly or indirectly to nearly all of them.

A very large species of Salpa, often five or six inches long, occurs, both at the surface and close to the bottom, in vast quantities. These are eaten by star-fishes, actiniæ, etc. Pteropods also frequently occur in the stomachs of star-fishes, while Foraminifera furnish a large part of the food of many of the mud-dwelling species. The fishes, which are very abundant, and of many species, of which the file-fish is the most notable, find a wonderfully abundant supply of most excellent food in the very numerous species of crabs, shrimps and other Crustacea, which occur in such vast quantities that, not unfrequently, many thousands of specimens of several species are taken in a single haul of the trawl. Cephalopods are also abundant, and are eagerly devoured by the larger fishes, while others prey largely upon the numerous gastropods and bivalves. Many interesting fishes and mollusks were taken, some new to science, and of great interest; among the latter, the most remarkable is a new species of the tropical shell *Dolium (D. bairdii)*, taken alive in 202 fathoms. *Dolium galea* extends northward to North Carolina. This southern form, with a large Marginella, an Avicula, and various other genera, more commonly found in southern waters, are curiously associated, in this region, with genera and species which have hitherto been regarded as exclusively northern, or even arctic; many of them having been first discovered in the waters of Greenland, Spitzbergen, Northern Norway, Jan Meyen Land, etc. A number of northern, mostly arctic, forms, not previously found south of Cape Cod, were also dredged.

Does the Crow Blackbird Eat Crayfish?—Professor Beal, of the Iowa Agricultural College, asks this question in the November Naturalist, his inquiry having been prompted by finding twenty-six gastroliths, or stomach-stones in a bird's "gizzard." The little incident which I will here record, I think will fairly settle this question with an affirmative answer. Crayfish inhabit many, doubtless most of the sloughs and wet places on our prairies; but I suppose the species to be identical with that in our rivers and streams, though they are sometimes spoken of as "land-crabs." Outside of where the water covers the ground, they dig holes into the soil, and in carrying out the dirt their holes are frequently built up like little chimneys, sometimes five or six inches above the surface. In a dry time they are compelled to descend so far, in order to keep in the water which is necessary to their existence, that they pass through our very deep black soil, and bring up the light-colored sand and fine gravel. In this way, they do a vast amount of work—generally, I believe, in the night as they are seldom, if ever, seen so engaged. Passing a slough on the road, where these curious animals live, one day, three or four years ago, I saw a crow blackbird *(Quiscalus purpureus)*, very hard at work in an apparent effort to grasp some object on the ground. In a moment it flew up and alighted on a fence-post, having in its bill a quite large crayfish. The bird held it by the back, as a boy grasps one in his fingers, to keep clear of the creature's pinchings claws. The captor had evidently done that sort of thing before, for it manifested none of the awkwardness of a "new hand" at the business. During the moment which elapsed before the bird flew off with its prey, I could distinctly see the crayfish's legs and feet in rapid motion, as it was feeling about for some object to grasp, or struggling to escape. The bird seemed to have quite a job in mastering the bundle of claws and legs, but it appeared determined not to abandon its lucky "find." I believe this incident may be taken as a very positive answer to Professor Beal's inquiry, though in regard to the food of any of our birds we need just such crucial tests as those which have been made by Professor Forbes, of Normal, Illinois. As to the presence of such an unusual number of these gastroliths, in the bird's stomach, it would require close observation to determine whether they were picked up and swallowed as aids to digestion, in grinding up the food; or were left for the same purpose after the other portions of the crayfish had passed along into the intestines. But these sagacious and active birds are so often seen walking in the shallow water, that their mission is no doubt the capture of all sorts of "small deer" which abide in there, as minnows, crayfish, worms, small frogs, &c. They are wise birds, and they walk about within a few feet of an observer, with a degree of coolness and nonchalance which is as amusing as it is unusual in our feathered visitants. In spring and fall they industriously follow a plow all day long, devouring all sorts of insects, and at such times become exceedingly tame. In fact, their behavior is exactly of that kind to indicate that they take it for granted that no one desires to hurt them. At all events, that is the case on my farm.—*Charles Aldrich, Webster City, Iowa, Nov. 10, 1881.*

Wild Birds Racing with the Cars.—Several times I have noticed wild birds of different species flying along parallel with, and near a railroad train, in such a way as to suggest the idea that they were really trying to distance the iron horse! One day last spring I was coming east from Sioux City, Iowa, on the Illinois Central R. R., when my attention was attracted to a couple of birds which seemed to be making us a trial of their speed with the train. They were, as I supposed at the time, our smallest species of hawks—sharp, alert, powerful birds, possessed of a high degree of strength and endurance on the wing. They kept steadily on their course a dozen rods from the train, for at least a mile and a half, but the train was too rapid for them, and they finally turned aside and went back in the direction whence they came. A strong head-wind was blowing at the time, and the birds at some moments seemed to sail squarely in its teeth without fluttering a wing. I watched them with much interest, and I did not think I could be mistaken in the belief that they were really trying to beat the train in the race. Horses and dogs frequently race with railroad trains, and possibly the instinct for sport and excitement may also exist in the wild birds.—*Charles Aldrich, Webster City, Iowa, Nov. 9, 1881.*

Infusoria in Dew.—Mr. W. S. Kent states, in his Manual of the Infusoria, that he gathered in a very foggy day in Regent's Park a quantity of grass saturated with "dew," and found in every drop squeezed from the grass great numbers of infusoria of different genera, such as Heteromita, Vorticella, etc., with *Rotifer vulgaris* and other rotifers, and numerous Amœbæ, Anguillula, and various diatoms, the collection as a whole being indistinguishable from the ordinary microscopic fauna of a roadside pond.

Zoological Notes.—The practical aspects of zoölogy must be appreciably felt in India, where it is reported that no fewer than 21,990 persons were killed during the year 1880 by snakes and tigers. The annual percentage of loss has increased during the past five years, the number of victims in 1876 not exceeding 19,273. It also appears that the white ant in India costs the government £100,000 a year for repairing wood-work, bridges, etc., caused by its depredations.——A preliminary report, by P. H. Carpenter, on the Comatulæ dredged by the U. S. Coast Survey, under the supervision of Mr. A. Agassiz, in the Gulf of Mexico, the Caribbean sea, and the east coast of the United States, appears in the Bulletin of the Cambridge Museum. The collection embraces forty new species of Comatulæ, the number known to inhabit the Caribbean sea alone being fifty-five; the genus being essentially a shoal-water one.——An additional case of supposed hybridity in birds is noticed by W. Brewster, in the Bulletin of the Nuttall Ornithological Club, for October. He thinks that *Helminthophaga leucobranchialis* and *H. lawrencei* are hybrids between *H. pinus* and *H. chrysoptera.* Hitherto it was not known to occur in any American birds, except among grouse and some of the swimming birds. Among the Passeres Trotter's hybrid swallow, and Ridgway's case of a supposed hybrid between *Helminthophaga pinus* and *Oporornis formosa*, have lately been added. Mr. Brewster thinks there are several additional doubtful species, which "show strong traces of a hybrid origin."——In the same journal, A. M. Frazer concludes that, instead of following the land, a large number of species migrate direct from Central America to the Mississippi valley, across the Gulf of Mexico, and the scarcity of these species in Southwestern Texas is thus explained.——A new edition of Brehm's Thierleben, with 170 chromo-lithograph plates, is to be issued in 140 weekly parts, at 36 cents each, postpaid. B. Westermann & Co., of New York, are the agents in this country.——An annotated list of the birds of Nevada, by W. A. Hoffman, appears in the Bulletin of Hayden's U. S. Geological Survey, Vol. VI. It is prefaced by remarks on the distribution of vegetation in Nevada, as affecting that of the avi-fauna, and is accompanied by interesting profile views.——A valuable illustrated paper on the comparative anatomy and the histology of the brain, and more particularly of the *epiphysis cerebri* of Plagiostomes, Ganoids and Teleostei, by Dr. T. Th. Catter, gives us some apparently excellent drawings of the brains of *Raya clavata*, *Acanthias vulgata*, *Galeus canis*, *Acipenser sturio*, *Gadus morrhua*, *Cyclopterus lumpus*, and the common eel, which will be found very useful to naturalists in this country.——The *Zoölogischer Anzeiger*, for Nov. 14, contains a summary of new researches by Salensky, on the embryonal development of Salpa, and several articles on the intestinal worms.——Prof. Hæckel has gone to Ceylon on a scientific journey.——A new zoölogical station, to serve as a winter laboratory, and as an annex to the sea-side laboratory founded by Lacaze Duthiers at Roscoff, is to be opened at Banyuls-sur-Mer, on the Mediterranean. The building, says *Nature*, will be of considerable size, and the aquarium will be lighted by electricity.——An English adaptation of Claus' "Handbuch der Zoologie," by Mr. Adam Sedgwick, of Trinity College, Cambridge, with the addition of 500 to 600 drawings by Prof. Claus himself, is to be published by W. Swan, Sonnenschein & Co., London.——A hand-book of Vertebrate Dissection, by Prof. H. Newell Martin and William A. Moale, M. D., Part I, How to dissect a Chelonian, is announced as published by Macmillan & Co.

ENTOMOLOGY.[1]

On Some Curious Methods of Chalcid Pupation.—In the course of two years' study of the Chalcididæ, I have met with several anomalies connected with pupation, which seem to be worthy of description, and to which, so far as I can learn, with a single exception, the attention of entomologists has not been called.

One of the most curious of these instances, and one which has excited the greatest interest among my entomological friends to whom I have shown the specimens, is the case of a larva of *Phoxopteris divisana* Walk., an oak-feeding Tortricid, which has been parasited by an Euplectrus. The species I have called in MS. *E. albitrophis* and the method of pupation is so similar to that of *E. comstockii*, graphically described by Mr.

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

Schwarz in the January, 1881, number of the NATURALIST, as to need no extended description. The flat, empty skin of the host is united to the leaf by a mesh of coarse silk, in which are placed transversely the seven parasitic pupæ, each separated from the others by a silken partition, and protected as by a roof by the skin of the Phoxopteris. Other lepidopterous larvæ will undoubtedly be found to be infested by parasites of this interesting genus, and the only wonder is that no observations should have been recorded since the days of Fonscolombe.

In early July, while examining the mines of *Lithocolletis hamadryadella*, on the white oak at Washington, several mines were found, each of which presented a discolored portion, regularly elliptical in form, 3.5^{mm} long by 2^{mm} wide, the edge of which was marked by a series of small, regularly placed black dots. Upon removing carefully the separated epidermis of the leaf, the center of the discolored portion was seen to be occupied by a naked Chalcid pupa, not fastened to the leaf in any way, but held in place and protected by a series of minute cylindrical pillars, from twelve to fifteen in number, applied by flattened extremities to the upper and lower surfaces of the mine, and forming a regular ellipse around the pupa. The distances between the pillars were uniform, and the pillars themselves were very constant in size. Their length was about 0.35^{mm}. The excrement of Chalcid larvæ, as is well-known, is only voided at the change to pupæ, and is usually to be found in a few irregular pellets at the anal end of the body of the pupa. These pillars, however, seem to be clearly excrementitious, and yet must have been formed by the Chalcid larva prior to pupation; but, as the anal end of the alimentary canal is only open during the transition to pupa, the material composing the pillars must have been expelled from the mouth of the larva, and shaped while yet moist. The most natural thought which suggests itself as to the object of this peculiar disposition of the excrement, is that the pillars by separating the floor and the roof of the mine save the pupa from the pressure of the latter, as the mine of *L. hamadryadella* is flat and not tentiform. If this be so, and no other reasonable explanation offers itself, it is certainly a most interesting and unlooked-for provision. The adult proved to belong to a brilliant little species of *Chrysocharis* Först, which I have called in MS. *C. singularis.*

While engaged one day in October in an oak wood, gathering galls with a view of breeding parasites, I found upon the under side of a leaf a curious assemblage of small black bodies, resembling, as much as anything I could think of, the excrement of some caterpillar. They were shapeless little objects, each mounted on end, and at the extremity of each, next the leaf, was a small racemose cluster of minute light gray globules. Without giving them a careful examination I settled it in my mind that the globules were the sporidia of some fungus which had settled upon the excremental pellets as a matrix. With this view I stowed the leaf away in a pill-box, purposing to carry it to a mycological friend next day. On the following morning, however, I was greatly surprised to find that from several of my supposed excremental pellets had issued active little Chalcid flies. This of course led to a closer examination, and to the discovery that the supposed pellets were the bunchiest, most shapeless, most coarctate Chalcid pupæ I had ever seen. There were twenty-two of them in all, arranged around an irregular oval a centimeter long, the center of which had evidently, from the scattered hairs, once been occupied by the caterpillar upon which they had fed. Each pupa was fastened by its anal end to the leaf, and the clusters of light gray globules at the end of each, which I had taken for sporidia were nothing more than the contents of the alimentary canal, ejected before pupation. The surface of the leaf in the center of the oval space, round which the pupæ were clustered, was covered with a thin web of silk, which rendered the attachment of the pupæ to the leaf easier and firmer.

From these strange objects the adult Chalcids emerge by bursting off the upper portion of the pupa skin, leaving the separated part attached only by the sheaths of the posterior legs. The line of fracture extends behind the head and down caudo-ventrally, including the wing and leg sheaths in the separated portion. It has been suggested to me that the apparent want of form which these pupæ show—their extreme coarctation—could be explained on the supposition that the very delicate larval skin was not shed at all, but simply contracted closely around the pupa and its members as it formed. After softening the pupa, however, in various menstrua, the most careful examination showed no trace of such a skin. The strange form must rather be laid to some peculiarity in the secretion of the chitine.

Since this first experience I have several times found these interesting and sociable-looking little groups of pupæ upon oak leaves. The little mass of excremental globules at the end of each, by its decided contrast of color, adds much to the strangeness of the appearance. I have never found other trace of the host than the scattered hairs, which show it to be a bombycid larva. The Chalcid issuing normally from these pupæ is a species of the true genus *Eulophus*; but one is apt to be misled by the frequent presence of a secondary parasite—an *Astichus*. The latter, however, instead of issuing in the manner indicated above, makes its exit through a circular hole, cut usually in the thorax of the pupa. It is, moreover, a much smaller insect than the Eulophus.—*(To be continued.)*—*L. O. Howard.*

On the Oviposition of Prodoxus decipiens.[1]—In his paper treating of this insect, read at the Boston meeting, the author

[1] Abstract of a paper read by C. V. Riley at the Cincinnati meeting of the A. A. A. S.

stated that oviposition had not been observed. He has studied it carefully the past summer, and finds that, as the structure of the ovipositor would indicate, the female stations herself lengthwise with the axis of the stem, usually head upward, and literally saws through the epidermis with an up and down motion, just such as a carpenter would make in endeavoring to work the tip of an ordinary hand saw into the trunk of a tree. She never has anything to do with the stigma of the flower, as Pronuba does, and the important and interesting fact is recorded that the eggs of Prodoxus are all inserted while the stem is soft and before the flowers begin to open, *i. e.*, before Pronuba usually appears. As soon as the flowers begin to open (in *Yucca filamentosa*, the species upon which the observations were made) the stem has become too hard to permit the female to do her work, and the species has, for the most part, disappeared, only a few belated individuals being subsequently found, and these, so far as could be observed, perishing without issue. In experiments made to test the matter, it was found that where a female succeeded in inserting the ovipositor into a stem that had become hard, she perished in the effort to disengage herself, and remained firmly attached to the stem.

Clover Insects.—We have received an interesting brochure on the insects of the clover plant by Mr. Lintner, the State Entomologist of New York. After an introduction showing by quotations from Mr. George Geddes, the importance of the clover crop, especially to the people of New York State, he makes manifest the large increase of insect depredators on the plant. He then remarks upon the fact that no notice of clover insects appears in the reports of Dr. Fitch, his predecessor; which fact indicates the scarcity or the unimportance of the insects affecting the crop in Fitch's time. He next quotes from Kaltenbach's Pflanzenfeinde a list of sixty-six species affecting clover in Europe, and by way of comparison gives a list of our own species which includes thirty-three Lepidoptera, three Coleoptera, three Diptera, five Orthoptera and two Homoptera, and concludes with a detailed account of *Hylastes trifolii*, *Cecidomyia leguminicola*, *C. trifolii* and *Oscinis trifolii*.

It may be safely assumed that the number of species in this country affecting the plant, though not perhaps injuriously, will be at least doubled by future observation, and in Coleoptera we feel confident that it will be quintupled.

Horn's Classification of the Carabidæ.—A great deal of the classificatory work done by entomologists is based upon the study of isolated groups or of more or less restricted local faunas. Useful as such work may be, yet the complex relationships of forms; the true value of characters used for separating genera and higher groups; the coördination or subordination of characters, and other important classificatory questions, can be fully recognized only by study of a whole family from all parts of the globe. Dr. Geo. H. Horn, whose excellent work on the Silphidæ was noticed not long since in these columns (p. 128), has just published in the Transactions of the American Entomological Society (vol. IX, pp. 91–196, plates III–X), an elaborate paper "On the genera of Carabidæ with special reference to the fauna of Boreal America." This is the first paper covering the general classification of this large family which has appeared since the publication of Lacordaire's first volume of his "Genera des Coléoptères" though a number of important papers by LeConte, Schaum and Chaudoir have contributed to our knowledge of the subject. Dr. Horn begins with a discussion of the characters of the Adephagous series of Coleoptera and divides them into seven families, the formation of the metasternum being of primary importance. The Haliplidæ, Amphizoidæ and Pelobiidæ are considered as families equivalent to the long established ones, viz: Cicindelidæ, Carabidæ, Dytiscidæ and Gyrinidæ. The Pseudomorphidæ, formerly looked upon as a distinct family, are made to constitute one of the three sub-families (Pseudomorphinæ) of Carabidæ, the two others being the Carabinæ and Harpalinæ, the bulk of the tribes and genera being embraced in the Harpalinæ. Tables and full expositions of the characters of the tribes of the whole family are then given, accompanied by tables of the genera occurring in our fauna. We cannot, in our limited space, treat of this important paper in detail; but if the student will compare the lucid and ingenious arrangement of the sub-family Harpalinæ, for instance, as given by Dr. Horn, with the former chaotic arrangements, he will be able to form an idea, not only of the immense amount of labor expended, but also of the excellency of the work. It is, perhaps, the most important of the several revisions the author has of late years given us—all of them so fresh, thorough and original, that it is a veritable pleasure to work by them.—*C. V. R.*

The Butterfly Trees of Monterey Again.—We gave in the July number of this magazine an abstract from a letter of Miss Jennie R. Bush, of San José, Cal., in reference to the so-called butterfly trees, near Monterey, of that State. From specimens sent some time ago by Miss Bush, we find that the butterfly in question is the cosmopolitan *Danais archippus*, which, as is well known, has a similar habit of congregating in immense numbers on trees in the Atlantic States, and does this during winter in the extreme Southeast (vide *American Entomologist*, Vol. III, p. 102). It was on the 27th of February that Miss Bush observed the phenomenon above related. The inference to be drawn from the interesting facts is, that the species finds on the Pacific slope, about the latitude 36° 30′, a climate congenial to its hibernation, whereas on the Atlantic side, it has to migrate southward so far as latitude 30°.

Interest Felt in Economic Entomology in California.—The Board of State Horticultural Commissioners issued a call for a State Convention of fruit-growers, shippers, packers, nurserymen, and others interested in horticulture in California, to be held at the Senate Chamber, Sacramento, on Tuesday and Wednesday, the 6th and 7th of December, 1881, to commence at 10 o'clock, A. M. of the 6th, for the purpose of consultation and discussion of the most practical means of exterminating the insect pests, now infesting the orchards and gardens of that State; and such other subjects as may be introduced for the improvement of the fruit-growing industries of California. The Central Pacific Railroad Co. kindly allowed a two-thirds rate of fare from all their stations in California, to persons attending the convention, and issued instructions to their agents at all points in California, to sell tickets at a two-thirds rate of fare.

Obituary.—We regret exceedingly to have to record the death of Joseph Duncan Putnam, president of the Davenport Academy of Natural Science. He died on the 10th of December, at his home in Davenport, in the 27th year of his age, having been born in Jacksonville, Ills., Oct. 18, 1855. From boyhood, Mr. Putnam found fascination in the study of nature, and as he grew older, gave more and more attention to entomology. In 1872 and 1873 he traveled and collected in Colorado and Wyoming, in company with Dr. C. C. Parry. By the people of Davenport he will be most remembered for his unflagging efforts in behalf of the Academy of Sciences, which is so largely indebted to him. In entomology, his chief work was on the Coccids, and at the time of his death he was still deeply interested in the family, and in the Solpugidæ. Soon after his return from the West, in 1872, he contracted a severe cold, from the effects of which he never fully recovered. We first became acquainted with the deceased about that time, when he was greatly emaciated and racked by a very severe cough. Of late years he seemed to grow stronger, and get more free of his lung trouble, so that there was hope of prolonged life and usefulness for one who made friends of all whom he met, by a quiet modesty and lovable disposition, combined with diligent study, earnestness and enthusiasm, all the more remarkable, because of the physical suffering he struggled with. His bereaved family have our heartfelt condolence.

The announcement of the death of Count Georges Vandalia Mneszech, on Nov. 17th, at Paris, aged 58, has also just reached us through the editor of *Psyche*. He had one of the most extensive collections of Coleoptera in the world.

ANTHROPOLOGY.[1]

REVIEW OF RECENT WORKS ON ANTHROPOLOGY.—

Anthropology; an introduction to the study of Man and Civilization. By Edward B. Tylor, D.C.L., F.R.S., with illustrations. New York, D. Appleton & Co., 1881. 12mo, pp. 448.

The ancient Bronze Implements, Weapons and Ornaments of Great Britain and Ireland. By John Evans, D.C.L., LL.D., F.R.S., &c. New York, D. Appleton & Co., 1881. 8vo, pp. 509.

Primitive Industry; or Illustrations of the handiwork in stone, bone and clay of the native races of the Northern Atlantic seaboard of America. By Charles C. Abbott, M.D., etc. Salem, Mass., George A. Bates. Cincinnati, Robert Clarke & Co. 1881. 8vo, pp. 560.

Report upon United States Geographical Surveys west of the 100th meridian, in charge of First Lieut. Geo. M. Wheeler, Corps of Engineers, U. S. Army, under the direction of Brig. Gen. A. A. Humphreys, Chief of Engineers, U. S. Army. Published by authority of the Honorable the Secretary of War, in accordance with Acts of Congress of June 23, 1874, and Ferbuary 15, 1875, in seven volumes, accompanied by one topographical and one geological atlas. Vol VII—Archæology. Washington, Government Printing Office, 1879. [Special Titles, page VII and VIII.] 4to, pp. 497.

Anthropology is the application of scientific methods to the study of man—it is the natural history of the human race. In order to appreciate the merits and the defects of a scientific treatise, it is first necessary to have a clear conception of the extension and structure of the subject matter itself. Of anthropology the best idea can be conveyed by giving its subdivisions as they are understood by those most conversant with the subject, to wit:

1. *Hexicology* (Mivart).—The study of environment, inorganic, organic and social, in all its relations to our race.

2. *Anthropogeny* (Haeckel).—The discussion of man's origin with respect to place, time, zoölogic affinities and primitive condition.

3. *Archæology.*—Prehistoric and classical. The early history of mankind, including modern races still in the stone period.

4. *Biology of Man.*—The investigation of man's physical nature during its life-history, embracing anatomy, physiology and anthropometry, and compared with the evolution of lower forms.

5. *Comparative Psychology.*—The study of intelligence among all animated beings, and the comparison of the various races of men in this regard.

6. *Glottology.*—Research into the origin of language and of the various forms which it has assumed.

7. *Ethnology.*—The discussion of the origin and characteristics of the races of men. The description of races is ethnography.

8. *Comparative Technology.*—An examination of human arts as to their origin and the lines of their elaboration.

9. *Sociology.*—The study of society in the family, the community and the organized government. It includes the structure of

[1] Edited by Professor OTIS T. MASON, 1305 Q. street, N. W., Washington, D. C.

society, the function of its members as well as their processes and customs.

10. *Comparative Religion.*—The description of humanity in all its attitudes with reference to the soul, a future life, and spiritual beings related to man.

11. *Anthropological Apparatus.*—A science so comprehensive must have its instruments of precision, its museums and libraries, and its special works. No treatise upon the subject at large would be complete without an account of these instrumentalities.

With this analysis before us, it is not difficult to gauge the works under review. Tylor's Anthropology professes to cover the whole field. In this regard it not only enters into competition with older works, such as Waitz's Anthropology, and Klemm's Culturgeschicte, but with more recent publications, such as Peschels' Races of Men, Topinard's Anthropologie, and Quatrefages' L'Espéce Humaine. Each of these works has great merit, especially in those divisions of the subject wherein the author is a specialist. Peschel is an ethnologist, Topinard and Quatrefages are distinguished anatomists, Tylor has devoted his whole life to linguistics, technology, and comparative religion. In this work of the latter, therefore, we should reasonably expect to find the greater space given to these themes. In fact, Hexicology is almost totally neglected; Anthropogeny, Archæology, Biology and Ethnology are dismissed in the first three chapters of 113 pages; Glottology has chapters IV–VII, 68 pages; Technology, chapters VIII–XIII, 160 pages; Sociology, chapter XVI, 35 pages; and Comparative Religion, chapters XIV and XV, 58 pages. Furthermore, merit in this instance, has no relation to the number of pages, those subjects which are treated in a short space being very superficially handled, while those which occupy the greater part of the book show everywhere the hand of a master. Dr. Tylor is a pleasant writer, never dips his pen in gall, and never rushes into extremes. It would be no disparagement to the great number of anthropologists in England to say that Dr. Tylor was, of all, the best adapted to write this work. The book fills a decided gap in our scientific literature, and will, no doubt, find its way into the library of every one interested in the natural history of man.

The volume of Mr. Evans is of an entirely different character. It is a fraction of a fraction, as regards its subject matter, being a chapter in archæology, restricted in its area to Great Britain, and in the material described to bronze, in the widest acceptation of that term. For ten years Evans' Ancient Stone Implements, Weapons, and Ornaments of Great Britain, has been the Bible of archæologists. Whether we regard the analysis of the book, its typographic appearance, the beautiful cuts, or the wonderful nicety of description, it is well nigh faultless. The volume on bronze implements is a fit companion to the one just mentioned.

The introductory chapter reviews the history of bronze in the classical languages and touches upon the mooted question of an antecedent copper age. The rest of the work takes up in detail celts of various forms, chisels, gouges, hammers, sickles, knives, razors, daggers, spears, halberds, maces, swords, armor, trumpets, bells, pins, ornaments, and vessels. The great interest of the book, however, centers around the two closing chapters, relating to the methods employed by ancient bronze-workers, and the chronology and origin of bronze. The relation of Mr. Evans to modern archæological investigations as a cautious doubter, gives to all his utterances a credibility of the highest order.

Dr. C. C. Abbott has long been known as an indefatigable worker in archæology. For some years he has enjoyed exceptionable advantages as an associate curator of the Peabody Museum at Cambridge, Mass. Like the work of Dr. Evans, this volume is devoted to a part only of one of the subdivisions of anthropology, being restricted in area to the north-east Atlantic States, and in material to stone, bone and clay; but, like Dr. Evans in another respect, the author rambles frequently far from the Atlantic ocean, and even inserts a chapter on copper implements. The illustrations, like those in most American archæological works, not excepting some of the publications of the Smithsonian Institution, are, most of them, very poor, indeed. The great merit of the book is its adaptation to a very large class of intelligent people in our country, who are interested in local archæology, and would like to place themselves under the guidance of a skilled workman. For such persons Primitive Industry is valuable, though a little prolix. Practical archæologists will run rapidly over the volume until they come to chapters XXXII and XXXIII (the latter by Professor Henry Carvill Lewis), in order to hear Dr. Abbott's latest utterances upon the palæolithic implements of the Trenton gravels. This is his own peculiar province, and a subject worthy of the most careful scrutiny. In short, Dr. Abbott finds in the Trenton gravels, at a depth varying from three to forty feet, along-side of and beneath remains of the mastodon, "turtle-back" celts. The geological age of this deposit is unknown, but the implements are held to be veritable traces of a people who inhabited the northern Atlantic seaboard of America untold centuries prior to the advent of the Indian, or of Indians who reached our shores as far back as the glacial epoch.

Volume VII of the United States Geographical Surveys, west of the 100th meridian, is a joint production of F. W. Putnam, C. C. Abbott, S. S. Haldeman, H. C. Yarrow, H. W. Henshaw, Lucien Carr, and Albert S. Gatschet, in very unequal proportions, however, the greater part of it being the work of Prof. Putnam and Dr. Abbott. Several of the chapters are reproduced from Lieut. Wheeler's annual reports. Although a child of hope deferred, the imprint dating 1879, its parents have many reasons to be proud of it. There are 22 plates, including the frontispiece and a map of the coast of Southern California; seventeen of these are heliotypes and very excellent, excepting those representing deep vessels, to which the process is not adapted. The remaining plates, front, XVI, XVII, XVIII, XIX, are beautiful colored lithographs, in whose praise too much cannot be said; the dancers in the front, we think, are much too light colored. This method of illustration is very expensive, however, and must be looked upon as the luxury of the science. The cuts, photo-relief drawings, though rude, are most of them, especially those representing rotundity, quite graphic. The great desideratum now is a method of depicting a great number of objects correctly at a moderate expense. Now, what is this volume about? The subject is graphically set forth by Dr. Yarrow, on pages 32–47. It is the description of a fortunate series of discoveries upon the main land and on the Santa Barbara islands opposite, in Southern California. These sites yielded a large and unique collection of crania and aboriginal implements which were subsequently placed in the hands of Prof. F. W. Putnam and his assistants at Cambridge to describe. Some of the chipped flints are of extreme delicacy of form and finish, well shown in the heliotypes but not in the cuts. The sandstone mortars occur in great abundance, are quite symmetrical, and some of them are massive; of these the cuts are excellent and the heliotypes bad. The most interesting stone implements are the steatite ollas, nearly spherical, thin-walled cooking vessels, having small opening or mouth. The method of manufacturing these vessels was discovered by Mr. Paul Schumacher (pp. 117–121). Curious pipes of the same material, resembling very large cigar-holders, were abundant in the graves, and were evidently used by the savage taking a siesta while lying supinely. Next in order come the perforated stones varying greatly in size, form, and consequently in function. Upon this chapter Prof. Putnam has put some excellent work, it is, indeed, one of the best in the volume. The closing chapters of Part I relate to implements of wood, shell, and bone, textile fabrics, ornaments and paint beads, contact with Europeans and crania. An appendix to Part I gives a translation of an account of Cabrilla's voyage, which is a precious addition to the meager stock of early literature relating to our west coast.

Part II relates to the Pueblo ruins and the interior tribes, and is made up of a series of short sketches, some of which are reproductions from former reports; it contains an extended chapter by Professor Putnam on the implements of stone, and pottery, collected mainly by Dr. H. C. Yarrow; a chapter on the crania collected by the expeditions, written by Mr. Severance and Dr. Yarrow; and an appendix on linguistics, prefaced by a classification of western Indian languages, by Albert S. Gatschet. The forty vocabularies belong to seven stocks: Tinné, Numa, Yuma, Rio

Grande Pueblos, Kera Pueblos, Wintún, Santa Barbara, and their area is given with great precision. The volume closes with tables of these 40 vocabularies, 211 words each, and additional notes and lists of very great value.

The space assigned to the works just noticed makes it necessary to give but a mention to the following meritorious publications:

The Madisonville Prehistoric Cemetery; Anthropological Notes. By F. W. Langdon, M.D., from the Journal of the Cincinnati Society of Natural History, Vol. IV., October, 1881, pp. 237–257.

Remarkable change in the color of the hair from light blonde to black in a patient while under treatment by Pilocarpin. By D. W. Prentiss, A.M., M.D. J. B. Lippincott & Co., Philadelphia, 1881, pp. 15.

Visitors' Guide to the Smithsonian Institution, National Museum, and Fish-Ponds. Edited by William J. Rhees. Judd & Detweiler, Washington, 1881, pp. 72.

Indian Names of Places, etc., in and on the borders of Connecticut, with interpretations of some of them. By J. Hammond Trumbull. Brown & Gross, Hartford, 1881, 8vo. pp. 93.

The distinguished name of the author as well as the great benefit to the future historian to be rendered by the publication of information which must be gathered now or never, are a sufficient guarantee of the lasting value of the last-named work.

ANTHROPOLOGY IN JAPAN.—The Transactions of the Asiatic Society of Japan, do not often reach us. Vol. IX, Part II, contains the following papers:

Edkins, Joseph, D.D., Contributions to the History of the Japanese transcription of Chinese sounds, pp. 107–124.

James, J. M., Descriptive Notes on the Rosaries (Jiu-Dzu), as used by the different sects of Buddhists in Japan, pp. 173–182.

Satow, Ernest, Ancient Japanese Rituals, Part III, pp. 183–211.

SNAKE SUPERSTITIONS OF THE PUEBLOS OF NEW MEXICO.—When I opened the old Turquoise mine at Bonanza, near Santa Fé, New Mexico, we found at least two hundred rattlesnakes of different kinds; also, long, thin red snakes, etc., etc., in it, all nesting together. We had four men in the shaft, two men excavating and two protecting the others from snakes, which crawled about in all directions (this was about eighteen months ago).

The Pueblo Indians came and protested, saying the mine belonged to Montezuma. They took the killed snakes most devoutly, and lamented their fate.

An Indian friend of mine told me that the snakes are servants of Montezuma. When an Indian wants to send a message to Montezuma, he catches a rattlesnake and carries it to the mine, being convinced that the bearer of the verbal notice will return to him one day with an answer. To this may be attributed the fact that certain old mines are filled with snakes. They were carried there by Indians.—*Dr. Fritzgærtner.*

GEOLOGY AND PALÆONTOLOGY.

The Oldest Artiodactyle.—Members of this order have been found in the upper Eocene of N. America (*Achænodon*), but none have been determined as yet from the American Suessonian or lower Eocene. A species represented by teeth from the Siderolitic beds of Switzerland has been referred to *Dichobune* (*D. campichii* Pict); but dental characters alone are not sufficent to distinguish that genus from the Perissodactyle *Phenacodontidæ*[1]. Dr. Lemoine found astragali of a small Artiodactyle in the Suessonian of Reims, which he has recently ascribed to his *Lophiochærus peroni*, which he believes (Proceedings French Assoc. Adv. Sci., Montpelier, 1880) to be a suilline. I have reported an astragalus from the Wind river formation of Wyoming Territory, which is almost exactly similar to those found by Lemoine. A specimen of *Mioclænus brachystomus* Cope now to be described, enables me to characterize with some degree of completeness this interesting form, which precedes in time all the known American *Artiodactyla*.

The characters of the tarsus are typically those of the Order *Artiodactyla*. The astragalus exhibits a distal trochlea which is continuous with the sustentacular facet, and which articulates with both cuboid and navicular bones.

The distal portion of the fibula is free from the tibia, and its shaft becomes very slender, but it is possible that a more perfect specimen would display it as continuous. Its distal extremity articulates with the ascending tuberosity of the calcaneum. The cuboid facet of the latter is narrow. The cuboid and navicular are distinct from each other and the cuneiforms; the mesocuneiform is shorter than the ectocuneiform, and *is coössified with it.*

There are probably four metatarsals. The median pair are distinct, but appressed; their section together, subcircular; the lateral metatarsals are slender, the external one is wanting, but its facet on the cuboid is very small.

These characters are in general similar to those of the genus *Dichobune*, but Cuvier[2] does not state whether the cuneiforms are coössified in that genus or not. They are united in *Anoplotherium*.

Mioclænus differs from *Dichobune* in the presence of but one internal tubercle of the superior molars, and in the single external tubercle of the superior premolars. Both genera are referable to a family to be distinguished from the *Anoplotheriidæ* by the presence of external digits. This has been already named by Gill the *Dichobunidæ*. The genus *Lophiochærus* is not yet fully characterized, but its inferior true molars are very elongate and have their cusps connected by oblique ridges.—*E. D. Cope.*

[1] See American Naturalist, 1881, December.

[2] Ossemens fossiles, v, p. 183. Gaudry Enchainements d. Regne Animal, p. 147.

THE CHARACTERS OF THE TÆNIODONTA.—Additional material gives the following results with regard to the affinities of this suborder. There are three allied groups represented by the genera *Esthonyx*, *Tillotherium* and *Calamodon* of the American Eocenes which are equally unlike each other. *Esthonyx*, as I long since showed, is related to the existing *Erinaceus*; very nearly indeed if the dentition alone be considered. Its anterior incisor teeth are unusually developed and have, as in *Erinaceus*, long roots. One pair at least in the lower jaw has enamel on the external face only, and enjoys a considerable period of growth. The genus *Tillotherium* is (fide Marsh) quite near to *Esthonyx*. Its molars and premolars are identical in character with those of that genus, the only important difference being found in the incisors. Here, one pair above and one pair below, are faced with enamel in front only, and grow from persistent pulps as in the *Rodentia*. This character has been included by Marsh in those he ascribes to his "order" of *Tillodontia*, but as he includes *Esthonyx* in that order,[1] which does not possess the character, it is not very clear on what the supposed order reposes. The rodent character of the incisors is the only one I know of which distinguishes *Tillotherium* from the *Insectivora*. I have on this account retained the *Tillodonta* as a suborder, and referred *Esthonyx* to the *Insectivora*.

The *Tæniodonta* agree with the *Tillodonta* in the possession of a pair of inferior incisors of rodent character, but it adds several remarkable peculiarities. Chief among these is the character of the inferior canines. In the *Tillodonta* they are either wanting, as in *Erinaceus*, according to the Cuvierian diagnosis, or they are insignificant. In *Calamodon* they are of large size, and though not as long rooted as the second incisors, grow from persistent pulps. They have two enamel faces, the anterior and posterior, the former like the corresponding face of the rodent incisors. The function of the adult crown is that of a grinding tooth. This character distinguishes *Calamodon* as a form as different from *Tillotherium*, as the latter is from *Esthonyx*. There are, however, other characters. The external incisors, wanting in *Tillotherium*, are here largely developed, and though not growing from persistent pulps have but one, an external band-like enamel face. Their function is also that of grinders. The fact that the rodent teeth in the lower jaw are the second incisors, renders it probable that those of the *Tillodonta* hold the same position in the jaw. This is to be anticipated from the arrangement in *Esthonyx*, where the second inferior incisors are much larger than the first and third. The superior dentition of the *Tæniodonta* is unknown. There are two families, the *Ectoganidæ* with two species, and the *Calamodontidæ* with five species.—*E. D. Cope*.

[1] Report of U. S. Geol. Survey 40th Parallel by Clarence King, Vol. I, p. 377.

New Forms of Coryphodontidæ.—The Wasatch beds of the Big Horn basin have yielded several important additions to this family. Of eleven species found, two belong each to a new genus, and one is a novelty of the little-known genus *Metalophodon.* The characters of the genera of the family may be stated as follows:

I. Two internal cusps of the last superior molar.
All the true molars with a developed posterior external V .... *Manteodon.*
II. One internal lobe of the last superior molar.
a. Last superior molar with posterior external cusp.
Anterior two molars with posterior external V...................... *Ectacodon.*
aa. Last superior molar without external posterior cusp.
†Anterior two molars with posterior external V.
Astragalus transverse, with internal hook .... *Coryphodon.*
Astragalus subquadrate, without internal hook...................... *Bathmodon.*
††First superior molar only with posterior external V............. *Metalophodon.*

The type of *Manteodon* is the *M. subquadratus*, which was about the size of an ox. The characters of its superior molars are more like those of Perissodactyles than are those of the other *Coryphodontidæ.* The type of *Ectacodon* is the *E. cinctus*, a species of about the dimensions of the last named. Its last superior molar is parallelogrammic, and has a cingulum all around it except on the external side. Of *Coryphodon*, a species larger than any yet known has been abundantly found by Mr. Wortman, which I call, in a paper now passing through the press, *C. anax.* The new *Metalophodon* is as large as the *Ectacodon cinctus*, and has the second true molar more triangular and less oval than in the type *M. armatus.* The posterior external V of the last molar, is reduced to a cone. I have called it *M. testis.*—*E. D. Cope.*

An Anthropomorphous Lemur.—The stock from which the true quadrumana have been derived, is supposed to have been the lemurs, but no type of that sub-order has hitherto been found, which presents any near resemblance to either of the four families of monkeys. The two inferior families *Cebidæ* and *Hapalidæ*, agree with most of the *Lemuridæ* in having three premolar teeth, but those of the upper jaw generally have well developed internal lobes like the true molars, while most of those of the Lemurs have none. One group of Lemurs, the *Indrisinæ*, agree with the higher monkeys in having but two premolars, but these also are only one lobed.

A nearly perfect cranium of a species of *Anaptomorphus* Cope, shows that this genus had but two premolars in the superior series, as in the *Indrisinæ*, but that they are two lobed, as in the *Simiidæ* and *Hominidæ.* Of these two families, the *Hominidæ* is the one to which *Anaptomorphus* makes the nearest approach in dental characters. The canine is small with a crown little longer than those of the premolars, and is not separated from the latter or from the incisors by any appreciable diastema. All but one of the superior incisors are lost from the specimen, but those of the lower jaw, which I discovered in 1872, were nearly erect as in man and the *Simiidæ*, and not procumbent as in most Lemurs. The cerebral hemispheres are remarkably large for an Eocene mammal, extending to between the middles of the orbits; the anterior parts, at least, are smooth. The cerebellum projected beyond the foramen magnum posteriorly, as in *Tarsius*. The orbits are large, approaching those of *Tarsius*, but are not so much walled in by a septum from the temporal fossa as in that genus. The superior molars have only one internal cusp.

The species, which I propose to call *Anaptomorphus homunculus*, has a wide palate much as in man, and the true molar teeth diminish in size posteriorly. The pterygoid and zygomatic fossæ are short and wide, and the petrous bone is large and inflated. The animal was nocturnal in its habits and was the size of a marmoset. The genus is nearer the hypothetical lemuroid ancestor of man than any yet discovered.—*E. D. Cope*.

The Archæan Rocks of Great Britain.—Professor Hull, director of the Geological Survey of Ireland, discriminates two petrographic types in the British Cambrian beds, the one consisting of purple sandstones or conglomerates, the other of hard green and purple grits and slates. The former is the "Caledonian" type, and is found in the north-west Highlands of Scotland. The second is the Hiberno-Cambrian, and characterizes East Ireland and North Wales. Professor Hull thinks these formations were deposited in distinct basins, which were separated by an Archæan ridge of crystalline rock which extended from Scandinavia, through the central Highlands of Scotland to Northwest Ireland. The Caledonian basin was an inland lake, the crystalline rocks of the outer Hebrides forming its western shore. Professor Hull also finds the Laurentian granite in N. W. Ireland overlaid unconformably by the Lower Silurian quartzite schists and limestones.—*Geological Magazine*.

A New British Formation.—The name Devono-Silurian is given by Professor E. Hull to a series of cotemporary deposits found in various parts of the British Isles, and to some extent on the continent. He finds them in Devonshire and on the Welsh borders, and probably concealed in Southeast England; also, in the south of Scotland and North and South Ireland. The beds were deposited under estuary or lacustrine conditions, and constitute a great group between the Silurian on the one hand, and the Devonian on the other.—*Geological Magazine*.

Recent Extinction of the Mastodon.—The existence of the mastodon in North America must have been more recent than commonly supposed. A number of new facts bearing on this subject are to be found in Professor John Collett's "Geological Report of Indiana for 1880," recently issued. Of the thirty individual specimens of the remains of the mastodon *(Mastodon giganteus)* found in Indiana, in almost every case a very considerable part of the skeleton of each animal proved to be in a greater or less state of decay. The remains have always been discovered in marshes, ponds, or other miry places, indicating at once the cause of the death of the animal and the reason of the preservation of the bones from decay. Spots of ground in this condition are found at the summit of the glacial drift or in "old beds" of rivers which have adopted a shorter route and lower level; consequently, their date does not reach beyond the most recent changes of the earth's surface. In fact, their existence was so late that the only query is, says Professor Collett: Why did they become extinct? A skeleton was discovered in excavating the bed of the canal a few miles north of Covington, Fountain county, in wet peat. The teeth are in good preservation, and Mr. Perrin Kent states that when the larger bones were cut open the marrow, still preserved, was utilized by the bog-cutters to "grease" their boots, and that pieces of sperm-like substance, two and a-half inches to three inches in diameter (adipocere) occupied the place of the kidney fat of the monster. During the past summer of 1880 an almost complete skeleton of a mastodon was found six miles north-west from Hoopston, Iroquois county, Illinois, which goes far to settle definitely that it was not only a recent animal, but that it survived until the life and vegetation of to-day prevailed. The tusks formed each a full quarter of a circle, were nine feet long, twenty-two inches in circumference at the base, and in their water-soaked condition weighed one hundred and seventy-five pounds. The lower jaw was well preserved, with a full set of magnificent teeth, and is nearly three feet long. The teeth, as usual, were thickly enameled, and weighed each from four to five pounds. The leg-bones, when joined at the knee, made a total length of five and a-half feet, indicating that the animal was not less than eleven feet high, and from fifteen to sixteen feet from brow to rump. On inspecting the remains closely, a mass of fibrous, bark-like material was found between the ribs, filling the place of the animal's stomach. When carefully separated, it proved to be a crushed mass of herbs and grasses, similar to those which still grow in the vicinity. In the same bed of miry clay a multitude of small fresh-water and land shells were observed and collected. These were: 1, Pisidium, closely resembling *P. abditum* Haldeman; 2, *Valvata tricarinata* Say; 3, Valvata, resembling *V. striata*; 4, *Planorbis parvus* Say. These mollusks prevail all over the States of Illinois, Indiana and parts of Michigan, and show conclusively that, however other conditions may differ, the animal and vegetable life, and consequently climate, are the same now as when this mastodon sank in his grave of mire and clay.

THE MESOZOIC OF VIRGINIA.—Professor Fontaine gives a pretty full account of the geology of the Mesozoic of Virginia, with explanations of its peculiar features. He "has a very large collection of fine plants, many of them are new, and some exceedingly fine. The collection is a pretty fair representation of the flora of the older Mesozoic, and will throw light on the Mesozoic of North Carolina and Pennsylvania. The secretary communicated the following notes by Professor Fontaine, made in the same letters: Upon the views of H. C. Lewis, respecting the Saltville valley in Southern Virginia, published in the Proceedings, No. 107, page 155. Mr. Fontaine points out that the little salt and gypsum bearing valley of Saltville cannot be "eroded along an anticlinal of Lower Silurian limestone, because the south-east wall hills only are of that age, while north-west wall hills are of the Umbral (Mauch Chunk or Sub-carboniferous) age." He was the first to find in the limestone on that side of the valley an abundance of Umbral fossils in the highly fossiliferous shale beds intercallated between the various limestones. The species are the same as those found near Lewisburg, West Virginia, in the Umbral. The magnesian (Lower Silurian) limestone strata, bounding the valleys on the south-west, show no trace of fossils. The physical aspect of the two formations also differs. Beds of shale and limestone alternate in the hills north-west of the valleys; and some of the limestone is cherty and some of the shales are red. But the south-east hills contain only solid limestone strata. Those on the north-west have a more rounded typography. It is, however, quite true that the stratification is in opposite south-east and north-west directions, gently to the south-east, much steeper to the north-west. The structure is, therefore, anticlinal, and this fault must run along the south-east edge of the little valley. The explanation is then simple, the Umbral limestone is synclinal, and the red shale formation comes up on both sides of it—with north-west dip in the little valley, with a south-east dip in the valley of the Holston river at the foot of the mountain. A reference to the place in the Michigan salt group in the Palæzoic series makes the presence of salt here easily understood. The horizon seems to be salt-bearing in other places in Southern Virginia. There is a salt ooze near Max Meadows, at the above geological horizon. The secretary suggested in addition to the underlying Vespertine (Pocono) sandstone is a salt-producing formation on the Ohio river and up country. That the gypsum is an acid reaction upon the eroded out-crops of the limestone, is shown in Proceedings A. P. S., Vol. IX, pp. 34, 1862.—*American Philosophical Society.*

Geological News.—Messrs. Wachsmuth and Springer are publishing in the Proceedings of the Philadelphia Academy a revision of the *Palæocrinoidea* which will prove of great value to students. It is accompanied by numerous plates.——Professor Heilprin continues his researches on the Tertiary Geology of the Southeastern United States.——Edward Wethered, F.C.S., F.G.S., has communicated an important memoir on the formation of coal, of which an abstract is given in the October, 1881, Geological Magazine of London.——The Bulletin of the Geological Society of France for 1881, contains many important memoirs, principally relating to the geology of France, Algiers and Belgium.——An analysis of the structure and age of the formations about Lake Champlain is given in the same periodical, by Professor Marcou. ——Dr. Lemoine has added many important discoveries to those he has previously made in the Lower Eocene near Reims, France. He has procured almost perfect skeletons of the Mammalian genera *Heteroborus*, *Pleuraspidotherium*, *Pachynolophus*; of the bird *Gastornis*, and the reptile *Champsosaurus*. He has also discovered a number of the Marsupial family *Plagiaulacidæ*, which is probably nearly allied to the *Ptilodus*, described from New Mexico in the November, 1881, NATURALIST.——Professor Newberry criticizes adversely Professor Spencer's view on the Ancient outlet of Lake Erie, published by the American Philosophical Society.

MINERALOGY.[1]

SYSTEMATIC MINERALOGY.—Bauerman. (Appleton & Co., New York, 1881.) The latest number of that excellent series known as the "Text-books of Science" consists of the first volume of a Text-book of Systematic Mineralogy, by H. Bauerman. The introduction states the two-fold object of the work to be that it should form (1) a guide to general students; (2) an elementary introduction to larger text-books. The greater part of the volume deals with the principles of crystallography. Not only are the simple and compound forms of the different systems fully described and illustrated, but by means of shaded figures, the origin of the hemihedral and tetartohedral modifications is explained. The optical properties of crystals are considered at length in some well written chapters, and the volume concludes with an elementary review of the physical and chemical characters of minerals. The descriptive portion of the work is not yet issued. We cannot help thinking that this work does not quite attain the object for which it was written. While not sufficiently thorough for the advanced student, the method of treatment is not such as would recommend it for the beginner. The language employed in a large portion of the book is by no means simple, and the practical performance of mineralogical work is but slightly considered.

LIME CRYSTALS IN A LIME-KILN.—Several years ago, Brugelmann succeeded in obtaining artificially microscopic cubes of

[1] Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia. The Mineralogical Editor requests short original communications for publication in this department. Early copies of mineralogical papers printed elsewhere are also solicited for review.

lime by heating calcium nitrate. Recently Levalois and Meunier[1] have observed in the inner walls of a lime-kiln cubes of lime 5 centimeters in diameter. The crystals were sharp on the edges, and had the specific gravity of 3.3. Analysis showed that the crystals were composed of nearly pure anhydrous lime. They dissolved slowly in cold, but energetically in warm acids, giving out considerable heat. The crystals were formed upon the limestone walls of the kiln, which, with the exception of a few days, had been kept at a temperature of 1200°–1300° C. for over two years.

NITROBARITE.—Groth[2] describes a natural nitrate of Baryta from Chili. It occurs as small colorless octahedral crystals, with tetartohedral characters, belonging to the isometric system. Artificial crystals of nitrate of Baryta have a similar form. An appropriate mineralogical name for this mineral would be *Nitrobarite.*

VANADIUM MINERALS.—Within the last few years special attention has been directed to the natural occurrence of Vanadium and its compounds. It has been shown that Vanadium, formerly regarded as one of the rarest elements, is of widespread diffusion, and that it almost universally accompanies Titanium in the older geological formations. This fact acquires a cosmical importance when taken in connection with the observation of Lockyer that Vanadium exists with Titanium in the innermost portions of the photosphere of the sun.

Among recent investigations upon Vanadium minerals, those of Rammelsberg[3] are of great importance. He gives several new analyses, and after reviewing the Vanadium minerals, gives the following table of the natural vanadates:

Simple Vanadate	Dechenite $Pb V^2 O^6$
Half Vanadate	Lead Vanadate from Wicklow and Wanlockhead $Pb^2 V^2 O^7$
Third Vanadates	Eusynchite $(Pb, Zn)^3 V^2 O^8$
	Arãoxene $(Pb, Zn)^3 (V, As)^2 O^8$
	Vanadinite $Pb Cl^2 + 3 Pb^3 V^2 O^8$
	Pucherite $Bi^2 V^2 O^8$
Quarter Vanadates	Descloizite $(Pb, Zn)^4 V^2 O^9 + aq$
	Volborthite (Friedrichsrohe) $(Cu, Ca)^4 V^2 O^9 + aq$
Of uncertain composition	Psittacinite $(Pb, Cu)^5 V^4 O^{19} + 9 aq$
	Mottramite $(Cu, Pb, Ca)^6 V^2 O^{11} + 2 aq$
	Volborthite (Perm) $R^8 V^2 O^{19} + 24 aq$

Websky[4] and Urba[5] have investigated the crystalline forms of Descloizite and Vanadinite. Websky describes pseudomorphs of Vanadinite after Anglesite.

[1] Compt. Rend., 90, 1566, June, 1880.
[2] Zeits. f. Kryst., 1881. VI, 195.
[3] On the composition of Descloizite and the natural Vanadium compounds. Monatsber. d. k. Ak. Wiss. Berlin, July, 1880, p. 652.
[4] Monatsb. d. k. Ak. Wiss. Berlin, July, 1880, p. 672. Oct., 1880.
[5] Zeits. f. Kryst., 1880, p. 353.

In America, our knowledge of Vanadium minerals has been largely increased by the important papers of Genth.[1] Vanadium has been shown by the editor to occur in the Philadelphia gneisses.[2] More recently Silliman[3] has announced the discovery of two important localities for Vanadium minerals in Arizona. He states that very beautiful and perfect orange-red and yellow crystals of Vanadinite have been found in that State. He also describes Vanadium minerals which he believes to be Descloizite and Volborthite. Chileite and Mottramite are also suspected. It is to be hoped that a more exact chemical and crystallographic examination may be made upon these interesting minerals.

MICROLITE FROM VIRIGNIA.—Very fine and large crystals of this rare mineral have been found in Amelia Co., Virginia.[4] The crystals are octahedrons modified by cubic, dodecahedral and sometimes also trapezohedral planes. Some of these crystals which have been brought to Philadelphia are several inches in diameter, and we have seen masses of the mineral weighing as much as thirty pounds; a circumstance rendering the name of the mineral an inappropriate one. The mineral is of a wax yellow or brown color, and has a resinous lustre and conchoidal fracture.

Amelia county has become a remarkable mineral locality. It has yielded also Beryl, Fluorite, Columbite, Amethyst, Apatite, and Tourmaline. We have seen a beryl from there which was a perfect hexagon with sharp edges, measuring nine inches in diameter by over two and a half feet in length. The interesting variety of quartz which occurs in the Amelia county muscovite as minute circular plates composed of radiating fibres is already known to microscopists as a most beautiful object for the polariscope.

DIADOCHITE, a phosphato-sulphate of iron has been found in some French anthracite coal mines. It occurs as amorphous brown crusts of resinous lustre. It should be looked for in the coal mines of this country.

VIVIANITE has been produced artificially by fusing a salt of iron with bone black.

ROSTERITE is a variety of beryl from Elba, of a light rose red color. It occurs in short hexagonal tables.

URANOTHORITE is a Thorite from the Lake Champlain Iron district, containing much Uranic oxide.

BEAUXITE, according to Fischer, is a mixture of oxide of iron and red clay.

[1] Amer. Journ. Sc., July, 1876, p. 32. Proc. Amer. Philos. Soc., XVII, 113.
[2] Proc. Acad. Nat. Sc., Phila., 1880, 256.
[3] Amer. Jour. Sc. XXII. 198. Sep. 1881.
[4] Dunnington. Amer. Chem. Journ., III, 2. 130.

BERGAMASKITE.—A variety of amphibole. Lucchetti[1] describes under this name a variety of hornblende from Italy, which contains almost no magnesia. It occurs in green acicular crystals with the following composition: SiO_2 36.8 FeO 22.9 Fe_2O_3 14.5 Al_2O_3 15.1 CaO 5.1 MgO 0.9 Na_2O 4. K_2O 0.4.

NEW BISMUTH MINERALS.—Domeyko[2] has described a large number of interesting Bismuth minerals from South America. Among them are *Bolivite*, an oxysulphide of bismuth ($Bi^2S^2 + Bi^2O^3$) and *Taznite*, a chloro-arseniate and chloro-antimoniate of Bismuth. Bolivite occurs crystallized. Taznite is amorphous and sometimes imperfectly fibrous.

THE OPTICAL PROPERTIES OF PYROMORPHITE AND MIMETITE.—Jannetez and Michel[3] in a paper comparing the optical and chemical properties of pyromorphite and the mimetite find that these minerals can be divided into four types; (1) pure pyromorphite, uniaxial, (2) pure mimetite, biaxial, (3) mixtures showing pyromorphite in the centre, surrounded by mimetite, part uniaxial, part biaxial, (4) groups of crystals having their axes inclined to one another, biaxial appearance.

CHALCOCITE ON AN OLD COIN.—Upon some bronze Roman coins found at the bottom of a French lake, Daubree[4] has observed an incrustation, 2^{mm} in thickness, of chalcocite. The chalcocite forms hexagonal plates like the cupreine of Breithaupt. Some chalcopyrite and malachite were also formed. While similar incrustations are common in thermal springs and mineral waters, the present case is interesting in that the water was cold and pure.

NOVA SCOTIA MINERALS.—Among other minerals found in the trap of Nova Scotia, Gilpin[5] mentions Chlorophœite, Delessite, Acadialite, Mordenite, Louisite, Ledererite, Gyrolite, Centrallasite, Cyanolite, Steelite, etc. He regards Louisite as a variety of Okenite, and Steelite as a variety of Mordenite.

GEOGRAPHY AND TRAVELS.[6]

M. DE BRAZZA'S JOURNEY FROM THE OGOWE TO THE CONGO.—Some further details of M. de Brazza's journey are given in the Royal Geographical Society's *Proceedings* for November, 1881. "After leaving his station at Francheville in July, 1880, the traveler saw the sources of the Passa affluent of the Upper Ogowé, and crossed the River Lekéti (an affluent of the Alima, the Kunia

[1] Mem. Ac. Sci. Bologna, 1881, 2, 397.
[2] Ann. d. Min., XVIII, 538.
[3] Bull. Soc. Min. de France, 1881, 196.
[4] Comp. Rend., XCIII. 572. Oct., 1881.
[5] Proc. and Trans. N. S. Inst. Nat. Sc., V, 283.
[6] Edited by ELLIS H. YARNALL, Philadelphia.

of Mr. Stanley's map), which appears to have been misnamed M'pama in the map of his previous journey, by this route reaching the navigable portion of the Alima in four days. It is thought probable that the plateau of the Batékés reaches to the right bank of the Upper Ogowé, and is connected with that of the Bayakas, in which, perhaps, the River Ngunié, which joins the Ogowé below Lambaréné, takes its rise. The plateau of the Batékés (Achicuyos) separates the Alima from the M'pama (the M'paka of Mr. Stanley), which probably rises in the plateau of the Balalis, flowing direct to the Congo. Leaving the plateau of the Batékés (Achicuyos) by the M'pama, M. de Brazza arrived at the plateau of the Abomas, which is well peopled and very fertile, and separates the M'pama from the Lefini (the River Lawson of Mr. Stanley). On leaving the plateau of the Abomas M. de Brazza was assured that he could reach Stanley Pool on the Congo in four days, by way of the plateau of the Makokos, but he thought it advisable to change his route, in order to enter into negotiations with the Ubangi tribe, with whom he had had previous difficulties. He afterwards descended the Lefini on a raft to within a day's journey of its confluence with the Congo. He then marched by land, with only five attendants, in two days, to the Congo, which he reached near to a populous part of the Ubangi country. He was received by the chief Ngampéi, who is subject to the Makokos, and arranged with him to make certain propositions to the Ubangis. Without waiting for the result of this step, he returned to the Lefini, and in two days' time reached the plateau of Makoko, to whom all the country is subject between the Lefini, the Jué (Zué of Mr. Crudgington, and Gordon Bennett of Mr. Stanley), and the Congo. Makoko assembled all the chiefs of the Ubangis, from the Alima, the Bakinga (the Likuma or Likona of the old maps), and the Ikelemba and through his influence peace was made with M. de Brazza. Makoko then sent two chiefs down with him by canoe to the spot ceded for the Brazzaville station, near Stanley Pool. Whilst there, M. de Brazza explored the road from the village of N'gamforu, chief of the Abomas, to the River Kunia, across the plateau of the Makokos; and he considers that the principal difficulties to be met with on the road from Francheville to Stanley Pool would be the passage of the Rivers Leketi, M'pama, and Lefini."

Central Africa.—The African traveler, Dr. Enim Bey, believes there are three lakes lying to the north of the Victoria Nyanza. Beatrice Gulf certainly does not belong to the Albert Nyanza, but to a lake south of the Albert. Steamers now go regularly from Dufilé to Mahagé, a station on the west coast of Lake Albert.——At the beginning of the present year Mr. J. M. Schuver left Cairo with the intention of traversing Africa from north to south. When last heard from he was on his way to

Fadasi near the Yabos affluent of the Blue Nile in about E. long. 35° 10′ N. lat. 9°. He expected to return to Fazogl and journey through the Galla country after the rainy season was over. In this stage of his great journey Mr. Schuver's chief objects are stated to be the determination of the sources of the Sobat and the discovery of the lakes, which are believed to exist on the high plateau between the White Nile and Kaffa.——Mr. Joseph Thomson has recently been exploring the Loende tributary of the Roouma River. No coal was found. The whole country is thickly covered with forest composed chiefly of India rubber trees. The land rises immediately from the shores of the Indian Ocean to an altitude of three hundred feet, and gradually an elevation of three thousand feet is attained. Mr. Thomson now intends to visit the region lying between the sea and Mount Kilimanjaro and extending from Melinda on the north to Pangani on the south. ——The Missionary Expeditions to Lake Tanganyika continue to be unfortunate. The Algerian Mission at Urundi, near the head of the lake, reports the murder of three of its members and nearly all the missionaries of the London Missionary Society on the west shore of the lake were incapacitated by illness at last accounts.——Herr Flegel has succeeded in ascending the Niger to Gomba, but the boatman refused to go on to Say. He proposed to explore Adamawa in search of the sources of the Binué.——Mr. Stanley succeeded in reaching Stanley Pool in the latter part of July and spent several days there. He confirms the belief expressed by M. de Brazza and the Baptist Missionaries, that the Pool is more than one degree further west than he fixed it in his map. The longitude now given is 15° 47′ west from Greenwich. The country on the north bank of the Congo is reported to be exceedingly healthy.——The *Athenæum* says: "The expedition which the American Board of Commissioners for Foreign Missions, despatched to West Africa a little more than a year ago, appears to have made fair progress. The object is to found an extensive American mission on the Bihé plateau as that field of labor is entirely distinct from those worked by European agencies. The party arrived at Benguela in due course and afterwards took up their abode at Calumbella, twelve miles off, and were delayed there till March 11th, chiefly owing to difficulties about porters, which appear to be as great there as on the eastern side of the continent. Starting at last on the day named, they made what is, for African traveling, a rapid march to Bailunda, accomplishing the two hundred miles in fifteen days. Mr. Bagster and his companions settled here for a month to await the arrival of stores from the coast before moving on to Bihé, some fifty miles distant. In the middle of April it became evident that Mr. Bagster must go to the coast and hurry on matters. He accordingly left his companions at Bailunda to study the Ambunda language and returned to Benguela." Later intelligence informs us of his having rejoined the party, now settled in camp, some six days march from Bihé. The nights there are cool, the thermometer falling as low as 40° and rising at noon to 85° or 90°. The natives are friendly. The missionaries have made some progress in learning their language.——Dr. Pogge and Lieutenant Wissmann were at Malange at the end of last May, and hoped to arrive at Kimbundo in the latter part of June. They started from Loanda in January and ascended the Kwanza river for some distance.

ARCTIC DISCOVERY.—The Brothers Krause, sent out by the Bremen Society, have visited the Chukchi peninsula at various points and intend spending the winter in the north of Alaska.

Captain Adams, the well known Arctic whaling captain, has this last summer penetrated as far up Wellington Channel as an expedition has ever been. He then steered down Peel Sound to within a short distance of where the *Erebus* and *Terror* were lost. He also visited Beechey Island and the Gulf of Boothia. From an Eskimo near Fury and Hecla Straits, Captain Adams heard a story concerning the death of an officer—possibly Lieutenant Crozier, and two seamen of the Franklin expedition.

Mr. Leigh Smith's vessel, the *Eira*, in which he sailed for Franz Josef Land, has probably been beset by the ice, as she has not been heard from. She was provisioned for fourteen or fifteen months.

The Italian Antarctic Expedition has failed for want of funds. Lieutenant Bove has, however, gone to Buenos Ayres, to explore the coast lands of Patagonia and Eastern Tierra del Fuego for the Argentine Government. He will be accompanied by a number of Italian savants in a separate vessel.

INTERNATIONAL POLAR CONFERENCE.—The Conference was held this year at St. Petersburg. Delegates were present from Denmark, Norway, Sweden, Russia, Austria-Hungary, France and Holland. Polar stations are to be established at Upernavik by Denmark, at Bosskop, Finland, by Norway, at Jan Mayen by Austria-Hungary, at the mouth of the Lena and Novaya Zemlya by Russia and in Spitzbergen by Sweden. Observations are to be begun as soon as possible after August 1, 1882, and continued as far as practicable until September 1, 1883. Meteorological and magnetic phenomena will be observed, hour by hour, and on the 1st and 15th of each month observations will be taken every five minutes during the twenty-four hours, and every twenty seconds during one hour, which will be previously fixed; mean time at Göttingen being adopted in all cases. It was recommended that observations of the temperature of the soil, of evaporation, of terrestrial galvanic currents, of atmospheric electricity, etc., be taken. It was resolved (1) to found, if possible, a special publication to bring more quickly to the knowledge of the scientific world, as well as of the leaders of the various expeditions, the results achieved from time to time, etc.; (2), to leave behind, where practicable, the buildings and other of the equipments of expeditions likely to be useful to future investigators in the same branches of science, and to take all possible precautions for their preservation; and (3), to endeavor to make arrangement with railway and steamer companies for the reduction of the cost of passages and transport.

GEOGRAPHICAL NEWS.—The second Geographieal Society in the United States has been organized at San Francisco, under the title of The Geographical Society of the Pacific.——The recent census of India, shows the total population to be 252,000,000.——Russian explorers have recently visited the Bai Shan Mountain, twelve miles north-east of Kuldja and found that the fires that have been burning there from time immemorial are not volcanic, but proceed from burning coal. On the sides of the mountain there are caves emitting smoke and sulphurous gas. The question as to the existence of volcanic formations in Central Asia, may now be considered as decided in the negatative.——The *Nature* states that "Mr. James Jackson, 'Archiviste-Bibliothécairé' of the Paris Geographical Society, has published, in a volume of 340 pages, a 'Liste Provisoire de Bibliographies Géographiques Spéciales.' The list was undertaken at the instance of the Society, and was printed in some haste, we believe, for the recent Venice Congress. But when we remember that the list is only a bibliographical one, a list of lists, in fact, the accumulation of geographical literature is almost appalling. It bears evidence of extensive and careful research, though the author admits that it is by no means exhaustive. Mr. Jackson recently visited the United States to search the libraries there, and the result is a work invaluable to all students of geography. He has wisely devoted comparatively small space to Europe, because, as he states, the works relating to the countries of that continent are well known and easily accessible. Mr. Jackson gives not only bibliographies proper, but references to works on travel and geography, and to periodicals, journals, and transactions, which contain special lists. The divisions of the list are:—Europe, Asia, Africa, America, Oceanica, Polar regions, Oceans and Hydrography, Peoples and Nations, Voyages, Travelers, and Geographers, and Generalities. By means of the arrangement under each division the methodical table of contents, the index to authors and periodical publications, the work is rendered easily consultable. It reflects the greatest credit on Mr. Jackson's industry and on the enterprise of the Paris Society."——A new island has been discovered in lat. 7° 48′ S. long. 82° 48′ W. and 188 miles from Punta Aguja, south of Guayaquil, the nearest land. It appears to be of volcanic origin and is only fifty feet above the sea, in its highest part. It is a mile long and about the same width.——In the northern portion of the Chinese province of Shensi the sand from the desert is seriously encroaching on the country and has already half buried some cities. The high walls which have hitherto kept it out of Yülin will not much longer be of any avail, as the sand is already heaped almost to the top.——An expedition was sent last summer to explore the neighborhood of Bear Lake, British Columbia, which was previously quite unknown.——In the Geographical Section at the Meeting of the British Association, in addition to the papers heretofore mentioned the following were read:—Progress of Arctic Research since the Foundation of the British Association, by Clements R. Markham, F. R. S; On the Island of Socotra, by Professor J. Bailey Balfour; Journey to the Imperial Mausolea, East of Peking, by F. S. A. Bourne; Comparative Sketch of what was known of Africa in 1830, with what is known in 1881, by Lieutenant Col. J. A. Grant; Some Results of Fifty Year's Exploration in Africa, by the Rev. Horace Waller; Recent Visit to the Gold Mines of the West Coast of Africa, by Commander V. L. Cameron, R. N.

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SCIENTIFIC NEWS.

— The first part of a valuable work by M. Alph. Milne Edwards, on "The Fauna of Austral Regions," has been presented to the French Academy. The geographical distribution of birds is chiefly dealt with. It is remarkable (and would hardly have been expected) that these animals are eminently adapted to reveal the existence and position of the zoölogical centers whence the various species have radiated. The penguins are specially interesting in this respect. They appear to have migrated from a center of production in the Antarctic islands, near Victoria land, and to have followed the great currents going northwards, reaching the waters of Cape Horn, the Falklands, New Georgia, the Cape of Good Hope, and various islands of the Indian ocean, establishing, in each case, powerful colonies, with (in time) distinctive characters. Another colony, represented by the Spheniscans, starting from the same center, and favored by Humboldt's current, has gone to the west of Cape Horn, along the coast of Chili, to Peru and the Gallipagos islands, touching at various points.

— The volume on the Vertebrata of the Western Tertiary formations on which Professor Cope has been engaged for several years, is, we understand, approaching completion. Most of the plates are drawn, and the printing of the text is well advanced. This work will cover much ground, and will furnish much detailed information on a subject which has of later times excited general interest. The volume is No. IV of the Hayden series. Vol. III will follow. It will give a similar account of the recent discoveries in the Permian and Mesozoic formations of the West. Nearly a thousand species of Vertebrata will be described and figured in these volumes. The Hayden series, when completed, will form a monument to Dr. Hayden, who projected it, and will reflect credit on the Government, which has sustained the publication.

— Among recent publications of the Census Bureau is an extra Census Bulletin containing tables showing the approximate areas of the United States, the several States, and their counties. It has been prepared by Mr. Henry Gannett, the geographer and special agent of the tenth census. It appears that of several States a number of estimates of area have been in use, differing from one another by thousands of square miles, and none of them perhaps traceable to any authentic source; while many of the results are palpably wrong, being so far from the truth that it is a source of surprise that they were not corrected before. A map defining the gross areas of the States and Territories accompanies this useful Bulletin.

— Mr. Allen Whitman, a native of East Bridgewater, Mass., died recently in St. Paul, Minnesota, aged 45 years. He was a graduate of Harvard, and while one of the best classical scholars in the country, was one of the most valuable assistants in the U. S. Entomological Commission, having previous to the organization of the Commission, published two valuable reports on the locust as it appeared in Minnesota.

— The University of Cambridge, England, has conferred the honorary degree of Doctor of Laws upon Professor Thomas Sterry Hunt, LL.D., F.R.S., a native of Connecticut, who was for twenty-five years chemist and mineralogist to the Geological Survey of Canada, and resigned that post in 1872 to accept the Chair of Geology in the Massachusetts Institute of Technology.

— Professor W. N. Rice, and Mr. H. L Osborn, in their report as curators of the Museum of Wesleyan University, gives a review of the state of the museum. Many important additions have been made, and the spirit and zeal shown by the curators should result in such pecuniary benefactions as would liberally endow that department.

— An autobiographical sketch by Rev. Titus Coan, entitled, "Life in Hawaii," is announced by A. D. F. Randolph & Co. It includes accounts of the eruptions of the volcanoes in the Hawaiian Islands, of which this missionary has been a diligent historian since 1835.

— The late John Amory Lowell bequeathed $20,000 to Harvard College, for the botanical garden, on condition that it be called the "Lowell Botanic Garden," in memory of his grand-father, who started the first subscription for the purpose of establishing this department.

— Mr. G. H. Darwin in his work on the tidal evolution of the moon has drawn the inference that geological denudation and deposition must have been vastly more active in former times than at present.

— Mr. C. S. Nachet, the founder of the well-known French firm of microscope manufacturers, died October 28, at the advanced age of 83.

— The Census Bulletin, No. 270, refers to the production of iron ore in the United States, which was 7,971,706 tons; with a valuation of $23,167,007.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

MIDDLESEX INSTITUTE, Oct. 12, 1881.—The President, L. L. Dame, read a paper on "Botanical Nomenclature," in the course of which he alluded to the different pronunciations prevailing even among good botanists, and advocated, subjecting all names becoming Latinized to the Latin rules of prounciation without regard to the vernacular as the only way of ensuring absolute uniformity. In the discussion which followed it was objected that under such an arbitrary rule many names derived from persons would become so disguised as to be practically lost, thus defeating the object for which they were established. But how far this objection may prevail against the unquestionable advantages of a uniform pronunciation is an open question. The paper was, however, the most important in its bearings of any yet presented to the Institute, and well calculated to set the members to thinking in the right direction. A new by-law providing for the formation of sections was adopted, and the completion of arrangements for a course of lectures announced. Prof. Edward S. Morse, and Rev. Edwin C. Bolles, D. D., of Salem; Prof. John Fiske and Prof. Wm. H. Niles, of Cambridge, Mass.; and Prof. Chas. A. Young, of Princeton, New Jersey, were elected honorary members.

NEW YORK ACADEMY OF SCIENCES, Nov. 14.—Dr. A. A. Julien read a paper on the excavation of the bed of the Kaaterskill, N. Y.

Nov. 21.—Dr. Louis Elsberg remarked on the cell-doctrine and the bioplasson doctrine.

Nov. 28.—Commander Cheyne, R. N., delivered a lecture entitled, "The Discovery of the North Pole practicable."

Dec. 5.—Dr. A. A. Julien read a paper on the volcanic tufas of Challis, Idaho.

BOSTON SOCIETY OF NATURAL HISTORY, Nov. 16.—Mr. William Trelease compared the glands of plants with those of animals. He described the histology and showed the homology of the organs in question. The glands are anomalous in that a deep-lying tissue secretes the fluid, which reaches the exterior through a distinct break in the epidermis—not a stoma. The secreting tissue is the end of a fibro-vascular bundle, the cambium having produced the active cells, instead of wood cells, the whole being surrounded by a thin bast sheath. He described a number of cases showing the glands to represent undeveloped flowers, as previously indicated by Delpino. Professor D. P. Penhallow then read a paper on the temperature of trees.

Dec. 7.—Professor A. Hyatt described the sponge found in the Boston Water Supply, and Mr. B. H. Van Vleck discussed its distribution in Farm Pond, and the general condition of the latter; Dr. Wm. F. Whitney showed a skull of an ancient Mexican, with an arrow-head imbedded in the superior nasal fossa.

AMERICAN GEOGRAPHICAL SOCIETY, NEW YORK, Nov. 25.—Dr. I. I. Hayes[1] delivered a lecture on the water-ways of New York, considered in relation to the transportation interests of the State, and the commerce of the city.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE, Dec.—Lower Silurian fossils (Graptolites) in Northern Maine, by W. W. Dodge. A contribution to Croll's theory of secular climatal changes, by W. J. McGee. On the relation of the so-called "Kames" of the Connecticut River valley to the Terrace formation, by J. D. Dana.

GEOLOGICAL MAGAZINE, Nov.—Evaporation and eccentricity as co-factors in glacial periods, by E. Hill. The valley system of S. E. England, by S. V. Wood. Sudden extinction of the Mammoth, by C. Reid.

ANNALES DES SCIENCES NATURELLES, Sept., 1881.—Observations on the development and organization of the Proscolex of *Bilharzia hæmatobia*, by J. Chatin. Observations on the sexual cells of Hydroids, by A. Weismann. Observations on the functions of the caudal appendage of Limuli, by J. de Bellesme. Rare or new Crustacea of the coast of France, by M. Hesse. Observations on the encystment of *Trichina spiralis*, by J. Chatin.

ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE, Nov. 1.—On the developmental history of the ophiuran skeleton, by H. Ludwig. Contributions to the anatomy and histology of *Sipunculus nudus*, by J. Andreæ. Comparative anatomical studies on the brain of bony fishes, with especial reference to the Cyprinoids, by P. Mayser.

[1] Since suddenly deceased, Dec 17.

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THE SIPHONOPHORES.

BY J. WALTER FEWKES.

(*Continued from October number, 1881.*)

IV.—ANATOMY AND DEVELOPMENT OF DIPHYES.

THE Siphonophores which we have thus far considered all agree in this particular, that they have a float attached at one end of the stem to buoy it up in the water. It may, in some genera, be doubtful how far this structure is necessary, or to what extent it is functional, but it is never without representation in any of the Physophoridæ. We come now to consider tubular jelly-fishes, which may be looked upon as in many respects the highest[1] of the Siphonophores. In no member of the group is there a float such as is to be found in Agalma and its allies, while in details of structure their organization is very characteristic, and different from the tubular Medusæ already studied. A good representative of these Medusæ, whose several genera make up the Diphyidæ,[2] is the beautiful genus Diphyes, represented in our waters, as far as explored, by a single species. An account of the anatomy and development of this genus seems a fitting introduction to a more extended acquaintance with the remaining Siphonophores, which embrace some of the most beautiful animals with which the student of marine life is familiar.

The differences between Diphyes and Agalma seem so great

[1] If we consider, however, their anatomy, and the likeness of some of the Diphyidæ to the primitive medusa of Agalma, we may place them, as a whole, below the Physophoridæ. My reasons for placing them higher will be given later in this paper.

[2] The designation Diphyidæ seems to me preferable to Leuckart's term, Calycophoridæ. The very aberrant genus Hippopodius is the type of a family between the Physophoridæ and Diphyidæ.

that, at first sight, it is almost impossible to recognize anything in common between them both. A more intimate study, however,

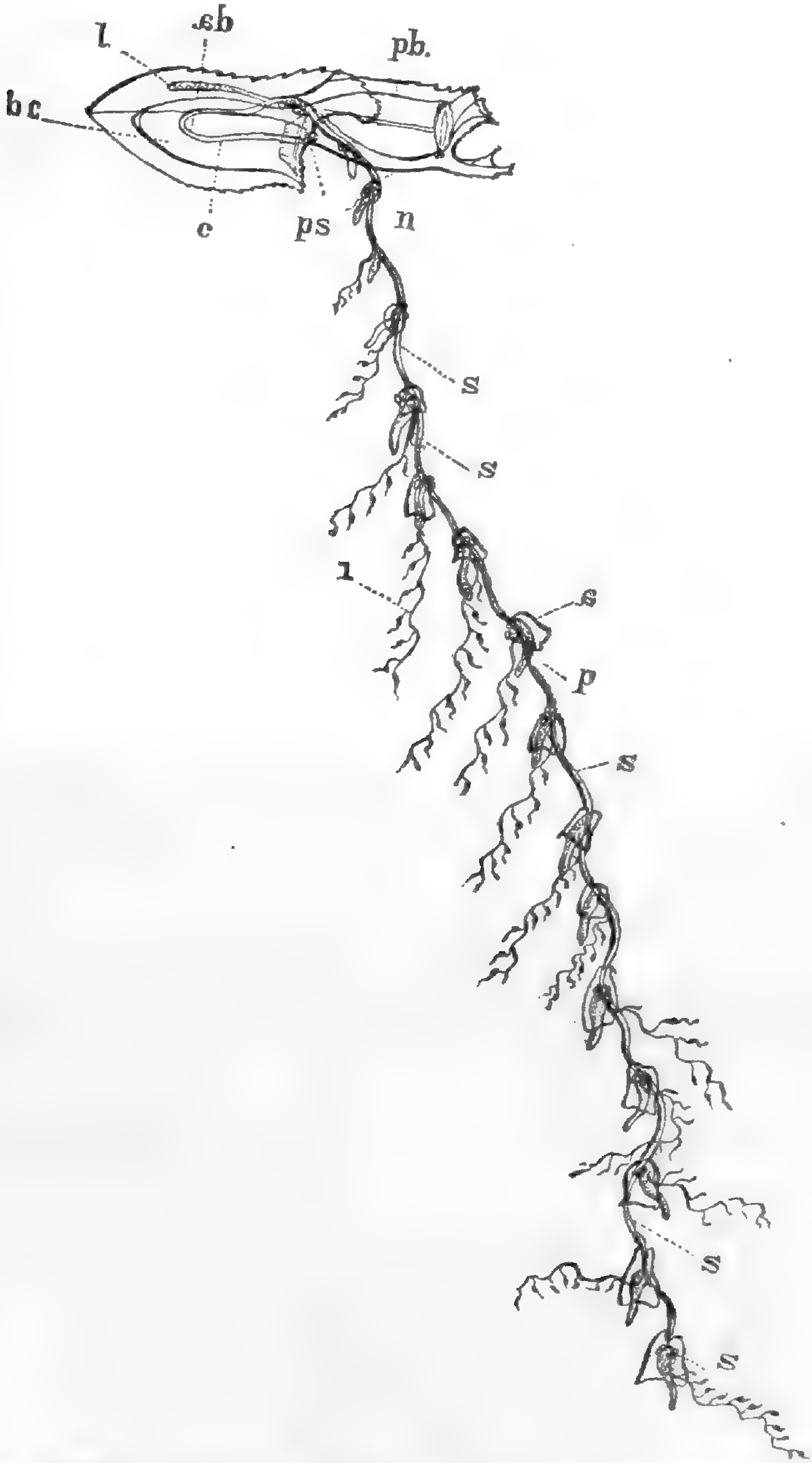

FIG. 1.—*Diphyes formosa*, sp. nov. *a*, covering scale; *ab*, anterior bell; *bc*, bell cavity; *pb*, posterior bell; *ps*, pigment spot (ocellus?); *c*, long tube of anterior bell; *l*, somatocyst; *n*, ridges on lower side of posterior bell; *s*, stem; *a* covering-scale; *p*, polypite; *i*, tentacle.

brings out very many resemblances which a casual observation had overlooked.

Prominent among all the structures which characterize the Siphonophores, is the axis or stem from which the group is named. In Diphyes this part *(s)* is very well developed, and in live specimens may be seen trailing behind to a great distance in the water, just as we have seen was the case in the genera of Physophoridæ already mentioned. Along its whole extent we find appendages so fastened that they do not incommode in the least possible manner the direct motion of the animal through the water. In the genus Diphyes it will be noticed that all the organs are especially adapted for rapid motion, and as one watches these graceful tubes, with their appendages, shooting through the sea, the adaptation for this mode of life seems complete. With this thought in mind, one can almost predict the organs of the Physophores which should be missed in Diphyes, and the modifications of their form which would be expected.

A float would, if of any size, be a great impediment to the free motion of the jelly-fish. In Diphyes, consequently, it is altogether wanting, and other methods are resorted to in order to diminish the specific gravity of the colony.

No organ of Diphyes better illustrates the modification and adaptation which has taken place to bring about rapid motion, than those which move the colony, which are here, as in all Siphonophores, the nectocalyces. There are only two of these swimming-bells, as they are called, and they are very different in outline and general appearance from the swimming-bells of any of the animals which we have yet considered. These bells differ also one from the other, in size, shape and anatomy.

At one end of the axis of Diphyes, as it floats gracefully extended in the water, there are two gelatinous, transparent bodies of somewhat conical shape *(ab, pb)*; these are the two nectocalyces which, with the exception of one genus, Hippopodius, are double throughout all the members of the Diphyidæ.[1] The connection between the two bells at the extremity of the axis is so strong, that when they are raised from the water they are not broken apart, but the axis, by contraction, is simply drawn up into a deep groove in the under side of the bell, while the appendages, even when the colony is lifted out of water, remain attached

[1] In the genus Monophyes there is but a single nectocalyx. This genus is, in this respect as well as in other details of structure, very peculiar. I shall speak of it more at length in considering the different genera of Diphyidæ. Hippopodius has many nectocalyces.

much more strongly than corresponding structures of Agalma and kindred forms. In this retracted position they are often carried, as the animal darts forward in its course through the water. To facilitate that motion by diminishing the resistance of the surrounding medium, the method of attachment no less than the form of the bells, contributes.

In Agalma the nectocalyces, as we have seen, seem to arise in two rows, with bell openings looking in opposite directions. They are capable of a very limited change of position, and most of the variety of motion which the colony has, is brought about by combination in the action of nectocalyces situated in different regions of the stem, or in a muscular twisting of the axis upon which they are fastened, by which their openings are made to face in different directions. The method is too simple if rapid motion be desired, and ill adapted to that purpose in Diphyes. In Stephanomia variety and rapidity of movement are brought about by multiplication of nectocalyces. Even in this genus the means are inferior to those which we find in Diphyes.[1]

The swimming-bells of Diphyes are placed one behind the other, so that their longer axes lie in a straight line which falls in the direction of motion. Both bell cavities open in the same way, facing backward as they float in the water. When they act simultaneously the fluid ejected from their cavities by the contraction of the bell walls, presses together on the surrounding medium and reinforces each other. There is no action of one bell in opposition to another, as may happen in Agalma. The volume of ejected water is comparatively much larger than in any of the Physophoridæ.

The anterior bell *(ab)* of the two nectocalyces has a pyramidal shape, and is pointed at the apex opposite the bell opening. If this bell were attached by the same region as the nectocalyx of Agalma, it would seem as if this apical prolongation should also indicate the place of attachment of the stem. In Diphyes, however, this is not the case. The apex of the first bell is not homologous to the apex of the bell of other Medusæ, nor does it correspond to the point of attachment of the nectocalyx to the stem

[1] The motion of the Diphyes is sometimes so rapid that the eye cannot follow the animal. The water is driven out of the bell cavity by a single muscular contraction of the bell walls and when the impetus is lost a new contraction follows. The movement of the two nectocalyces is simultaneous.

of Agalma. The apex of the anterior bell is in reality the prolongation of the side of the bell, while the true apex has been abnormally twisted out of position, and is found just above the bell opening, near the origin of the stem which seems to hang down between the two nectocalyces.

Nowhere in its structure is the modification, which takes place in the organs of the bell as a result of this abnormal twisting, better shown than in the course of the chymiferous tubes upon the inner walls of the bell cavity. The radial tubes are especially modified in their course by the change in external form which the bell has undergone.

The chymiferous tubes of the anterior nectocalyx in Diphyes, consist of a system of four radial vessels placed upon the inner walls of the bell cavity, and a single large tube or cavity extending into one side of the bell walls parallel to the outer surface. The former tubes start from a common junction, and pass radially to the bell margin, while the latter ends blindly about two-thirds the distance between the bell rim and the pointed extremity of the nectocalyx. Both open into the cavity of the stem; the former by a vessel passing from their junction to the stem; the latter more directly through the same tube.

The length of the four radial tubes is very unequal, as would naturally be expected if the distortion which we have suggested as having taken place in the anterior bell, has in reality occurred. The two tubes *(c)* which lie in those parts of the bell which have been enlarged, are therefore naturally much longer than those in the remaining portions of the bell. So small indeed has that side of the nectocalyx which adjoins the posterior bell become, and so enormously has the opposite half been enlarged, that the tubes of one are inconspicuous and with difficulty traced, while those of the other are very prominent on the inner bell walls. At first sight then, we might suppose that there were but two radial vessels, while a closer study shows that there are four such tubes as we have seen exists in the nectocalyces of all Siphonophores. At the common junction of these tubes, we must look for the apex of the bell cavity. At that point, about midway in the length of the two bells, the vessels communicate with the stem cavity by means of a short tube, similarly placed to a like vessel in the nectocalyx of Agalma.

There is, however, in the anterior nectocalyx a tube *(l)* which has the form of a cavity filled with a spongy mass[1] of cells, and which seems without representation in the bell of Agalma. This cavity starts from the union of the vessel last mentioned with the stem cavity, and extends through the substance of the bell walls, ending blindly a short distance from its union with the stem. If we look for its homologue in the bells of Agalma, it will be found to exactly correspond in position with the mantel tubes, which are diminutive branches from the vessel which in Agalma connects the radial system with the cavity of the axis. This greatly developed mantel tube in the anterior nectocalyx of Diphyes has been called the somatocyst. It is not a float, as far as its homology goes, although it may, at times, contain globules of oil, which serve to diminish the specific gravity of the animal. The existence of the somatocyst in the bell walls on one side, and not on the other, necessitates a thickening of those lateral walls, which are usually placed uppermost as the medusa floats in the water. The walls on the opposite or lower side are very thin. The thickened upper bell walls, from which the axis hangs, are continued beyond the margin of the bell in order to give a basis of attachment to the stem. This elongation extends over and protects[2] a portion of the posterior nectocalyx, as shown in the figure. It often happens that the posterior bell is ruptured from its connection with the anterior, and but one nectocalyx, with its attached stem, is found. Such a find is liable to deceive a novice in the study of the tubular medusa. It can be laid down as a law to which there is but one exception as yet known, that all the adult Diphyidæ have two nectocalyces in their normal condition.

The second or posterior nectocalyx *(pb)* differs widely from the anterior in shape and in the character of its chymiferous vessels, more particularly in their course through the bell walls. While it has the elongated form of the anterior, the course of the

[1] The appearance of a "spongy mass," which seems to fill the somatocyst of Diphyes, is due to an enlargement of the walls so that the cells seem to fill the whole cavity. *D. turgida*, described by Gegenbaur, has no somatocyst. (Gegenbaur, Zeit. f. Wiss. Zool., v, 1854, p. 442–448, Taf. 23. Keferstein and Ehlers, Zoologische Beiträge, p. 16.

[2] It is to be noticed that the projection of the prolongation of the anterior nectocalyx over the posterior, strengthens the union of these two structures. A firm union is necessary in order that in their simultaneous action no movement of one bell on the other should take place. If such a motion occurs a part of the forward impetus would be lost. Rigidity of the nectocalyces is here very necessary, and hence the close soldering together of these parts.

radial tubes as well as the point of attachment of the bell to the stem, shows that one side of the bell is not abnormally developed at the expense of the other. Its general form is exactly what would take place if an Agalma bell were much elongated in the line of its height, in order to secure a greater capacity for the cavity.

The most important variation in shape from the anterior bell, is the formation of two ridges extending the whole length of the under side of the posterior nectocalyx on the side which is opposite that part of the anterior bell which is thickened and bears the somatocyst. These ridges are continued into two prominences beyond the bell opening.[1] In the interval between these two ridges there is a groove in which is lodged the stem when retracted. In some genera, as Abyla, still further means of covering the stem when thus retracted are found, but in Diphyes the groove is without covering. The posterior bell is smaller than the anterior, and is easily detached. Its radial system of vessels communicates with the stem cavity by a small vessel which is destitute of mantel tubes or somatocyst. While the two nectocalyces of Diphyes are the most prominent structures in the animal when alive, and the only organs to be studied in alcoholic specimens, they are by no means the most important. The active habits of Diphyes has given them this predominance in size. There remain many other appendages to the stem yet to be mentioned.

These parts of the colony are fastened regularly along the whole length of the stem to its very extremity. They consist of covering-scales, polypites to which are appended tentacles dotted along their length with tentacular pendants, and clusters of sexual bells. Representatives of the bodies called tasters in my account of Agalma do not exist, as far as known, in the Diphyidæ. The appendages are not placed irregularly upon the stem, a polypite in one place and a cluster of sexual bells in another, but are found in clusters, separated by short intervals of the stem. Each cluster consists of a covering-scale, a polypite with its ten-

[1] The projections formed by the continuation of the ridges on the under side of the posterior nectocalyx probably act as rudders to determine the direction which the animal takes as it moves, or to regulate the angle at which the water leaves the bell cavity. In some genera of Diphyidæ, similar structures undoubtedly have this function, and it seems highly probable that the same is true in the projections under the opening of the posterior bell in Diphyes.

tacle and a cluster of sexual bells. In Apolemia we find a like clustering of homologous parts, and the same law goes through all the Diphyidæ with the exception of the single genus Hippopodius.

The clusters which were described in the genus Apolemia, separate from the remainder of the colony and lead an independent life. This is also true in a more complete form in the clusters of the Diphyes colony. For a long time these separated fragments were thought to be new genera, that from a Diphyes had been called Eudoxia, until it was shown by Leuckart that it was in reality only a fragment dropped from the stem of a Diphyes.

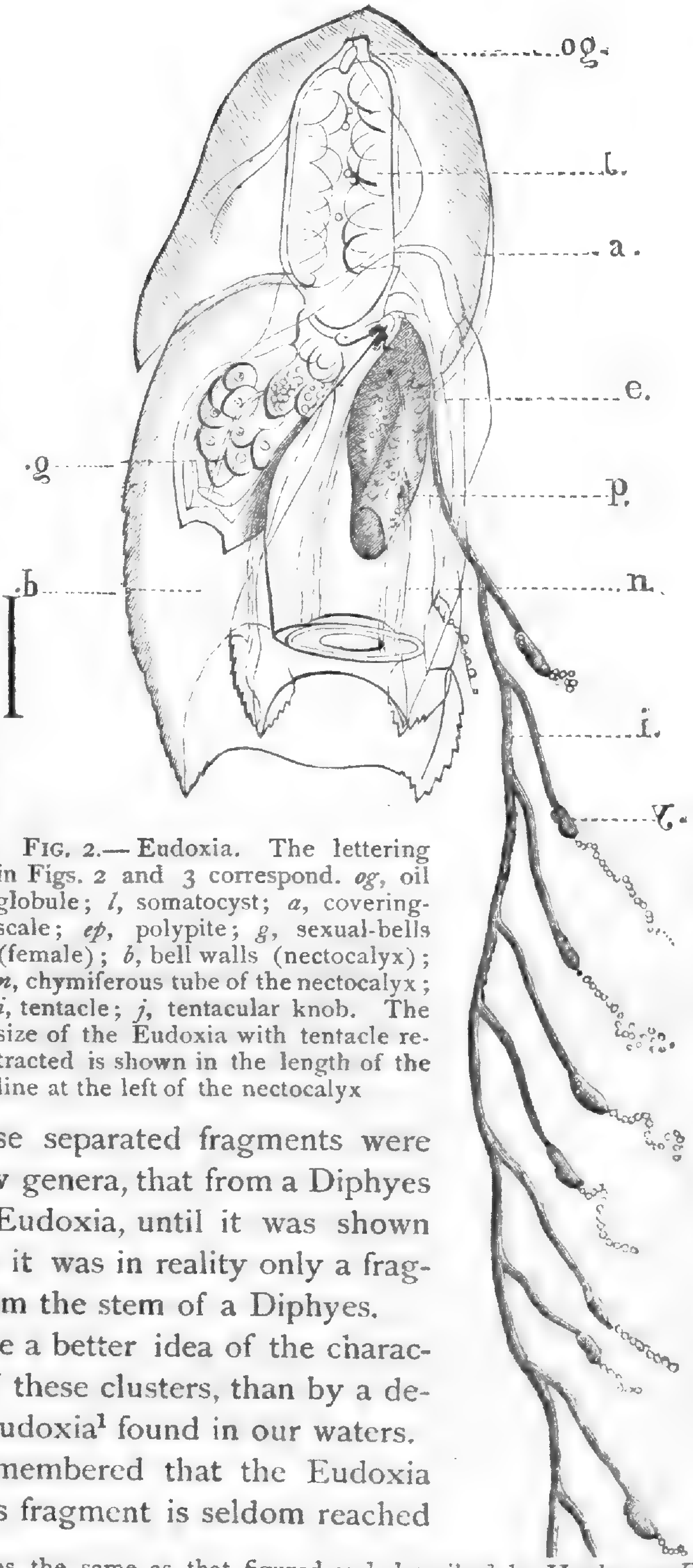

FIG. 2.— Eudoxia. The lettering in Figs. 2 and 3 correspond. *og*, oil globule; *l*, somatocyst; *a*, covering-scale; *ep*, polypite; *g*, sexual-bells (female); *b*, bell walls (nectocalyx); *n*, chymiferous tube of the nectocalyx; *i*, tentacle; *j*, tentacular knob. The size of the Eudoxia with tentacle retracted is shown in the length of the line at the left of the nectocalyx

We cannot give a better idea of the characteristics of one of these clusters, than by a description of the Eudoxia[1] found in our waters.

It must be remembered that the Eudoxia form of a Diphyes fragment is seldom reached

[1] This Eudoxia seems the same as that figured and described by Huxley as *E. Lessonii*. It is here supposed that this Eudoxia is the diphyizoid of *Diphyes acuminata*. The form of the appendages extending backward on the lower surface of the posterior nectocalyx are so different in shape in this species and *D. acuminata*, that the species here figured may be as yet undescribed.

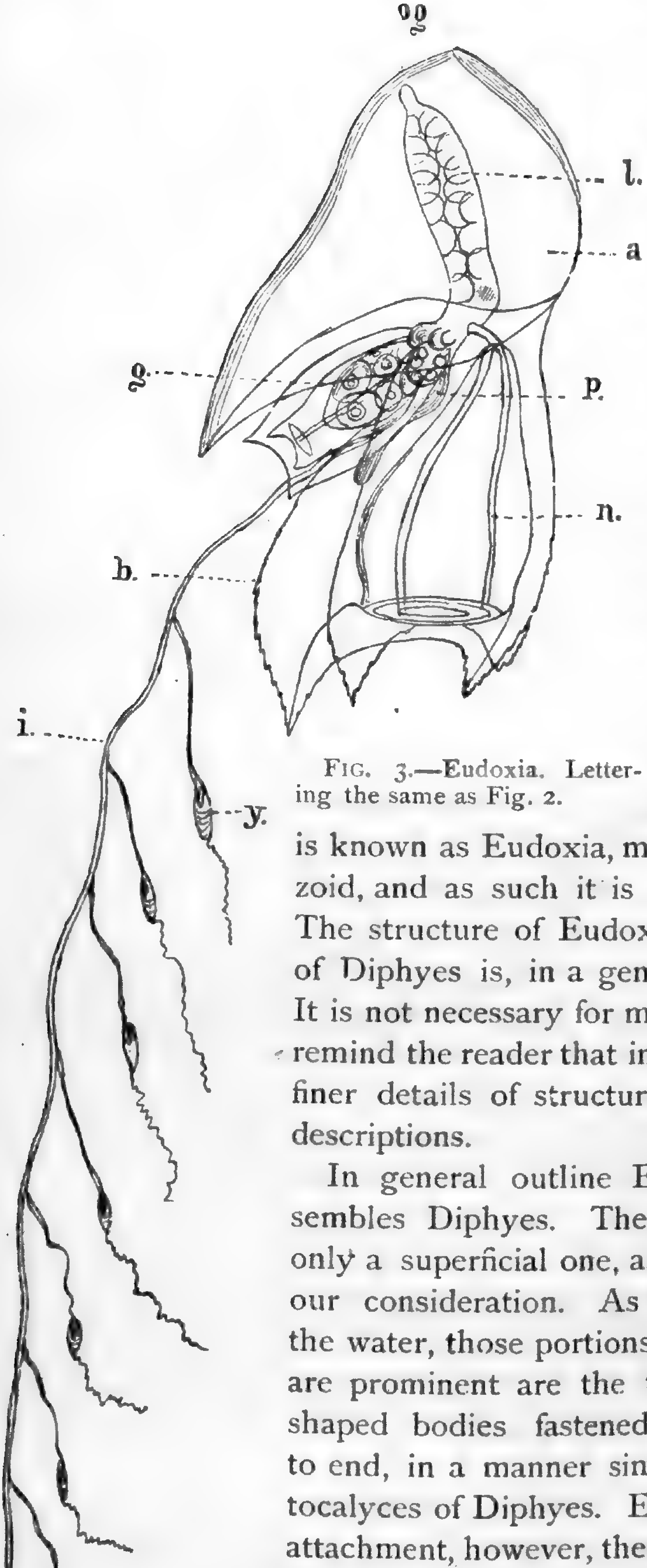

FIG. 3.—Eudoxia. Lettering the same as Fig. 2.

while attached to the axis. It is only after separation that the appendages grow to a form like that which we are about to describe. The Eudoxia discovered by us at Newport, R. I., although probably the same species as that mentioned by Huxley and others, was found one or two seasons before its Diphyes was taken.

A separated fragment of one of the Diphyidæ, which in the case of Diphyes is known as Eudoxia, may be called a Diphyizoid, and as such it is commonly described. The structure of Eudoxia, or the Diphyizoid of Diphyes is, in a general way, as follows. It is not necessary for me again to more than remind the reader that in these popular papers finer details of structure are omitted in my descriptions.

In general outline Eudoxia (Fig. 2) resembles Diphyes. The likeness, however, is only a superficial one, as will be seen later in our consideration. As it floats or swims in the water, those portions of the colony which are prominent are the two gelatinous bell-shaped bodies fastened to each other, end to end, in a manner similar to the two nectocalyces of Diphyes. Except in the mode of attachment, however, there is little likeness between them, either morphologically or functionally. Of the two transparent campanulate bodies, the anterior (*a*) is not, in Eudoxia, a nectocalyx, but a thickened, almost conical covering-scale; its surface is convex with one side flattened and the base concave for the lodgment of the sexual bells and retracted tentacle. There are no radial vessels in this covering-scale, and only the central cavity *(l)* of peculiar cellular appearance, representing the somatocyst. At the fundus of this cavity there is generally found an oil globule *(og)* which it is unnecessary to say has no morphological relationships with the float of Agalma and its allies. A similar globule is also found at the base of the somatocyst near the point of attachment of the young Eudoxia to the stem of the Diphyes, before the rupture of the fragment took place.

The structure of the covering-scale of Eudoxia betrays at once the homology of the central tube of the covering-scales of other Siphonophores, as well as of the somatocyst of the anterior bell of Diphyes. The covering-scale of Eudoxia resembles the anterior bell of Diphyes except that it has no radial system of vessels and no bell cavity. The somatocyst of the swimming-bell of the Diphyes is represented in its fragment, Eudoxia, by the central cavity *(l)* of the large covering-scale. This cavity is in turn the same as the central tube of the covering-scales of all other Siphonophores. When we recollect what has been pointed out above in relation to the homology of the somatocyst to the mantle vessels in the nectocalyces of Agalma, the true homology of the covering scale and the nectocalyx becomes evident. If this view of the morphology be a correct one, the comparison of the covering-scale with the asymmetrical bell of a hydroid like the genus Hybocodon, is not correct, or at least its medially-placed tube does not correspond with a radial tube in the bell walls of the hydroid medusa.

The under side or base of the conical covering-scale of Eudoxia is very concave, and in this recess hang, when retracted, the remaining structures of the animal. The largest *(b)* of these bodies is a nectocalyx whose outer walls are crossed by four longitudinal ridges, serrated on their edges and continued into projections beyond the bell cavity. Two of these ridges, corresponding with those found on the under side of the posterior nectocalyx of Diphyes, are more prominent than the other pair, and enclose a canal in which the polypite, tentacle and sexual bell, lie when retracted. The bell cavity is deep, filling almost the whole interior of the nectocalyx, and along its surface pass the four radial tubes *(n)* from common junction at the apex of the cavity to the bell rim. Their length is about equal, and their course in the bell walls is direct, without division or bifurcation. In the interval between the point of union of the covering-scale and nectocalyx, suspended from the under side of the former, hangs a flask-shaped body *(p)* which resembles very closely the feeding polyps of Agalma. It contains the stomach, and at its free end is found the mouth. The stomach cavity is in direct communication with the cavity of the covering-scale. From a point near the origin of the polypite there is suspended a long flexible highly contractile tentacle. This tentacle can be wholly retracted at the base of the polypite, but when the Eudoxia is in motion, is found reaching far behind the point of suspension, gracefully extending to a great length. In addition to the polypite we also find a cluster of bells *(g)* occupying the interval below the covering-scale and its point of attachment to the nectocalyx already mentioned. These bells enclose in their cavities, in place of a proboscis, a globular mass of eggs. It will be seen that the Eudoxia, which I have described, has female[1] sexual bells only; the male bells I have never been fortunate enough to find. The sexual bells are found in all stages of growth, from a simple bud to a well developed bell hanging from a stout peduncle. The history of the growth of the egg after it is dropped from the female bell, will be treated of in a special paper on the embryology of Diphyes.

The anatomy of Diphyes seems to me to sustain the homology of the Siphonophores as pointed out in our account of the anatomy of Agalma. The absence of the float at the extremity of the stem offers no difficulty to this homology when we recollect that the air bladder itself is only a modified medusa bell, and consequently homologous to the anterior of the two bells of Diphyes. The posterior nectocalyx is homologous to a true nectocalyx, while the anterior represents the float of the Physophoridæ. The axis of Diphyes, as that of Agalma, is homologous with the proboscis of a Lizzia, and from its sides bud the medusoid individuals. There is this very important difference between

[1] According to Gegenbaur, Keferstein and Ehlers, male and female sexual organs coexist on the same Diphyes stem. In the Diphyes which I have studied, that is not the case. The male sexual bell of the American form is unknown to me. Leuckart has also long ago (1853–4) shown that the European Diphyidæ are diœcious (Siphonophoren von Nizza, p. 28. Zoologische Untersuchungen, p. 36).

the proboscis of Lizzia and the stem of Diphyes, that while the buds from the former separate without absorption of the stomach walls, the Eudoxia appropriates a section of the Diphyes axis to form essential parts of its body.

To my mind there is no difficulty in a comparison of the Eudoxia with Lizzia[1] and with the Physophoridæ. Eudoxia is the adult form of which the Diphyes is the "nurse stage," so that we have here a true alternation of generation as in other medusæ. It is natural, therefore, that the likeness between Eudoxia and Agalma should be a distant one, since the latter genus never passes out of the Diphyes form, or the "nurse" from which the Eudoxia buds. On this account I consider the Physophoridæ as lower, anatomically and embryologically, than the Diphyidæ. Like those forms of fixed hydroids, which never drop medusa-shaped buds, and never, therefore, advance out of the fixed "nurse stage," the Physophoridæ never attain as completely developed a form as the Diphyidæ. They never bud off a gonophore as the medusoid bud is sometimes called, but always remain in the embryonic form. As the Diphyes stage is comparable with a strobila or a budding Lizzia, the Eudoxia is the completed generation comparable with the adult Lizzia which drops the eggs, or the sexual form.

The following table exhibits the corresponding parts of Lizzia and Eudoxia:

LIZZIA.	EUDOXIA.
Bell.	Covering scale (*a*).
Manubrium (proboscis).	Feeding polyp (polypite) (*p*).
Tentacle of a bud from the proboscis, the bell of which is aborted.	Tentacle (*i*).
Modified medusa bud from the proboscis, the proboscis and tentacle of which are lost (aborted).	Swimming-bell (*b*).
Several buds from the proboscis (young Lizziæ).	Sexual-bells (*g*).

[1] The comparison of Eudoxia to a "budding Lizzia" was set first forth, substantially as given in this article, by Professor McCrady in 1857 (Gymophthalmata of Charleston Harbor, p. 67). Since that date the theory has been urged on embryological grounds, without a mention of McCrady's suggestion, by Haeckel, Metschnikoff and P. E. Müller. (Haeckel. Zur Entwick. der Siphonophoren, 1869. Metschnikoff, Stud. uber Entwick. d. Medusen u. s.w., Zeit. f. Wiss. Zool., Bd. XXIV. P. E. Müller, Iag. over Nogle Siphonophorer, Nat. Tidsskrift 3. R. 7. B. Resumé in French). I am indebted to my friend, the late Mr. G. Winther, for a written MS. translation of portions of Müller's work.

If we were to follow precedent in our studies of the Siphonophores, we must apply to the adult the name Eudoxia instead of the almost universally used Diphyes. It is just as absurd to retain the name Diphyes to designate anything but a younger stage in the growth of Eudoxia, as it would be to designate the adult sea-urchin a pluteus, or to retain the word auricularia for the adult starfish. The monogastric form, or the Eudoxia, is the adult; the polygastric, or Diphyes, the larva.

There is another point to be considered. If from the embryonic feature of possessing a long axis, or stem, the relatives of Diphyes are referred to the Siphonophores, is that reference a good one, and would the characters as assigned to the group to which Agalma belongs (Siphonophoræ) hold in descriptions of the adult Diphyid? The Eudoxia has no stem-like structure, which gave the name to the group, although it is a true relative.

The comparison of Eudoxia with Agalma, or the adult stage of Diphyes with the corresponding larval condition, Agalma, is evidently legitimate, as the comparison of the developed bud of Lizzia with a genus similar to the Lizzia from which it budded. Although we have in Eudoxia an alternation of generation, it is unlike that condition in some other animals, as in the echinoderms, where the nurse cannot be homologized with the adult. In some respects it resembles most closely that process of growth which we are familiar with under the name of strobilation. The Eudoxia is the separated Ephyra, and the Diphyes is a free-swimming scyphistoma, as far as the relation of the nurse to the adult goes. Here however the parallelism ends. The same holds true also in a comparison of genera of Diphyidæ with the free-living proglottids of the tape worms (Leuckart, Siphonophoren von Nizza, p. 29). As McCrady has already pointed out (Lectures), there is a close resemblance between a Tænia and the Scyphistoma in mode of strobilation, but as there is no homology between the proglottids and the Ephyra, so there is little in common in the structure of the Diphyizoid and Ephyra. They resemble each other simply in the mode of strobilation.

The corresponding parts of an Agalma and an Eudoxia are given in the table below:

Agalma.	Eudoxia.
Float.	Covering-scale.
Nectocalyx.	Nectocalyx.
Polypite and tentacle.	Polypite and tentacle.
Covering-scale.	Covering-scale.
Taster and filament.	Wanting.
Sexual bells.	Sexual bells.

The axis or stem of Agalma is reduced in Eudoxia to the polypite condition, and is not distinguishable from this structure.

REMARKS ON THE CRETACEOUS AND TERTIARY FLORA OF THE WESTERN TERRITORIES.

BY LEO LESQUEREUX.

THE following notes were suggested by two valuable communications to *Nature*, in the numbers bearing date June 30 and October 6, 1881; the first, that of Dr. J. S. Newberry, tending to show that the flora of the Dakota group, together with that of the Laramie group, are of Cretaceous age; the second, that of J. Starkie Gardner, Esq., of London, contending to the contrary, that both those floras are Tertiary.

As there is not any fixed characters admitted as standard points of determination of the age of a fossil flora, phytopalæontologists have no means of coming to an understanding on the subject, except by a comparison of the vegetable remains of the divers formations with those of localities whose geological horizon has been ascertained.

I take here, for comparison with the plants of the Dakota group, the Upper Cretaceous flora of Groenland, Atane; that of Moletin, of Quedlinburg, of the Quader-sandstone of the Hartz and other localities of Germany where this formation, generally considered as Middle Cretaceous, or Cenomanian, has been observed.

One hundred and seventy specific forms of plants are now known from the Dakota group; they represent six ferns, one Equisetum, or seven cryptogamous acrogens; seven Cycadeæ, ten conifers, three monocotyledonous plants; the others, about one hundred and fifty, all dicotyledonous angiosperms.

As far as known until now, the flora of Atane, Groenland, is represented in sixty-three species—thirteen ferns, two Cycadeæ, ten conifers, three monocotyledonous, while thirty-four, or a little more than one-half, are angiosperms.

The relation of the Atane flora with that of the Dakota group is marked by ten identical species: one fern, two conifers and seven dicotyledonous; while quite as distinct an affinity is demonstrated by allied types of the genera Ficus, Sassafras, Diospyros and Sapindus.

The flora of Quedlinburg is composed of twenty species; four ferns, four conifers, one monocotyledonous, with eleven angiosperms, a little more than half of the species. Of this group of plants, the relation to the flora of the Dakota group is shown by only one identical species, a fern, which is also found at Atane and Moletin, while analogy is marked by two species of Myrica and a Proteoides.

Moletin, in eighteen species described of its flora, has one fern, four conifers, one monocotyledonous and twelve angiospermous plants, these, therefore, constituting two-thirds of the flora.

Though the number is small, the flora is related to that of the Dakota group by identity of one fern, one conifer, both also recognized at Atane, and of two dicotyledonous species. This is a remarkably close relationship indeed, more intimate than that between the Quedlinburg and Moletin floras, and it is positive, for the species indicating it, *Gleichenia kurriana*, *Pinus quenstedti*, *Aralia formosa* and *Magnolia speciosa*, all described by Heer, are of easily identifiable characters.

The quader-sandstone of the Hartz is, by its numerous species of Credneria, related to the no less numerous representatives of the genus Protophyllum of the Dakota group.

In the Monde des Plantes, by Saporta, the author, who has had opportunity to compare specimens of plants of the Cenomanian of Bohemia with those of the more common and characteristic species of the Dakota group, remarks, p. 202, that the flora of this group presents, if not identical species with those of Bohemia and Moravia, at least a number of equivalent forms.

Mr. Feistmantel says, in a note to Professor Heer,[1] that the lower division of the Cretaceous of Bohemia (Perutzer-Schichten) is Cenomanian. After naming a number of plants found in the sandstone of this formation, he adds that the beds of shale, partly between, partly above the sandstone, contain remains of plants, ferns, conifers and a mass of dicotyledonous leaves and fresh-water shells. Of the forty-nine species determined by him, nine are also at Moletin, seven at Niedershoena, while three ferns and conifers are present in the Lower Cretaceous of Groenland, and four in the Upper, that of Atane. Of the same plants the Dakota group has five, positively identified: *Gleichenia kurriana*, *Pinus quenstedti*, *Sequoia Reichenbachi*, *Magnolia speciosa* and *Aralia formosa*. A sixth might be added, *Sequoia fastigiata*, but its identification is less definite. And still with the flora of Niedershoena, that of the American Cretaceous is related by one identi-

[1] Fl. Arc., Vol. III, p. 3.

cal species, and the affinity of character of a Pterophyllum, a Caulinites, a Fagus, two species of Ficus, a Myrica and a Daphnogene.

To set aside the evidence derived from the remains of plants indicating synchronism and Cretaceous age of the localities above named, it may be said, as it has been done for the Laramie group, that vegetable remains are not sufficient authority for the determination of the age of a formation.

But here the determination of the formation from where the remains are derived, has been first made, or later confirmed by the characters of animal remains found in the intercalated or superposed strata. Heer states that the Moletin formation is positively referable to the quader-sandstone, Cenomanian, overlying the planer of Reuss referred to the Turonian; and of that of Quedlinburg, he states that it is referable to the lowest zone of the *Belemnitella quadrata*, which constitutes the lowest stage of the Senonian or Upper Cretaceous. In the quader-sandstein of the Hartz, from where the Credneria species have been obtained, a large number of animal remains, mostly of invertebrate and fishes, have been found. Stiehler, in his Beiträge,[1] quotes a long list of these genera and species, all Cretaceous. It is the same with the animal remains found in the strata overlaying the Dakota group in a space of more than two thousand feet.

The objection by Mr. Gardner is, that these so-called Cretaceous animal remains may not or are not generally or specifically identical with those of the Middle Cretaceous of England. Of this I am unable to judge. But it is said also that the vegetable types of the Dakota group appear too young to represent a Cretaceous formation, for some of them are closely related to plants of the Miocene. This is true, as it will be seen here below; but that cannot be taken into account in the discussion, for the relation is quite as prominent, rather still more marked with species of the present vegetation of North America, where a number of types of the flora of the Dakota group are reproduced in some of the more important and beautiful trees of our forests. This is the more remarkable that the affinity is not at all observable with the plants of the Lower Tertiary or Eocene of the Laramie group. But this refers to the second part of the discussion; before coming to it there are still a few words to say on the present objection.

[1] Beiträge zur Kentniss der Vorweltlichen Flora, 1857.

The Lowest Cretaceous flora of Groenland, that of Come, is composed, as far as known, of seventy-five species, of which forty-two represent Cryptogamous acrogens, ferns, Lycopods and Equisetaceæ; nine Cycadeæ, seventeen conifers, six monocotyledonous and only one dicotyledonous angiosperm plant. Composed as it is, the group has rather the character of a Jurassic than of a Cretaceous flora. It is, however, related with Atane by five identical species, three ferns and two conifers, and also by that first or more ancient dicotyledonous plant, a Populus of the same type as three other forms of this genus described from Atane.

What conclusions can be derived from the above? The character of the flora of Come being Jurassic, the formation which it characterizes cannot be considered as Tertiary. Heer thinks even that the true Cretaceous begins with the flora of Atane. But admitting Come as lowest Cretaceous, we may follow the relation of its flora through Atane, not only with the Dakota group, but with all the formations mentioned above from Germany—Quedlinburg, Moletin, the Quader-sandstone and others; and, therefore, to admit the Dakota group to the Tertiary, it would be necessary to erase from the Cretaceous, as it is constituted, the whole of the formations related to it with Come, or the whole of the formations where angiospermous plants have been found.

On the second question considered in the memoirs of Mr. Starkie Gardner and Dr. Newberry, or the relative age of the Cretaceous and Lower Tertiary formations of North America in comparison with those of England, I have to omit the facts derived from animal palæontology. I can only briefly remark on the affinity and disparity of some vegetable types of the Dakota group compared to those of the American Eocene (the so-called Laramie or Lignitic group); of the Miocene of Carbon, and on the relation of the plants of the Lignitic with those of the Eocene of England and France.

From what is known until now of the plants of the American formations named above, the flora of the Dakota group is, as said already, more distinctly related by analogy and identity of species to that of the Miocene than to that of the Lignitic. Except the close affinity remarked between *Cinnamomum Heerii* (U. S. Geol. Rept., VI, p. 84, Pl. XXVIII, f. 11) and *Cinnamomum affine* (same Rept., VII, Pl. XXXVII, f. 1–5, 7), I do not know of any Cretaceous species which can be pointed out as indicating a distinct relation to plants of the Laramie group. Leaves of Cinnamomum have been described by Dr. Newberry from the Orcas island (Descriptions of fossil plants collected by Mr. G. Gibbs) and supposed by the author to be referable, partly at least, to *Cinnamomum Heerii*, described first from Vancouver's island. The author's remark, that the specimens, though typically allied to *Cinnamomum Scheuchzeri and C. lanceolatum*, indicate a larger and thicker leaf, confirms his supposition; for *Cinnamomum Heerii*, of which a fine specimen, preserved entire, has been obtained this year in Kansas for the Museum of Comparative Zoölogy of Cambridge, merely differs from *C. affine*, found at Golden and Carbon, by its more rounded base, both species being represented by leaves equally large and subcoriaceous. This form, therefore, passes to the Miocene through the Eocene without apparent modification. Of smaller leaves described from specimens of the Dakota group as *Cinnamomum Scheuchzeri*, a species of which two fine specimens have been also procured this year in Kansas, none have been seen in the plants of the Lignitic. The ferns of the last group also are without analogy to those published by Heer and myself from the Dakota group. The same can be said of the conifers, except *Abietites dubius*, which according to Saporta, has, by the scars left by the base of the leaves upon the stems, some analogy with Cunninghamites, a Cretaceous type. In the monocotyledonous, the palms especially, in the angiosperms the types of Populus, Platanus, Quercus, Ficus, Laurus, Viburnum, Rhamnus, Juglans, etc., all appear without relation to any of those of the Dakota group. Per contra, when comparing the plants of this Cretaceous formation with those of the Miocene of Carbon, even of the Pliocene of California, we find closely allied types, even identity of characters in species of Salix and still more in those of Populus. For example, between *Populus elliptica* Newby., Illustr. of species, Pl. III, f. 1–2, of the Dakota group, and *P. cuneaia* Newby., *ibid.*, Pl. XIV, f. 1–4, of the Union group, no possible difference is found in the shape, size and nervation of the leaves. In the Cretaceous species, the borders are a little more distinctly crenate-serrate. But such a difference is of no account in leaves of the same type as the polymorphous *Populus arctica*, whose borders are entire or undulate, or more or less deeply serrate-crenate. Liriodendron and sassafras, not at all represented in the Laramie, are found in the Miocene, especially in that of Europe, in remarkably similar forms of leaves. Even *Liriodendron giganteum* of the Dakota group, considering the leaves only, is reproduced in *L. tulipifera* of the present North American flora. The same observation can be made on Fagus and Quercus, in comparing *Fagus polyclada* and *Quercus primordialis* of the Cretaceous, which without representative in the plants of the Laramie group, have species of similar type in the Miocene and also in the flora of this epoch. The Cretaceous *Platanus primæva* is comparable to the Miocene *P. gulielmæ*, while of the types of Aralia, so remarkaby abundant in the Cretaceous of Kansas, two are found at Carbon and Evanston, and none in the Lignitic. *Aralia quinquepartita*, figured U. S. Geol. Repts., VII, Pl. XV, f. 6, and still from better specimen, Vol. VIII (ined.), Pl. VII, f. 4, is reproduced in *Aralia augustiloba* of the Pliocene (gold gravel formation) of California. More of this same kind of analogy could be given, but the above is sufficient to prove that the characters of the flora of the Laramie group, or Eocene, greatly differ both from those of the Cretaceous and of the Miocene of this continent.

That they are related, and some of them positively identical with those of the Eocene of Europe, is remarked by Dr. Gardner, who has found in the Eocene of England, among a number of ferns, two species identified in the flora of the Laramie group. The table in the U. S. Geol. Repts., Vol. VII, p. 314, etc., indicates the relation of the plants of the Lignitic with those of different formations and localities as it was known when the volume was published. With the flora of Sezane, for example, the affinity is marked by twenty-one species. Since then a new kind of palm Ludoviopsis, obtained at Golden, indicates affinity to a species of Sezane, and another that of a finely preserved dicotyledonous leaf, figured in the same volume, Pl. XV, f. 5, is recognized by Saporta as identical to one of his species of the same locality, *Sterculia modesta*, thus increasing in a remarkable degree, the evidence of the relation of the flora of the Laramie group with that of the Eocene of Sezane.

But the review and discussion of the data concerning the Tertiary age of the Lignitic may be now of little importance, as all the phytopalæontologists who have entered into the discussion, have recognized the Tertiary characters of its flora. For it is evident that a number of the species described as Miocene by Dr. Newberry from the Fort Union group, are identical with those abundantly represented at Golden. If this fact has not been acknowledged by the eminent geologist of New York, the cause is most probably due to the mingling of the specimens submitted to him, which, derived from divers localities, were representatives of two formations, but were labeled as from the same locality, as would be, for example, the specimens of Carbon mixed with those of Golden, or those of Washakie mixed with those of Black Butte. A lot of specimens sent to me by the U. S. Geol. Survey, and labeled Point of Rocks, were certainly obtained from the Washakie group, as all represent Miocene species without analogy to those collected later by Dr. Hayden at Point of Rocks. This supposition only can explain the aggregation in the same geological group, of species like *Taxodium occidentale*, the large palms, *Sabal Campbelli*, the remarkable leaves of *Platanus Haydeni*, *P. Raynoldsi*, *Tilia antiqua*, etc., with such positively Miocene plants as *Sequoia Langsdorffi*, the forms of Populus allied to *P. arctica*, even species of our time, *Onoclea sensibilis*, *Corylus Americana*, *C. rostrata*, etc. All this gives to the Union group an evident Miocene facies, and therefore, from this consideration only, and in substituting Miocene for Tertiary, it would be possible and right to say, that no Miocene plant has been found in the Laramie group.

On the identity of some of the species of plants of the Union group with those of the Laramie, there is no possible doubt. The most abundant remains procured at the Raton mountains, by divers explorations, represent *Sabal Campbelli*; some of the finest specimens procured at Golden are of *Platanus Haydeni* and *P. Raynoldsi*. Some large pieces of sandstone, procured at Golden for the Museum of Princeton College, represent both the species figured in the illustrations of Dr. Newberry, Pls. XIX and XXI. And as all the specimens I have described from the collection made by the Geological Survey of Dr. F. V. Hayden, are now deposited in the National Museum, the determination of the species can be there critically examined.

STRUCTURE AND OVARIAN INCUBATION OF GAMBUSIA PATRUELIS, A TOP-MINNOW.[1]

BY JOHN A. RYDER.

SINCE we have taken up our temporary residence at Cherrystone we have found this interesting genus of cyprinodonts in great abundance in fresh and brackish water streams, also in a fresh water pond in the vicinity, a few miles south of where our station is located. In the latter situation three forms have been collected all of which are in breeding condition—we will not say spawning condition, as they do not, as do most other fishes, commit their ova to the care of the element in which they live, but carry them about in the ovary, where they are impregnated and where they develop in a very remarkable manner.

Of the manner of impregnation we know little or nothing, except the evidence furnished by the conformation of the external genitalia of the two sexes. In the adult male, which measures one and one-eighth of an inch in length, the anal fin is strangely modified into an intromittent organ for the conveyance of the milt into the ovary of the female ; a tubular organ appears to be formed by the three foremost anal rays, but one which is greatly prolonged and united by a membrane. At the apex these rays are somewhat curved toward each other, and thus form a blunt point, but the foremost one of the three rays is armed for its whole length with ridges at its base and with sharp recurved hooks at its tip, the other two at their tips similarly with hooks, and between their tips are two small fenestra or openings which possibly communicate directly with the sperm duct from the testes. The basal elements of the fin are aggregated into a cylindrical columnar truncated bony mass, which is prolonged upward into the cavity of the air-bladder for the distance of nearly the eighth of an inch ; from it a series of fibrous bands pass to the dorsal and posterior wall of the air-bladder to be inserted in the median line. Whether this bony column serves to steady the fin in the act of copulation, or whether it serves to give passage to the sperm duct, is an unsettled question with the writer. The modified anal fin of the male measures a third of an inch in length. Other peculiarities of the male are noticeable—for instance, as the more abbreviated air-bladder or space which also occupies a more oblique

[1] From the *Forest and Stream*, New York, Aug. 18, 1881, with notes and corrections.

position than in the female. The most remarkable difference presented by the male as compared with the female, however, is his inconsiderable weight, which is only 160 milligrammes, while that of the gravid female is 1030 milligrammes, or nearly six and one-half times the weight of the male.

The female, as already stated, is larger than the male, and measures one inch and three-fourths in length. The liver lies for the most part on the left side. The intestine makes one turn upon itself in the fore part of the body cavity and passes back along the floor of the abdomen to the vent. The air-bladder occupies two-fifths of the abdominal cavity, and at its posterior end the wolffian duct traverses it vertically, to be enlarged near its outlet into a fusiform urinary bladder of very much the same form as in many embryo fishes. The ovary is a simple, unpaired organ which lies somewhat to the right and extends from the anterior portion of the body cavity to its hinder end, and serves to fill up its lower moiety when fully developed. The ova, when full grown, are each enveloped in a sac or follicle supplied with blood from a median vascular trunk which divides and subdivides as it traverses the ovary lengthwise in a manner similar to that of the stem to which grapes in the bunch are attached. In this way it happens that each egg or ovum has it own independent supply of blood from the general vascular system of the mother, from which the material for the growth and maturation of the egg is derived, and which afterward becomes specialized into a contrivance by which the life of the developing embryo is maintained while undergoing development in their respective follicles in the ovary or egg-bag. The ova develop along the course of the main vessel and its branches, as may be learned upon examining a hardened specimen, where the very immature ovarian eggs are seen to be involved in a mesh-work of connective fibrous tissue, which serves not only to strengthen the vessels but also afterward enters into the structure of the walls of the ovarian sacs or follicles externally.

The very immature eggs measure from less than a hundredth of an inch up to a fiftieth, and on up to a twelfth of an inch, when they may be said to be mature. They develop along a nearly median rachis or stalk which extends backward and slightly downward, and which gets its blood supply very far forward from the dorsal aorta. The ova, after developing a little way, are each inclosed in a follicle, the Græfian follicle, ovisac, ovarian capsule, *membrana granulosa* of Von Baer, or *membrana cellulosa* of Coste. As the egg is matured there is a space developed about it which is said to result from the breaking up of the granular layer of cells covering it. This space is filled with fluid, and in this liquid, which increases in quantity as development proceeds, the embryo top-minnow is constantly bathed. *There is no trace whatever in the egg of this fish of an independent egg membrane*, as is the case with all known forms which spawn directly into the water, and which is usually, if not in all cases, perforated by one or more micropylar openings or pores for the entrance of the spermatozoön. This fact raises the question whether the egg membrane or *zona radiata* usually present in the ova of water-spawning fishes is not entirely absent in all the viviparous species. Whether Rathke has recorded anything on this point in his account of the development of Zoarces, the viviparous blenny, I am not able to say at present, as I do not have access to his memoir.[1] Suffice it to say, however, that with very cautious preparation, staining and dissection of the follicles inclosing the ova of Gambusia, I have completely failed to discover what I could regard as an egg membrane, although personally familiar with the appearance of the coverings of the ova of more than twenty species, embracing fifteen or more families. The *zona radiata* or covering of the egg in other bony fishes is said to be secreted from the cells lining the follicles and is composed of a gelatinoid substance, and it is often perforated all over by a vast number of extremely fine tubules, called pore canals by their discoverer, Johannes Mueller. No such structure existing as a covering for the egg of Gambusia, we are in a position to ask the question why such an unique condition of affairs should exist in this case? The answer, it would appear to us, is not far to seek. In the case of eggs which ordinarily hatch in water it is necessary that they should be supplied with a covering more or less firm and capable of protecting the contained embryo, which in the case of the top-minnow is not needed, because the embryo is developed so as to be quite competent to take care of itself as a very well organized little fish

[1] Rathke's description accords pretty closely with my account of the egg follicles of Gambusia given farther on. The narrow, elongate stigma, devoid of vessels, on the follicle, spoken of on page 4 of his memoir on Zoarces, probably corresponds to what I have called the *follicular foramen*. He has described a vascular network in the follicle, a stalk joining it to the vascular rachis and a space around the yelk much as in Gambusia.

when it leaves the body of its parent. Nature will not waste her powers in an effort to make useless clothes for such of her children as do not need them; on the contrary, she is constantly utilizing structures economically, and often so as to serve more than one purpose. This is the apparent answer to the query with which we started.

The follicles or sacs containing the ova are built up internally of flat, polygonal cells of pavement epithelium, and externally of a network of multipolar, fibrous, connective tissue cells and minute capillary blood vessels, with cellular walls, which radiate in all directions over the follicle from the point where the main arterial vessel joins the follicle, and which, together with its accompanying veins and investment of fibrous tissue, constitutes the stalk by which the follicle and its contained naked ovum is suspended to the main arterial trunk and vein. The capillary system ends in a larger venous trunk, which also follows the course of the main median arterial trunk back to the heart by way of the Cuvierian ducts. The very intricate mesh-work of fine vessels which covers the follicle supplies the developing fish with fresh oxygen, and also serves to carry off the carbonic dioxide in much the same way as the placenta or after-birth performs a similar duty for the young mammal developing in the uterus of its parent. There is this great difference, however, between the fish and the mammal. In the former there is no uterus; the development takes place in the follicle in which the eggs have grown and matured; there is no true placenta, but respiration is effected by a follicular meshwork of blood vessels, and the interchange of oxygen and carbonic dioxide gases takes place through the intermediation at first of the fluid by which the embryo is surrounded in its follicle, and later when blood vessels and gills have developed in the embryo they, too, become accessories to aid in the oxygenation of its blood. In the mammal there is a uterus; the egg must leave its ovarian follicle; be conveyed to the uterine cavity before a perfectly normal development can begin; there is a fully developed richly vascular placenta joined to the fœtus, the villi or vascular loops of which are insinuated between those developed on the maternal surface of the uterine cavity. In both fish and mammal, however, this general likeness remains; that there is no immediate vascular connection between mother and embryo. In both the respiration of the embryo is effected by the transpiration of gases through the intermediation of membranes and fluids, oxygen being constantly supplied and carbonic dioxide carried off by means of a specialized portion of the blood system of the maternal organism.

There is still another difference which distinguishes the developing fish from the mammal, which has not been noticed. The body of the former is built up by a gradual transformation or conversion of the substance of the yelk into the various structures which make up its organization. In other words, the young fish obtains no nutrition from its parent; there is merely an incorporation of the stored protoplasm of the yelk sack. In the mammal, on the other hand, the embryo receives nourishment through the placental structures, the largest proportion of the embryo is built up from the protoplasm supplied from the blood system of the parent. Judging from the large size of the young of some viviparous fishes, such as in Embiotoca, it is possible that there may be some exceptions to the rule indicated above.

Besides the very intricate network of capillary vessels which covers the follicles of the ovary of Gambusia, a large opening of a circular or oval form makes its appearance in the wall of each one at or near the point of attachment of the vascular stalk by which they are supported. This opening appears to increase in size as the young fish develops; whether it is present during the earliest stages of the intrafollicular development of the embryo I do not know, as I did not have an opportunity to see those phases. A branch from the main nutritive vessel frequently lies near the margin of the opening, curving around it. Whether this opening serves the same purpose as the micropyle of ova provided with a membrane, would appear very probable, as it is difficult to see in what other manner the milt, which is probably introduced into the ovarian cavity by the male, could reach the ovum through the wall of its follicle. The opening into the follicle may be named the *follicular foramen.* Through it the cavity in which the embryo lies is brought into direct communication with the general ovarian space.

We found ourselves unable to determine the species of the form, the structure of which is described above; none of those described in Jordan's Manual appear to agree with our species. It may be, as some of us have surmised, that the isolation of the form on the eastern peninsula of Virginia, for a great length of time, may have served to develop specific characters, and that it is undescribed. We leave the determination of the species to the systematic ichthyologists.[1]

Thus far our account has dealt only with the structure of the adults and the peculiar contrivances by means of which reproduction is effected; we will now take up the discussion of the egg and the embryo.

The globular vitellus measures about a line in diameter including the embryonic or germinal portion. The germinal protoplasm probably occupies a peripheral position covering the nutritive or vitelline portion of the egg as a continuous envelope with strands of germinal matter running from it through and among the corpuscles of the vitellus. This peripheral germinal layer, when the egg is ready to be fertilized, migrates toward one pole and assumes a biscuit shape. This is essentially the history of the formation of the germinal disk of the Teleostean egg as worked out independently by Coste, Kupffer and the writer. Little of a trustworthy character is known of the history of the germinative vesicle and spot, which bear the same relation to the egg as the nucleus and nucleolus do to the substance of the cell of the ordinary type. When cleavage of the germinal disk has begun, *it is the first positive evidence that impregnation has been successful.* The disk then begins to spread over the vitellus or yelk and soon acquires the form of a watch glass, with its concave side lying next to the surface of the yelk. Coincident with the lateral expansion of the germinal disk, a thickening appears at one point in its margin which is the first sign of the appearance of the embryo fish. With its still further expansion, the embryo is developed more from the margin of the disk toward its center; in this way it happens that the axis of the embryo lies in one of the radii of the disk; its head toward the center, its tail at the margin.

But before the embryo is fairly formed, a space appears under the disk, limited by the thickened rim of the latter, and the embryo at one side. This space, the segmentation cavity,[2] *is filled*

[1] Our original reference of this fish to Zygonectes has proved to be erroneous, the species proves to be *Gambusia patruelis* of Baird and Girard. Its discovery north of the mouth of the Chesapeake marks the northernmost limit of its occurrence yet known, most of the members of the genus being sub-tropical and West Indian.

[2] This cavity is the exact homologue of that in the batrachian ovum. In the fish and bird it is somewhat modified, and no doubt serves to enable the blastoderm to spread over the yelk as segmentation proceeds.

with fluid and grows with the growth of the germinal disk, as the latter becomes converted into the blastoderm, and does not disappear until some time after the embryo has left the egg as a young fish; and then it often remains as a space around the yelk sac for as long as a vestige of the latter remains, as may be seen in the young of Cybium, Parephippus, Gadus, Elacate and Syngnathus. In regard to this point, I hold views entirely different from any other observers, but inasmuch as the writer has had opportunities for the study of the development of a greater number of species, representing a greater number of families, than any previous investigator, and because the observations are based on material studied without the use of hardening re-agents which either deform or obliterate the segmentation cavity, and also because it was found to be present in all of the forms which were sufficiently well studied, it is believed that it will be found in the developing ova of most or all Teleostean fishes. Should this prove to be the fact, the Teleostean egg will be as distinctly defined in respect to the sum of the developmental characters which it presents, from the developing ova of other vertebrates, as the adult Teleost is from the remaining classes of the sub-kingdom to which it belongs. The floor of the cavity appears to be formed by the hypoblast or innermost embryonic layer, while its roof is formed by the epiblast or outermost skin layer. Gradually this blastoderm, which has been derived by cleavage from the germinal disk, grows over the yelk, no part of its epiblast layer being in direct contact with the hypoblast below on account of the presence of the intervening film of fluid, except at its rim. The embryo is also found to be in fixed contact with the yelk. The blastoderm grows at about an equal rate all around its margin; the point where the edges of the blastoderm finally close is almost directly opposite the site where the germinal disk first appeared; the closure at last occurs just behind the tail of the embryo where a little crater-like elevation marks the point at which it disappears. The embryo now lies along a meridian of the blastoderm; its head at the original germinal pole, its tail at the other. The growth of the blastoderm over the yelk is greatly facilitated by the film of fluid contained in the segmentation cavity, over which it can glide as it grows without friction. This view seems to me to be the most rational yet proposed in explanation of the method by which the blastoderm grows laterally in all directions down over the yelk. In some cases the yelk sac is frequently much absorbed before the outer epiblastic sac begins to collapse. This is the case with Cybium after it leaves the egg, and proves very conclusively that the outer sac is entirely free, laterally and ventrally, from the inner one containing the yelk.

There are two principal methods by which the yelk is absorbed; the one where a more or less extensive net-work of vessels is developed over the surface of the yelk, and through which all, or nearly all, of the blood passes to reach the venous end of the heart; in many cases no such net-work is ever developed, as for instance, in the shad, mackerel cod and bonito. To the former class the young top-minnow belongs. Its yelk is orange-colored and imbedded in it superficially are a great number of refringent oil globules of small size. There appears to be a sinus beneath the head, continuous with the segmentation cavity in which the heart is developed. The body of the young fish lies in a groove or furrow on the surface of the yelk. This is the youngest state in which I have seen Gambusia, and explains why I have given the preceding general account of the development of a young fish. The somites or segments of muscle plates had been developed for some time. The heart, brain, intestine and organs of sense were defined.

The next important stage observed, was when the yelk sac was in great part absorbed and the fish nearly ready to hatch, or more properly to leave its follicle and the body of its parent. The extraordinary acceleration of development noted in almost every detail of structure, was such as I had never witnessed in any other species of young fish. The bones of the skull, although still cartilaginous, were advanced to a condition not seen in the shad until it has been hatched for three weeks or more. There were intermaxillary elements with teeth; pharyngeal patches of teeth; the brain was pretty well roofed over by the cartilaginous cranium; the branchiosteges were developed in cartilage; the opercles completely covered and concealed the gills, the opercular elements being differentiated; the gills already bore branchial leaflets; the neural and haemal arches of the vertebræ were being developed in cartilage; scales covered the sides and back and were developing in pockets of the dermal epithelium; in fine, all the fins were already developed except the ventrals with the same number of rays as in the adult, and yet the yelk sac was not nearly absorbed. I have never seen in any fish embryos of the same age, an instance where scales were developed or where the fins had approximated their adult condition so nearly as in this case. The only instance known to me at this writing where a continuous dorsal and ventral median fin-fold is never developed, is in the case of Syngnathus, where the caudal rays are developed before the dorsal ones. Whether the unpaired fins of Gambusia are or are not derived from such a fold would be an interesting observation. A marked acceleration is also noticeable in the development of the brain, a study of which, by means of sections, as compared with that of the adult, has furnished me with some valuable clues in following up the development of Teleostean brains in general.

To sum up, this fish begins an independent career as far developed as when the shad, cod, mackerel, bonito and many other fishes are from three to six weeks old. By so much it has the advantage over those types in the struggle for existence in that it is ready to feed, to pursue its prey discriminately, as soon as it is born, while the other forms alluded to are comparatively helpless until some time after they have absorbed their yelk sacs, although most of them by that time have acquired mandibular, maxillary or pharyngeal teeth or both. The Fish Commission authorities need never be uneasy about the fate of the top-minnows; they will take care of themselves; their species is sure of survival. But our study, it would seem to the writer, has not been in vain, because, even though the fish is too small to be of any practical value, it has taught us that where nature has so effectually provided for the protection of the young fish, she does not require one adult to produce as many embryos. In Gambusia twenty-five to thirty young is perhaps the limit of production for a single female; in Apeltes, or the four-spined stickleback, the male of which is provided, according to my observations, with a spinning apparatus with which he fabricates a nest in which the young are hatched and taken care of, the number of eggs is from fifteen to twenty. Contrasting these small numbers with 100,000 to 3,000,000, the number of ova easily matured in a single season by a single female of many anadromous and marine species which have heavy, adhesive or floating eggs, it would appear that the quantity of germs produced by different species of fishes is in some way proportioned to their chances of survival. Otherwise we are at a loss to explain the enormous fertility of many marine forms ; the astounding fertility of the oyster and clam are other instances illustrating this principle, where ova are matured by the tens of millions, but where barely one out of a million survives so as to attain adult age.

Certain adaptations of structure are also plainly noticeable on a comparative study of fish ova. Thus the egg membrane of floating eggs is extremely thin, thinner than that of heavy or adhesive eggs, while the thickest membranes are those provided with external filamentous appendages. The most thinly clad hatch out soonest. May it not be that the thinness of the envelope of the egg has some relation to the rapidity with which the oxygenation of the egg is effected, and consequently with the rapidity of tissue and embryonic changes? And, finally, who would undertake to say that all of these modifications of the embryonic envelope are not such as could be developed by natural selection so as to favor the survival of the greatest number of embryos?

Many other general views of a similar character might be drawn from the material in my possession, but I fear that there has been already too much detail entered into for this note to be of interest to the general reader.

Before closing I wish to state that it is the oviduct of the female in some cyprinodonts that is prolonged into a tube at the anterior edge of the anal fin. This difference, as compared with Gambusia, would be useful as a generic character, as suggested by Colonel Marshall McDonald, to whose unselfish, helpful interest I am deeply indebted for assistance in manifold ways, while the investigation of the material was in progress, upon which the foregoing account is based.[1]

[1] The only memoir which I have been able to find bearing on the development of a cyprinodont is that by M. Duvernoy, *Sur le developpement de la Pœcilia surinamensis, Ann. Sci. Nat., 3 Ser., I. 1844.* His account has however been based upon alcoholic material, but shows the remarkable acceleration of development of the embryos the same as in Gambusia. The number of embryos, their arrangement in the ovary, and the position of the ovary itself appear also to be similar.

Laboratory of the Experimental Station of the U. S. Fish Commission,
Cherrystone, Va., August 10, 1881.

NOTE ON A FEW OF THE USEFUL PLANTS OF NORTHERN JAPAN.

BY PROFESSOR D. P. PENHALLOW.

THE object of the following lines is, not so much to draw attention to the plants which are generally recognized as of great value to man, as it is to bring to notice plants less widely known for their useful properties and in which special interest centers, either from the novelty of their use or the fact that, while but little known, they possess qualities which, under the improvement of cultivation, would render them highly desirable acquisitions wherever they can be grown.

Depending upon the natural products of the uncultivated soil to supplement the products of the chase, the aborigines of Yesso have long since discovered whatever plants are of real value, either as articles of food, or as furnishing material for their few and simple manufactures, and some of these they have turned to such good account, that they are worthy of more than casual notice.

Various species of Lilium abound throughout the forests, and all those which furnish a sufficiently large bulb, are utilized as a source of farinaceous food. Early in autumn the women may be seen returning to their villages loaded with bulbs. These are thoroughly crushed in a large wooden mortar, after which the starch is separated from the cellular mass by repeated washing. The former is then dried and hung up in bags for winter use, while the latter is dried in round, perforated cakes somewhat resembling miniature mill-stones, and hung up to dry. Later, it serves as food for the Aino and for the caged bears which are generally to be met with wherever there is a small settlement. The Japanese hold the lily bulbs, as a source of farinaceous food, in great esteem, and the demand for them is so great that they are cultivated *(L. bulbiferum)* in large quantities and form one of the prominent farm products to be seen in the market. The bulbs are simply boiled and eaten as potatoes would be. From personal experience we are able to certify as to their qualities. It is somewhat more difficult, however, to give testimony bearing upon the flavor and desirable qualities of flowers and buds from various species of Hemerocallis. In certain sections of the island, particularly on the pumice formation of the east coast, these plants are particularly abundant, and at the time of blossoming, the fields, for miles along the road on either side, are an almost uniform golden yellow. At such a time the Aino women may be seen busily engaged gathering the flowers which they take home and dry, or pickle in salt. They are afterwards used in soups. I have been told that the Japanese make a similar use of them, but probably only to a very limited extent.

In the *Pitasites japonicus* Miq., or fuki, both Japanese and Aino find an article of food which they seem to hold in high esteem. During early summer, the leaves make a very rank growth, often reaching a height of three feet. While in the early stages of growth, the petioles are succulent and crisp, and are largely used in soups. They are devoid of flavor and it is difficult to conceive what quality they possess which should recommend them as an article of food. The fact remains, however, that they are not only collected from the woods, but the plants have even been brought into cultivation expressly for their succulent petioles. The fuki is common everywhere in Yesso, being abundant not only in the villages, but it is found to extend well up the mountain slopes and frequently occurs at an elevation of 3000 feet.

Not less interesting is the similar use which the Japanese make of the bur-dock root, *Lappa major* Gaert., which attains great length under cultivation, but as an article of food is tasteless, hard and fibrous.

The horned fruits of the *Trapa bispinosa* Roxb., var. *incisa*, which is common in all the large ponds, are largely used by the Aino, and to some extent by the Japanese, for food.

Turning our attention to those plants which yield something of more evident value, we find in the *Actinidia arguta*, or kokuwa, a vine which gives promise of being a valuable acquisition to our New England flora. The vine is common in all the valleys of Yesso, and extends southward to Central Niphon. Vigorous in growth and fruiting abundantly, it can be trained like a grapevine. The fruit is an oblong, greenish berry about one inch in length. The pulp is of uniform texture, seeds minute and skin thin. When fully ripe they possess a very delicate flavor. Aside from its fruit, the plant is of value as an ornamental vine, on account of its fine foliage. A somewhat less desirable plant is found in its congener, *A. polygama*, which grows in more elevated places, fruits less abundantly and is not so rich in foliage.

Arundinaria japonica is so abundant everywhere, from bottom lands to the summits of mountains over 4000 feet in height, and its rhizomes form such a strong network just below the surface, rendering it exceedingly difficult to properly clear the land and plough it, that the plant, from the farmer's standpoint, is regarded as an intolerable nuisance; nevertheless it possesses some qualities which render it of considerable value. Like the true bamboo, the wood is exceedingly strong and elastic, and finds many useful employments in a variety of manufactures. It likewise serves as an important material in the construction of houses and fences. During the winter months, when all else is covered with snow, the yet green, though dry and silicious leaves furnish almost the only food for the numerous wild deer, and constitute a very large part of the diet of the hard-worked and much-abused pack-horses. When the young shoots appear in early summer, they are carefully gathered, and under the name of *take-no-ko* are used for food as we would employ young asparagus; though by no means so tender as the latter, they make a very desirable dish.

The clothing of the Aino, though to some extent made of cotton cloth obtained from the Japanese, is almost entirely a product of their own industry, and made of such material as can be found in the fibers of wild plants.[1] The fiber for their cloth is obtained from both the *Ulmus campestris* and *U. montana.*

The long leaves of the *Typha latifolia*, or kina, serve the same people with most admirable material for floor mats. Each summer long excursions are made to the localities where the plant is particularly abundant, and large quantities of leaves are gathered and prepared for winter employment.

The bark and leaves of *Prunus padus* have long furnished the principal medicine in use by the Aino, and it is interesting to observe that they have been employed in precisely those disorders for which our *P. virginiana* bark is used.

Another plant which is held in high esteem for its medicinal properties, is a species of Acorus, the roots of which are employed in cases of dysentery with good effect.

[1] See AMERICAN NATURALIST for August, 1880.

HABITS OF BUTTERFLIES.[1]

BY W. H. EDWARDS.

I. On certain habits of Heliconia charitonia Linn., a species of butterfly found in Florida.—According to Wallace and Bates all species of Heliconidæ have so obnoxious a smell and taste by reason of the pungent odor which seems to pervade their systems, that birds will not touch them, though their flight is so early and their abundance so great all through the tropics, that they could be caught more easily than most other butterflies. So lizards and monkeys refuse them.

Heliconia charitonia is common at Indian river, being a forest species, and Dr. Wm. Wittfield observed three of these butterflies fixed upon a chrysalis of the same species in the forest last May. He watched them off and on for two days, and tried to drive them away, picking them off with the fingers, but they returned to the same position, and remained there till the morning of the third day, when he found all gone, and the empty shell of the chrysalis only remaining.

This led him to raise another chrysalis, which he placed in a flower bed frequented by *H. charitonia.* Soon some butterflies came and touched the chrysalis, but its wriggling caused them to move off. Two days before the imago was due, and before discoloration of the shell of the chrysalis had commenced, they attached themselves again, two or three at a time, and as before, would only yield to force, and then returned. On the third day all had gone and the empty shell remained. Query: Did the butterflies, aware of their own immunity from persecution, gather for the purpose of guarding the chrysalis from attacks of birds or other enemies, just at the time when it was most defenceless; or were they attracted by sexual desire, the imago perhaps being of the opposite sex to the butterflies gathered upon it?[2]

II. On an alleged abnormal peculiarity in the history of Argynnis myrina.—Mr. Scudder, in the AMERICAN NATURALIST, 1872, related "The Curious History of a Butterfly," and stated that in both *A. myrina* and *bellona* occurred a phenomenon which he considered unique among butterflies; there being two sets of individuals, each following its own cycle of changes, apparently with as little to do with the other set as if it were a different spe-

[1] Read at the Cincinnati meeting of the Amer. Assoc. Adv. Science.

[2] Later observations show that the chrysalids guarded as related are female, and the assembled butterflies are always male.

cies; each set having its own distinct seasons, and thus giving rise to the apparition of two or three successive broods in the course of the year. He regarded these series as distinct from each other as any two species, and offering differences such as usually characterize somewhat distinct genera.

All this was based upon what the author stated to be a fact, that the eggs of these species are wholly undeveloped at the birth of the female, and that they are not developed for weeks or months, so that what appears to be two successive broods of the butterflies cannot possibly be such, as one cannot be descended from the other. Any one, in fact, must have come direct from the second brood back of it and not the first.

Mr. Edwards ascertained in 1875, '76, and '77, by breeding *A. myrina* in the Catskill mountains (in part, bringing the eggs or caterpillars to Coalburgh, W. Va.) that the foregoing statement was based in error. That the females at birth have fully developed eggs, requiring but impregnation, and that they are laid almost immediately; in fact, two of his butterflies paired a few hours after both emerged from the chrysalis. Eggs were laid to the number of ninety-three, within forty-eight hours from chrysalis, and they produced caterpillars. Also that other points in Mr. Scudder's curious history were made in error; and his observations were published in the *Canadian Entomologist*. Nevertheless, in his work on Butterflies, Mr. Scudder repeats the same story, with no verification or data whatever, and with no direct allusion to the published refutation.

Mr. Edwards stated that *Thecla henrici* Grote, lays its eggs on the wild plum at the base of the plum stalks; the young larvæ climb the stalks and eat a hole in the side of the small plum, and thereafter continued to feed on the inner part of the plum, going to another when the first is excavated. The species is single-brooded, appearing in April, about the time the wild plum trees are coming into bloom (in West Virginia).

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

——The popular view as to the definition of science, if we are to judge from the subject matter of "scientific columns" in our newspapers and magazines, is somewhat wide of the mark. It is evidently not well understood that the application of science to practical life is not science itself, and should be treated of under a distinct name. Science (including metaphysics) embraces the description of the properties of bodies, and of the general laws which are derived therefrom. The processes necessary for accomplishing these ends, including deductive reasoning, are included, as accessories, under the same general head. But the manifold uses of the knowledge thus acquired are not science, but art. Not fine art of course, but mechanic art, medical art, etc. Mechanic art is the application to human uses of the facts and laws of physical and mathematical sciences. Medical art is an application of the facts and laws of anatomical and physiological science. The pursuit of applied science is always a shorter road to popular favor than the cultivation of pure science. People are naturally impressed by their senses, and they easily confound the exhibitor with the creator. Moreover the genius displayed by the inventor is like that of the artist proper, a wonderful attribute of the human mind. It is only second in rank to the power of discovering new truth, and it excites our wonder the more, because it is more automatic. *Omne ignotum pro mirabile* is a saying which describes the average sentiment of humanity. With lucid explanation, wonder ceases, for "anybody can understand it." From time immemorial the worker in mysteries has commanded the admiration and purses of mankind, while the expounder of truth has scarcely been tolerated. But it is becoming generally known that all mysteries yield to the solvent of investigation, and that when the web is unraveled, it is found to consist of the universal raw material, put together by the ordinary laws of necessity which reason discloses. Nevetherless mental automatism remains, after consciousness, the second wonder of the universe, whether it be displayed in scientific or artistic labor. While science has her true field—the discovery of truth, it will ever be the glory of art to apply it to human necessities and pleasures.

——In the death of the Hon. Lewis H. Morgan, American science loses one of its original thinkers, and one of its most indefatigable workers. His work on ancient society is "epoch-making," and advanced the science to a new stage of its history. In selecting the industrial history of mankind as the true test of his progress, Mr. Morgan applied the idea, subsequently worked out by Herbert Spencer, that the industrial form of society is a higher type than the militant, and is more prosperous, and more permanent. It is the available test of the progress of intelligence among primitive races; and the progress of intelligence is the evolution of man. We are satisfied that Mr. Morgan's general ethnologic system will remain, whatever may become of some of the details, and that his name will stand as that of the first of American thinkers in the high field of anthropology, up to this date. Like other men who are ahead of their generation, Mr. Morgan did not receive the popular recognition which was his due and which his native modesty forbade him to seek; but that his work rewarded him with true satisfaction cannot be doubted by those who knew him.

——Congress will soon be occupied with the question of the revision of the tariff. We have already referred[1] to the tax on intellectual progress which has been imposed in the shape of duties on books, apparatus and specimens necessary for private students of natural history in this country. No congressman familiar with the situation would countenance such a piece of medieval barbarism, and if scientists will act in the premises, we have not a doubt that the objectionable legislation will be repealed this winter. But we must act. Let every subscriber to the NATURALIST write to his representative in Congress, and ask for his influence in favor of repeal. Congressmen will naturally give the preference to those objects to which their attention is most urgently directed.

——American "Academies of Science" are frequently constituted like stock corporations, with a sufficient sprinkling of scientific men to furnish credit to the remaining members. Sometimes the president is a scientific man, but the secretary, like those of corporations, is generally selected for his clerical ability; so also many of the other officers. The Philadelphia Academy of Natural Sciences has lately done itself the honor of electing one of its most distinguished scientific members to the office of president. We refer to Professor Joseph Leidy. This is a step in the right direction, and one to be followed we hope by many others of the same kind.

——An American cotemporary accuses the NATURALIST of appropriating from its pages a notice of Dr. Hahn's so-called organic remains in meteorites. The note in question was taken from the Journal of the Royal Microscopical Society of London, and by an oversight was not credited to that source. The failure to credit the article will however hardly be regretted by its author.

——Of all the experts examined during the Guiteau trial, Dr. Edward Spitzka, of New York, seems to be the only one to recognize the fact that a man may be insane by malformation, and not be more diseased than a man with strabismus or with six fingers.

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RECENT LITERATURE.

HABIT AND INTELLIGENCE, by Joseph John Murphy.[2] This is a thoroughly well written and thoughtful work, and one which will well repay perusal even by those who are not prepared to accept the conclusions which the author himself asserts rather than endeavors to prove.

The writer is a thorough evolutionist in so far as the doctrine

[1] NATURALIST, February, 1881.

[2] *Habit and Intelligence;* a series of Essays on the Laws of Life and Mind. By JOSEPH JOHN MURPHY. Second Edition Illustrated. pp. 585. London. Macmillan & Co. 1879.

of evolution applies to organic life. He sees his way clearly for the continued development of life from the simplest protoplasmic protozoan upward to the complex bodily and mental organization of the higher mammals and of man himself. He traces with due precision the differentiation of a nervous system, and the gradual growth therefrom of the powers to which we give the names of consciousness, mind, and intelligence—the latter of which is but the result of consciousness. He perceives, in concert with most American naturalists, the insufficiency of Darwin's theory of "natural selection" to account for the *origin* of the slightest variation, though he admits, with some hesitation and occasional contradiction of himself, its efficiency to preserve a beneficial variation when it has once arisen. To refute Darwin he gleans facts and theories from Cope, Mivart, Wallace, and other naturalists, accepts also the aid of the physicists who deny the possibility of the countless millions of years required by the "natural selection" theory; and succeeds in fortifying himself in a position from which it would be difficult indeed for a pure Darwinian to dislodge him. But he dismisses in few words Spencer's masterly theory of the influence of the total environment upon an organism, and scarcely notices Cope and Hyatt's proofs of the ease with which new genera can be produced by an acceleration or retardation of the embryological stages of life.

Having thrown doubt upon Darwin, he is in a hurry to assert that all evolution is the result of a "Formative Intelligence" originally impressed upon organic existence from a source outside of them.

He does not admit the possibility of the evolution of the lowest protoplasmic life from inorganic matter; and still less can he conceive of the evolution from simple matter of the molecules of the so-called elements of the chemist. Upon such subjects as the origin of life the only safe position is that of the agnostic; we do not "know," we have no "positive proof," similar to that which tells us of our own existence, or informs us of the existence of tangible objects. But the agnostic may have his opinion, his belief, comparable to the beliefs and creeds of the religions and sects, and like them, incapable of "positive proof." But while the belief of the creeds is based upon a book or upon traditions, the opinions of the agnostic, held by him loosely and susceptible of modification in the face of new discoveries, are always in harmony with the facts of which we have "positive proof," and do but form their logical continuation.

Such a statement as that on page 41 of Mr. Murphy's book—"the notion of any finite thing existing without having been created is more inconceivable—it is absurd," proves nothing and disproves nothing. We admit that it is inconceivable, it is "too high, we cannot attain unto it," yet it is simpler than the belief in a Creator who breathed into certain particles of matter a "Formative Intelligence," and then left that intelligence, distributed among a number of organisms struggling for existence, to take care of itself, and to develop into higher life through an ordeal of suffering and in spite of imperfection, disease, and the dying out of individuals and of species; without taking any further interest in the life he had created. Still more is it simpler than to conceive of an omnipotent, omnipresent, personal, and good God who, after creating life, watches and sustains it, yet permits an evil spirit to exist, and allows pain and disease to mar the beauty of his creation. To conceive of the matter of the universe as capable of evolving conscientiousness is past our mental power, but is the difficulty removed by having to account also for the origin, existence and habitat of a non-material Creator who beneficently allows a non-material destroyer to play havoc with his creation? On this subject Mr. Murphy does but assert his opinions, his argument really stops with the accumulation of proofs of the coëxistence of intelligence with life—a point in which we cordially agree with him, objecting only to his term "unconscious intelligence," as applied to the acts of the lower animals. In this matter we would go further than Mr. Murphy. Proud man, ignorant of the inner life of the lower animals, finds it difficult to stand outside of his individuality sufficiently to judge fairly of their actions. Our author quotes the building of hexagonal cells by the honey-bee as an instance of unconscious intelligence. We believe, in the light of the numerous observations made by Lubbock, McCook, and others on hymenopterous insects, that one or several bees discovered this economical form of cell just as man stumbles, by simply trying, on the greater part of his discoveries. To account for the perpetuation of the discovery when made we have no need to call in "natural selection," or any power more abstruse than that of inter-communication, which is well known to be possessed in a high degree by ants and bees.

One of the principal points sought to be made out in favor of a "formative impulse" is the development of structure in advance of function, as evidenced in the metamorphoses of the Hydroida, Ascidia, Crustacea, and Batrachia, in all of which the writer contends that structures useless to the possessor are laid down in anticipation of a future development, in which such structures are useful. Such structures are the long abdomen of a Zoea, useless (our author asserts) to the Zoea, but coming into use in the lobster; the notochord of the Ascidian, destined to be aborted, but foreshadowing that of the vertebrate; the incomplete medusa buds of some hydroids, anticipatory of the free medusæ of others; and the transition from swimming bladder to lung, foreshadowed in Ganoids and Dipnoans, and carried out in the Batrachia. A teleologist might reasonably query by what process of reasoning it is provable that these structures, transitional though they may appear to us, are not of use to their possessors. But the gradual evolution of a structure not yet become functionally useful, is but a parallel case with the persistence for a long period of structure no longer functionally useful. The wonder is rather, when we review the wondrous changes passed through in the life history of an animal or of a plant, from the seed to the tree, from the egg to the free embryo and thence to adult life, that all works so truly as it does, and that variation is not more frequent. The slightest over-development of one organ, or arrest of development of another, caused by the surrounding environment or by heredity (the effect of the environment of ancestors) may change the genus, the change may neither be useful or hurtful, yet its tendency is to continue when commenced, and it may, in process of time, become functionally useful. On the other hand, a useful variation may take place suddenly (as we see in Amblystoma) and a hurtful one is put an end to by the death of the possessor. We commend this book to the notice of our readers.

SOUTHALL'S PLIOCENE MAN IN AMERICA.[1]—The author evidently means well enough in writing this pamphlet, but he appears to start with the idea that geology is an exact science, that we know the precise time, even geologically speaking, when the Pliocene epoch ended and the Quaternary began, and that certain haphazard estimates of the time in years that man has been on the earth made by an accomplished zoölogist like Mr. A. R. Wallace, who has, however, published little or nothing original upon palæontology or geology, are of real value. So when ten years ago a "Mr. Vivian and Mr. A. R. Wallace claimed for [man] an antiquity of 1,000,000 and 500,000 years" we do not see why Mr. Southall or any other man should in 1881, get into a flurry over the matter, unless he wants to make himself conspicuous as a critic of geologists and geological reasoning in general. Confining ourselves to the points of most importance in the query as to the age of Pliocene man, the geologist wants to know the limits of the Pliocene in western America. What Whitney calls Pliocene deposits may be contemporary with the incoming of the glacial period in eastern America, or it may be a transition period between the Pliocene and Quarternary period. As we understand it, the age of those lower level gold-bearing sands and gravels is quite uncertain, and they may, contrary to Whitney's opinion, be no older than our eastern boulder clays. Moreover what Mr. Southall overlooks, none of the specimens of human art found on the Pacific coast, in so-called Pliocene deposits, have been taken out either by the hands of or in the presence of a geologist, not even of Professor

[1] *Pliocene Man in America.* By JAMES C. SOUTHALL, being a paper read before the Victoria Institute, or Philosophical Society of Great Britain, with remarks by His Grace the Duke of Argyll, Professor W. Boyd Dawkins, Principal Dawson, Professor T.McK. Hughes, and others. London. [1881.] 8vo, pp. 30.

Whitney himself, and while we may accept nearly all of the statements Whitney makes at second hand, the testimony is of course weakened by this fact. Until, then, geologists who are also palæontologists, which Professor Whitney would not claim to be, have settled the age of our western gold drift, which may turn out to be no older than our eastern glacial drift, we do not see why the layman should not wait until geologists agree in the matter. At any rate the present pamphlet is a confused and hasty statement of conclusions from a mass of indigested and necessarily vague notions of a few geologists, naturalists and historians (the latter most worthy men, but not claiming to know anything about the Pliocene, or any other geological period). We doubt whether one geologist in a hundred thinks man is older than the glacial period, while if well verified facts warranted the conclusion, they would willingly allow that man lived not only through the Pliocene, but began his existence in the Chalk period. The true scientist is willing to follow the lead of facts; critics, such as our author, seem anxious to prejudice good people against geology and geologists, and to forestall public opinion on questions about which geologists themselves are divided and uncertain from the very nature of the evidence with which they are dealing. Perhaps before 1872 Mr. Dawkins would have made the same overstatements that Lyell made previous to 1872. There is a tendency in the mind of a scientific discoverer to overestimate in his enthusiasm the tendency of new found facts, and to at first exaggerate the importance of the results of his discovery. But for a critic after the lapse of ten or fifteen years to "run a muck" at such men, as though the same opinions were now held as ten or fifteen years ago, is to mislead good people who cannot distinguish between blind and indiscriminating, ignorant pseudo-criticism and the habit on the part of every candid scientific man to abandon extreme views if fresh discoveries teach him to hold more moderate ones. The pamphlet is only of value as containing remarks of Professors Dawkins, Dawson, Hughes and others, who cannot speak without saying something of interest.

Miss Ormerod's Manual of Injurious Insects.[1]—This is a well executed compilation from the best and most recent English sources, and reflects much credit on the judgment and skill of the authoress. It is devoted to "Food Crops and the Insects that injure them," "Forest Trees and the Insects that injure them," and finally to "Fruit Crops and the Insects that injure them." It closes with a glossary, and begins with a brief introduction to entomology. The illustrations are abundant, and their value is assured by the fact that they are mostly copied from Curtis and

[1] *A Manual of Injurious Insects*, with Methods of Prevention and remedy for their attacks to Food Crops, Forest Trees, and Fruit, and with a short introduction to entomology. By Eleanor A. Ormerod, F.M.S., &c. London, W. Swan Sonnenschein & Allens. (1881.) 12mo., pp. 323.

Westwood. Miss Ormerod has evidently taken a good deal of pains with the subject of remedies, and here the book is strong. We have found a number of most useful hints for dealing with forest insects, which are quite new to us. The style is compact and clear, and the book as a whole is an excellent and useful one.

Recent Books and Pamphlets.—Diptera, gesammelt von Hermann Krone auf den Aucklands-Inseln bei Gelegenheit der deutschen Venus-Expedition in den Jahren 1874 und 1875. Bearbeitet von Professor Josef Mik in Wien. From the Verhandl. der K. K. zool, bot. Ges. in Wien, 1881. From the author.

Praktische Insekten-Kunde. Von Professor Dr. E. L. Taschenberg. Band I, Einführung in die Insekten-Kunde. Bremen, 1879. 8vo, pp. 233. Band II, Die Käfer und Hautflügler. Bremen, 1879. 8vo, pp. 401. Band III, Die Schmetterlinge. Bremen, 1880. 8vo, pp. 311. Band IV, Die Zweiflügler, Netzflügler und Kaukerfe. Bremen, 1880. 8vo, pp. 227. Band V, Die Schnabelkerfe, Flügellosen Parasiten und als Anhang einiges Ungeziefer welches nicht zu den Insekten gehört. Bremen, 1880.

Beiträge zur Kenntniss der Flussfische Südamerikas. Von Dr. Franz Steindachner. Aus dem XLIV bande der Mathematisch-Naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften. Wien, 1881. III, 4to, pp. 18, V plates. From the author.

Ichthyologische Beiträge (XI). Von Dr. Franz Steindachner. 8vo, pp. 14, I plate. Extract from the LXXXIII Bande der Stizb. der k. Akad. Wissensch. I Mai-Heft. Leipzig, 1881. From the author.

Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. Fortgesetzt von C. K. Hoffmann, Doctor der Medicin und Philosophie in Leiden. Sechster Band, III. Abtheilung Reptilien 22, 23 und 24 Lieferung. 8vo. pp. 89, 21 plates. Leipzig und Heidelberg, 1881. From the author.

Molluscorum Systema et Catalogus. System und Aufzählung Sammtlicher Conchylien der Sammlung von Fr. Paetel. Zur Belebung des Interesses für Malakozoologie nach dessen Manuscript herausgegeben von Dr. L. W. Schaufuss. 8vo, pp. 113. Dresden, 1869. From the author.

Exposition D'Histoire Naturelle a Reims. M. Cotteau, Association Française pour L'Avancement des Sciences. Congrés de Reims, 1880. 8vo, pp. 8. From the society.

Recherches sur les Ossements Fossiles des Terrains Tertiaires Inférieurs des environs de Reims. Par M. Victor Lemoine, Docteur és Sciences, Professeur á l'Ecole de Medicin de Reims. 8vo, pp. 56, IV plate. Reims, 1880. From the author.

Recherches sur L'Organization des Branchiobdelles. Par M. Victor Lemoine. Ext. Association Française pour L'Avancement des Sciences, 1880. 8vo, pp. 30, III, quarto plate. Reims. 1880. From the author.

Remarques sur les Dépôts Marins de la periode Actuelle au point de vue du Synchronisme des couches. Par M. Léon Vaillant. 8vo, pp. 6. Extrait du Bulletin de la Société Geologique de France, 1880. Paris, 1880. From the author.

Sur les Colonies dans les roches taconiques des Bordes du lac Champlaine. Par M. Jules Marcou. 8vo, pp. 30. plate II. Ext. du Bulletin de la Société Geologique de France. Paris, 1880. From the author.

Memoire sur la Disposition des Vertébres Cervicales chez les Cheloniens. Par M. Léon Vaillant. 8vo, pp. 106, plates V. Paris, 1880. From the author.

Sur les Raies recueillies dans l'Amazone par M. le Dr. Jobert. Par M. Léon Vaillant. 8vo. pp. 2. Extrait du Bulletin de la Société Philomathique de Paris. Paris, 1880. From the author.

Ministere de L'Agriculture et du Commerce, Exposition Universelle Internationale de 1878. Groupe VIII, Classe 84. Rapport sur les Poissons, Crustacés et Mollusques. Par M. Léon Vaillant. Imprimerie Nationale. Paris, 1880. From the author.

Sur un gisement de Rennes aupres de Paris. Par M. Gaudry. 4to, pp. 3. Paris, 1880. From the author.

Ciel et Terre, Revue populaire D'Astronomie et de Météorologie. No. 1, 1er Mars, 1881. 8vo, pp. 24, 1 map. Bruxelles, 1881. Exchange.

On Portions of a Cranium and a Jaw in the slab containing the remains of the Archæopteryx. By John Evans, F.R.S., &c. 8vo, pp. 16, cuts. Reprint from the "Natural History Review," 1865. London, 1881. From the author.

The Scientific Roll and Magazine of Systematic Notes, Conducted by Alexander Ramsay, F.G.S. Climate, Vol. I. 8vo, pp. 22. London, November, 1881. From the editor.

On the Geographical Distribution of certain fresh-water Mollusks of North America and the probable causes of their variation. By A. G. Wetherby, A.M. 8vo, pp. 8. From the Journal of the Cincinnati Society of Natural History, January, 1881. Cincinnati, 1881. From the author.

Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College to the President and Fellows of Harvard College for 1880–81. 8vo, pp. 32. Cambridge, 1881. From A. Agassiz.

Proceedings of the United States National Museum. 8vo, pp. 15. Washington, 1881. From the Museum.

Bulletin of the United States National Museum. 20. On the Zoological Position of Texas. Edward D. Cope. 8vo, pp. 52. Department of the Interior. Gov. Printing Office, Washington, 1881. From the Sec. Interior.

Bulletin of the Museum of Comparative Zoology of Harvard College, Vol. III, Nos. 11–14. Exploration of Lake Titicaca. By Alexander Agassiz and S. W. Garman. 8vo, pp. 80, plate II, cuts. Cambridge, 1881. From the director.

Descriptions of new fossils from the Lower Silurian and Subcarboniferous rocks of Kentucky. By A. G. Wetherby. 8vo, pp. 4, 1 plate. From the Journal of the Cincinnati Society of Natural History, July, 1881. Cincinnati, 1881. From the author.

Subcarboniferous Fossils from the Lake Valley Mining District of New Mexico, with descriptions of new species. By S. A. Miller. 8vo, pp. 16, plates II. From the Journal of the Cincinnati Society of Natural History. Cincinnati, 1881. From the author.

Observations on the Unification of Geological Nomenclature, with special reference to the Silurian formation of North America. By S. A. Miller. 8vo, pp. 28. From the Journal of the Cincinnati Society of Natural History, Jan., 1882. Cincinnati, 1882. From the author.

The Genesis and Distribution of Gold. By J. S. Newberry. 8vo, pp. 14. Reprint from the School of Mines Quarterly, November, 1881. New York, 1881. From the author.

Were the ancient Copper Implements hammered or molded into shape? By F. W. Putnam. 4to, pp. 1. From the Kansas City Review of Sciences, December, 1881. Kansas City, 1881. From the author.

Annual Report of the Commissioner of Patents for the year 1880. 4to, pp. 430. Gov. Print. Office, Washington, 1881. From the commissioner.

Alphabetical List of Patentees and Inventions for the half year, January to June, 1881, inclusive. 8vo, pp. 252. Gov. Print. Office, Washington, 1881. From the commissioner.

The Penn Monthly, Vol. XII, No. 145. (New Series, Vol. I.) Philadelphia, January, 1882. Per annum, $3.00.

GENERAL NOTES.

BOTANY.[1]

An Instance of the Physiological Value of Trichomes.—The tissues of nascent organs are thin-walled, have a relatively large amount of protoplasm, and are gorged with nourishing sap. While in this condition they possess no air passages or cavities, and the stomata are consequently incapable of performing their function —they can no more "breathe" than can an animal with its lungs full of water. This formative period in the life of the tissues, however, is one in which a rapid supply of oxygen is required to carry on the metastatic changes incident to growth. This need is supplied by greatly increasing the surface of the organ bathed by the air, allowing a greater transfusion of oxygen through the uncuticularized surface walls. The expansion is secured by means of innumerable slender trichomes.

These trichomes are thus seen to be a provision for increasing the absorbing surface, to the end that abundant material may be supplied for metastasis.

As the tissues mature, the intercellular spaces beneath the stomata with their extensions ramifying throughout the organ become empty of sap and allow of the free circulation of air, while the cuticle becomes nearly or quite impervious. The oxygenation of the tissues is then more readily effected through internal communication; the hairs therefore disappear or are replaced by those serving a different purpose.—*J. C. Arthur.*

The Arrangement of Fibrous Roots.—A few years ago, in harvesting about fifty bushels of beets of several varieties, my attention was drawn to a peculiarity in the arrangement of the fibrous roots of which till then I had been unaware. While the greater part of the beet was nearly or quite bare of rootlets these were very numerous and closely clustered in two vertical bands on opposite sides of the main root. Each band covered, say, one-tenth of the entire circumference, more or less. Later I observed just such an arrangement of the rootlets of turnips. But this year I have seen some turnips with the fibers in simple rows as in carrots and parsnips. In these last the rootlets are in vertical (or now and then somewhat spiral) rows. The number of rows seems to be always four, but so situated as in some degree to correspond with the *two bands* in beets and turnips; that is, the rows are not exactly equidistant, but are, as it were, arranged in two pairs on opposite sides of the main root, and yet so nearly equidistant that it is sometimes difficult to say which two constitute a pair. The intervals between the rows are commonly in the ratio of 5 to 7, or on a cross section the lines joining the rows would form a parallelogram whose sides would be about as 5 to 7.

The rootlets of carrots differ from those of turnips and beets in

[1]Edited by Prof. C. E. Bessey, Ames, Iowa.

being thickened towards their base and this spreading laterally so as to give the surface of the carrot somewhat the appearance of having rings of growth. Furthermore these fibers instead of spreading out into the ground seem to hug the main root and are turned commonly to one side as if the carrot had been twisted in the pulling. Sometimes on the same root they are turned both ways, and generally or always more or less downward.

The rootlets of parsnips are distributed much as those of carrots, somewhat thickened at base, but generally much longer and more spreading and branching. They penetrate more deeply into the soil too and hence the difficulty of digging them. The rows of fibers seem to form a longer parallelogram than those of carrots, the sides being about as 4 to 7.

The rootlets in *curled dock (Rumex crispus)* are plainly in three rows (except in one forked root the larger branch of which had four distinct rows). Swamp dock *(R. verticillatus)* has the main root much divided, but the fibers of these divisions are mostly in fours, the rows perhaps not quite so regular as the three rows of the curled dock, still plainly to be distinguished.

The roots of evening primrose *(Œnothera biennis)* have rather large rootlets very plainly in three vertical rows.

I designed to make observations on other roots, but the cold weather has come on and frozen the ground.—*Charles Wright, Wethersfield, Conn., Dec.* 1881.

The Royal Gardens at Kew.—From the *Gardener's Chronicle* we learn that the Report on the progress and condition of the Royal Gardens at Kew, for the year 1880, has just been issued. Pending its receipt, the following will be found of interest. The number of visitors during the year amounted to very nearly three quarters of a million (723,681), the highest number for one day being 61,831. In the plant houses of the Botanic Gardens the palms have been entirely re-arranged owing to their crowded condition. In this department more space is urgently needed. The Arboretum suffered much from the frosts and gales of the winter of 1879–80. Curiously a number of Californian species suffered greatly from the inclemency of the weather; thus *Pinus insignis, P. muricata, P. sabiniana* and *Abies bracteata* were all more or less injured. *Pinus Elliottii* was also injured.

There are now no less than 220 species and varieties of Oaks grown in the Arboretum; 24 of Chestnuts, 34 of Beeches. A catalogue is in preparation "which will give the names of the principal species and varieties, with their native countries and synonyms." Such a catalogue from such a source can not fail to be of the highest value to botanists the world over, and its appearance will be looked for with interest by all.

The important economico-botanical collections from the India Museum at South Kensington were transferred to Kew during the year 1880. This consisted of an immense quantity of material, from which the Kew authorities selected suites of specimens. Thus of rice alone "there were about two thousand samples, from the most widely distributed districts of India, and weighing in the aggregate about three tons. Every one of these was carefully examined and compared, and a series was separated showing every type of variation to which Indian rice is subject. The amount of this variation in form, color and texture is almost inconceivable, and the trouble and expense which must have been involved in the accumulation of the specimens, is amply justified by the clearness with which this fact is now brought out. In form the individual rice-grains vary from elongated to ovoid, in texture from translucent to pearl white opacity, in color from white to pink, brown, mottled, and even black."

In the Herbarium Dr. M. C. Cooke's services have been secured. He has undertaken the arrangement of the collections of thallophytes, especially of the fungi, "which, owing to the press of work in keeping the Phanerogams and Ferns constantly worked up, have been somewhat neglected." This latter announcement will be received with gratification by the many students of fungi in this country and England.

A General Index to the Journal of Botany.—James Britten announces a "General Index to the *Journal of Botany*," from its beginning to the end of Volume xx, to be published at six shillings (about $1.50) per copy, provided that a sufficient number of subscriptions are received. The importance of this index to all botanists, even in cases where complete sets of the Journal are not possessed, is so great that it is to be hoped that many orders will be sent from this country. Orders should be addressed to West, Newman & Co., 54 Hatton Garden, E. C., London, England. As Volume xx, will not be completed until the end of the year 1882, the index will not appear for a year or more.

Bentham on Gramineæ.—George Bentham read an important paper on the Gramineæ before the Linnean Society at its meeting November 3, 1881. He recognizes fourteen tribes which he disposes under two sub-orders, or families as follows:

A. Paniceæ.	*B.* Poaceæ.
Tribe 1. Paniceæ,	Tribe 7. Phalarideæ,
" 2. Maydeæ,	" 8. Agrostideæ,
" 3. Oryzeæ,	" 9. Isachneæ,
" 4. Tristegineæ,	" 10. Aveneæ,
" 5. Zoysieæ,	" 11. Chlorideæ,
" 6. Andropogoneæ,	" 12. Festuceæ,
	" 13. Hordeæ,
	" 14. Bambuseæ.

Botanical Notes.—A fine full-page cut of a beautiful aroid (*Taccarum Warmingianum* Engl.), recently introduced into English gardens from Brazil, is given in a late number of the

Gardener's Chronicle. The leaf which is pinnatified, is from two to two and a half feet wide, and is borne upon a thick petiole between three and four feet long. The spathe, fifteen inches long, and borne upon a scape eight inches high, is of a brown coppery tint inside mottled with green, while the spadix is of a pale pink color. It will doubtless prove to be a valuable acquisition to our list of ornamental plants.——Rev. M. J. Berkeley describes a new parasite upon the lilac in the *Gardener's Chronicle.* It is evidently one of the Peronosporeæ, and is named by Mr. Berkeley, *Ovularia syringæ.* The conidia (acrospores) are large and ovoid, and occur singly on the ends of the hyphæ which protrude through the stomata. The parasite "produces large brown patches, sometimes occupying almost the whole of the leaf." Has this yet appeared in this country?——A leaf of the giant water lily *(Victoria regia)* growing in Lake Nuna in Peru is recorded by Paul Marcoy in the *Wiener Illustrirte Gartenzeitung* as having a circumference ot 24 feet 9¼ inches, and weighing between 13 and 14 pounds. One of the flowers measured 4 feet 2 inches in circumference, and weighed three and a half pounds. The outer petals were nine inches in length.——Dr. Vasey in the December *Botanical Gazette* describes three new species of grasses, viz: *Melica Hallii* from Colorado and the Great Plains of British America; *Sporobolus Jonesii* from Soda Springs, California, and *Poa purpurascens* from Oregon, and the Yellowstone region.——In the same journal some one under the pseudonym of "Emesby" puts in a plea for Systematic Botany, or rather, it would appear, for what has been called Analytical Botany, as opposed to histological and physiological Botany. The writer apparently places a higher value upon the "identification" of a few plants, or the finding of a "new species" than upon that study of the structure and function of plants which alone can enable us to understand them *as living things.* His ideal botany is apparently one which culminates in the study and description of species!——M. Lechantier read a paper recently before the Academy of Sciences, Paris, upon the modifications in the composition of plants preserved in silos. Indian corn and clover lost a little of their nitrogenous matter; but the loss of glucosides was much greater; the chief loss being now in the glucose and sugar group, now in the starch and cellulose. Fatty matter, on the other hand, increased.——Part 1 of the "Transactions of the Massachusetts Horticultural Society" for 1881, has just appeared. It contains in addition to much of interest to horticulturists, many lists of trees, shrubs and other plants interesting to the botanist also.——Figures and popular descriptions of the Short-leaved Skullcap *(Scutellaria brevifolia)* from Texas, and two fine species of Dahlia *(D. lutea* and *D. glabrata)*, now rapidly coming into cultivation, are given in the December *American Agriculturist.*——Good figures of *Chara baltica* Bruz., var. *affinis* Groves, and *C. contraria*

Kuetz. accompany "Notes on British Characeæ" by H. and J. Groves in the December *Journal of Botany*.——The two delayed plates illustrating a paper on *Cinchona Ledgeriana* (from Bolivia), by Henry Trimen in the November *Journal of Botany*, appear in the December number. They are excellently done.

ZOOLOGY.

Is the human skull becoming thinner?—If the doctrines of evolution are true, and the evidence supporting them is of a convincing character, questions relating to the operation of the laws by which improvement or degradation results, become of particular importance when applied to the human race, and it is a matter of serious inquiry whether, under the altered conditions of civilization, causes may not be at work which operate to the disadvantage of the whole organism, by detracting from the efficiency of a part?

According to the theory as expounded by Darwin and others, we have the tendency of all organisms to accommodate themselves to their environment, and to adapt themselves to altered circumstances within certain limits, this principle of adaptation in co-operation with heredity, or the tendency of the offspring to inherit the characteristics of its progenitors, are made to account for much of the otherwise inexplicable phenomena with which we are surrounded.

Now according to this doctrine, an organism is endowed with ability to succeed amid certain surroundings—in the higher vertebrates, for example, we have the framework of bone, with all its beautiful applications of the principles of mechanics, so arranged as to prevent to a great extent injury of the important organs, and when we come to the brain, we find it enclosed in a rigid covering, capable of resisting a considerable degree of violence without being fractured, and evidently intended to protect the delicate organ it contains.

If we accept the tenets of evolutionists, a race adapted to certain circumstances, will, if those circumstances be altered, become modified in a corresponding degree, and retrogression may result as well as improvement, and this modification may be confined to a certain part or organ. Let us consider, therefore, what forces have exerted their influence upon this casket of the brain.

First, natural selection in the case of those creatures that engaged in fierce combats, would tend to eliminate those individuals with frail craniums, and as man comes within the category of belligerent creatures, when barbaric warfare, and the dangers of the chase were common occurrences, natural selection would of course exercise a powerful influence in maintaining a standard of cranial strength. Then, too, in the presence of repeated violence, adaptation would undoubtedly provide a suitable armor for this delicate and important organ. And as it is difficult to conceive how the weight of its contents or the action of its muscles can exert any considerable influence upon its greater portion in man, the above may be regarded as the principal agencies, for sexual selection is confined to capabilities of an active character, and attributes which are displayed, and would be inoperative upon a hidden part, the function of which is only passive.

In civilized man, however, at all events in the higher grades of modern civilization, natural selection may be said to exert no influence in this direction, war is too infrequent and engages too small a portion of mankind, while the forces with which it deals, are of a nature to alter the whole aspect of the case. And while adaptation undoubtedly operates, particularly among the laboring classes, upon other portions of the frame to maintain their rigidity, it is only in rare instances that the skull is called upon to support any greater pressure than that exerted by the head gear.

It is not to be overlooked in this connection, that among semi-civilized peoples where the facilities for transportation are limited, the head is often made to support considerable weights, and except where rigid rules of caste prevent the intermarriage of classes, the joint action of adaptation and heredity disseminate the effects of this custom throughout the community.

There probably never was a time in the history of the world, when the skull was subjected to so little violence, as since the introduction of modern methods of transportation, and when we recall the fact, that it was but a few centuries ago, that the most advanced nations of the present day were barbaric, it is too soon to look for any great change. Yet it is not uncommon to hear of cases of fracture of the skull, which are ascribed to its unusual thinness. May not these be the results of fortuitous coöperations of the agencies mentioned?

If the force of the position assumed is accepted, the logical conclusion is that we are approaching a time when the human cranium will become much thinner, so delicate, in fact, that it will be easily fractured, we may therefore expect a revival of natural selection, and an increase of cases of death from violence to the head.—*W. B. Cooper.*

HABITS OF THE FIERASFER, A BOARDER IN THE SEA-CUCUMBER.—The Holothurians or sea-cucumbers have been long known by fishermen to harbor a curious fish, to which Cuvier gave the name *Fierasfer*. Several species of it are known. The most common in the Mediterranean, the *Fierasfer acus*, has been recently made an object of special study by Professor Emery, at the zoölogical station at Naples.

To procure Holothurians tenanted by the fierasfer, it is necessary to seek the animals at a certain depth; those living near the shore do not usually contain them. The two Mediterranean species of holothurians, which are most frequently tenanted, are *Stichopus regalis* and *Holothuria tubulosa*. When these animals are accumulated in certain quantity in the same tank, the little fishes ere long appear. According to Professor Emery, who has opened hundreds of holothurians in his search, the fierasfer is generally lodged in the cavity of the body. It penetrates first, as we shall see, by the anus into the intestine. Then it migrates into the pulmonary passages, the thin and delicate walls of which soon rupture in consequence, and allow the fish to pass into the peri-intestinal space.

When free, the fierasfer ordinarily swims in an oblique position, the head down and the tail curved towards the back. By undulatory movements of its ventral fin, it moves obliquely forward, keeping about the same level, or obliquely in the direction of the axis of the body. It is but a poor swimmer, and when placed in a tank along with other fishes it is soon devoured, being incapable of flight, of defending itself, or of hiding in a medium uninhabitable by it.

Swimming with its head downwards, the fierasfer explores the bottom of the water and the bodies lying there. If it comes upon a holothurian, it immediately shows some agitation, examines the object on all sides, and having reached one of the extremities, examines it attentively. If it be the head-extremity, the fish returns suddenly, and proceeds to the opposite end, by which the holothurian sucks in and expels the water necessary to its existance. Then commences a curious proceeding. In the time of expiration, when the holothurian is expelling water, the little fish, excited by this mechanical action, applies its snout strenuouly to the anal orifice, then curves back its pointed tail over one side of its body, and by a rapid movement of recoil, introduces the tail into the rectum of the holothurian. This accomplished, the fish raises the anterior part of its body, while its tail remains pinched in the holothurian, and pushes itself further and further in with each movement of suction. After a time the anterior part enters in its turn, and the fish is completely inclosed in its host.

Professor Emery has sometimes seen a small fierasfer get into its position at once, while in other cases the progress of the fish is so slow that the patience of the observer is exhausted. While the general mode of introduction is that described, there may be some modifications. Thus the fierasfer may penetrate head-first, or, victim of a mistake, may endeavor, generally without success, to effect an entrance by the mouth of the holothurian.

The fierasfer is not necessarily solitary; on the contrary, it often shares its abode with two or three of its kind. Professor Emery has seen, in the Naples aquarium, seven fierasfers successively enter the same holothurian, causing their host injuries which proved fatal.

It has already been stated that the fierasfer does not remain in the intestine, which is difficultly habitable because of the quantity of sand in it. We have to note, however, that it always remains near the anus, though which it protrudes its head, from time to time, in search of food. Thus it is not, in any way, either a parasite or a commensal, in the sense attached to these words in natural history—that is to say, it does not live at the expense of the holothurian, either consuming its substance or taking some of the food that animal has amassed for itself. Hence the earlier naturalists who studied the habits of the fish were mistaken in considering it as an example of parasitism by a vertebrate animal. The fierasfer is merely, as Professor Emery puts it, a lodger, or tenant.

According to Professor Semper, of Wurtzburg, however, there is on the coast of the Philippine islands, a small fish of the genus *Encheliophis*, closely allied to fierasfer, which, also living in holothurians, feeds on their viscera, and is, therefore, a true parasite. —*English Mechanic.*

Habits of the Menopoma.—Having recently collected specimens of the common Menopoma (*M. alleghaniensis*) for Professor Ward's museum in Rochester, N. Y., I give some of my observations on its habits.

All my specimens were caught in the Loyalhanna creek, Westmoreland Co., Pa. It is well known to those accustomed to fish in the streams of this region, from its troublesome habit of taking bait placed in the water for nobler game. When thus hooked, its vicious biting and squirming, together with the slime which its skin secretes, render it exceedingly disagreeable to handle. It is often hooked in bottom fishing for catfish. Many anglers cut the hook off, rather than extract it, and the amphibian's flat head is often rendered still flatter by a lively application of the sportsman's boot heel.

In the early summer when the water is clear, Menopomæ are often to be seen on the pebbly bottom in considerable numbers. Once when fishing with some friends from off a large rock in the Loyalhanna creek, we saw quite a shoal of them moving sluggishly about among the stones on the bottom. They would quickly take our hooks baited with a piece of meat or a fish head. In one instance two large ones laid hold of the same bait and were promptly landed on the rock. In a few minutes we had a dozen. Last August I fished the same spot for them but without success. Acting on the advice of a "native" (which was to drop some bait—dead fish, &c., near certain rocks under which he insisted the "alligators" staid) I caught ten large specimens in a single morning, and ten more a few days later. Those taken were of various sizes, measuring from ten to eighteen inches in length. One taken by a friend was twenty-two inches long. Fishermen hereabouts say they have frequently caught hell-benders two feet long.

They are remarkably tenacious of life. I carried my specimens six miles in a bag behind me on horseback, under a blazing hot sun, and kept them five weeks in a tub of water without a morsel to eat, and when I came to put them in alcohol they seemed almost as fresh as ever. During their confinement in the tub, two of the females deposited a large amount of spawn. This spawn was something similar to frog spawn in its general appearance, but the mass had not the dark colors of the latter. The ova were exuded in strings and were much farther apart than frog eggs. They were of a yellow color, while the glutinous mass which connected them had a grayish appearance. The spawn seemed to expand greatly by absorption of water. It lay in the tub among the animals for a week but was not disturbed by them.

The Menopona, here called "alligator" and "water dog," is an exceedingly voracious animal, feeding on fish, worms, crayfish, &c. Some of those taken by me disgorged crayfish shortly after being caught. Its large mouth which literally stretches "from ear to ear," takes in almost any bait not too large to be swallowed. May it not be a sort of scavenger of the water? It inhabits the Mississippi and Ohio rivers and their tributaries.—*Chas. H. Townsend.*

THE SPARROW PEST IN AUSTRALIA.—Through the kindness of a correspondent I have received an interesting official document showing that *Passer domesticus* has proved not less obnoxious in Australia than in this country. It is a folio of eleven pages, being the progress-report of a commission appointed by His Excellency, Sir W. F. D. Jervois, Major-General, &c., to inquire into and report upon the "alleged injuries by sparrows" together with an analysis of correspondence and minutes of proceedings of the commissioners, published in September, 1881, at Adelaide by order of the House of Assembly. "The commissioners appointed to inquire into the alleged damages caused by sparrows to horticulture and agriculture in South Australia, and into remedial measures, and to report thereon, having proof of the evil existing in great force, and over larger districts of country, and being convinced that their suppression is urgent before another harvest and fruit season sets in, and before another nesting season (now beginning) shall swell their numbers, beg to present a progress report," &c.

The analysis of correspondence on the questions of inquiry shows: 1. That the sparrow is established over an immense area in South Australia. 2. That sufferers in such area "cry for relief from sparrow depredations as if from a pest." 3. That the sparrows are increasing at an astonishing and alarming rate, their work being "done under conditions despairing to the cultivator, and under conditions that he cannot control; for the seed is taken out of the ground, the fruit-bud off the tree, the sprouting vegetable as fast as it grows, and the fruit ere it is ripe." 4. The cultivated plants attacked are apricots, cherries, figs, apples, grapes, peaches, plums, pears, nectarines, loquats, olives—wheat and barley—peas, cabbages, cauliflowers and garden seeds generally. 5. All means of defence have hitherto proved inadequate. 6. The commissioners suggest in addition to the usual means of defence, the tender of rewards for sparrows' eggs and heads; the removal of gun-licenses for the season, poisoned water in summer, sulphur fumes under roosts at night, plaster of paris mixed with oatmeal and water. "It is further declared that the *united action* of all property holders, including the government, *is essential* to effective results."

The state of the case in Australia being no worse than it is in the United States, these sensible and energetic measures contrast favorably with the neglect and indifference we have shown in so practically important a matter, notwithstanding the unceasing protests of all competent judges, chiefly through our long-suffering national good-nature, partly through sickly sentiment, and in some slight degree through the ranting pseudo-zoöphily of such persons as Mr. Henry Bergh, for example.—*Elliott Coues, Washington, D. C.*

OCCURRENCE OF THE OPOSSUM IN CENTRAL NEW YORK.—Dr. W. H. Gregg of Elmira informs me that an opossum was last spring taken about 6 miles from the city, being the first specimen known to him to have occurred in that locality, which is certainly beyond the usual range of the species as commonly understood. —*Elliott Coues, Washington, D. C.*

THE CLAW ON THE "INDEX" FINGER OF THE CATHARTIDÆ.—

DECEMBER 7, 1881.

To the Editors of the American Naturalist.

Gentlemen:—I read with much interest Dr. Shufeldt's article in your journal for November last, on the claw on the "index"[1] of the *Cathartidæ*, to the existence of which he had previously called my attention when I had the pleasure of making his acquaintence in Washington last month. Dr. Shufeldt certainly deserves great credit for being the first to detect a structure, which has previously, so far I am aware, escaped the notice of all observers. I may add that since my return I have been able to confirm the truth of Dr. Shufeldt's statements on specimens of *Cathartes aura* and *C. atratus* in my possession.

Allow me, as one perhaps more favorably situated than Dr. Shufeldt has been as regards the literature of ornithology, to call my friend's attention to Nitzsch's "Osteographische Beiträge zur Naturgeschichte der Vögel," published at Leipzig in 1881. In that[2] he will find an excellent account of the claw and phalanx in question as it exists in many other birds.

[1] The digit of the Avian manus called "index" by Professor Owen is now universally recognized by anatomists as really the pollex.

[2] "Ueber das Nagelglied der Flügelfinger, besonders der Daumen." pp. 89–97.

Nitzsch does not seem to have observed it in the *Cathartidæ*, but found it in *Haliaëtus albicilla*, *Tinnunculus alaudarius* and some others of the Falconidæ. It is very conspicuous in Pandion. In fact, the occurrence of such a claw is of very frequent occurrence in the class Aves, though by no means universal amongst them. Amongst birds in which it may be well seen, I may mention *Struthio* and *Rhea*, *Cypselus*, *Caprimulgus*, the *Rallidæ* and *Parridæ*. Such a claw must not be confounded, as has been done by some writers, with the long "spurs" covered by epidermic tissues, formed by outgrowths from the *metacarpal* elements, of most birds as *Parra*, *Palamedea*, *Plectropterus*, &c. In fact, the two may, as in *Parra* or *Plectropterus*, coëxist. Believe me, yours very truly,

W. A. Forbes,
Prosector to the Zoölogical Society of London.

A new Distomum Parasite in the Egg-sacks of Apus.—While opening the egg-sack of an *Apus lucasanus* from Kansas, my attention was attracted by a small cylindrical worm-like object attached to the walls of the interior of an egg-sack on the eleventh pair of feet. It is represented by the accompanying figure, which gives enlarged sketches of the side and under surface. The worm is 1 ¼ of a millemeter in length, and $\frac{4}{10}$ mm in thickness at the thickest part of the body, which is in the region of the sucker (*s*). Seen sidewise the body is moderately long and slender, a little curved and flattened on the concave side. The mouth (*m*) is situated near the end of the body, and is much smaller than the sucker (*s*). The anterior end of the body is not so much pointed as the posterior; the latter is somewhat produced, the end even somewhat incurved. The animal was white in color. This fluke may be called *Distomum apodis*. This is the first occurrence of any parasite on the members of this family *(Apodidæ)* of Phyllopods, and so far as we are aware the first instance of the occurrence of any parasitic worm in the Phyllopods in general. Living as it does in the ovisack, it can hardly be called an internal parasite.—*A. S. Packard, Jr.*

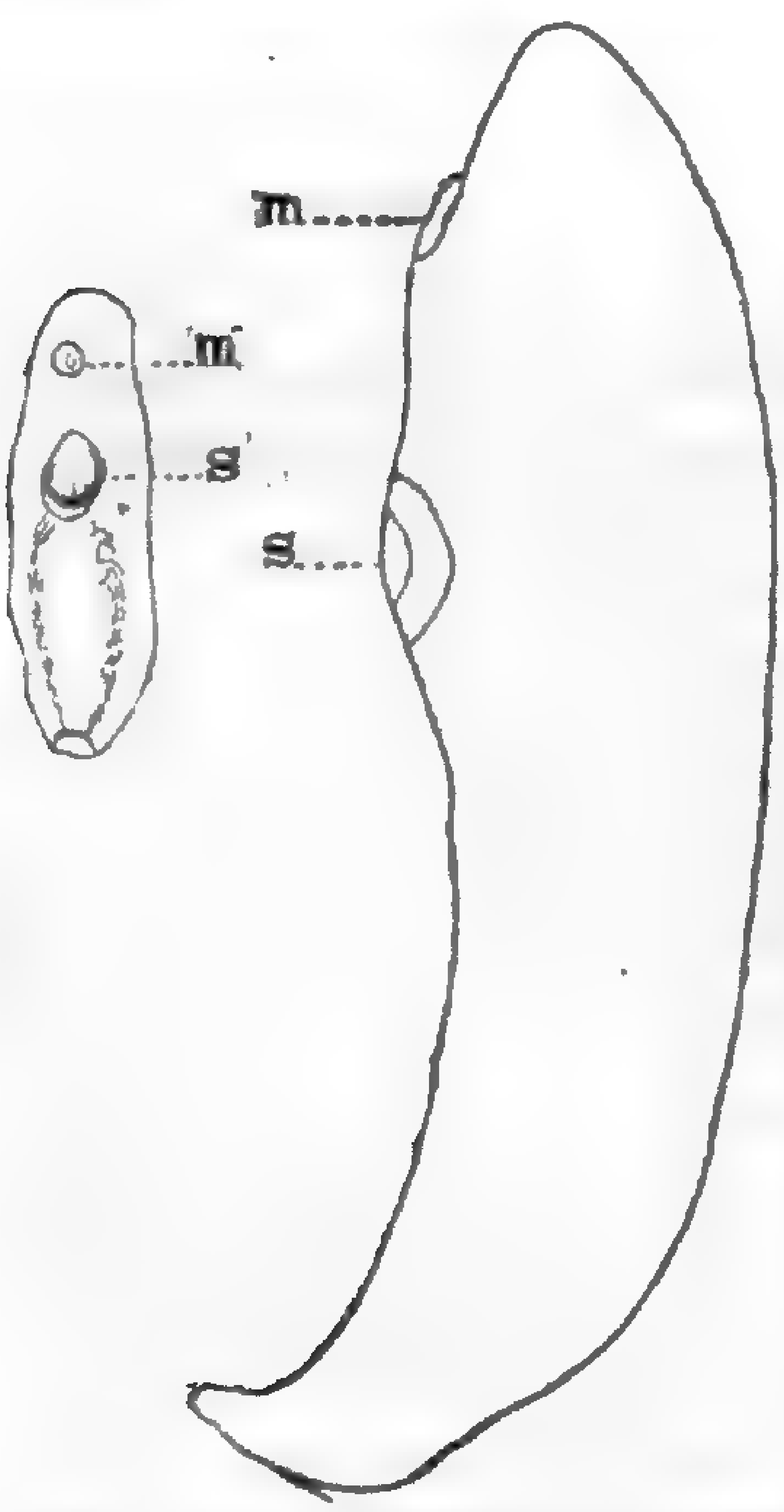

Fig. 1. — Diastomum of Apus, side and ventral view; *m*, mouth; *s*, sucker. Much enlarged.

Additional note on the Egg Cases of Planarians ectoparasitic on Limulus.—In the January number of this journal, by a curious coincidence, Dr. Gissler contributed a note covering in part the same ground as one by myself which appeared in the same issue. I desire to make a correction in regard to the supposed air-tubes alluded to by the former as occurring at the tips of the egg-capsules. These are in fact nothing more than killed distorted protozoa of the genus Epistylis or Zoöthamnium, clusters of which I have frequently observed in the living condition on the ends of the egg-capsules in fresh material presenting almost precisely the appearance represented in Fig. 2 *b c*, of Gissler's note. They are present or absent according as opportunity may have been afforded for the protozoans to attach themselves, the oldest capsules and those from which the embryos had escaped, being the ones to which the Vorticellinæ had most often affixed themselves. At the time my note was written I did not think it worth while to mention the occurrence of the protozoa which are very common, the stalked forms especially. So numerous are these, in places, that to estimate their occurrence at one hundred per square inch of horizontal surface, we find the population of a square rod to be nearly four millions (more exactly 3,896,800). From what I have seen in the Chesapeake, this estimate, in many localities, would be very low, from which it may be inferred that the importance of the part played by the protozoa in the economy of the world of life is, like that of the earth-worm, not yet appreciated at its right value.—*J. A. Ryder.*

NOTES ON SOME FRESH-WATER CRUSTACEA, TOGETHER WITH DESCRIPTIONS OF TWO NEW SPECIES.—*Palæmon ohionis* Smith.—(*Palæmon ohionis.* Smith, S. I., Freshwater Crustacea, U. S. 640; Forbes, S. A., Bulletin Ills. Mus. Nat. Hist., No. 1, 5.) While seining for fishes in the vicinity of Vicksburg, Miss., during the past summer, I captured numerous specimens of this species. The largest specimens were taken in the open river with a small, fine-meshed, collecting seine. In some places they occur in enormous numbers. On the 4th of July we were in Louisiana, across the river from Vicksburg, seining in some ponds formed in the making of levées along Grant's canal. At a single draw of the net we brought out not less than a half bushel of these river shrimps. Considering their size and abounding numbers, they must constitute an important part of the food of the fishes of these waters. They are captured for bait, and are used to some extent for food; and I can, from actual experience, testify that they are not to be despised by the hungry hunter. My largest specimens agree exactly in size with those obtained by Professor Smith from the Ohio river at Cannelton, Ind. Many of the females were laden with eggs. The mandibles of this species, as in the case of many other crustaceans, are not perfectly symmetrical. The biting portions of the two mandibles are alike and tridentate. The triturating process of each is long, and stands out at right angles to the body of the mandible. That of the left mandible is truncated at nearly right angles; that of the left is quite oblique, so that a dentated edge is presented to the other mandible. Both molar surfaces are tuberculated.

Palæmonetes exilipes Stimpson.—(*Palæmonetes exilipes* Smith, S. I., loc. cit., 641; Forbes, S. A., loc. cit., 5.) I have collected this species in tributaries of the Tombigbee and Noxubee rivers, in Eastern Mississippi, in the Mississippi river at Memphis, in Pearl river at Jackson, and in the Chickasawha river at Enterprise, Miss. It is now known to occur as far north as Ecorse, Mich., in South Carolina and Florida, in Mississippi and in Illinois.

Crangonyx lucifugus, n. sp.—This is a small, rather elongated species, that was obtained from a well in Abingdon, Knox county, Illinois. As befits its subterranean mode of life, it is blind and of a pale color. In length the largest specimens measure about 6^{mm}.

Male.—Antennulæ scarcely one-half as long as the body. The third segment of the peduncle two-thirds as long as the second; this, two-thirds the length of the first. Flagellum consisting of about fourteen segments. The secondary flagellum very short, and with but two segments. Antennæ short, only half as long as the antennulæ. Last two segments of its peduncle elongated. Flagellum consisting of but about five segments, and shorter than the last two segments of the peduncle taken together.

Second pair of thoracic legs stouter than the first. Propodite of first pair quadrate, with nearly a right angle between the palmar and posterior margins. Palmar surface on each side of the cutting edge, with a row of about six notched and ciliated spines, one or two of which at the posterior angle are larger than the others. The cutting edge is entire. Dactylopodite as long as the palmar margin, and furnished along the concave edge with a few hairs.

Propodite of the second pair of legs ovate in outline, twice as long as broad. The palmar margin curving gradually into the posterior margin. The cutting edge of the palmar surface uneven, and having near the insertion of the dactyl a square projection. The palmar surface also armed with two rows of notched and ciliated spines, five in the inner row, seven in the outer. Dactyl short and stout.

Two posterior pairs of thoracic legs longest of all and about equal to each other. All the legs are stout and their basal segments squamiform.

Postero-lateral angle of first abdominal segment rounded; of second and third, from obtuse-angled to right-angled.

First pair of caudal stylets extending a little further back than the second; these exceeding slightly the third. The peduncle of the first pair somewhat curved, with the concavity above, the rami equal and two-thirds as long as the peduncle. The peduncle of the second pair little longer than the outer ramus. Inner ramus nearly twice as long as the outer. Third pair of caudal stylets rudimentary, consisting of but a single segment. This somewhat longer than the telson, broadly ovate, two-thirds as broad as long and furnished at the tip with two short spines.

Telson a little longer than wide, narrowing a little to the truncated tip, which is provided at each postero-lateral angle with a couple of stout spines.

Female.—In the female the propodite of the anterior pair of feet resembles closely that of the corresponding foot of the male. The palmar margin of the second propodite is less oblique than in the second foot of the male, and does not pass so gradually into the posterior margin. It is also destitute of the jagged edge and the square process of the male foot. There are fewer spines along the margin. One of the spines at the posterior angle is very long and stout.

This species appears to resemble *C. tenuis* Smith, but is evidently different. In that species, as described by Prof. S. I. Smith, the first pair of feet are stouter than the second, and have the palmar margin of the propodite much more oblique. The reverse is true of the species I describe. Nor do I understand from the description of *C. tenuis* that the posterior caudal stylets each consist of a single segment. There are some minor differences. From *C. vitreus*, judging from Prof. Cope's description in AMERICAN NATURALIST, Vol. VI, p. 422, it must differ in the caudal stylets. "Penultimate segment, with a stout limb with two equal styles," is a statement that will not apply to my species, whichever the "penultimate" segment may be.

Crangonyx bifurcus, n. sp.—General form and appearance those of the Western variety of *C. gracilis*. Length of specimens about 9^{mm}. Eyes oval, black. Antennulæ scarcely half the length of the body. First two basal segments of the peduncle about equal in length; the first much the stouter; the third segment about two-thirds as long as the second. Primary flagellum about twice the length of the peduncle, consisting of about twenty-four segments. Secondary flagellum scarcely as long as the basal segment of the primary flagellum, consisting of but two segments. Antennæ about one-half as long as the antennulæ. Basal segments short, the first provided with a prominent process, which appears to be perforated (the opening of a gland?). Ultimate and penultimate segments of the peduncle elongated and equal in length. Flagellum shorter than the two distal segments of the peduncle and consisting of about eight segments. The antennæ furnished with about a dozen curious sensory organs; three of these on each of the two distal segments of the peduncle; the segments of the flagellum with one each, except the terminal three or four, which have none. These organs in alcoholic specimens resemble, under the microscope, a lanceolate or oblanceolate leaf having a midrib and parallel veinlets running from this to the margins.

Propodite of first thoracic foot subquadrate in outline; a very little longer than wide. Palmar surface somewhat oblique, armed on each side of the cutting edge with about a dozen notched and ciliated spines. Two or three short, stout and serrated spines at the posterior angle. A number of stiff, slender hairs planted among the spines. Dactylopodite scythe-shaped, bent rather abruptly near the base, then straight, and finally incurved near the tip. Propodite of second foot more elongated than in the first foot, and with a more oblique palmar surface; armed with about fourteen spines along each side of the cutting edge. The first, second, and third abdominal segments have their postero-lateral angles drawn backward into a decided tooth.

Of the three pairs of caudal stylets, the first extends backward beyond the second; the second beyond the third. The latter consists of a stout peduncle and a single ramus, which is about two-thirds as long as the peduncle and provided with a few slender spines. There appears to be no inner ramus, but there is to be seen on the inner side of the ramus present a process of the peduncle that represents, perhaps, the inner ramus. There is, however, no involution of the integument at the base of this process. Telson elongated, twice as long as broad, the sides nearly parallel. The posterior border is provided with a notch that extends nearly three-fourths of the distance to the base. Each prong is armed at the tip with from three to five spines.

This species differs from *C. gracilis* more particularly in the form of the telson, and in the length of the outer ramus of the posterior stylets as compared with the peduncle. From *C. antennatum* Packard (AMERICAN NATURALIST, 1881, p. 880), it differs in the form of the telson, and in the much greater size of the eyes. Found by myself about 1st of April, 1880, in a rivulet flowing down the limestone hills into the Noxubee river, at Macon, Miss. Only four specimens were secured, all of which appear to be males.

The three species, *C. gracilis, C. bifurcus* and *C. lucifugus* present an interesting gradation in the forms of the posterior caudal stylets. In the first-named the outer ramus is twice the length of the peduncle, and the inner ramus is present, but rudimentary. In *C. bifurcus* the outer ramus is but two-thirds as long as the peduncle, while it is doubtful whether there is anything whatever to represent inner ramus. In *C. lucifugus* both the outer and inner rami are absent, and the peduncle itself is much reduced.—*(To be Continued).—O. P. Hay, Irvington, Ind.*

REVIVAL OF TARDIGRADES AFTER DESSICCATION.—The truth of the occurrence of this phenomenon has been denied by various observers, and the appearances explained by Ehrenberg as due to the development of fresh specimens from eggs left by the animals, which die in the process. Professor Yung, however, considers that his observation of the process, in a single specimen of Milnesium, proves the correctness of the old opinion. The specimen was taken from a ditch, contained eighteen eggs, and manifested lively movements. It was left for five hours until quite dry, and all that could be seen of it under 350 diam., was a brown speck under the cover-glass. A drop of water was allowed to run beneath the latter. Almost immediately after it had reached the remains of the Tardigrade, a fine pellicle was evident, surrounding the brown speck and manifesting the general outlines of the body and ova. The normal wall then appeared, enclosing the contents of the intestine; the minutest details of the outer skin appeared; after twenty minutes the mouth with its fingers and tube, the jaws, and the feet were fully developed. Subsequently the parts connecting the jaws with the œsophagus came into view. No movements and no development of the ova were observed in the three hours occupied by these observations. The too close apposition of the cover-glass to the slide being now remedied, the animal was supplied plentifully with water, but, when searched for the next day, could not be found, having probably departed in search of more comfortable quarters, for the algae which had surrounded it were disturbed, and neither the remains of the jaws and skin, usually found after specimens have died, nor eggs, were discovered.

Variation in Æquorea forskalea.—Professor C. Claus, according to the Journal of the Royal Microscopical Society of London, while giving an account of this Adriatic medusa, takes the opportunity of making some criticisms on Professor Haeckel's classification of the Æquoridæ. A careful study of this form has shown Claus that it is subject to extreme variation; variations so great as to have led Professor Haeckel to make a number of genera and sub-genera for their reception. It is not possible to abstract a critical paper of this kind, and we must be content to direct attention to the following points. Claus finds that the color varies with age and sex; the young may well be called *vitrina*, as Gosse called them; later on blue pigment-granules may appear in the ectoderm, and especially in the gonads of the male, while the female may take on a more or less reddish coloration (the *A. violacea* of Milne Edwards). The radial canals vary in number from just over fifty to nearly eighty. The form and size of the mouth-lips depend on the state of contraction of the specimen, on its age, and on the breadth of its umbrella. Altogether, according to Professor Claus, Haeckel would seem to have afforded a very interesting proof of the origin of species by variation.

Development of the Sterlet.—A résumé of Professor W. Salensky's Russian paper on this subject appears in the Journal of the Royal Microscopical Society. The segmentation of the egg is on the amphiblastula type; the gastrula, however, is an archigastrula. In the endodermal origin, and in the primitive formation of its mesoderm, the sterlet resembles Amphioxus, but it differs from it in having the chorda dorsalis derived from the mesoderm, and not from the endoderm. There is no real difference in the mesodermal layer of these two forms, and intermediate stages between the two conditions have been observed in Elasmobranchs. So, also, the author thinks that the segmentation of the ovum presents a transitional arrangement between the bony fishes and Plagiostomes on the one hand, and the Cyclostomata and Amphibia on the other.

Zoological Notes.—The view that the Brachiopods are shelled worms, which has been so fully discussed and insisted upon by Professor E. S. Morse, appears to be gaining ground. Drs. O. and R. Hertwig in their lengthy essay on the cœlom theory agree with Gegenbaur that the Brachiopods have little more in common with the molluscs than the possession of a shell, the latter being wholly different from that of ordinary bivalves, and that they have taken their origin from the stem of the worms, especially the Chætopods.——It appears that two shells from Lake Tanganyika, in Central Africa, described in the Proceedings of the Zoological Society of London, and, according to a note by Dr. C. A. White in *Nature*, generically identical with the *Pyrgulifera humerosa* of Meek, from the Laramie group, an extensive brackish water formation in western North America; these beds being transitional between the Mesozoic and Cenozoic series.——In a paper recently read by M. Yung before the French Academy on the influence of the nature of food on sexuality, he states that he fed separate sets of tadpoles with fish, meat, coagulated albumen of hen's eggs, yellow of eggs, and with a mixed diet. These aliments do not appear to have had a very distinct influence on the sex; but along with M. Born's experiments, those of M. Yung support the idea that a special diet afforded to young tadpoles from the time of leaving the egg, favors the development of a female genital gland. This is the reverse of that arrived at by Hoffman, who found that deficiency of nourishment resulted in the case of plants, in the production of an excess of males. In a recent memoir entitled "Metagenesis und Hypogenesis von *Aurelia aurita*," Professor Haeckel by keeping a number of specimens in his aquarium, has observed certain phenomena in the mode of reproduction, which deviate from those which usually occur. Besides *metagenesis* or the ordinary development by alternate generation, he observed a direct development which he calls *hypogenesis*. This is effected by the gastrula developing directly into an Ephyra; the Scyphistoma and Strobila stages being suppressed. It remains to be seen whether this abbreviated mode of development occurs in a state of nature. Two large plates crowded with figures of generous size render the meaning of the text very clear. Indeed Haeckel's style is as clear and beautiful as his drawings and we wish all German scientific papers were as easy to read.——A fishing bat which lives in the caves at Mono island, Trinadad, is described in *Nature*. These queer creatures catch fish at night in a manner not very clearly made out.——Dr. Kobelt, the malacologist, who has visited North Africa and Spain to study the mollusks of the two countries reports, says *Nature*, that it may be safely assumed that the connection was not confined to the Straits of Gibraltar, but extended at least as far as the meridian of Oran and Cartagena.——M. Kunstler has found a flagellate Infusorian very much like Noctiluca living in fresh water.——It appears that 38 naturalists worked at the Roscoff sea-side laboratory during 1881 against 27 in 1880. The number of foreigners is eight.——The French dredging expedition, in *Le Travailleur*, under the direction of A. Milne Edwards, has published a preliminary report. Many crustaceans, and star-fish, such as Brisinga, and other animals were found, these being Atlantic forms new to the Mediterranean. "In general the Mediterranean is not to be thought a distinct geological province; its inhabitants have probably come from the ocean, and their development and reproduction have been more active than in their place of origin. Some have been slightly modified. The more we get to know of oceanic productions off the coast of Portugal, Spain, Morocco, and Senegal, the more do differences from Mediterranean animals disappear." *(Nature.)*——A species of fluke *(Distomum cirrigerum)* have been found by G. Zaddach in the crayfish, where they occur as blackish spots on the testes, and in greater numbers in the muscles of the hinder part of the abdomen. The author, says the *Journal* of the Royal Microscopical Society, comes to the somewhat remarkable conclusion that in *Distomum isostomum*, another fluke of the crayfish, the sexually mature forms succeed one another.

ENTOMOLOGY.[1]

On Some Curious Methods of Pupation among the Chalcididæ.—(*Concluded from the January number.*)—The mines of *Lithocolletis fitchella* Clem., at Washington, contain oftentimes a most interesting object, which I have never yet seen described. Imagine a short, slender chain of small, closely welded brown dipterous puparia and you will have the exact appearance. Such a chain I have often found in the center of a mine of the Lithocolletis, supported by the silken threads which the larva of the latter always spins prior to pupation. The number of individuals in a chain is always quite constant, never varying more than from ten to thirteen, and not a trace of any other occupant of the mine is to be seen, no matter how careful the examination may be.

Finding many specimens in the course of a winter I racked my brains for a long time, trying to find out what they were. I had settled in my mind that they were dipterous, though I knew of

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

no insect of that order having such habits. I thought of the gregarious habits of Sciara, and wondered if I had not found some new form which carried the larval custom on into the pupa state. My friends were equally puzzled with myself—none had ever seen such an object before.

One day I found that a number of small Chalcids had issued from one of the chains. This, however, did not shake my belief as I considered the Chalcids as simply parasites upon the original makers of the chain, and I waited with impatience for the real owner. However, more and more of the Chalcids issued, until at last every specimen I had collected, with the exception of those put away in alcohol, had excluded ten or a dozen of the parasites, and I had made up mind that I should have to wait till the next season before solving the problem, the idea never striking me that I had the solution right before my eyes.

The next spring I bred from a mine of *Gelechia pinifoliæ* Cham., a few specimens of a closely allied Chalcid and, upon opening the mine from which they had issued, I found one of the familiar chains, in which, however, the individual "puparia" seemed more fused together, and an examination with a Tolles ¼th showed a delicate membrane surrounding them all. This membrane the compound microscope showed to be the true skin of the Gelechia larva, but so stretched as to leave the sutures perfectly indistinguishable and to be recognizable only from the spiracles and anal hairs. Now going back to my oak chains I found, of course, the same to be the case; but the skin of the Lithocolletis larva had shrunken down into the crevices so tightly and its surface was so smooth that the resemblance to a string of puparia was perfect.

Later I had the opportunity of examining a larva of *Anarsia lineatella* Zeller, parasited by an allied species, and the same appearance resulted, greatly modified, however, by the larger size of the host and the greater thickness of its skin. I remember seeing somewhere a statement by Dr. Lintner, to the effect that he had bred a very interesting parasite from this Anarsia, and I hazard a guess that this was the species. I saw at once from this last larva that the appearance which had puzzled me so was after all only a modification of a phenomenon often met with in larger larvæ, the minute size of the Lithocolletis larva and the extreme delicacy of its last skin combining to produce the curious effect.

A somewhat similar appearance, caused by an allied parasite in the rather large larva of *Gelechia gallæ-solidaginis*, is described by Professor Riley in his First Missouri Report. He calls the parasite popularly "the Inflating Chalcis," and figures the parasited larva at Fig. 5, Plate 2.

Moreover, many attempts which were made last season to carry through the larva of *Plusia brassicæ* were frustrated by a congeneric parasite with similar habits. The Plusia larva, up to the time of commencing to spin, appeared quite healthy, although perhaps a little sluggish. Then suddenly its torpor increased, and through the semi-transparent skin were seen hundreds of small white parasitic larvæ. In two days at the most the host was dead, having perhaps partially finished its cocoon, while its entire body was completely packed with the parasitic larvæ or pupæ, each surrounded by a cocoon-like cell. A cross section of the host at this stage showed a regular honeycombed structure. After remaining in the pupa state not longer than twenty days the Chalcids commenced to emerge by the hundreds. My friend, Mr. Pergande, took the trouble to count the parasites which actually issued from one Plusia larva, and, to our utter astonishment, the number reached 2528!

An interesting problem now presents itself as to the nature of the cocoon-like cell surrounding each Chalcid pupa in all these different hosts, from Lithocolletis up to Plusia. In the first place it is no silken cocoon, as is readily shown by the microscopic structure. Neither is it a membrane secreted from the general surface of the Chalcid's body, for but a single wall exists between two adjoining pupæ. For the same reason it is not the loosened last larval skin of the parasite. But one hypothesis remains, and that is that it is a morbid or adventitious tissue of the host, and this the histological structure of the cell-wall seems to show, as it is hyaline with a few simple connective tissue fibers running through it. Serious objections can also be brought up against this conclusion; but it is a point which it will be difficult to absolutely settle without closely watching the actual process of formation.

To return to our Lithocolletis parasite. I find the following note in Westwood, showing how even he was puzzled by what seems to have been a very similar object:

"De Geer has figured a minute black species with dirty white legs, which he reared from *minute cocoons* attached together side by side, found in the burrow of the larva of one of the pear leaf miners. *The figure has somewhat the air of an Encyrtus;* but the pupæ are naked in that genus. Can it be a Platygaster? or is it one of the Eulophides as the antennæ would seem to imply?" (Introduction, Vol. II, p. 170, foot-note.)

The italics are mine and the clause is emphasized from the fact that all the species to which I have referred above belong to the Encyrtid genus *Copidosoma*, of Ratzeburg, which, at the time Westwood wrote, was still included with Encyrtus. Westwood's mistake was in considering the cocoon-like objects as really cocoons, and this led him astray in his determination.—*L. O. Howard.*

New Insects Injurious to Agriculture.[1]—Almost every year the appearance of some insect or insects injurious to agriculture, but previously unknown in an injurious capacity, has to be re-

[1] Abstract of a paper read at the Cincinnati meeting of the A. A. A. S., by C. V Riley.

corded. The present year (1881) has afforded several striking examples, as *Crambus vulgivagellus*, which has seriously injured pastures, and *Phytonomus punctatus*, which has proved destructive to clover in the State of New York.

A new Pyralid has also very generally ravaged the corn plants in the Southern States. These new destructive species may either be (1), recently introduced species from some foreign country; (2), native species hitherto unobserved, or unrecorded, and new in the sense of not being described; (3), native species well known to entomologists, but not previously recorded as injurious.

The author argues that in the two last categories, more particularly, we frequently have to deal with newly acquired habits, and in the second category with newly acquired characters that in many cases systematists would consider of specific value. In short, he believes, that certain individuals of a species that has hitherto fed in obscurity on some wild plant may take to feeding on a cultivated plant, and with the change of habit undergo in the course of a few years sufficient change in character to be counted a new species. Increasing and spreading at the rapid rate which the prolificacy of most insects permits, the species finally becomes a pest and necessarily attracts the attention of the farmer. The presumption is that it could not at any previous time have done similar injury without attracting similar attention; in fact, that the habit is newly acquired. The author reasons that just as variation in plant life is often sudden, as in the "sport," and that new characters which may be perpetuated are thus created, so in insects there are comparatively sudden changes, which, under favoring conditions, are perpetuated. In this way characters which most systematists would consider as specific, originate within periods that are very brief compared to those which evolutionists believe to be necessary for the differentiation of specific forms among the higher animals.

New Entomological Periodicals.—We are in receipt of a circular from M. Constant Vanden Branden, Rue de la Madeleine, 69, Bruxelles, Belgium, announcing the monthly publication, beginning with February 1st, 1882, of a "Revue Coléoptérologique." This Review will be divided into five parts: I. Bibliography; II. New species described during the past month (latin diagnosis and precise reference); III. Synonymical remarks; IV. Necrology (if there be occasion for it); V. Sundry communications (sale of collections and books). Subscription price 10 francs for foreign countries. We have also received the prospectus of the *Wiener Entomologische Zeitung*, a journal to be devoted to general entomology, and to appear in 1882. It will be published "chez le libraire de la cour I. R. et de l'Université *Alfred Hölder*," and the editorial staff, which consists of Louis Ganglbauer, Francois Löw, Josèphe Mik, Edward Reitter and Franz Wachtl, is of a character to guarantee excellence. Price 8 marks. There is also a prospect of a new entomological journal from Paris, under the auspices of "La Société Francaise d'Entomologie," a new society which is being talked of among certain members of the Société Entomologique de France who find the old society too slow for them.

Locust Probabilities for 1882.—In a letter from Missoula, Montana, written September 30th, Mr. Lawrence Bruner gave an encouraging report as to locust prospects. Starting from Ogden, Utah, he took the Utah and Northern railway to Melrose, Montana, laying off at various points along the Snake river, and in Southwestern Montana. From Melrose the route lay through the Valleys of the Big Hole, Deer Lodge and Hellgate rivers, all of which are noted as rich agricultural districts. From Missoula, Mr. Bruner went down the Missoula river to its junction with the Flathead river and thence on to the Spokane farming district. In reference to his observations in Montana, Mr. Bruner states: "So far I am led to believe there are no locust eggs east of the Rocky range this season. There were a few locusts in the Hellgate and Missoula valleys, also some in the valley of the Bitter Root. They left toward the west and north. A few eggs were deposited."

Entomological Notes.—Mr. C. A. Briggs gives in the October number of *The Entomologist* (London, Eng.) an illustrated account of a hermaphrodite hybrid between *Smerinthus ocellatus* and *Smerinthus populi*.

Mr. J. Jenner Wier of Blackheath, S. E., London, has recently studied some large collections of Lepidoptera made by Mr. E. G. Meek in the Outer Hebrides which consist chiefly of gneiss rocks and granite, and which are treeless and rather barren of other vegetation. Out of 56 species he was struck with the coloration in many which deviated from the normal coloring, especially among the Geometridæ which showed the gray color of the gneiss, having varied in the direction of the color of their environment.

Mr. V. R. Perkins records the capture of *Heliothis armigera* in Gloucestershire, Eng., and remarks on its sitting head-downwards.

ANTHROPOLOGY.[1]

Mr. Morgan's Last Work.—It seldom happens that a literary man lives to witness the completion of his labors. In the preface to Vol. iv., of the Contributions to North American Ethnology, upon the houses and house-life of the American aborigines, Mr. Morgan says: "As it will undoubtedly be my last work, I part with it under some solicitude; but submit it cheerfully to the indulgence of my readers." After the usual delay of printing, the volume made its appearance just in time to be placed in the author's hands upon his dying bed. "He feebly turned the pages, and as feebly murmured, 'my book.'" The New York *Nation*, of De-

[1] Edited by Professor Otis T. Mason, 1305 Q. street, N. W., Washington, D. C.

cember 22, and the Rochester *Democrat-Chronicle* of Dec. 18, contain brief sketches of the author's life and labors.

The work before us is not altogether new to students of anthropology, portions of it having appeared in Johnson's Cyclopedia, the *North American Review*, and the first volume published by the Archæological Institute of America. Nevertheless, there is here the added charm of maturer deliberation and a homogeneous plan. Mr. Morgan's whole conception of domestic life among our aborigines grew out of his theory of their social organization exhibited in the gens, the phratry, and the tribe. This is made manifest in the various chapters on the law of hospitality, communism in living, usages and customs respecting land and food, modern edifices, ancient structures, and even in those relating to the mound-builders.

The volume is profusely embellished and the illustrations are exceptionally fine. The NATURALIST is very hard to please in this respect, and in giving unqualified praise to Vol. IV., passes no empty compliment to the officers of the Bureau of Ethnology who have superintended the work.

THE CALENDAR STONE.—Mr. A. W. Butler, Secretary of the Brookville Society of Natural History, Ind., takes exception to Mr. Palmer's conclusions respecting the Calendar Stone. Mr. Butler spent several weeks in the city of Mexico and examined carefully not only the stone itself, but all the surroundings. The sides and upper surface of the stone are beautifully sculptured and the carving is as old as that upon any of the other great remains. Mr. Palmer has also misinterpreted the import of the sculptures. The idea of its having been a millstone is preposterous, all grinding having been done with the metate stones. Mr. Palmer also falls into another error respecting the beheading of victims, all authors agreeing that their hearts were cut out and offered to their idols. This may not be *the* "Sacrificial Stone," but all evidence points in this direction.

STONE IMAGE FOUND IN OHIO.—Some workmen, while excavating the foundation of a machine shop at Newark, Ohio, came upon an image of a bear, six inches in height, in a sitting posture. It is made of a soft material found plentifully in the locality. The left paw rests under the ear, the right paw on the abdomen. Projecting from under the chin is the face of a woman. Below the right paw is the inverted face of a man. Near the image was a human skeleton and a conch shell.

THE AMERICAN ANTIQUARIAN.—With the October number the *Antiquarian* enters on its fourth volume, and from the indications it is destined to live. Few persons know, however, what a great and unremunerative labor it is to sustain a periodical of this kind. The contents of the present number are as follows:

Gratacap, L. P.—Prehistoric man in Europe. (Contind. fr. III, No. 4.)
Brinton, Dr. Daniel G.—The probable nationality of the Mound-Builders.

Miller, O. D.—Dr. Brugsch-Bey on the origin of the Egyptians and Egyptian civilization.
Smith, Mrs. E. C.—Myths of the Iroquois.
Welch, Dr. L. B., and J. M. Richardson.—A description of Prehistoric relics found near Wilmington, Ohio.
Avery, Professor John.—Polyandry in India and Thibet.

The Correspondence, Editorial comments, Linguistic notes, and Recent Intelligence are by no means the least important part of the number. Dr. Brinton's article, to our taste, is the best contribution. A sentence or two will show the drift of the argument. "It would appear that the only resident Indians at the time of the discovery who showed any evidence of mound-building comparable to that found in the Ohio valley were the Chahta-Muskokee. I believe that the evidence is sufficient to justify us in accepting this race as the constructors of all those extensive mounds, terraces, platforms, artificial lakes, and circumvallations which are scattered over the Gulf States, Georgia and Florida."

Contributions here and there.—It seems to be an insuperable difficulty to have all anthropological articles of our country published in one journal. The next best thing is to have one periodical that shall act as a ledger in posting up all items for the student. This the Naturalist fervently wishes to do, and in this note gives the titles of a few very important papers of this class.

Abbott, Dr. C. C. In the Proceedings of the Boston Society of Natural History, Vol. xxi, January 19, 1881, will be found an historical sketch of the discoveries of palæolithic implements in the valley of the Delaware river. Supplementary remarks by Mr. Henry W. Haynes, Mr. G. Frederick Wright, Mr. Lucien Carr, Dr. M. E. Wadsworth, and Professor F. W. Putnam are appended.

Putnam, Professor F. W. Were ancient copper implements hammered or moulded into shape? *Kansas City Rev.*, Dec. (The author holds that the aborigines did not cast copper.)

Ballou, Wm. Hosea. As scientific editor in *The American Field*, of Chicago, publishes quite frequently notes on anthropology.

The *Kansas City Review of Science and Industry*. The editor, Mr. Thos. S. Case, has done some good archæological work and never fails to give an original article and judicious selections with each number.

The Monthly Index to Current Periodical Literature, Proceedings of Learned Societies and Government Publications, issued from the office of the American Bookseller, 10 Spruce street, New York, is absolutely indispensable to every student who would keep himself posted upon what is doing in his peculiar field.

Recent Popular Works.—We are called upon to mention the titles of two volumes recently issued not because they contain anything new upon scientific anthropology, but because they show how deeply seated in all thoughtful minds are those questions which the anthropologist is daily busy with. I refer to Professor J. P. Lesley's "Man's Origin and Destiny sketched from the platform of Physical Sciences," published in Boston by George H. Ellis; and "The League of the Iroquois and other Legends, from the Indian Muse," issued by S. C. Griggs & Co. of Chicago. The former is the second edition of a course of lectures delivered before the Lowell Institute in the winter of 1865 and 1866. The work has long been before the public and has achieved a permanent success. The style is highly poetical, indeed it is at times painfully so. The burden of the argument is nowhere clearly stated, but the theme progresses by a series of surprises, a plan that is agreeable to the audience room, but not to the reader who wishes to digest. It is needless to state that Professor Lesley can tell us nothing new, either of man's origin or of his destiny.

Mr. Hathaway's poem is an attempt to give in a series of pictures the story of the origin of the Iroquois confederation and especially all that relates to Hayowentha. We hail with delight any and every attempt to preserve in prose or verse the sacred lore of our aborigines. The Bureau of Ethnology at Washington has during the past two years collected a hundred or more new myths, which will be published in the contributions to North American Ethnology.

ANTHROPOLOGY IN GREAT BRITAIN.—Trübner & Co. announce a work to be completed in ten volumes, entitled, "The Social History of the Races of Mankind." The IVth and concluding number of Volume X, of the Journal of the Anthropological Institute of Great Britain and Ireland gives us the following original papers.

Biddoe, Dr. John.—On anthropological colour phenomena in Belgium and elsewhere.
Rowbotham, —.—Certain reasons for believing that the art of music in prehistoric times passed through three distinct stages of development, each characterized by the invention of a new form of instrument, and that these stages invariably succeeded one another in the same order in various parts of the World.
Milne, John.—The Stone Age in Japan; with notes on Recent Geological changes which have taken place.
Tylor, E. B.—President's Annual Address.

Six pages of President Tylor's address are devoted to a very flattering review of Yarrow's "Mortuary Customs," and Col. Mallery's "Introduction to the study of the Sign Language among the North American Indians."

GEOLOGY AND PALÆONTOLOGY.

A NEW GENUS OF TILLODONTA.—An interesting new form of this sub-order has been found in the *Catathlæus* beds (probably the Puerco formation) of New Mexico. It differs widely from the two genera hitherto known, *Anchippodus* and *Tillotherium*. Owing to the absence of the superior dental series it is not possible to be sure which tooth is the canine. The inferior dental formula may be therefore written, I. 2; C. 1; Pm. 3; M. 3; or I. 3; C. 0; Pm. 3; M. 3; or I. 3; C. 1; Pm. 2; M. 3. The first and second incisors are large and rodent-like, growing from persistent pulps; the second are the larger. The third, or canines, are small and probably not gliriform. There is no diastema. The first premolar (or canine) has a compressed crown with two cusps placed transversely to the jaw axis, and has a complete enamel sheath, and probably two roots. The succeeding tooth is also transverse, and is two-rooted, judging from the alveolus. The first and second true molars are rooted, and the crown consists of two transverse separated crests, each partially divided into two tubercles. On wearing, the grinding surface of each assumes the form of a letter B with the convexities anterior. The last inferior molar is injured. The rami are short, and the symphysis deep and recurved. This genus may be named *Psittacotherium.*

Psittacotherium multifragum, sp. nov.—The base of the coronoid process is opposite the junction of the second and third true molars. The ramus is deep and moderately stout. The enamel of the first incisor does not extend below the alveolar border, at the internal and external faces, and does not reach it at the sides. It has a few wrinkles on the anterior face. The anterior enamel face of the second incisor is thrown into shallow longitudinal grooves with more or less numerous irregularities from the low dividing ridges. There is a deeper groove on each side of the tooth, and there are about a dozen ridges between these on the anterior face. Both cusps of the first premolar are conic, and the external is the larger. The second true molar is a little smaller than the first. The enamel of the premolars and molars is smooth, and there are no cingula.

Probable length of dental series .0750; diameters of I. 1: anteroposterior .0120, transverse 0066; diameters I. 2: anteroposterior .0160, transverse .0115; diameters Pm. 1.: anteroposterior .0072, transverse, .0130; diameters of M. II: anteroposterior .0090, transverse, .0090. Length of true molars .0038; depth of ramus at M. II. .0360.

The short deep jaws of this animal must have given it a very peculiar appearance, not unlike that of a parrot in outline.—*E. D. Cope.*

A GREAT DEPOSIT OF MUD AND LAVA.—The Atlantic and Pacific R. R. traverses the Territory of New Mexico westward from the Rio Grande river, north of its center. For a great part of the distance between that river and the Arizona border, it passes over the plateau of the Sierra Madre, which chiefly consists in this region of mesas. The mountain ranges to the north are not in sight from the railroad, and those of the south are visible at a distance. The plateau is a large anticlinal one hundred miles in width, and consists of triassic and jurassic beds. The cretaceous formations are seen highly inclined, resting upon both the eastern and western flanks. The railroad engineers have availed themselves of a line of drainage which cuts into the beds, forming a long valley extending east and west. Its water shed is about ten miles east of Fort Wingate, the streams on the one side flowing into the Atlantic, and on the other side into the Pacific oceans. They are called respectively the Puerco of the East and the Puerco of the West. Puerco means muddy, and the rivers are well named. The cliffs of jurrassic age on the north side of the valley are now a thousand feet in height near Fort Wingate, showing the enormous extent of the erosion. They consist everywhere of a soft red argillaceous arenaceous rock, and include a layer of gypsum. This material is readily eroded by atmospheric agencies, and is carried down into the valley during each rainy season in enormous quantities. The lower levels for a distance of one hundred and fifty miles E. and W., and from ten to twenty miles N. and S. consist of a vast deposit of mud. During the rainy season the streams are choked with it, and after the cessation of the rains, the borders of dried sheets of mud may be seen everywhere. Grass is buried up, but with many plants, in time, struggles through it. On the northern side of this valley, in the region of the extinct vent of San Mateo (Mt. Taylor), a lava sheet covers the older mud deposit. It displays exactly the characteristics of the cooled lava of late eruptions of Mount Vesuvius. It lies in innumerable ropes and coils, and forms like heavy drapery, as though it had cooled but yesterday. In cooling it has cracked into huge cakes. Water has percolated through the fissures, and has, in some localities, removed a large part of the supporting mud bed. Of course a portion of the mud is left beneath the middle part of the block, forming a fulcrum. With advancing erosion below, the lava block tips up, and stands obliquely on its edge. Tracts of this kind form most forbidding regions, and are absolutely impenetrable to any but small animals. Snakes appeared to be abundant in some localities passed by the train.—*E. D. Cope.*

Invertebrate Fossils from the Lake Valley district, New Mexico.—Mr. S. A. Miller, of Cincinnati, has identified the following fossils from the silver-bearing carboniferous limestone of Lake Valley, New Mexico:

Strophomena rhomboidalis, *Spirifera striata*, *S. novomehicana*, n. sp., *S. temeraria*, n. sp., *Athyris lamellosa*, *A. planosulcata*, *Orthis ruspinata*, *O. dalyana* n. sp., *O. michelini*, *Productus semireticulatus*, *P. vittatus*, *Rhynchonella pustulosa*, *R. tuta*, n. sp., *Platyceras oëquilatera*, *Prætus proceidens*, *Amplexus fragilis*, *Cyathophyllum subcæspitosum*, *Actinocrinus dalyanus*, n. sp., *A. copei*, n. sp., *A. lineatus*, n. sp., *Nautilus (Euomphalus) rockymontanus*, n. sp., *Camaraphoria occidentalis*, n. sp., *Trematopora americana*, n. sp: two undetermined species of *Bryozoa* of the family Fenestellidæ; two undetermined species of *Zaphrentis;* a fragment of *Ortho-*

ceras; two undetermined species of *Platycerinus;* three undetermined species of *Actinoceras.* Mr. Miller remarks that the age of the rocks, if all the fossils are from one range, is that of the Upper Burlington or Lower Keokuk, but if of different elevations, they represent these two groups respectively.

Some specimens are of interest as showing the nature of the process of deposit of silver in the limestone. A *Zaphrentis* and an *? Orthis* in good preservation, are partially replaced by argentiferous iron, which retains their structual details. This shows clearly that the process is one of replacement of the limestone by a fluid holding the metals in solution, and not by injection. This is also demonstrated by the undisturbed condition of the thin bedded limestone where traversed by veins of ore.—*E. D. Cope.*

INSECTS OF THE AMYZON SHALES OF COLORADO.—In the Bulletin of the U. S. Geological Survey of the Territories of Hayden, Mr. Scudder publishes a review of the geology and palæontology of the above deposit. He observes: "The insects preserved in the Florissant basin are wonderfully numerous, this single locality having yielded in a single summer more than double the number of specimens which the famous localities at Oeningen, in Bavaria, furnished Heer in thirty years.

"The examination of the immense series of specimens found at Florissant has not gone far enough to yield data sufficiently definite for generalizations of any value, or which might not be altered, or even reversed, on further study. It may, nevertheless, be interesting to give a running note of what has been observed in assorting the collection, and to make the single comparison with the Oeningen insect fauna which the number of individuals will furnish.

"This is indicated by the following table, based on a rough count of the Florissant specimens, but which cannot be far astray.

Percentage of representation by	At Florissant.	At Oeningen.
Hymenoptera	40	14
Diptera	30	7
Coleoptera	13	48
Hemiptera	11	12
Neuroptera	5	17
Orthroptera	$\frac{1}{4}$	3
Arachnida	$\frac{1}{4}$	$\frac{1}{2}$
Myriapoda	$\frac{1}{25}$	
Lepidoptera	$\frac{1}{25}$	$\frac{1}{10}$
	99.58	101.6

"The plants, although less abundant than the insects, are exceedingly numerous, several thousand specimens having passed through the hands of Mr. Leo Lesquereux. Of these he has published thirty-seven species in his Tertiary Flora, about two-fifths of which are considered identical with forms from the European Tertiaries. "We have in all from ninety to a hundred species of plants recognized from these Florissant beds, of which half the species belong to the apetalous exogens.

"The testimony of the few fishes to the climate of the time, is not unlike that of the plants, suggesting a climate, as Professor Cope informs me, like that at present found in latitude 35° in the United States; while the insects, from which, when they are completely studied, we may certainly draw more definite conclusions, appear from their general ensemble to prove a somewhat warmer climate. White ants are essentially a tropical family, only one or two out of eighty known species occurring north of latitude 40°. In North America only three have been recorded north of the border of the Gulf of Mexico, excepting on the Pacific coast, where one or two more extend as far as San Francisco. Two species, both belonging to the second section, are found in the valleys below Florissant, in 39° north latitude. Florissant itself is situated 2500 meters above the sea, and the presence of so considerable a number of white ants embedded in its shales, is indicative of a much warmer climate at the time of their entombment than the locality now enjoys. Investigation of other forms increases the weight of this evidence at every step, for nearly all the species (very few, certainly, as yet) which have been carefully studied, are found to be tropical or sub-tropical in nature. As, however, most of those studied have been selected for some striking feature, too much weight should not be given to this evidence."

This subject will be discussed in a forthcoming volume of the Report of the U. S. Geological Survey of the Territories of Dr. Hayden. The illustrations of this work which we have seen are of unusual excellence.

THE FUTURE OF GEOLOGY.—Professor Ramsey, in his address before the British Association, said that in the British Islands the art of geological surveying has, he believed, been carried out in a more detailed manner than in any other country in Europe, a matter which has been rendered comparatively easy by the excellence of the Ordnance Survey maps both on the 1-inch and the 6-inch scales. When the whole country has been mapped geologically little will remain to be done in geological surveying, excepting corrections here and there, especially in the earliest published maps of the Southwest of England. Palæontological detail may, however, be carried to any extent, and much remains to be done in miscroscopic petrology which now deservedly occupies the attention of many skilled observers.

It is difficult to deal with the future of geology. Probably in many of the European formations more may be done in tracing the details of subformations. The same may be said of much of

North America, and for a long series of years a great deal must remain almost untouched in Asia, Africa, South America, and in the islands of the Pacific ocean. If, in the far future, the day should come when such work shall be undertaken, the process of doing so must necessarily be slow, partly for want of proper maps, and possibly in some regions partly for the want of trained geologists. Palæontologists must always have ample work in the discovery and description of new fossils, marine, fresh-water, and truly terrestial; and besides common stratigraphical geology, geologists have still an ample field before them in working out many of those physical problems which form the true basis of physical geography in every region of the earth. Of the history of the earth there is a long past, the early chapters of which seem to be lost forever, and we know little of the future except that it appears that "the stir of this dim spot which men call earth," as far as geology is concerned, shows "no sign of an end."

MINERALOGY.[1]

PHYTOCOLLITE, A NEW MINERAL FROM SCRANTON, PA.—This name has been given[2] to a very curious, jelly-like mineral recently found near the bottom of a peat bog at Scranton, Pa. An excavation for a new court-house had cut through a peat bog, below which was a deposit of glacial till. Near the bottom of the bog, in a carbonaceous mud, or "swamp muck," there occur irregular veins, of varying thickness and inclination filled with a black, homogeneous jelly-like substance, elastic to the touch. This substance becomes tougher on exposure to the air, and finally becomes as hard as coal. When thus dried, it is brittle, has a conchoidal fracture and brilliant lustre, and closely resembles jet. It is nearly insoluble in alcohol and ether, but is entirely soluble in caustic potash, forming a deep reddish-brown solution, from whence it can be again precipitated on the addition of an acid. It has a specific gravity of 1.032 and burns with a bright flame. After having been dried at 212°, it has the following composition, according to the analysis of J. M. Stinson:

			or without Ash
C	28.989	C	30.971
H	5.172	H	5.526
N	2.456	O + N	63.503
O	56.983		
Ash	6.400		100.
	100.		

yielding the empirical formula $C_{10}\ H_{22}\ O_{16}$.

In its mode of occurrence and in general appearance, this substance closely resembles Dopplerite, but differs from that mineral

[1] Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] H. C. Lewis, Proc. Amer. Philos. Soc., Dec. 2, 1881.

in burning with flame and in its composition. Another jelly-like substance from a Swiss peat bog, differing both from Dopplerite and from the Scranton mineral has been described by Diecke.

It is now proposed to group all these jelly-like minerals, produced by the decomposition of vegetable matter, under the one generic name of *Phytocollite* (φυτόν, κόλλα = "plant-jelly") of which the three minerals now known would be varieties.

Special interest is attached to these substances, in that they illustrate the first step in the transformation of peat into coal.

Cossyrite.—Förstner[1] has given this name to a hornblendic mineral which abounds in the igneous rocks of the Lipari islands. It occurs in triclinic crystals closely approaching monoclinic forms. It has an easy cleavage in two directions, the included angle being 65° 51′. Spec. grav. 3.75. It has the following composition.

SiO^2	Fe^2O^3	Al^2O^3	FeO	MnO	CuO	CaO	MgO	Na^2O	K^2O
43.55	7.97	4.96	32.87	1.98	.39	2.01	.86	5.29	.33

Before the blowpipe it melts readily to a brownish-black glassy slag. It is partially decomposed by acids. It appears to be a variety of iron amphibole.

Alaskaite.—A new sulphide of bismuth and lead from Alaska mine, Colorado, has been described by Dr. G. A. König.[2] It occurs as a pale lead-gray mineral of scaly structure and metallic lustre, which forms a more or less intimate mixture with quartz, barite, chalcopyrite, etc. It is soft, and has a spec. grav. of 6.878. In the closed tube it decrepitates and fuses. On charcoal gives characteristic coatings. It is soluble in sulphuric acid. It has the following composition:

Bi	Pb	Ag	Cu	Fe	Zn	S	Ba
51.35	17.51	3.	5.38	1.43	.20	17.85	2.83

The formula given is $(\overset{II}{Pb}, \overset{II}{Zn}, Ag_2, Cu_2) S + (Bi\ Sb)^2 S^3$.

Pseudomorphs of Copper after Aragonite.—Domeyko has described some interesting cases of pseudomorphism of copper after aragonite observed in some Bolivian mines. He found hemitropic crystals of aragonite presenting all degrees of transformation into metallic copper, and showing every transition from crystals of pure aragonite to those of pure copper.

Electricity developed by the compression of Crystals.—Jacques and Curie[3] have shown that by the mere compression of an inclined hemihedral crystal, electricity is developed. They experimented by placing a crystal or a suitable section of it between two sheets of tinfoil insulated on the exterior by plates of

[1] Zeits. f. Kryst., v, 1881, p. 348.

[2] Zeits. f. Kryst., 1881, vi, 42.

[3] Bull. Soc. Min. de France, 1880, 93. Comp. Rend., 1881, iv, 186, and vii, 250.

caoutchouc, the tin foil being connected to a galvanometer. By now compressing the crystal in a vise or otherwise, electricity is developed and may be measured by the galvanometer. The electricity developed is the opposite of that produced by heating a crystal,—that is to say, the extremity of the crystal which becomes positive on heating, becomes negative on compression. On releasing the pressure, electricity of an opposite kind is produced. The authors find that the production of electricity by pressure can only be obtained with hemihedral crystals having inclined faces. By combining a number of such crystals in a pile, they have invented a new apparatus for producing electricity. The amount of electricity developed varies for different minerals. They find, for example, that a section of quartz, cut perpendicular to the main axis, evolves more electricity than a similar section of tourmaline.

Note on Gold.—There is a simple method for the detection of gold in quartz, pyrite, etc., which is not generally described in the mineralogical text-books. It is an adaptation of the well-known amalgamation process, and serves to detect very minute traces of gold.

Place the finely powdered and roasted mineral in a test tube, add water and a single drop of mercury; close the test tube with the thumb and shake thoroughly and for some time. Decant the water, add more and decant repeatedly, thus washing the drop of mercury until it is perfectly clean. The drop of mercury contains any gold that may have been present. It is therefore placed in a small porcelain capsule and heated until the mercury is volatilized and the residue of gold is left in the bottom of the capsule. This residue may be tested either by dissolving in aqua regia and obtaining the purple of Cassius with protochloride of tin, or by taking up with a fragment of moist filter paper, and then fusing to a globule on charcoal in the blowpipe flame.

It is being shown that gold is much more universally distributed than was formerly supposed. It has recently been found in Fulton and Saratoga counties, New York, where it occurs in pyrite. It has also been discovered in the gravel of Chester creek, at Lenni, Delaware county, Penna. In one of the Virginia gold mines wonderful richness is reported, $160,000 worth of pure gold having been taken from a space of three square feet.

A New Textbook of Mineralogy.—The mineralogists of Germany are fortunate in possessing a new and valuable work on mineralogy by Professor G. Tschermak. This work, the first volume of which has recently appeared, contains a full description of the physical, optical and crystallographic characters of minerals, and of the various delicate means of investigation at the command of modern mineralogists. Under the head of physical mineralogy an account is given of the latest discoveries in elasticity and cohesion. Among the optical characters of minerals described are double refraction, phenomena of thin plates, interference figures, optic axial divergence and method of measurement, determination of the plane of polarization, circular polarization, pleochrism, theoretical explanation of the characters of uniaxial and biaxial crystals, etc.

It is to be hoped that this work may be translated into English for the benefit of the many students who feel the need of some such advanced textbook.

MINERALOGICAL NEWS.—It is stated that Mt. Mica, Maine, has been purchased by a mining company and is being worked for tourmaline, cassiterite and mica. This locality has yielded a large number of interesting minerals, and has been especially famous for its beautifully colored tourmalines.——*Monazite* has been found as minute tubular crystals, less than a millimeter in diameter, at Nil St. Vincent, near Brussels. It occurs in a crystalline schist associated with rutile, tourmaline and zircon.——The great beds of nitrate of soda which occur in the desert of Atacama, Chili, have been derived from the decomposition of underlying felspathic rocks.——*Vasite* is an altered orthite found near Stockholm.——It has been proved that the jade or nephrite of Siberia, like that of China, is a compact variety of tremolite.——An excellent method of separating from one another the minerals composing a rock, is to immerse the crushed rock in a very dense liquid of known specific gravity. The specific gravity of most of the minerals constituting rocks being between 2.2 and 3, it results that by preparing a liquid whose density may be made to vary between those limits, the minerals may be readily separated. Such a liquid is a solution of iodide of mercury in iodide of potassium. A solution of borotungstate of sodium may also be employed, the latter having a specifie gravity of about 3.——*Native lead* has been found in Idaho.——*Fahlunite* occurs at McKinney's Quarry, Germantown, Penna.——*Vermiculite* occurs in Japan. It is in short six sided prisms of a brownish color. When thrown upon hot charcoal, it expands longitudinally to many times its original length, twisting and writhing like a serpent, and is shown to passing travelers as a local wonder. It is also used as a medicine. In many of its characters it is similar to the variety known as *Philadelphite*.——Out of 200 columns of *Basalt* from the Giants Causeway, recently measured, there were tetragons 3 per cent., pentagons 25 per cent., hexagons 50 per cent., heptagons 19 per cent., octagons 2 per cent.——Microscopic investigations have revealed frequent impurities in the *diamond*. Organic matter, carbon and bubbles of gas are common impurities. Quartz, chlorite, pyrite and hematite have recently been found inclosed in diamonds. Small crystals of topaz have also been seen within diamonds.——Cossa has shown that all *apatite* contains phosphate of cerium, lanthanum and didymium united with phosphate of lime, and that there is no such mineral as cryptolite. The rare earths were recognized by means of spectral analysis and are present in all apatite. Their presence in the Canadian apatite has also been proved by chemical analysis.

GEOGRAPHY AND TRAVELS.[1]

The Jeannette and the Search Expeditions.—A portion of the crew of the *Jeannette* arrived in two boats at the mouth of the Lena about the 17th of September last. They report that their vessel was crushed in the ice on June 23, 1881, in N. lat. 77° 15′ E. long. 157°, about one hundred and fifty miles north-east of the New Siberian Islands. It appears that the *Jeannette* was caught in the pack on October 1, 1879, and drifted with the winds and currents up to the time she was abandoned.

From the Report of Captain C. L. Hooper we learn that the U. S. revenue steamer *Corwin*[2] sailed from St. Michaels on July 9th 1881. She reached Herald Island on July 30th, and, a landing being effected, a thorough exploration of the island was made. The cliffs which render it almost inaccessible are about 1200 feet high. After much difficulty with the ice Capt. Hooper succeeded in reaching Wrangell Land, off the mouth of a river. The landing was made at about the locality where the supposed Plover Island has generally been designated on the maps and is in latitude 71° 4′ N. and longitude 177° 40′ W. and is the most eastern part of Wrangell Land. It is forty-five miles from Herald Island and in clear weather is in plain sight from it. Wrangell Land was taken possession of in the name of the United States and re-named "New Columbia." No snow was found in the lowlands or hills though remains of very heavy drifts were observed on the distant mountains. The river was named Clark; it was seventy-five yards broad and twelve feet deep. The party proceeded four miles inland and from a high hill traced the course of the river northwards for about forty miles. Over twenty species of Arctic plants were found in bloom. Capt. Hooper believes that the sea between Herald Island and Wrangell Land is almost always closed; the water is shallow and solid ice appears to remain constantly frozen to the bottom. The *Corwin* next visited Point Barrow which was found to be clear of ice. She arrived at Plover Bay on August 4th, finding the *Golden Fleece* there. After an unsuccessful attempt to revisit Herald Island and Wrangell Land the *Corwin* left the Arctic Sea on September 14th, and reached San Francisco on the 22d of October.

The U. S. steamer *Rodgers* reached Plover Bay about August 14th and arrived at Herald Island on August 24th, where a landing was made. The south coast of Wrangell Land was reached after passing throught about twelve miles of loose ice on

[1] Edited by Ellis H. Yarnall, Philadelphia.
[2] The name of this vessel is *Corwin* not Thomas Corwin.

August 25th. The next day a good harbor was found and exploring parties were sent out to examine the interior and the coast line. A mountain about 2500 feet high was ascended. Open water was seen in all directions except between the west and south-south-west, in which quarter a high range of mountains seemed to terminate the land. Two parties were sent out in boats, of which one followed the eastern and the northern shores until stopped by ice when the boat had to be abandoned and a return made on the land, while the other boat took the western shore along which it passed until stopped by the same ice, after passing the most northern point of Wrangell Land, where the position of the other party could be seen. Wrangell Land is thus shown to be an island about sixty miles in length. At the northern end there is a current running to the north-west at about six knots an hour. The *Rodgers* anchorage was in N. lat. 70° 57′ W. long. 178° 10′. It is situated to the south and west of Capt. Hooper's landing place at the mouth of Clark River. The *Rodgers* afterwards reached N. lat. 73° 44′ W. long. 171° 48′ on September 19th. She expected to winter in St. Lawrence Bay.

The U. S. steamer *Alliance* reached lat. 79° 36′, in the neighborhood of Spitzbergen, in September last. Captain Wadleigh found the ice extending far to the eastward and southward of the ordinary limit, and it was also much heavier. The Norwegian walrus hunters, who ordinarily go to Hinlopen Straits and even further on the north coast of Spitzbergen, did not this season get as far to the north and east as the *Alliance*. Wyde Jan's Water on the south-east was full of ice, which extended from Hope Island nearly to Cape Petermann, Novaya Zemlya. Captain Wadleigh says that the southerly position of the ice is accounted for by the last very severe winter, and the fact that during July and August the usual southerly winds did not prevail and force the ice northwards. Captain David Gray confirms this report in a letter given in the Royal Geographical Society's Proceedings, in which he states that the ice for the past two years has been almost stationary, notwithstanding that strong northerly winds prevailed. "The absence," he writes, "of southerly drift can only be accounted for by the lanes of water making amongst the floes being immediately frozen up again with the severe frosts, keeping the ice fixed together, and preventing any large waters being made to force the ice south. The ice has not diminished during the last two summers so fast as usual owing to the frosts covering the lanes and pools of water with bay ice, preventing the wash of the water from cutting into it and washing it away. Close ice melts very slowly; open ice soon disappears."

The Lady Franklin Bay Expedition made the most rapid passage through Melville Bay ever recorded and reached their destination one month after leaving St. John's, N. F. They stopped to take aboard natives, furs and dogs at Godhaven, Rittenbank, Uppernavik and Proven. Dr. O. Pavy joined the company at Godhaven. They sailed from Uppernavik through the middle passage to Cape York in thirty-six hours, and, though delayed by a fog for thirty-two hours, were only six days and two hours in reaching Lady Franklin Bay. They stopped at Cary Island and visited the depot of provisions placed there by Captain Nares in 1875. They also visited Littleton Island, where they found the English Arctic mail, left by the *Pandora* in 1876; and the *Polaris* quarters at Life-boat Cove, where they discovered many relics, including the transit instrument belonging to that unfortunate company. They also stopped at Washington Irving Island and Cape Hawks to inspect depots established by Nares, and landed supplies at Carl Ritter Bay. No heavy ice was met until inside of Cape Lieber, eight miles from their destination. They entered Discovery Harbor on August 11th, and when the *Proteus* left Lieutenant Greely had got the house erected and partly framed and three months' rations of musk cattle secured. About 140 tons of coal were landed from the *Proteus*. The *Proteus* reached St. John's on her return voyage on September 19th.

The Point Barrow party also safely reached their station early in September. The *Golden Fleece* returned to San Francisco on November 5th. The station is five miles from Point Barrow and is called Ooglalamie. The observatory was completed when the *Golden Fleece* left on September 17th and the main building begun. Early in the spring Lieut. Ray hopes to explore the valley of the Coppermine and afterwards visit Kotzebue Sound where a vessel is to be sent with supplies.

Arctic Exploration.—In a paper read by Professor George Davidson before the Geographical Society of the Pacific, Plover Island was described as a low pyramidal rock extending as a cape from the east end of Wrangell Land and connected by a low neck of swampy land covered with grass.

The Russian expedition to the mouth of the Lena, to establish one of the stations agreed upon by the International Polar Conference, will go by rail to Nishni Novgorod, thence by sleigh to Perm, by rail to Yekaterineburg, by sleigh to Irkutsk where they are expected to arrive in January and stay until May, to complete their preparations. They will descend the Lena on a barge. Owing to a lack of funds the second Russian station in Novaya Zemlya will not be established at present.

In a recent work "Die Temperatur Verhältnisse des Russischen Reichs" by Professor Wild of St. Petersburg, the Siberian pole of cold in winter is transferred from the neighborhood of Yakutsk to a point somewhat further north, lying in the Arctic circle about E. long. 125°. At this center of maximum cold round which the isotherms lie in fairly regular ovals, the mean temperature in January sinks as low as—54° F., the mean temperature at Yakutsk being 11° higher.

The *Athenæum* states that "Captain J. W. Fisher, of the American whaler *Legal Tender*, reached San Francisco at the end of September from Point Barrow, and he reports that in August the ice barrier was over twenty miles north of the point, and was every day moving further northward. The steam whaler *Belvidere* had gone much further to the east than the rest of the whaling fleet in an endeavour to reach the Mackenzie River, about 450 miles east of Point Barrow. On her outward voyage the *Legal Tender* had on board Drs. Arthur and Aurel Krause, who had been sent out by the Bremen Geographical Society to undertake a journey in the coast districts and islands of Behring Strait and Sea, partly for the purpose of investigating the ethnology and marine zoölogy of Alaska. Capt. Fisher landed them at St. Lawrence Bay where they were to spend a fortnight, and then proceed to East Cape and the Diomede Islands. On returning to St. Lawrence Bay they proposed to work their way down the Siberian coast to Plover Bay. Capt. Fisher states that Mr. W. H. Dall, of the U. S. Coast Survey, has made a great mistake in his reports respecting the current in Bering Strait. During the whole summer a strong current sets northward through the strait and it is only in September or October that northerly winds affect it. Mr. Dall's observations, he says, extended only over a few days and were made in an eddy current under the lee of the Diomede Islands. Capt. Fisher further reports that off Point Barrow a current of three or four knots an hour sets regularly along the land to the north-east, but it does not extend for fifty miles off the shore."

Geographical Notes.—A committee of the Royal Society consisting of Sir George Airy, Professor J. Adams and Professor Stokes, appointed to consider what "might yet be required in order to render the pendulum operations, which have been carried out in connection with the great trigonometrical survey of India, reasonably complete as an important contribution towards the determination of gravity all over the earth," have reported that it is desirable that "the Indian group of stations, which have already been connected with Kew, should be differentially connected with at least one chain of stations which are so connected with one another, and which have been employed in the determination of the figure of the earth." They refer to the suggestion made by Professor Peirce of the U. S. Coast Survey, that the same two pendulums that were swung in India should be used first at Kew and then at Washington. They say—"As Washington is, or shortly will be, connected differentially with a large chain of stations widely distributed in America and elsewhere, we think that the value of the Indian series would be decidedly increased by being connected with one of the American stations, such as Washington."——It appears that as early as the sixteenth century plans had been formed by the Spanish for canals in Central

America between the two seas. A canal via the lake of Nicaragua was projected in 1548. Other explorations were made, for this purpose, in the Isthmus of Tehauntepec and the Isthmus of Panama.——M. Alphonse Milne Edwards has recently been making investigations in the waters of the Mediterranean. During the seventy days he was so engaged the greatest depth reached by sounding and dredging was 2600 metres. The bottom was found not devoid of living beings, species of low organization being found between depths of 1068 and 2600 metres. At an average depth of 250 metres the temperature was constant at 13° Cent. This explains the small development of life in the depths of that sea, the muddy bottom and the absence of rocks being also unfavorable to germination. The report also confirms the belief that the Mediterranean is a sea of recent formation.——The English missionary Mr. Pearson has recently returned home from Uganda with a large amount of information concerning the country and the Victoria Nyanza. He has surveyed the western shore of the lake, taken many observations, and left a careful meteorological journal. He speaks highly of the general accuracy of Mr. Stanley's work and found that nearly all his latitudes were correct. ——The reinforcement of laborers for Mr. Stanley, numbering 135, left Zanzibar for the Congo on October 20th. The Belgian Association has abandoned its proposed expedition to Nyangwe which was to have effected a junction with Mr. Stanley on the lower Congo.——*Petermann's Mittheilungen* for November last contains a valuable paper by Ernest Marno on the Grass Barriers of the Nile.

MICROSCOPY.[1]

A Hollow Glass Sphere as a Condenser for Microscopic Illumination.—A glass globe filled with water has long been employed by watchmakers and engravers for the purpose of condensing the light upon their work; it was also used by some of the early microscopists. Ledermüller, in his "Mikroskopische Gemüth-und-Augen-Ergözung" (Microscopic Mind-and-eye-delights) 1763, gives a representation of his lamp and condenser; the latter is a globe without foot or neck, and is supported on the top of a square brass rod by six claws, the lamp being supported in the same way, both of them sliding into square holes at the opposite ends of a brass arm fixed on a stand. In the "Micrographia," Hooke gives a figure of his microscope and accessories, amongst them is a globe condensing the light on the stage of the instrument. This form of condenser was probably used by many of the old microscopists, but it appears soon to have fallen into disuse, as it is not mentioned by Adams in his "Micrographia Illustrata," 1771, or in his "Essays on the Microscope," 1787. Possibly the opticians of the period did not care to introduce so

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

simple and inexpensive a contrivance to their patrons (mine cost one and eightpence).

I had looked upon the "globe condenser" as one of the relics of the past, and not worthy of resuscitation, until a short time ago when watching an artist engraving some fine shading on wood. I was struck with the sharpness and definition of the engraved lines (about $\frac{1}{80}$ inch apart). It at once occurred to me that this kind of illumination would suit the microscope. I therefore borrowed it and tried it first with a ¼ objective (a Ross 75°) upon *Pleurosigma angulatum,* using oblique light from the mirror; the striæ came out very distinctly. I then removed the globe, and the striæ vanished and required a more oblique ray to render them again visible. I next tried it on *Synedra robusta,* and resolved the striæ into beads; this I had not been able to do before with this objective. I next tried it with low powers (1½ in., 1 in. and ⅔ objectives). I first used the ⅔, but forgot to alter the previous position of the mirror, and consequently obtained a "black field;" the object I had placed upon the stage was *Haliomma humboldtii;* I was surprised at the beautiful effect upon that form. It appeared as though illuminated by intense moonlight with a slight green tinge, and delightfully cool to the eye. I have since purchased a smaller globe (six inches in diameter) than the one I tried; the liquid with which it is filled is a dilute solution of sulphate of copper (about ½ ounce of saturated solution to one pint of water). The mixture must be filtered if ordinary water is used, the intensity of color is, however, somewhat a matter of taste. The distance of the globe from the lamp should be about two or three inches; from the globe to the mirror about eight to twelve inches. As the height of the globe cannot be altered, the necessary adjustments must be made with

$\left\{ \begin{matrix} C\ C \\ B\ B \\ A\ A \end{matrix} \right\}$ the lamp, *e. g.*, if the mirror is at A, the lamp flame must be at C; if at C, the flame must be at A. I have just received a letter from a friend to whom I recommended the illumination, in which he writes: "I am delighted with the black ground illumination, which is certainly softer and the definition sharper than any I have tried before. Have you tried it with polarized light? I think you would be pleased with it, there is such great softness of tint and such impenetrable blackness of field when the prisms are crossed.—*F. Kitton in Science Gossip.*

Arrestation of Infusorial Life.—Three years ago I brought with me to the Alps a number of flasks charged with animal and vegetable infusions. The flasks had been boiled from three to five minutes in London, and hermetically sealed during ebullition. Two years ago I had sent to me to Switzerland a batch of similar flasks containing other infusions. On my arrival here this year 120 of these flasks lay upon the shelves in my little library. Though eminently putrescible, the animal and vegetable juices had remained as sweet and clear as when they were prepared in London. * * * * I took advantage of the clear weather this year to investigate the action of solar light on the development of life in these infusions, being prompted thereto by the interesting observations brought before the Royal Society by Dr. Downs and Mr. Blunt, in 1877. The sealed ends of the flasks being broken off, they were infected in part by the water of an adjacent brook, and in part by an infusion well charged with organisms. Hung up in rows upon a board, half of the flasks of each row were securely shaded from the sun, the other half being exposed to the light. In some cases, moreover, flasks were placed in a darkened room within the house, while their companions were exposed in the sunshine outside. The clear result of these experiments, of which a considerable number is made, is that by some constituent or constituents of the solar radiation an influence is exercised inimical to the development of the lowest infusoria. Twenty-four hours usually sufficed to cause the shaded flasks to pass from clearness to turbidity, while thrice this time left the exposed ones without sensible damage to their transparency. This result is not due to mere differences of temperature between the infusions. On many occasions the temperature of the exposed flasks was far more favorable to the development of life than that of the shaded ones. The energy which in the cases here referred to prevented putrefaction was energy in the radiant form. In no case have I found the flasks sterilized by insolation, for, on removing the exposed ones from the open air to a warm kitchen, they infallibly changed from clearness to turbidity. Four-and-twenty hours were in most cases sufficient to produce this change. Life is, therefore, prevented from developing itself in the infusions as long as they are exposed to the solar light, and the paralysis thus produced enables them to pass through the night time without alteration. It is, however, a suspension, not a destruction, of the germinal power, for, as before stated, when placed in a warm room, life was invariably developed. * * * It would also be interesting to examine how far insolation may be employed in the preservation of meat from putrefaction.—*Professor Tyndall before British Association, 1881.*

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SCIENTIFIC NEWS.

— The Annual Report of the Chief Signal Officer for 1881, show that this Bureau was never in more efficient order, nor doing more to promote scientific as well as purely practical interests. For example Gen. Hazen reports that he has endeavored to bring this service into active sympathy and coöperation with the ablest scientific intellects of the country. "In this direction and in response to my request, the Natural Academy of Sciences has appointed an advisory committee of consulting specialists with which I may confer as occasion demands. I take pleasure in acknowledging this courtesy as showing the establishment of more intimate relations between the scientific interests of the United States and the Signal Service."

A Scientific and Study Division, was established January 27, 1881, for the purpose of scientific research and investigation into the laws of meteorology. Connected with this division are consulting specialists, who are employed as occasion may require. To this division also are referred all questions relating to standard measurements, altitudes of signal stations, and the preparation of tables for the reduction and the conversion of meteorological observations.

During the past year stations of observation on the habits and ravages of the Rocky Mountain locusts or grasshoppers, were established in those sections that the experience of past years has shown to be most exposed to the ravages of these pests. These stations were at Omaha, Grand Island, North Platte, and Sidney, Nebr.; Cheyenne, W. T.; Denver, Colorado Springs, and Pueblo, Col.; Ft. Sill, Ind. T.; Ft. Elliott and all other stations on the United States military telegraph lines in northern, central and southern Texas, and those on the Northwestern military telegraph line in Dakota, and Montana. Where civilians were employed in making the observations, their services were voluntary and without compensation, the government bearing the necessary expenses for stationery and telegraphing.

It is gratifying to state that not a single report of the ravages of locusts has reached this office, and their presence has been announced only at Grand Island, Nebr.; Ft. Supply, Ind. T., and Ft. Elliott, Texas, but in no instance has any danger been reported.

— In continuance of the biological explorations made by the U. S. Coast and Geodetic Survey, M. Alexander Agassiz spent portions of last March and April at the Tortugas and Key West. On the days when the weather was not favorable for work in collecting surface animals, Mr. Agassiz cruised among the reefs and examined carefully the topography of the different groups of corals characteristic of the Florida reefs, with reference to the light they threw on the share the different species of coral have in the formation of the reef, and he has collected data from which he expects to construct a map, showing the position of the different species of corals within the area occupied by the reef-builders of the Tortugas. It was found that the members of the surface fauna of the Atlantic coast are inhabitants of the surface of the Gulf stream, which are driven on the northern shores by the prevailing southwesterly winds during the summer and autumn months. Much of this surface work during March and April reminded him of similar work done at Newport from the end of July until late in September; but, of course, the number of specimens was far greater at the Tortugas. The surface fauna of the Gulf stream can undoubtedly be best studied at the Tortugas, though important additions to our knowledge of it have been made at Charleston, S. C., and at Beaufort, N. C., and along the coast of New Jersey, of Rhode Island, and of Southern Massachusetts. It is remarkable that the beautiful purple floating shell (Janthina), which is so common at the Tortugas, should not find its way further north than off Cape Hatteras, in common with other surface forms. There are also found at the Tortugas a large number of pelagic crustaceæ in their larval stages, among them Phyllosoma and the nauplius stage of a Peneus, similar to that observed by Fritz Müller; also multitudes of young Annelids, Molluscs, Actiniæ, the planulæ of several of the corals, Echinoderm embryos, and a host of young pelagic fishes, among which he mentions the young of the flying fish and Leptocephali. For the study of the young stages of fishes and of Acalephs the Florida reefs present an unrivaled field of observation, but the number of pelagic Foraminifera was unexpectedly small.

— A work on the Gymnotus, or electric eel, was presented to the Paris Academy the other day by M. Du Bois-Reymond. It gives the results of recent researches in Venezuela by Dr. Sachs, who went out some five years ago, at the suggestion of the Berlin physiologist, to study the creature in its habitat. Dr. Sachs had not completed the working up of his material for publication when, unhappily, he lost his life on a glacier in the Tyrol, in 1878. His work has been extended by M. Fritsch, with the aid of numerous specimens and preparations of the fish brought home. Among other things, M. Fritsch has succeeded in proving, with all but certainty, the development of the electric organs from striated muscles by metamorphosis. Various obscure points have been elucidated.

— Mr. Alfred G. Lock, F. R. G. S., of 16 Charing Cross, London, England, is preparing a book on gold mining, in which he desires to describe every process and every machine of recognized value in use, both in alluvial and quartz mining. He wishes also to treat fully of the mineralogical associations and geographical occurrence of gold in all parts of the world, and to give maps showing the geographical position of all the gold fields known to exist, the strike of the reefs and the rivers whose lands are known to be gold bearing. The United States being the greatest gold producer and its gold saving machinery being the most elaborate, he desires to give it the prominent position in the book which its importance demands. He desires therefore to procure all papers, reports, photographs, or other illustrations of the subject. In all cases the sources of his information will be fully acknowledged.

— The Providence Lithograph Company are about to publish the Chautauqua Scientific Diagrams. Series No. 1, *Geology*, to be edited by Professor A. S. Packard, Jr. Price $6. The series will consist of ten chromo-lithographic charts, 33 × 23 inches. The subjects are mostly restorations of Silurian, Devonian, Carboniferous, Mesozoic, Tertiary and Quaternary fossil plants and animals. While the series is designed for popular audiences, they will be found useful in colleges and high schools.

— Edward Wethered, F. G. S., of Hillylands, Weston Park, Bath, England, has become sub-editor of the *Geological Record*, for America, and he asks the coöperation of all geologists by sending to his address all pamphlets or reports, connected directly or indirectly with the geology of this country. His connections will commence with the volume for 1879, and he says that a great effort will be made to bring it up to the present time.

— Dr. John W. Draper, the eminent scientist, and author of Human Physiology, a History of the Intellectual Development of Europe, the History of the Conflict between Religion and Science, numerous memoirs on chemical and physical subjects, and a History of the American Civil War, died at Hastings-on-the-Hudson, Jan. 4, aged 71. He was born in England, May 5, 1811.

— Professor Arch. Geikie, Director of the Geological Survey of Scotland, has just been appointed Director-General of the whole of the Geological Survey of Great Britain, and also Director of the Geological Museum, Jermyn street, London. He will therefore resign his professorship in the University of Edinburgh and make his residence in London.

— Dr. Chr. G. A. Giebel, an eminent geologist and author of a work on bird-lice and other insects, died at Halle, Nov. 14. Professor P. G. Lorentz, a well known German botanist, author of a work on mosses, died at Concepcion, in Uraguay, aged 46.

— Robert Mallet, whose researches on earthquakes have made his name well known, died in London, Nov. 5, aged 71. His Earthquake Catalogue was completed, says *Nature*, with the aid of his son, now Professor J. W. Mallet, of Virginia.

— Professor J. E. Hilgard, after a term of service of thirty-four years as assistant, has been appointed Superintendent of the U. S. Coast and Geodetic Survey; a most fitting appointment.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

California Academy of Sciences, Nov. 4.—The announcement of the generous gift of $20,000 by Charles Crocker, Esq., recorded in the December Naturalist, was made.

A paper by Professor Davidson, on the Transit of Mercury, accompanied with drawings, was then read, and Dr. Robert E. C. Stearns read a paper on "The Botanical Relations of *Physianthus albens*: the structure of its flowers and their peculiarities as an insect trap." He referred to this plant as related to groups which possess various important economical characters, furnishing peculiarly fertile fields for investigators of pharmaceutical and organic chemistry. Dr. Stearns then exhibited many beautiful specimens of these flowers, each one of which had entrapped an insect or moth of some kind, which it held firmly by the proboscis. They are found in many gardens adjoining San Francisco, are hardy and of rapid growth, having a white, sweet-scented flower suitable for ornamental purposes. It came originally from Buenos Ayres and is popularly called a moth-trap. It is a species of milk-weed. This plant belongs to a group which is related to the ornamental phloxes, the parasitic dodders, one form of which is destructive to our alfalfa, as it winds its fatal thread and strangles the plant by preventing the upward flow of the sap. The bind-weeds are popularly known by the sweet potato, also by jalap, scammony and other medicinal plants. Other related groups include tobacco, mandrake, potatoes, and egg-plant; also the olive, the common lilac and flowering ash. In all plants of this group the sap is milky, acrid and bitter; also contains more or less caoutchouc. The roots are diaphoretic, emetic or cathartic. The inner bark yields very strong and fine fiber. One form is known in Ceylon as the cow plant, and yields a palatable sap, which is used by Cingalese as milk. It is supposed that these plants are fertilized by insects, and the insects are caught by their probosces, between the wings of the anthers while seeking for the nectar. Other insects, such as ants, beetles, etc., are often found in the nectary of these flowers, but not as prisoners. The paper was elaborately illustrated by blackboard drawings.

Dr. Behr and Dr. Gibbons then spoke in further explanation of insect traps, and Dr. Behr read a paper on "The Part Played by Hawk Moths in the Economy of Nature."

Dr. Arthur Krause and Mr. Aurelius Krause, of the Bremen Geographical Society, who have just returned from explorations in Siberia, were present and promised to address the Academy at a future meeting.

Mr. Dieckmann, of Nicolaeskfy, Amoor river, an entomologist, said tigers were very plenty on the shores of the Okhotsk sea, and were found throughout Siberia with white bears. They have hair five inches long, and are larger than Himalayan tigers. They prey on large herds of reindeer, and remain far north all winter, where snow is four feet deep, never migrating far south. They also eat wild boars. Natives believe the bear to be influenced by the Good God, and tigers by the Evil Spirit. Five natives frequently lasso and catch bears alive, but always kill the tigers. He then described the native ceremonies at a bear feast, some of which were quite laughable.

The matter of some lectures on islands of the South Pacific, by Captain Augustus E. Bruno, was referred to the Council for action, many members desiring to hear from Captain Bruno before his departure East, to lecture before the Peabody Institute, Boston Society of Natural History and other scientific societies.

Mr. Brooks then made some remarks, giving the late news from the *Rodgers*, and illustrated her track with an outline of the Coast of Wrangell Island.

NEW YORK ACADEMY OF SCIENCES, Dec. 12.—The following papers were read: Additional notes on the geology of Staten Island, by Mr. N. L. Britton. Remarks on the Mammoth cave of Kentucky, by Mr. W. Le Conte Stevens.

Dec. 19.—The following papers were read: On a peculiar coal-like transformation of peat, recently discovered at Scranton, Penn., by Professor H. L. Fairchild. On the means of giving accuracy to ventilation by steam, by Professor W. P. Trowbridge.

BOSTON SOCIETY OF NATURAL HISTORY, Dec. 21, 1881.—Mr. John A. Jeffries spoke on the spurs and claws of birds' wings, and Mr. S. H. Scudder on Tertiary fossil spiders, especially those of Florissant.

Jan. 4, 1882.—Professor E. S. Morse compared the shells of New England Kjökkenmöddings with the present forms of the same species, and Miss M. H. Hinckley showed some structural differences between our native tadpoles and their bearing on the classification of the species.

AMERICAN GEOGRAPHICAL SOCIETY, Dec. 21.—Mr. W. E. Griffis lectured on Corea, the hermit nation.

Jan. 10.—Mr. T. By. Myers read a paper entitled, Our acquisition of French territory west of the Mississippi, in 1803.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

BULLETIN OF THE U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, Vol. VI, No. 2, Sept. 19, 1881.—Annotated list of the birds of Nevada, by W. J. Hoffman. North American moths, with a preliminary catalogue of species of Hadena and Polia, by A. R. Grote. The Tertiary lake basin of Florissant, Colorado, by S. H. Scudder. Revision of the genus Sciurus, by E. L. Trouessart. Osteology of the North American Tetraonidæ, by R. W. Shufeldt. Osteology of *Lanius ludovicianus excubitorides*, by R. W. Shufeldt. Review of the Rodentia of the Miocene period of North America, by E. D. Cope. On the Canidæ of the Loup Fork Epoch, by E. D. Cope. On a crayfish from the Lower Tertiary beds of Western Wyoming, by A. S. Packard, Jr.

AMERICAN JOURNAL OF SCIENCE, Jan., 1882.—Contributions to meteorology: mean annual rainfall for different countries of the globe, by Elias Loomis (map). Post-glacial joints, by G. K. Gilbert. The connection between the Cretaceous and the recent Echinid faunæ, by A. Agassiz. Classification of the Dinosauria, by O. C. Marsh.

GEOLOGICAL MAGAZINE, Dec., 1881.—Contributions to fossil Crustacea, by H. Woodward.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT, Nov. 25.—Free-cell formation in the embryo-sack of Angiosperms, by F. Soltwedel. On the so-called compass-plant, by E. Stahl. Sketch of a system of Radiolaria based on a study of the *Challenger* Radiolaria, by E. Haeckel.

FIG. 1.—Scene in the Bad Lands of the White River formation in Nebraska. From Dr. Hayden.

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AMERICAN NATURALIST.

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THE TERTIARY FORMATIONS OF THE CENTRAL REGION OF THE UNITED STATES.

BY E. D. COPE.

THE principal Tertiary formations of the region between the Mississippi river and the Sierra Nevada are the following, as mainly determined by Dr. Hayden: The Puerco, the Wasatch, the Bridger, the Uinta, the White River, the Truckee, the Loup Fork and the Equus beds. Several of these are again distinctly subdivided, and in a few instances such divisions have been regarded by authors as of equal importance with those above mentioned; as, for instance, the Green River portion of the Wasatch. But the evidence of vertebrate palæontology is not as yet clearly favorable to further primary subdivision than is indicated by the above names. In the following pages I will briefly describe the character and distribution of these formations.

The general history of the succession of the Tertiary lakes of the interior of the North American continent and their deposits has been developed by the labors of various geologists, prominent among whom must be mentioned Hayden, Newberry and King. It may be synoptically stated as follows:

The Laramie Cretaceous period witnessed a great difference in the topography of the opposite sides of the Rocky Mountain range. To the east were extensive bodies of brackish and nearly fresh water, with limited ocean communication, studded with islands and bordered by forests. On the west side of the range was a broad continent, composed of mostly marine Mesozoic rocks, whose boundaries are not yet well ascertained. Towards the close of the Laramie, the bed of the great eastern sea began to emerge from the waters, and the continent of the western side of the great range descended. The relations of the two regions were reversed; the east became the continent, and the west became the sea. The latter, receiving the drainage of the surrounding lands, was a body of fresh water, whose connection with the ocean permitted the entrance of a few marine fishes only. This was the great Wasatch lake, whose deposits extend from the upper waters of the Yellowstone far south into New Mexico and Arizona, between the Rocky mountains on the east and the Wasatch range on the west. Its absence from the east side of the former range indicates the continental condition of that area at the time. The only locality where the Wasatch deposits are extensively deposited on the Laramie, is in the region intermediate between the two districts in Wyoming Territory. Here the sediments of the former are seen to have succeeded those of the latter, and to have been coincident with an entire cessation of brackish conditions. Elevations of the continent northward and southward contracted the area of the great Wasatch sea, and perhaps deepened it, for at this time were deposited the fine limestones and silico-calcareous shales of the Green River epoch. There is no evidence that these beds had a greater eastern extension than that of the parent Wasatch lake. King has given distinct names to these ancient lakes. I think it better to pursue the usual course of using for them the names already given to their deposits, as involving less strain on the memory; the more as the number of these lakes is being increased by numerous new discoveries. The only known region which it covered west of the Wasatch range, is represented to-day by the calcareous strata in Central Utah which I have called the Manti beds. The exact equivalency of these is, however, not quite certain. Further contraction reduced this area to perhaps two lake basins, whose deposits now form two isolated tracts in Southern Wyoming, and are known as the Bridger formation. Continued elevation and drainage caused the desiccation of these basins also, leaving only, so far as present knowledge extends, a body of water on the south of the Uinta mountains, in Northeastern Utah. The sediments of this lake form the Uinta formation, which is the latest member of the series now found in the region lying between the Rocky and Wasatch mountains.

About the time that the elevation of the present drainage basin of the Colorado river was completed, a general subsidence of level of the great region east of the Rocky mountains commenced. Extensive lakes were formed in the depressions of the Laramie and older beds which formed the surface, which were probably connected over a tract extending from near the Missouri river to Eastern Wyoming and Colorado. Near the same time a similar body of fresh water occupied a large part of what is now Central Oregon and certain areas in Northwestern Nevada, according to King. The sediments now deposited constitute the White River formation, and the faunal distinctions which I have discovered to characterize the eastern and western basins have led me to employ for them the subdivisional names of White River beds for the former and Truckee (King) for the latter. It may have been during the early part of this period, or during the Uinta, that there existed two contemporary bodies of water, separated by a wide interval of territory. One of these extended over a considerable tract in Northern Nevada, and deposited a coal bed near Osino. A formation probably the same, has been found by Professor Condon in Central Oregon, underlying the Truckee Miocene beds. The other lake left its sediments near Florissant, in the south park of Colorado. This formation I have named the Amyzon beds,[1] from a characteristic genus of fishes which is found in it. It has been referred to the Green River formation by King, but in contradiction to the present palæontological evidence, as it appears to me.

The oscillations of the surface which brought the White River period to a close, are not well understood. Suffice it to say here, that after an interval of time another series of lakes was formed, which have left their deposits at intervals over a wider extent of the continent than have those of any other epoch. These constitute the beds of the Loup Fork period, which are found at many points between the Sierra Nevada and the Rocky mountains, from Oregon to New Mexico, and over parts of the Great Plains of Colorado, Kansas, and northward, and in the valleys of the Rocky mountains. King has shown that the beds of this epoch are slightly elevated to the westward, thus proving that the elevation of the Rocky mountains had not entirely ceased at that late day. A probably continuous succession of lakes has existed from this period to the present time in ever-diminishing numbers. The most important of these later lakes were in the Great basin in Oregon, in Washington and in Nebraska, and their

[1] American Naturalist, May, 1879.

deposits enclose the remains of a fauna entirely distinct from that of the Loup Fork period and of more modern character. They are known as the Equus beds. This fauna was probably contemporaneous with that which roamed through the forests of the eastern portion of the continent, whose remains are inclosed in the deposits of the caves excavated from the ancient limestones.

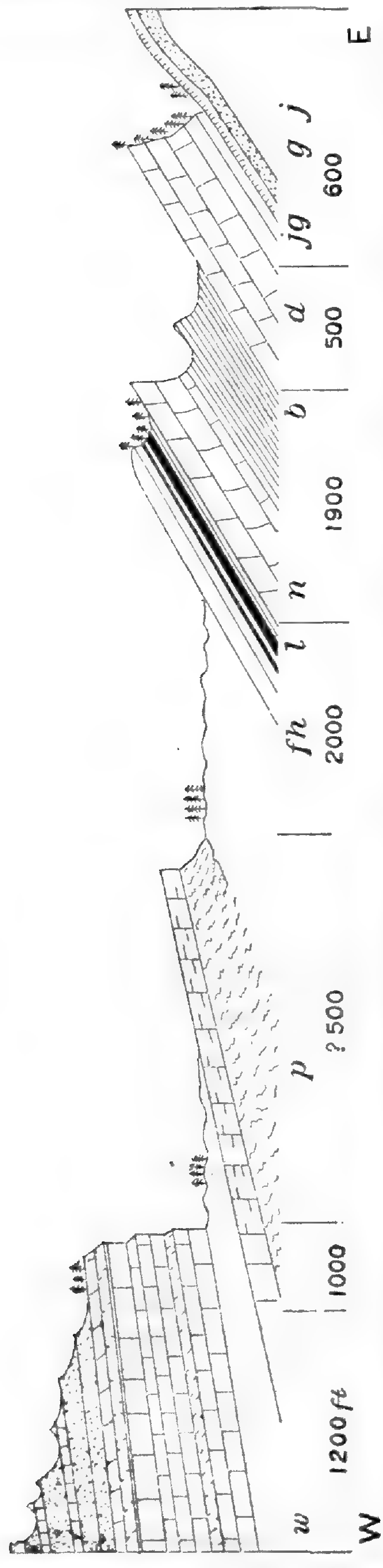

FIG. 2.—Section west of the Gallinas mountains, New Mexico, from Gallinas creek to the Eocene plateau. Letter *j*, Jurassic; *jg*, Jurassic gypsum; *g*, Gallinas creek; *d*, Dakota; *b*, Benton; *n*, Niobrara; *l*, lignite; *fh*, Fox hills, *p*, Puerco; *w*, Wasatch; from Lt. Wheeler's report.

A more detailed account of the formations is now given, with the names of a few of the characteristic fossils.

THE PUERCO.

This formation, having furnished numerous mammalian fossils, is known to belong to the Tertiary rather than the Post-cretaceous series. It is regarded by Dr. Endlich as a subdivision of the Wasatch, but the characteristics of its fauna are so marked as to constitute it a distinct horizon.

The most southern locality at which it has been observed, the one from which I named it, and where its characters are distinctly displayed, is west of the Jemez and Nacimiento mountains, in New Mexico, at the sources of the Puerco river. At this place its outcrop is about 500 feet in thickness, and has an extent of several miles on both sides of the river. From this point the strike is northward, keeping at the distance of a few miles to the eastward of an escarpment of the Wasatch formation. It contracts in depth to the northward, and it extends to the south-west, beyond the overlying Wasatch beds.

It is well developed in Southern Colorado, where Dr. F. M. Endlich[1] and William H. Holmes,[2] of Dr. Hayden's Survey, detected it in 1876. Its mineral character is there similar to that seen in New Mexico, and its thickness is much greater. On the Animas river it is 1000 to 1200 feet; on the San Juan river, near the Great Hog Back, 700 feet. The general characters of the formation are expressed in the following description, extracted from my report to Lieut. G. M. Wheeler.[3]

"South of the boundary of the Wasatch, the varied green and gray marls formed the material of the country, forming bad land tracts of considerable extent and utter barrenness. They formed conical hills and flat meadows, intersected by deep arroyos, whose perpendicular walls constituted a great impediment to our progress. During the days of my examination of the region, heavy showers of rain fell, filling the arroyos with rushing torrents, and displaying a peculiar character of this marl when wet. It became slippery, resembling soap in consistence, so that the hills were climbed with difficulty, and on the levels the horses' feet sank at every step. The material is so easily transported that the drain-

Fig. 3.—Section near the borders of Colorado and New Mexico; from Dr. Hayden.

[1] Annual Report U. S. Geol. Surv. Terrs., 1875, p. 189.

[2] Loc cit., 247.

[3] Annual Report of Chief of Engineers, 1875, p. 89. Appendix 44.

age channels are cut to a great depth, and the Puerco river becomes the receptacle of great quantities of slimy looking mud. Its unctuous appearance resembles strongly soft soap, hence the name *Puerco*, greasy. These soft marls cover a belt of some miles in width, and continue at the foot of another line of sandstone bluffs, which bound the immediate valley of the Puerco to a point eighteen miles below Nacimiento.

"The Puerco marls have their principal development at this locality. I examined them throughout the forty miles of cutcrop which I observed for fossil remains, but succeeded in finding nothing but fossil wood. This is abundant in the region of the Gallinas, and includes silicified fragments of dicotyledonous and palm trees. On the Puerco, portions of trunks and limbs are strewn on the hills and ravines, in some localities the mass of fragments indicating the place where some large tree had broken up. At one point east of the river I found the stump of a dicotyledonous tree which measured five feet in diameter."

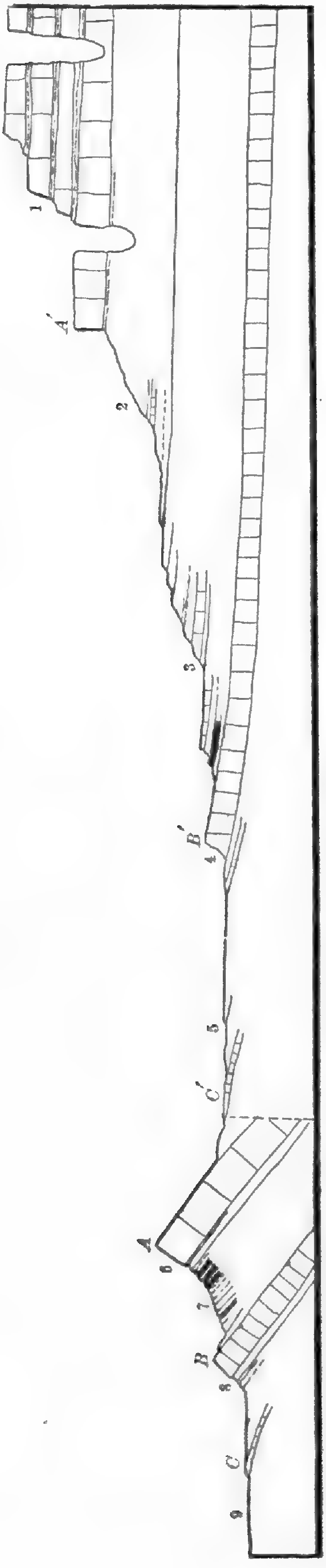

Fig. 4.—Section in southern Colorado, showing apparent duplication of strata and location of the supposed fault, by which *A* would be the same as *A'*, *B* the same as *B'*, and *C* the same as *C'*. Figures are the same as in Fig. 5; from Dr. Hayden's ann. report.

The fauna of this formation is different from that of the other Eocenes in the presence of a saurian, *Champsosaurus*, which is characteristic of the Laramie Cretaceous, and a marsupial Mammal (*Ptilodus*) which is a remnant of a type only known otherwise from the Jurassic. Its characteristic genera are *Catathlæus*, a many-toed hoofed animal, *Psittacotherium*, a gnawing Tillodont, and various flesh-eaters with primitive teeth. *Coryphodon* is, so far, unknown.

THE WASATCH.

In lithological character, the Wasatch consists of a mixed arenaceo-calcareous marl, alternating with beds of white or rusty sandstone. The more massive beds of sandstone are in New Mexico, Colorado and Wyoming, at the base of the formation. The marls readily weather into the fantastic forms and cañon labyrinths of bad-land scenery. The marls often contain concretionary masses of a highly silicious limestone, which cover the banks and slopes of the bluffs with thousands of angular fragments. It is characteristic of this formation that the marls contain brightly colored, usually red strata; and in many localities the colors are various, giving the escarpments a brilliantly banded appearance.

Petrographically this formation has two divisions, the Wasatch proper and the Green River beds; the latter name having sometimes been given to the entire formation as well as the former.

Of the few vertebrate fossils known from the Green River division, some are identical with those of the Wasatch, while at least one genus of fishes is common to the Bridger.

The Wasatch beds proper are much more widely distributed than those of the Green River. They appear first in the south in Northwestern New Mexico, and extend thence into the adjacent parts of Colorado. They are exposed over extensive areas of Colorado west of the Rocky mountains, and reappear in Southwestern Wyoming. They extend along the western portion of the Green River valley, whose northern portion they entirely occupy. On the eastern side of the Wind River mountains it has, according to Hayden, an exposure of from one to five miles in width for a distance of one hundred miles, from the source of the Wind river to the Sweet Water river. North of this point it fills the extensive basin of the Big Horn river to the borders of Montana. It does not occur east of the Rocky Mountain range. The thicknesses given by geologists are the following:

Northwestern New Mexico (Cope).

	Feet.
Red-striped marls	1500
Reddish-brown sandstone	1000
	2500

Rio San Juan, Colorado (Holmes).

Coarse yellowish sandstones, alternating with variegated marls	1200

White and Yampa Reservations (Endlich and White).

Chiefly yellow and reddish sandstones, alternating with shales	1500

Bear River, Wyoming (Hayden).

Red banded marls	700
Sandstones and shales	800
	1500

Wind River Valley (Hayden).

Variegated marls and sandstones	5000

The Green River division of the Wasatch is much less extensively distributed than the Wasatch proper. Its exposures are confined to the valley of Green river, particularly the regions between its affluents both north and south of the Uinta mountains. In the Bridger basin it forms a wide rim around the Bridger formation, and is especially developed on Fontanelle creek and on Bitter creek, and the region to the south of it. I here found its thickness to be 1200 feet.[1] Farther south, in Western Colorado near the Yampa river, Dr. White gives its depth at 1400 feet.[2] South of this, in Western Colorado, Dr. A. C. Peale[3] gives the united thickness of this formation and the Wasatch at 7670 feet; but how much of this is to be referred to the Green River proper we are not informed. It does not appear to exist on the San Juan, according to Endlich and Holmes, and I did not find it in New Mexico.

According to King, the deposits of the Green River formation rest unconformably on those of the Wasatch.[4] He also believes that it has a considerable extent west of the Wasatch mountains, over parts of Utah and Nevada. I have shown that the palæontological evidence is opposed to the identification of these "Amyzon" beds with the Green River, and that they are probably of later origin. There is, however, a series of calcareous and silico-calcareous beds in Central Utah, in Sevier and San Pete counties, which contain the remains of different species of vertebrates from those which have been derived from either the Green River or *Amyzon* beds. These are *Crocodilus* sp., *Clastes* sp., and a fish provisionally referred to *Priscacara* under the name of *P. testudinaria*. There is nothing to determine to which of the Eocenes this formations should be referred,

[1]Annual Report U. S. Geol. Surv., 1873, pp. 436, 437.
[2] Annual Report U. S. Geol. Surv., 1876, p. 36.
[3] Annual Report, 1874, p. 156.
[4]U. . Survey of the Fortieth Parallel, 1, p. 377.

but it is tolerably certain that it is to be distinguished from the

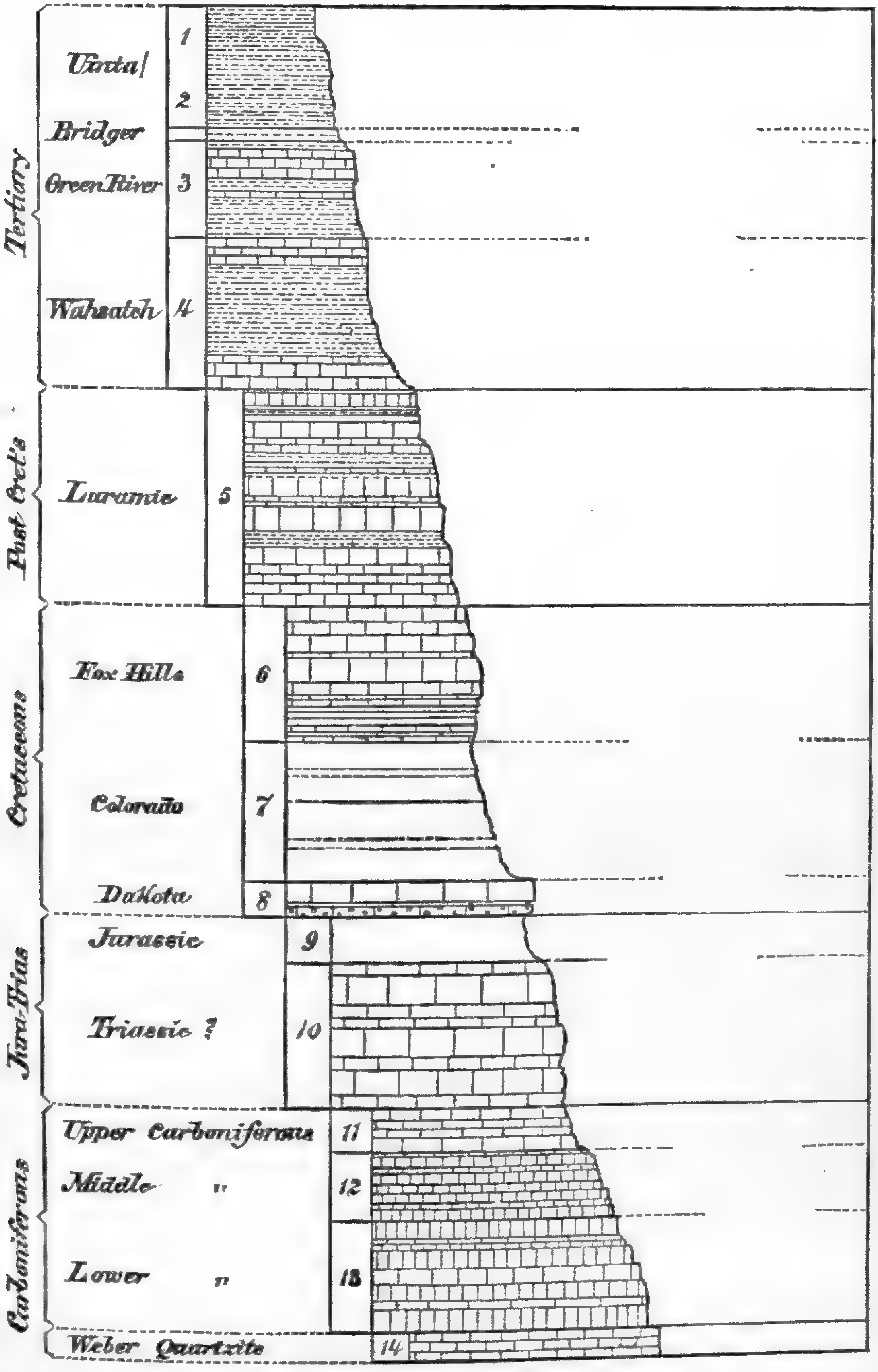

FIG. 5.—General section in the Yampa district.

Amyzon beds. In its petrographic characters it is most like the Green River.[1]

The writer first referred the Wasatch to the Eocene division of the Tertiary, it having been previously regarded as Miocene. (Proceedings American Philosophical Society, February, 1872.)

The vertebrate fauna of the Wasatch is rich, and presents many peculiarities. Prominent among these is the presence of the strange *Coryphodontidæ*, which reached a great development at this time. Also the *Phenacodontidæ*, and the genus *Hyracotherium*. These are the ancestral types of the hoofed mammals, and they were associated with numerous flesh-eaters of partly marsupial character. It is nearly identical with that of the Suessonian of Western Europe, which is at the base of the Eocene series. The fullest account of it is that which I have given in the Report of Captain Wheeler of Explorations and Surveys west of the 100th meridian, Vol. IV.

THE BRIDGER.

"This is one of the more important of the groups among those that, in Western North America, are referred to the Tertiary period, especially as regards the vertebrate remains that have been obtained from its strata. It is most fully and characteristically developed in the region known as the Green River basin, north of the Uinta mountains, only the south-eastern portion of the formation, so far as is now known, extending into Northwestern Colorado. In its typical localities it is found resting conformably upon the Green River group, into which it passes without a distinct plane of demarkation among the strata.

"Its molluscan fossil remains correspond closely with those of the Green River group, some of the species being common to both, all indicating a purely fresh condition of the waters in which the strata of both groups were deposited. At the typical localities the group is composed in great part of soft, variegated, badland sandstones, a peculiar greenish color often predominating over the others, which are reddish, purple, bluish and gray. Limestone strata, marly and clayey beds, and cherty layers are not uncommon, and grits and gravelly layers sometimes occur."

To the above general remarks of Dr. C. A. White I add, that the material of this formation consists of indurated clays more or less arenaceous, which display various degrees of hardness. The harder beds are, however, thin, and the intervening strata yield readily to meteoric influences. They are frequently quite arena-

[1] See AMERICAN NATURALIST, April, 1880.

ceous, and rather thin beds of conglomerate are not uncommon. The colors that predominate are greenish-gray and brownish-green, with frequent ash-colored beds. The peculiar condition of hardness of most of the strata, render it one of the formations which most generally present the bad-land scenery; it permits the erosive action of the elements without general breaking down, great numbers of fragments of the strata remaining in spaces between the lines of destructive action. The result is the extraordinary scenery of Black's Fork, Church Buttes and Mammoth Buttes, of which mention has been made in various recent publications.

The distribution of the Bridger formation is limited, and is, so far as I am aware, restricted to three areas, whose mutual connection is as yet uncertain. Its principal mass is in the Bridger basin, which extends from the northern base of the Uinta mountains to the latitude of the mouth of the Big Sandy river northward. In this area it reaches a depth, according to King, of 2000 or 2500 feet. A second district is also in Wyoming, and lies east of Green river, between Bitter creek and the northern boundary of Colorado, in what is called by King the Washakie basin. The depth of the formation there reaches 1200 feet.[1] The third region is in Western Colorado, where it loses much of its importance. Dr. C. A. White found it only 100 feet in thickness near the White river.[2] Dr. Peale found it near the Gunnison river, as he discovered vertebræ of *Pappichthys*, a genus which belongs to this horizon only; but he did not distinguish it from the underlying formations, so that I do not know its thickness at that point. South of this locality it is unknown.

As pointed out by Leidy, this period is especially characterized by a peculiar and rich vertebrate fauna. This is of truly Eocene character, as I first showed, but it is distinguished from the Wasatch by various subordinate peculiarities. These are the presence of Dinocerata, and of the leading Perissodactyle genera, *Palæosyops* and *Hyrachyus*, together with the absence of many types, as *Coryphodon*, *Tæniodonta*, etc.

THE UINTA.

"Resting directly, but by unconformity of sequence, upon all the Tertiary and Cretaceous groups in the region surrounding the

[1] Annual Report U. S. Geol. Surv. Terrs., 1873 (1874), pp. 436–437.

[2] Annual Report, 1876, p. 36.

Annual Report U. S. Geol. Surv. Terrs., 1874, pp. 157, 158.

eastern end of the Uinta Mountain range is another Tertiary group that has received the name of "Uinta group" from Mr. King, and "Brown's Park group" from Major Powell. It is possible that this group was deposited continuously, at least in part, with the Bridger group, but at the places where the junction between the two groups has been seen in this region, there is an evident unconformity, both of displacement and erosion.

"The group consists of fine and coarse sandstones, with frequent layers of gravel, and occasionally both cherty and calcareous layers occur. The sandstones are sometimes firm and regularly bedded, and sometimes soft and partaking of the character of bad-land material. The color varies from gray to dull reddish-brown, the former prevailing north of the Uinta mountains and the latter south of them.

"The only invertebrate fossils that are known to have been discovered in the strata of this group are some specimens of a *Physa*, very like a recent species. Therefore, invertebrate palæontology has furnished no evidence of its assumed Tertiary age and lacustrine conditions of its deposition. Its fresh-water origin, however, seems unquestionable, because of its intra-continental position, its limited extent, and the fact that none but fresh-water deposits are known in this part of the continent that are of later date than the close of the Laramie period."

To these remarks of Dr. White I add, that several species of *Vertebrata* have been obtained from this formation by Professor Marsh, who has determined from it a few genera of Tertiary and Upper Eocene character. Such are, of *Mesodonta*, the genus *Hyopsodus* and of *Ungulata*, the Perissodactyle form *Amynodon*.

THE WHITE RIVER.

The material of which the beds of this formation are composed in their eastern division, are calcareous clays and marls, alternating with a few unimportant strata of light-colored sandstone. They are white and gray, with occasionally a pink and red, and sometimes greenish tinges. The beds of the western deposit in Oregon, consist of a more or less indurated mud, which is, according to King, of trachytic origin, which is rarely hard, and frequently rather soft. Its predominating color is light green, but is frequently olive and light brown. The depth of the formation on the White river of Nebraska is, according to Hayden,[1] about 150 feet; and on Crow creek, Colorado according to King,[2] 300 feet. Sixty miles east of Crow creek I estimate its thickness as some-

[1] Proceedings Academy, Philada., 1857, p. 153.

[2] Report of Geol. Survey of 40th Parallel, I, 410.

Fig. 6.—Scene in the Bad Lands of the White River formation, in Nebraska. From Dr. Hayden.

what greater. The Truckee beds of Oregon have, according to Marsh, a depth of from 3000 to 4000 feet, and King estimates the deposit exposed in the Hawsoh mountains, Nevada, at 2300 feet.[1] An extensive deposit exposed in the region of the Cajon pass, Southern California, is suspected, by King, to belong to the same horizon.

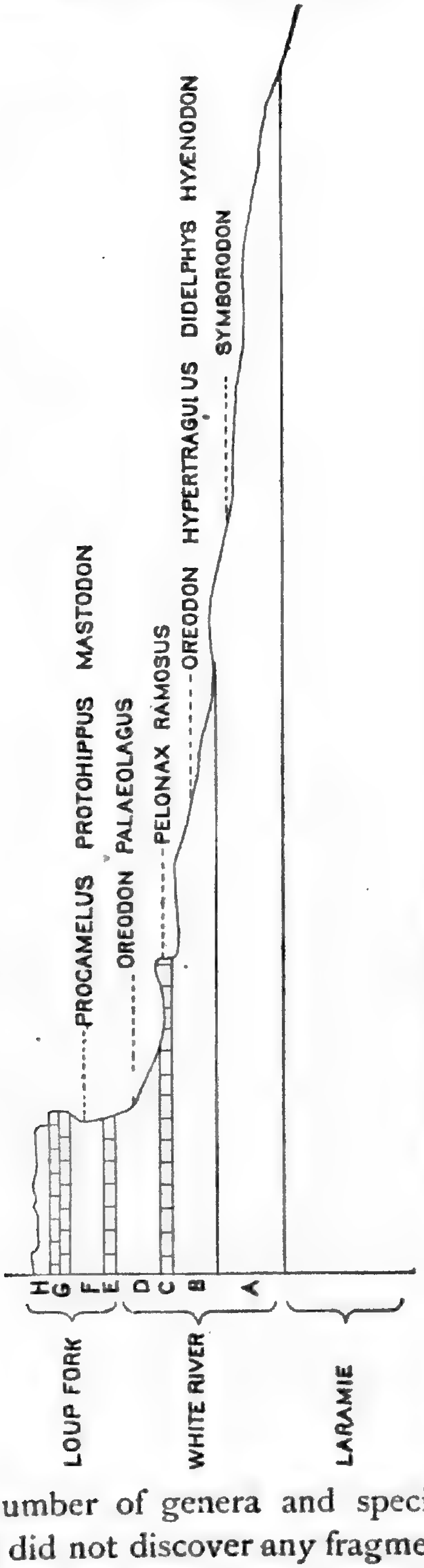

FIG 7.—N. and S. section on Horse-Tail creek, Northeastern Colorado.

The fauna of this epoch is widely different from that of the Eocene in its more modern characteristics. These are the presence of various types of Rodentia, of true Carnivora, of Dicotylidæ, *Elotherium*, *Oreodontidæ*, *Poëbrotherium* and *Rhinocerontidæ*. All the especially Eocene groups are absent, except *Leptictidæ* and a few *Hyænodontidæ*. These give it a more ancient character than the Miocenes generally, so that it is frequently referred to as "Oligocene."

The following diagram represents without much detail, the section in Eastern Colorado, along the Horse Tail creek, from the Chalk bluffs southward.

At both localities the lower beds carry the bones of the gigantic *Menodontidæ*, *Menodus* in Nebraska, and *Symborodon* with *Menodus* in Colorado. But few other types occur in this bed in Colorado, the great number of genera and species being found in bed B, in which I did not discover any fragments of *Chalicotheriidæ* among a large

[1] L. c. p. 423; l. c., p. 415.

quantity of remains of *Ungulata*, *Carnivora*, *Rodentia*, etc. The lithology is as follows: Bed A is a white calcareous soft clay rock, breaking into angular fragments. Bed B has a similar mineral character, with frequently a red color of different obscure shades. Bed C is a sandstone of varying persistence. Bed D is a white argillaceous rock like that of bed A. Fossils are less numerous than in bed B, and included no *Symborodons* nor other *Menodontidæ*.

The eastern area of this formation is the true White River epoch of Hayden; the western deposits form the Truckee epoch of King. I named this formation the Oregon, but Mr. King's name is the older and must be retained.[1]

According to Professor Condon, the Truckee formation of Oregon, on the John Day river, rests unconformably on the laminated beds, containing *Toxodium* and fish remains, which, as I have suggested on a previous page, may be an extension of the Amyzon shales. These in turn rest on a formation of hard laminated beds, which contain an abundance of *Calamites*, which doubtless belong to the Triassic or Jurassic period. The Truckee beds are, like the true White River, overlaid by the Loup Fork, and this in turn by heavy beds of basalt.

The fauna of the Truckee presents some characters which distinguish it from that of the White River. These are, the absence of *Hyænodon*, *Leptictidæ* and *Ischyromys*, and most of the *Menodontidæ*, and the presence of several genera of *Canidæ*, *Nimravidæ* and *Rodentia*. Many genera, and apparently several species, were common to the two epochs.

THE LOUP FORK.

This formation has now been studied in many widely-separated localities in the region west of the Mississippi river. It was discovered by Dr. Hayden, whose collections furnished the basis of Dr. Leidy's determination in 1858.[2] It was next observed by myself in Colorado in 1873,[3] and twenty-one species were determined; and in the following year I identified the Santa Fé marls of New Mexico, already observed by Dr. Hayden, with the same

[1] Bulletin U. S. Geol. Surv. Terrs., v, p. 52.

[2] See Proc. Acad. Nat. Sci. Phila., 1858, p. 20, and Extinct Mammalia of Dakota and Nebraska.

[3] Bulletin of the U. S. Geol. Surv. Terrs., No. 1, Jan., 1874.

horizon.[1] Messrs. Hayden and King have discovered it west of the Wasatch range in Utah and Nevada, and Marsh has observed it in Oregon. Messrs. Dana and Grinnell found it occupying the valley of Deep river in Montana, and Professor Mudge any myself have seen it in Northern and Western Kansas. There is a near lithological resemblance between the strata at these localities, and the fauna presents a common character as distinguished from those which preceded and followed it; but sufficient care has not always been exercised to distinguish its upper members from the *Equus* beds above them. The latter contain a distinct fauna.[2]

According to King, about 1500 feet of beds are included in this formation.

The water-shed between the South Platte river and the Lodge Pole creek, Colorado, is composed superficially of formations of the Loup Fork epoch, of Hayden. On its southern side is an abrupt descent in the level of the country, which generally presents the character of a line of bluffs varying from 200 to 900 feet in height. This line bends to the eastward, and extends in a nearly east and west direction for at least sixty miles.

The upper portion of this line of bluffs and buttes is composed of the Loup Fork sandstone in alternating strata of harder and softer consistency. It is usually of medium hardness, and such beds, where exposed, on both the Lodge Pole and South Platte slopes of the water-shed, appear to be penetrated by numerous tortuous friable silicious rods and stem-like bodies. They resemble the roots of the vegetation of a swamp, and such they may have been, as the stratum is frequently filled with remains of animals which have been buried while it was in a soft state. No better preserved remains of plants were seen.

This formation rests on a stratum of white friable argillaceous rock of the White River epoch, as represented in Fig. 7.

The lithological characters above described are precisely those presented by the same formation in New Mexico.[3]

Mr. King employs the name Niobrara for this formation, but Dr. Hayden's name[4] was introduced many years previously. The

[1] Ann. Rep. Chief of Engineers, 1874, II, p. 603.

[2] See Bulletin U. S. Geol. Surv. Terrs., IV, p. 389, and V, p. 47.

[3] See Report Lieut. G. M. Wheeler's Explorations west of 100th Meridian, Vol, IV, p. 283.

[4] See Dana's Manual of Geology, edit. 1864, p. 511.

new name has also the disadvantage of being already in use for a horizon of the Cretaceous, which is well distinguished palæontologically.

Some genera of Rodentia are common to this formation and the White River (*Steneofiber*, *Palæolagus*), but its fauna is well distinguished by the presence of *Camelidæ* with a cannon bone, three-toed horses with cementum in the molars, Antelope with a burr of the horns (*Cosoryx*) and *Mastodon*.

I have divided the Loup River formation into two divisions on palæontological grounds,[1] under the names of the *Ticholeptus* bed, and the *Procamelus* bed. The former occurs in the valley of Deep river, Montana, on the White river in Northern Nebraska, and in Western Nebraska, where it has been found by Mr. Hill. Its fauna presents, in Montana, a mixture of fossils of the *Procamelus* horizon; while in Nebraska, according to Hayden, its typical genera are accompanied by White river Mammalia. In the former region, *Hippotherium*, *Protohippus* and *Blastomeryx* are mingled with genera allied to *Leptauchenia* and with *Merycochœrus*. In Nebraska, *Leptauchenia* is said to be accompanied by *Ischyromys*, *Palæolagus*, *Hyracodon* and even *Oreodon*, genera which do not extend to the *Procamelus* bed. There is, however, a question in my mind whether this collocation is entirely correct. It is bed D of Hayden's section in Leidy's Extinct Fauna, Dakota and Nebraska, p. 20.

The material of the *Ticholeptus* horizon is a more or less friable argillaceous sand; not so coarse and gritty as the *Procamelus* bed, nor so calcareo-argillaceous as the White River.

The *Procamelus* bed is extensively distributed. It is found in Kansas, Nebraska, Colorado, New Mexico, Utah, Nevada and Oregon.

THE EQUUS BEDS.

I can give little information respecting the depth and stratigraphy of the beds of this period as they occur on the plains west of the Mississippi river, for although sections of them as they occur in Nebraska and elsewhere have doubtless been published by authors, their palæontological status has not been determined for the localities described. My own knowledge of the deposits is based on localities in California and Oregon. In Nebraska they have probably been confounded with the Loup Fork beds. They

[1] Bull. U. S. Geol. Surv. Terrs., v, pp. 50–52.

represent the latest of all the Tertiary lakes, and include a fauna which consists of a mixture of extinct and living species, with a few extinct genera.

I have received fossils of this age from Idaho, Washington, Oregon and California. The most important locality in Central Oregon is from thirty to forty miles east of Silver lake.[1] The depth of the formation is unknown, but it is probably not great. It consists, first, of loose sand above, which is moved and piled into dunes by the wind; second, of a soft clay bed a few inches in thickness; third, by a bed of sand of one or two feet in depth; then a bed of clay mixed with sand of unknown depth. The middle bed of sand is fossiliferous. In Northern and Middle California the formation is chiefly gravel, and reaches a depth, in

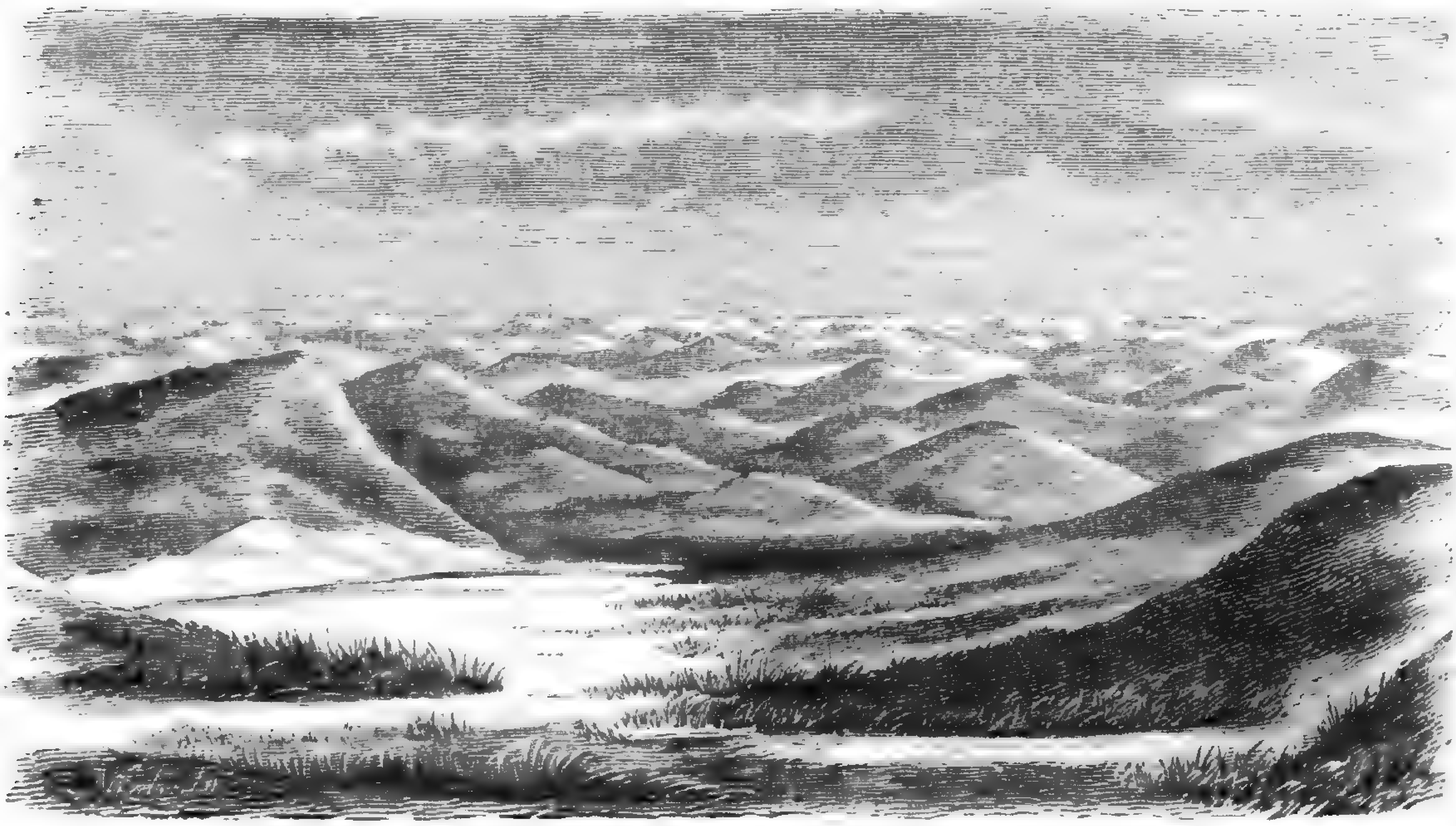

FIG. 8.—Sand hills, Northwestern Nebraska, from Hayden.

some localities, of several hundred feet. Here, as has been proven by Whitney, it contains human remains, associated with *Mastodon*, *Equus*, *Auchenia*, etc. I have obtained *Mylodon* from the same gravel.

Traces of this fauna are found over the Eastern United States, and occur in deposits in the caverns excavated in the Lower Silurian and Carboniferous limestones, wherever the conditions are suitable. This deposit is a red or orange calcareous mud, varied with strata of stalagmite and gypsum. Remains of the fauna are found in clay deposits along several of the Atlantic rivers, as the Delaware and Potomac.

[1] See AMERICAN NATURALIST, 1878, p. 125.

It is probable that the formation in the western localities mentioned is mostly sand. Near Carson City, Nevada, it consists of a light-buff friable calcareous sandstone.

This is the Upper Pliocene of King and the Post-pliocene of various writers..

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A PATHOGENIC SCHIZOPHYTE OF THE HOG.[1]

BY PROFESSOR H. J. DETMERS.

ABOUT twenty-five years ago Professors Brauell and Pollender in Dorpat, Russia, made an important discovery, which, though at first not considered as of much significance, soon led to investigations, the results of which have already revolutionized the ætiology of contagious and infectious diseases. Brauell and Pollender, and soon afterwards also Dr. Leisering in Dresden, discovered in the blood of man and beast, affected with anthrax or splenic fever, an infinite number of exceedingly fine, apparently solid, almost transparent, straight and motionless, rod-shaped bodies (cf. Virchow's Archiv. für Pathol., Anat. und Physiol., und für Klinische Medicin, XI, 2). They called them *staebchenfoermige Koerper* (Bacilli), but left it undecided whether the same bear a casual connection with the morbid process, constitute a product of the same, or are merely accidental. Still, finding these Bacilli in every fatal case of anthrax, Brauell and Pollender considered their presence as something characteristic, and as of great diagnostic and prognostic value. As early as 1860 the relation of these Bacilli to anthrax formed a topic of discussion in the annual meeting of the Veterinary Society of the Grand Duchy of Oldenburg. Later investigations, but especially those by Davaine, Koch, Cohn, Pasteur, Toussaint, and more recently by Dr. Hans Buchner, in Munich, have demonstrated beyond a doubt that these Bacilli, first discovered by Brauell and Pollender of the Imperial Veterinary School of Russia at Dorpat, and first known as Brauell and Pollender's *staebchenfoermige Koerper*, constitute the real and sole cause, and also the infectious principle, of that terrible disease known as anthrax or *Milzbrand* to the Germans, charbon to the French, and anthrax or splenic fever to the English. About the same time, or soon after Brauell and Pollender published their discovery, other simi-

[1] Read before the Chicago Academy of Sciences.

lar microscopic bodies were found, not only in the blood and morbid products in contagious diseases, but also in a great many other things, particularly in putrefying, decomposing, and fermenting substances, in pus, secretions of wounds, in the mucus of the mouth, etc. All this, however, is well known, and as I do not intend to give a history of the discoveries in regard to these minute bodies, comprehended under the generic name of Schizophytes, nor dwell upon the investigations made by many European and some American scientists for the purpose of ascertaining the true character and the relation of those Schizophytes to contagious and so-called zymotic diseases, I will only make one further remark, and then briefly relate what I have seen and ascertained myself. I mentioned the discovery of Brauell and Pollender as a fit introduction to what I shall have to say, and also for the purpose of correcting certain erroneous statements in American literature, which ascribe the first discovery of *Bacillus anthracis* to Davaine, and to other French investigators. For a long time it remained a puzzling question how certain Schizophytes, found in certain diseases in the blood, exudations, and other animal fluids, etc., can constitute the cause and infectious principle of those diseases, while other Schizophytes, apparently identical, or at least very similar in appearance, and of almost universal occurrence, are known to be perfectly harmless. To illustrate, it will only be necessary to mention the great similarity between *Bacillus anthracis* and *Bacillus subtilis*, two of the best known Schizophytes. This question has been solved by the researches of Dr. Hans Buchner in Munich (cf. his monography "Ueber de Experimentelle Erzeugung des Milzbrand Contagiums aus den Heupilzen, und ueber die Entstehung des Milzbrandes durch Einathmung, Muenchen, 1880"). Dr. Buchner, by repeated and continued cultivations in solutions of meat extract, with and without an addition of peptone and sugar, succeeded in converting *Bacillus anthracis* into *Bacillus subtilis*; 36 generations made the former harmless, and about 1500 generations converted the same into a veritable hay-bacillus or *Bacillus subtilis.* Vice versa, by continued and repeated cultivations in fresh blood Dr. Buchner also succeeded in changing a harmless *Bacillus subtilis* into an exceedingly malignant *Bacillus anthracis*, which, introduced into the organism of a healthy animal by inoculation, in every instance caused sure and speedy death. But as all this is on record, published in works and periodicals just as accessible to my readers as to myself, or perhaps more so, as my present residence is in a country town, I shall not dwell upon it any longer.

It is now fourteen years ago, when so-called Texas fever was decimating the cattle in Central Illinois, the peculiarities of that disease, the characteristic morbid changes, the long period of incubation, and particularly the manner in which the disease was said to be communicated by Texas cattle to native animals, led me to think that some microscopic organism, endowed with life and power of propagation, and subject to changes and metamorphoses, must constitute the cause and the means of infection. I communicated my views to the Hon. John P. Reynolds, then Secretary of the Illinois State Board of Agriculture, and now Chief Grain Inspector of Chicago. My communication, written in very poor English, and coming from an unknown person living in a country town in Northern Illinois, was published in two Chicago papers, but did not procure me an opportunity to make an investigation. Still, even if it had, the investigation, very likely, would not have resulted in anything. In the first place, I had neither the means to procure, nor the necessary experience to use, a first-class microscope, and moreover doubt whether, at that time, fourteen years ago, an instrument was in existence in America that could have successfully coped with the question. Our first-class homogeneous immersion objectives were not known then. My suggestions to Hon. John P. Reynolds, whether known or unknown to them, I do not know, were partially carried out, or acted upon, by Professor Gamgee and his associates, and by the Commissioners of the State of New York (cf. New York Agricultural Report of 1867), but no satisfactory results were obtained. The New York Commissioners even went so far as to send some bile to Professor Hallier in Jena, who, of course, found and cultivated a great variety of fungi, and left the whole thing in a more confused state than it ever was. At any rate, the whole investigation, as far as the ætiology of Texas fever is concerned, did not throw much light upon the subject.

A little over three years ago I was requested by the late Commissioner of Agriculture, Hon. Wm. G. Le Duc, to investigate a very fatal disease of swine, known to the farmers as hog cholera, and from the reports of the Department of Agriculture as swine plague. I procured a No. 8 Hartnack stand, with three eye-pieces and three Hartnack objectives, a 1 inch, a ¼ inch, and a four-system $\frac{1}{9}$ inch, with correction and immersion. Of course, such an instrument was not at all what was needed, but it was the best I could get, and, to tell the truth, the best I was then able to handle. It soon revealed the presence of microscopic organisms —Schizophytes, or, if preferred, Microbes or Bacteria—in the morbid products of the disease, and in the blood of the diseased and dead animals, but its definition and its magnifying power, about 800 diameters, were not sufficient to show the characteristics of the Schizophytes, and to distinguish the same under all circumstances from other bacteria similar in size. Consequently I made several, under the circumstances excusable, errors. If the light happened to be very good and well adjusted, a micrococcus chain appeared as a moniliform rod, and if the light was not very good, as I am sorry to say was very often the case, a Micrococcus chain could not be distinguished from a rod-shaped Bacterium or a Bacillus. All this was very much of a drawback; still I became soon convinced that in the morbid products of the disease and in the blood of the diseased and dead hogs, I had to deal with a specific Schizophyte, which does not occur in the blood, etc., of other animals not affected with swine plague, and is entirely different from *Bacterium termo*, because I observed whenever putrefaction set in, and *Bacterium termo* made its appearance, my swine plague Schizophytes commenced to disappear, and disappeared in about the same ratio in which *Bacterium termo* increased in numbers. Being unfortunately not sufficiently familiar with the classification of Schizophytes, and the distinguishing characteristics of micrococci, bacteria, bacilli, etc., as laid down by Cohn and others, the inadequacy of my microscope caused me to commit a blunder, for which I have to apologize. Professor Klein in England, in his investigation of swine plague, also found a Schizophyte, which he called a "*Bacillus.*" Not knowing then, as I do now, that his bacillus, seen with better instruments than that at my command, was an intruder, and not at home where found, and having no doubt whatever that he had seen the identical Schizophyte which I saw and found in every case of swine plague, I proposed the name *Bacillus suis.* As soon as Cohn's classification of Schizophytes fell into my hands I saw my mistake, and endeavored to correct the same in my next report to the Commissioner of Agriculture, two years ago, in as plain language as I can command; but not knowing at that time the spuriousness of Professor Klein's bacillus, I did not say anything about it. Still, a colaborer—it will not be necessary to give his name—does not appear to be satisfied, misconstrues my language, and yet insists that I call the swine-plague Schizophyte a *Bacillus suis*. But enough of this. It widely differs from a bacillus as defined by Cohn. One of its most characteristic features consists in its forming zoöglœa-masses or coccoglia, which, according to Cohn, a bacillus never does. It also does not form straight and motionless rods, nor is its effect directly poisoning, or causing decomposition, like that of *Bacillus anthracis*, but mostly, if not entirely, brought about in a mechanical way, by its mere presence, and by a withdrawal from the animal organism of such elements as are needed for its existence, its metamorphoses, and its propagation. To put it in a few words, it acts like a veritable parasite. I discarded the name Bacillus as soon as I discovered my mistake, and have simply called it Swine-plague Schizophyte or Swine-plague Microbe, leaving it to others, better versed in the classification of Schizophytes, to give it an appropriate name.

About two years ago I obtained the means, a large Beck's stand and a Tolles' $\frac{1}{10}$ homogeneous immersion objective, which enabled me not only to make a more thorough investigation, but also to distinguish, as to shape, form, size, and undergoing-changes, the swine-plague Schizophytes from other Schizophytes classed under the various heads of Micrococci, Bacteria and Bacilli, and particularly from those which invariably make their appearance in all animal fluids and tissues when putrefaction or decomposition is setting in. Still, the amplification to be obtained by eyepiecing without any loss of definition—about 925 to 1000 diameters—proved to be insufficient. Certain characteristics, which I had reason to suppose are existing, and of which I could obtain only occasional glimpses, could not be seen, or were to be seen only in an imperfect manner. I therefore requested Mr. Tolles to make for my special work an objective which, if possible, would give as good and sharp definition with an amplification of 1500 diameters as the $\frac{1}{10}$ in my possession with 925. Mr. Tolles has nobly responded, and it is but just to say that the objective he made, nominally a $\frac{1}{15}$, but in reality close up to a $\frac{1}{17}$, is not only equal, but in some respects even superior to a magnificent $\frac{1}{18}$ homogeneous immersion objective of Zeiss, which I was fortunate enough to procure last spring. It, the Zeiss objective, is a trifle higher than a $\frac{1}{20}$. These two objectives, the $\frac{1}{15}$ Tolles, and the $\frac{1}{18}$ Zeiss, have been almost exclusively used during the last year. The $\frac{1}{15}$ of Tolles gives, with the No. 2 eyepiece, according to length of tube and collar correction, from 1356 to 1525 diameters.

The Swine-plague Schizophytes present themselves in three, and probably in four, or even five, different forms. As to the three different forms I am certain, as to the fourth and possibly fifth I will not be so positive. The form to begin with is that of a very minute spherical body, a micrococcus of 0.7 to 0.8 μ in diameter. It is invariably present in the blood and blood serum, in all morbid products and exudations, and in such morbid tissues as can be conveniently examined with high power objectives

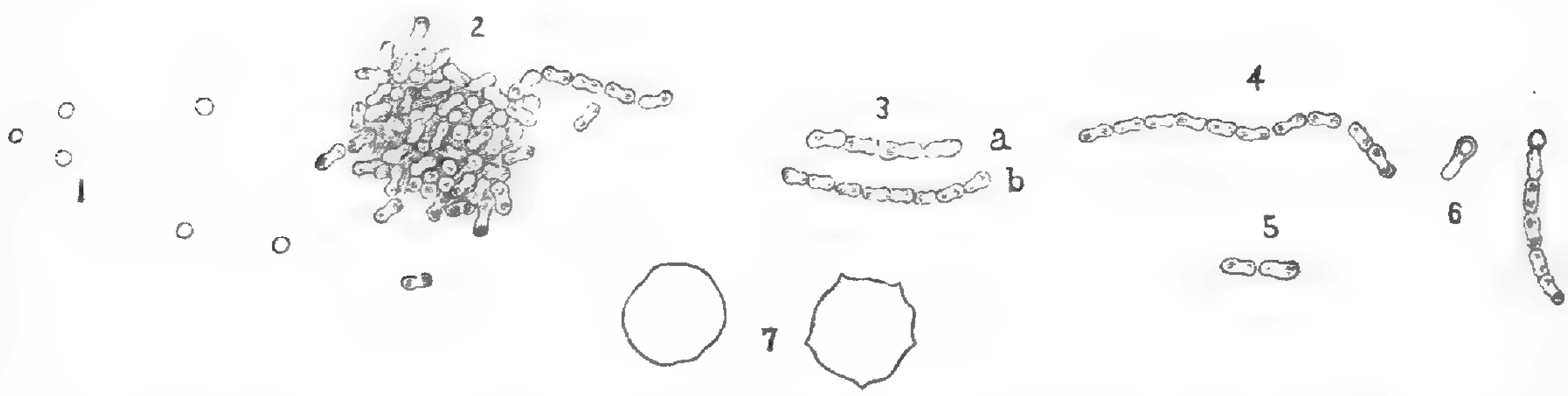

FIG. 1.—1, Swine-plague Micrococci; 2, do. Coccoglia; 3, do. Micrococcus-chain —*b*, five minutes later than *a*; 4, do. do. parting; 5, do. do. pasted joint with flagellum; 6, Helobacteria with lasting spore; 7, blood corpuscles. × 1525 objective: Tolles' $\frac{1}{15}$ homog. immersion.

while fresh. It probably is not necessary to state that the micrococci of Swine-plague, being spherical, do not present any characteristic difference from other micrococci, occurring in other substances, if the latter happen to be of about the same size as the former. Still, differences can be observed, if the micrococci are kept under the microscope for some time—a few hours—at a suitable temperature. The Swine-plague micrococci soon form zoöglœa-masses or aggregate in clusters and become imbedded in an apparently viscous substance. While thus imbedded they soon commence to duplicate by growing in two opposite directions, and at the same time becoming contracted in the middle. This contraction gradually becomes plainer and plainer, and increases in the same degree in which the micrococcus is growing in length, till finally the latter presents the appearance of two closely connected spherical bodies without any visible partition, and somewhat resembles the shape of a figure 8. At this stage the now bispherical micrococcus is about twice as long as its transverse diameter, or measures about 1.5 μ. In the interior of each spherical body a somewhat darker substance, or a kind of a nucleus can be observed. This duplication, or process of division, which occurs in a large number of micrococci at the same time, it seems, finally breaks the glia, or the viscous mass, which apparently holds the micrococcus cluster together; the micrococci, many, or perhaps most of them now bispherical, and some yet single, become free and make their exit. Whether the glia constitutes the pabulum needed to effect this growth and duplication, and is gradually consumed, or whether the same only serves to hold the micrococci together, and breaks because its contents become too large or too voluminous, I am

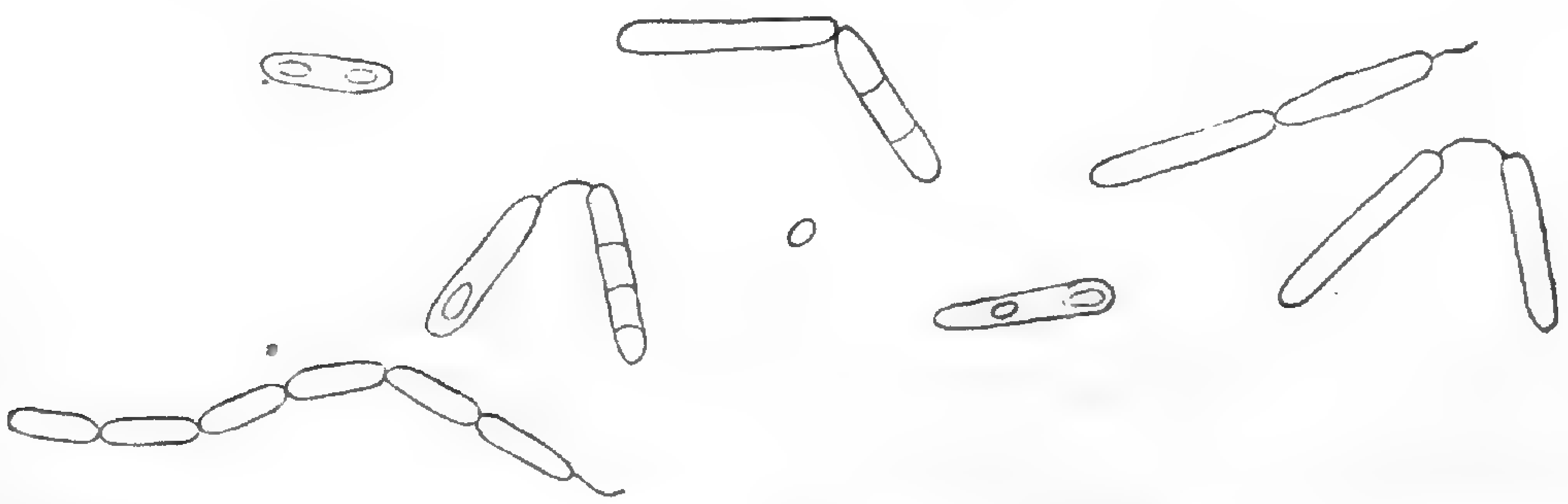

FIG. 2—Schizophytes (Bacilli) found in the blood of the vena cava posterior of a cow which died of Texan fever. × 925 objective: Tolles' duplex $\frac{1}{10}$ homog. immersion.

not able to decide. These zoöglœa-masses occur and can be found, though seldom in large numbers, in the fresh blood and blood serum; and are very numerous, and often very large in the morbid tissues, the exudations, particularly the lung exudations, and blood extravasations, and in the morbid products in general. I never found them absent. The bispherical, and also the single micrococci, when freed from their glia, do not cease to multiply by fission; on the contrary, the process of division proceeds with great rapidity, provided the temperature is not too low. At an ordinary temperature, say about 70° to 75°, a double or bispherical micrococcus is often changed into a small chain of two double micrococci, connected endways, in less than 5 minutes. While the process of division is thus going on, and the single cells of such a bispherical micrococcus are becoming double by a longitudinal growth, and becoming contracted in the middle, the original contraction between the secondary cells also gradually increases and becomes deeper, till it finally appears like a separation, and then the end walls of both cells appear to be closed; the connecting neck cannot be seen, and the cells, now two bispherical micrococci, seem to merely touch each other. The single micrococci, too, become double or bispherical, and those already double gradually increase to chains of various length, and not dissimilar in appearance to a chain of an old-fashioned watch. These micrococcus-chains I consider as the third form spoken of. The same, however, hold together only temporarily, or for a short time, and then break up into larger or smaller joints, each joint consisting of one or more bispherical micrococci. When these chains separate or break up, the separation is not a sudden nor a rapid one; on the contrary, the bispherical micrococci which are about to separate appear to become at first more loosely connected with the rest of the chain; do not seem to be in as close a contact with the adjoining portion as before; a small space between them becomes visible; still there is evidently yet a connection, because the movement of the separating joints, although apparently independent, are limited to a swinging to and fro. The space, however, gradually widens, till finally a separation takes place, and each link or joint goes its way. If the light is very good and well adjusted, and the human eye in first-rate condition, an objective like my Tolles' $\frac{1}{15}$ or Zeiss' $\frac{1}{18}$ will reveal the existence of an exceedingly slender thread, a flagellum, which, gradually lengthening and finally snapping apart, constituted the connecting link or medium between the separating joints. I have repeatedly seen it as a post-flagellum when the joint or bispherical micrococcus was slowly moving, but so far have never seen one at both ends. It may here be remarked, I have never seen any single micrococci separating from such a chain or its joints, consequently the single or spherical micrococci must have another source or origin; but there is little hope that the latter will ever be fully revealed, unless our makers of objectives—men like Tolles, Zeiss, Powell and Leland, and others—will succeed in producing objectives which will give as good and sharp definitions, with an amplification of 2500 or 3000 diameters, as their best ones now in existence are giving with 1200 or 1500 diameters. Still, there is a multitude of other much larger Schizophytes, and concerning them our present means are about sufficient to observe what cannot be seen in regard to the very minute swine-plague Schizophytes. Therefore, a little more than what is really known about the latter may almost safely be inferred from analogy. But I will not enter into speculations, and, at any rate, first state what I have seen. Sometimes in perfectly fresh blood serum and in fresh lung-exudation, and almost always in blood serum and lung-exudation 12 to 24 hours old, and also in the mucus and morbid products of a diseased piece of intestine, peculiar-shaped Schizophytes can be found. The same are rod-shaped, but have at one end, or sometimes towards the middle, a very bright granule, which strongly refracts the light, and consequently is more dense than the rest of the bacterium. It is of about the same diameter as the rod itself. This granule is surrounded or enveloped by a zone or ring—possibly a membrane—which is less dense, and much less light-refracting. The whole rod, therefore, if this granule is situated at one end, as is usually the case, presents the shape of a club, or rather that of a short stick with a bright round knob at one end. It is a so-called Helobacterium (Billroth), and the bright and dense or light-refracting granule is a so-called lasting spore (Dauerspore of Billroth).

(To be continued.)

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ON CERTAIN ABORIGINAL IMPLEMENTS FROM NAPA COUNTY, CALIFORNIA.[1]

BY ROBERT E. C. STEARNS.

THE figures herewith presented illustrate a collection made by me in October, 1881, on the top of Howell mountain, in Napa county.

The mortars are exteriorly rude unworked stones, generally of much harder quality than most of the country rock in the neighborhood. Fig. 1 is the most symmetrical of the five specimens collected; in this respect it is the least characteristic; otherwise so far as diameter and depth of the concavity are considered, it is a fair type of all.

I was unable to find a single specimen, or even a fragment,

[1] Read before the California Academy of Sciences, October 19, 1881.

where the exterior had been shaped. The cavities in all of the

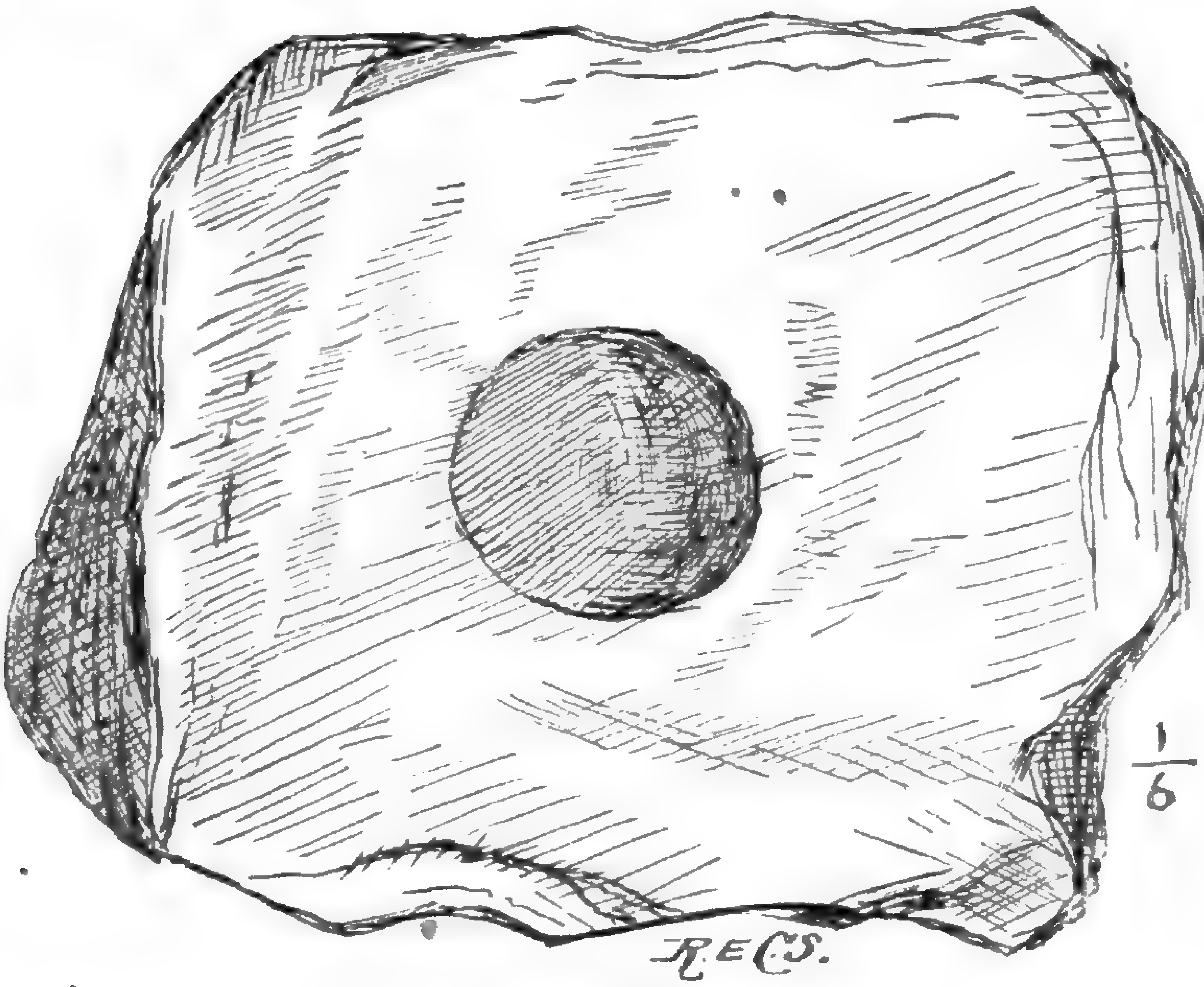


FIG. 1.—California Indian Mortar.

specimens are nearly alike, about four inches in diameter and of the depth of a small saucer.

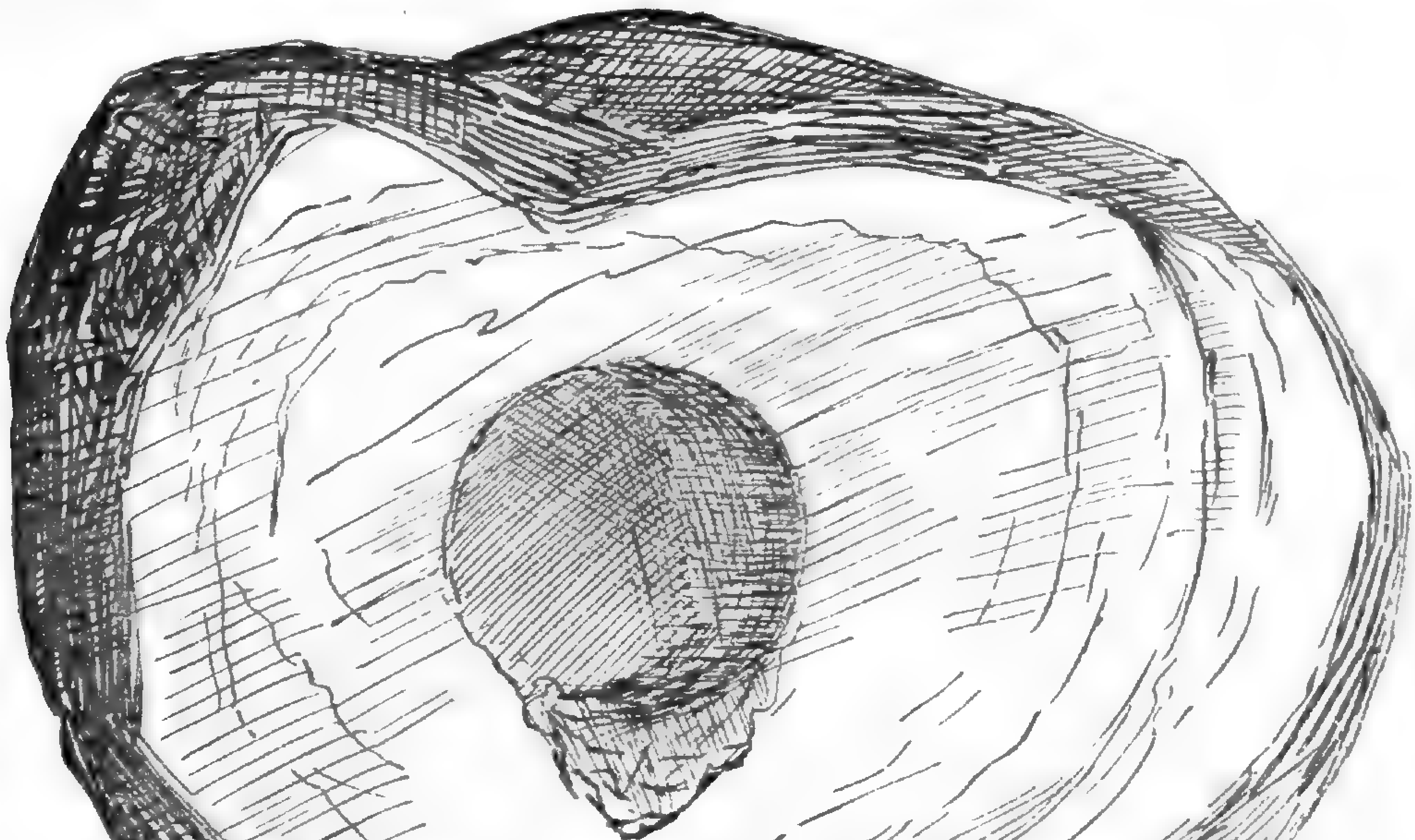


FIG. 2.—Typical Indian Mortar.

The foregoing figure (2) is a fairly typical specimen of this class of mortars. It was found in nearly the same locality as the subject of the preceding figure.

It is not probable that such shallow mortars were used for the pulverization of acorns or pine-nuts, or any other of the principal articles which constituted the bulk of the aboriginal cuisine. This supposition is further supported by the fact of the great number of mortar holes which may be seen in the outcroppings of the permanent or fixed rocks in the immediate neighborhood.

The territory from which the material under review was obtained, embraces an area of some two hundred acres; for the greater part a fertile intervale or small valley surrounded by hilly ground which merges by moderately inclined or gentle slopes into the general level. This intervale is about a mile in length, if measured between the extreme points, though probably not one-fourth of a mile in width at the widest place. When the present owner purchased it, it was for the most part a willow swale about midway of its length; where on the easterly side the slope descends to the intervale, are several perpetual, running springs of most excellent water. These springs are only a few rods apart. In convenient proximity outcroppings of volcanic pudding-stone occur, which are full of mortar-holes of various sizes, from four inches in diameter and depth to twelve inches in diameter and depth. None of the mortar-holes in the fixed rocks are as shallow as those in the portable mortars figured above from which we may infer that these latter were used for some special rather than for general purposes, perhaps for the grinding of paint or medicine, while the fixed mortars were used for general purposes like the pounding of acorns, nuts, &c., &c. Of these latter it is often the case that the larger holes are united at the top and for an inch or more down, through close proximity and abrasion, through constant use the intervening wall or side at the top breaking through. As the springs are more numerous and better situated at this middle station, which by way of distinction may be called station A, so also are the mortar holes more numerous, though the latter are also met with at or near the extreme points or ends of the intervale, which runs in a general way northerly and southerly. The northerly point may be indicated as station B, and the southerly as station C.

Pestles were collected at all of these stations. Some are hardly more than symmetrical cobble-stones, while others are of the usual pestle-form. None of them are nicely finished, and like the mortars are exceedingly simple and rude.

The nearness of the outcropping country-rock to the springs and to the chief articles of food, operated, quite likely, to prevent that degree of development in stone working which is found in such implements among the relics of nearly related and geographically approximate tribes.

There was no imperative necessity, nor anything to be gained by the careful and laborious finishing of portable mortars where the material requiring trituration was abundant and close at hand, making a permanent settlement possible, where otherwise only a temporary camp could be made, dependent for duration upon the extent of the mast or nut-harvest or acorn-crop.

The mortars herewith figured, with, as before remarked, only the capacity of a common saucer, are in stones which weigh from *thirty* to *fifty pounds.* If these had belonged to a tribe within whose domain the acorn and nut-bearing trees were widely scattered, and thereby compelled to be more roving in their habits than the tribe which inhabited the region herein described, the mortars would probably have been smaller in bulk and consequently lighter in weight. To perpetrate a hibernicism, a *portable* acorn mortar of corresponding size and weight as related to capacity, *would not be portable.* Where the food conditions are as above indicated, the mill would of necessity have to be carried to the grist, instead of the grist to the mill; this would compel the carrying of pulverizing implements, and lead not only to a reduction in the weight of such utensils, through finishing the exterior by cutting away every superfluous pound of stone, but also to the careful selection of pieces of stones or cobbles of a more compact and solid quality, so as to combine the greatest strength with the least weight.

This also explains why mortars and pestles are so frequently met with in places near which the evidences of an aboriginal camp or settlement do not exist.

That the tribe which inhabited this Howell mountain locality were not as expert in this class of stone working as those even of the not distant Calistoga and Knight's valley region, the Ash-o-chi-mis, or Wattos, is proven by the mortars collected by me at the last named place in August, 1879; for though the lot of half a dozen included one specimen hollowed in a rough stone, of the same general type as those figured in this paper, it also embraced specimens worked in well selected cobbles, and one hollowed in end of a section of a basaltic column. This latter as well as the rough-stone one of the Knight's valley collection, are in the Museum of the University of California.

Obsidian in pieces and chips are abundant at each of the stations, though more so at A than the others. The number of arrow-heads, and fragments of arrow-heads, collected principally at A, numbered about two hundred, of which one-third were found by my companion, Mr. A. L. Roach, of Indianapolis. A few were obtained by other parties. With occasional exceptions, the arrow-heads were in the rough stage of manufacture, awaiting critical selection and finishing by experts in this line, probably the veteran Nimrods of the tribe.

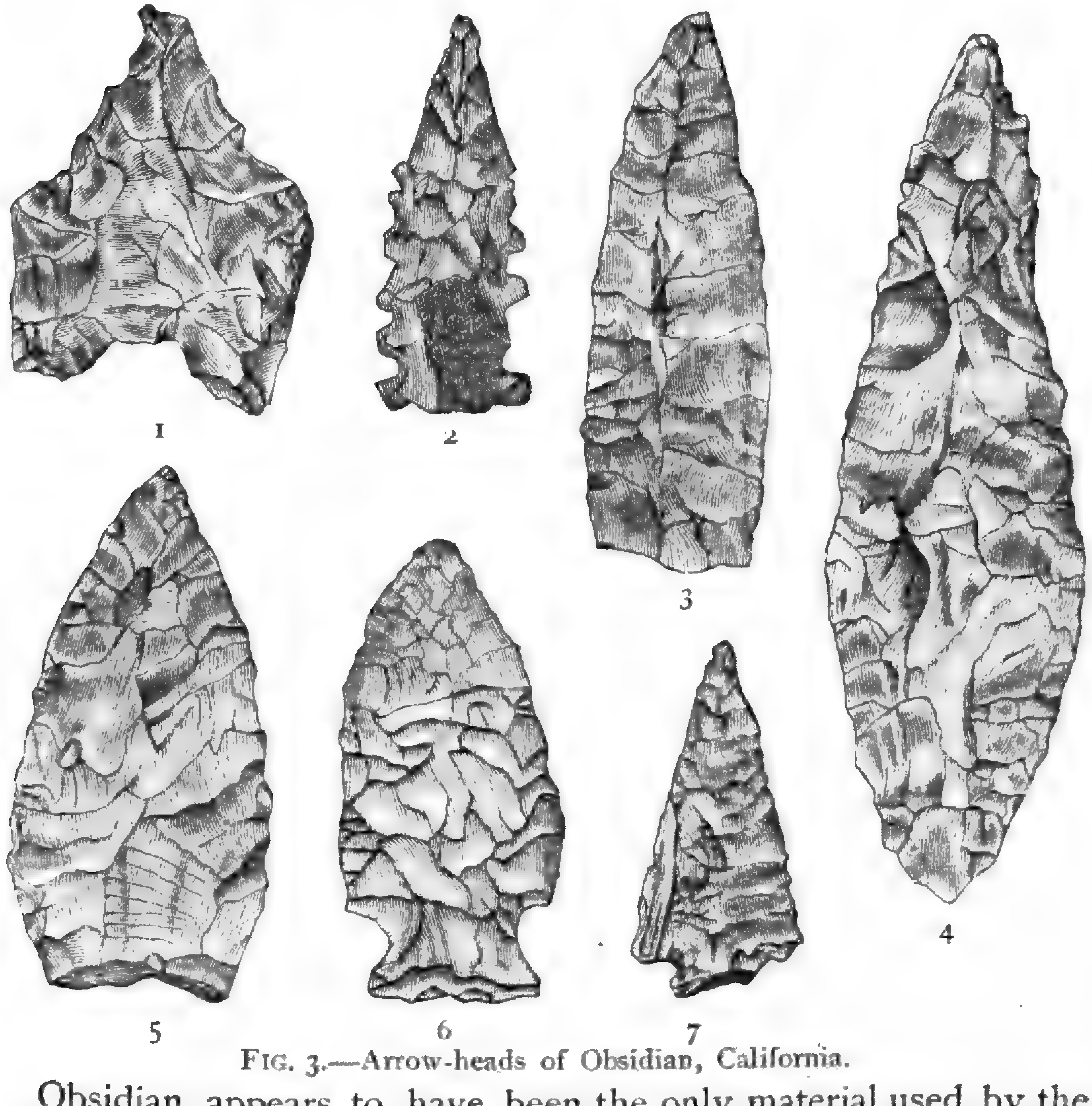


FIG. 3.—Arrow-heads of Obsidian, California.

Obsidian appears to have been the only material used by the ancient arrow-makers of this region; none other was detected among the débris or remains of their long abandoned workshops.

On the opposite side of Napa valley, in a hill not far from the town of St. Helena, obsidian is found in great abundance, and it is probable that from that locality the supply was obtained. About one-third of the arrow-heads were found at station B; the forms of these are shown in the above figures.

Of number one but two specimens were found; number two is another exceedingly rare form, of which the specimen figured is the most perfect, only three or four fragments of this, in addition to that figured, were detected. Mr. Roach obtained a single specimen rather more complete than the above. This form, which is scarcely met with in most California collections, presents the very highest skill in arrow-making art. Number three is perhaps the most abundant form, while four, five and six are numerous; seven is also seldom met with, and is very delicately and nicely worked.

A single bead was detected by Mr. Roach at station C. At this southerly station the mortar (Fig. 1) was found.

The general region herein referred to must have been a paradise to the red man, so far as his needs and aboriginal comfort are concerned. Acorns of several species of oaks, pine nuts, hazel nuts and manzanita berries were probably as abundant in former times as now, and it is altogether probable that game of all kinds was far more abundant than at the present day; in fact all of the requisites for the sustentation of a numerous aboriginal population.

If the community which existed here was at all possessed of æsthetic perceptions, the scenery must have added largely to the other attractions of the place.

As to the particular tribe which constituted that community, I have been unable to learn.

Since this mountain valley became the property of the present owner, I was informed by his wife, that a few years ago there came along, one day, an old Indian, who told her that when he was a boy he lived here with his tribe, and he had now come back to see once again the place where his childhood was passed. "He went up and away over the hills."

Stephen Powers,[1] in his "Contributions to North American Ethnology," places this region within the geographical area of the Wintuns, one of the great groups of Northern Californian Indians, which included numerous tribes. I would particularly call the attention of all interested in this line of inquiry, to this important and interesting volume.

The nearest adjacent tribes were the Napas, the Caymuses, the Calajomanas, the Mayacomas, the Ulucas and the Mutistals.[2]

[1] U. S. Geog. and Geol. Survey, Powell, Vol. III, text and map.

[2] Bancroft's Native Races of the Pacific States, Vol. I, p. 363.

Howell mountain as well as the country beyond, known as Pope's valley, form a region full of attractions for the lover of nature, whether a devotee of science or art. The mountain has an elevation variously stated at from 1500 to 1800 feet above the sea; from favorable points a magnificent panorama is presented, extending to Mt. Diablo in the south, and covering the whole valley of Napa and the westerly mountain ranges which fence in the pleasant valleys between their ridges. The atmosphere is full of health, and the scenery full of inspiration. On every hand, at every turn of the road, right or left, are pictures full of beauty, refreshing to the soul and delightful to the eye. Towering pines, often two hundred feet in height, the Douglass spruce, full of grace and beauty when young, and standing grim, valiant and erect with outstretched and sometimes naked arms when old—as if prepared to wrestle with the storm; sturdy madronas with broadly buttressed bases holding firm to earth, with clean-barked branches widespreading to the sky; noble oaks whose port and bearing are full of stately grandeur. These form but a part of the sylvan deities in whose majestic presence adoration mingles with admiration; these and humbler forms of vegetation, with rock and earth and mountain, are the elements here combined in picturesque harmony, a perpetual feast of beauty, changing only in the morning and evening to put on new splendor in the changing light, and revealing new graces and fresh charms of color and of form. Amid such scenes the California red man, indigenous and to the region born, lived, roamed, hunted and passed away, to be followed by paler faces of exotic lineage, who travel over the long unused and obscure trail, seeking among the chips and stones abandoned by the way, the story of those who made them.

Lack of time prevented investigations elsewhere than at Howell mountain; Angroin's farm is a good point for a base, as well as for recreation, and here more might be done. Pope valley, just over the ridge, should also be explored. It offers great inducements to the ethnologist, the artist and all others who love nature, or who seek for release or rest away from the tumult of traffic and the town.

BARBADOS.

BY F. M. ENDLICH.

AS the good ship *Solent*, of H. M. Royal Mail Service, is slowly steaming into the main harbor of Barbados, a small flotilla of boats gradually accumulates around her. Boats of all sizes, of many colors, and in variable conditions of seaworthiness, contain a motley crew of black oarsmen. While following alongside of the steamer these enterprising substitutes for hackmen keep incessantly shouting, with many gestures:

"Mastah! mastah! here's de boat for ye; take ye right in; go wid de boat of Christopher Columbus; come right 'long, now."

Christopher Columbus is appropriately clad in linen trousers, which once may have been white. The capacious folds of a sea-green "duster" envelops his manly form, and a gray beaver hat with a broad mourning band surmounts his stately figure.

"Shut up dar, you black nigger," chimes in a thick-set darkey of the most pronounced type; "don't go wid dat fellow, mastah; come wid your own little snow drop!"

It is refreshing to note under the sub-tropical sun even this energy of competition. While passengers are listening to the alluring words of numerous boatmen the ship has anchored and everything is made ready for transfer to the shore. A short time must still elapse before the baggage and its owners can be placed into the tossing boat, and meanwhile a new scene presents itself. Rapidly approaching is a skiff propelled by the arms of a strong man. Within it are three or four boys and young men supplied with only a minimum of wearing apparel. Resting a few yards from the steamer the mysterious young darkeys make known the object of their visit:

"Trow down sixpence, mastah! trow him in de watah, far out; trow him far out!"

Compliance with this apparently unreasonable request immediately proves them to be expert divers. With eager eyes and an attitude of intense excitement they closely watch every movement of the passengers who may be standing at the rail. A slight splash may be seen in the water, at once followed by that of four human bodies. Often the coin is recovered even before its last glitter has faded into the dull gray of the water. It is a rare case, indeed, that any sixpence should escape their eyes. Although occasionally a shark's fin may be seen in close proximity, the divers ply their vocation without paying any attention to the rapacious animal. Not until either the patience or small change of passengers has been exhausted will the dripping youths take their departure, seeking fresh fields for their novel enterprise.

Finally the baggage and personel of some particular party is safely stowed away in a rickety boat, which bears the name "Pearl of the Ocean" emblazoned in yellow letters on a pale green ground, and the pull for land is begun. Rowing along and between the various craft which lie anchored here, the breakwater is at last passed and the boat glides smoothly along to one of the wharves. Generally the steamers anchor nearly a mile out, and a fine view of the harbor is afforded during the shoreward trip. The breakwater is a solid stone structure, extending outward for some distance. All boats and smaller ships enter within the shelter it affords and there discharge cargoes. As vessels are constantly arriving and departing, the scene here is one of great interest.

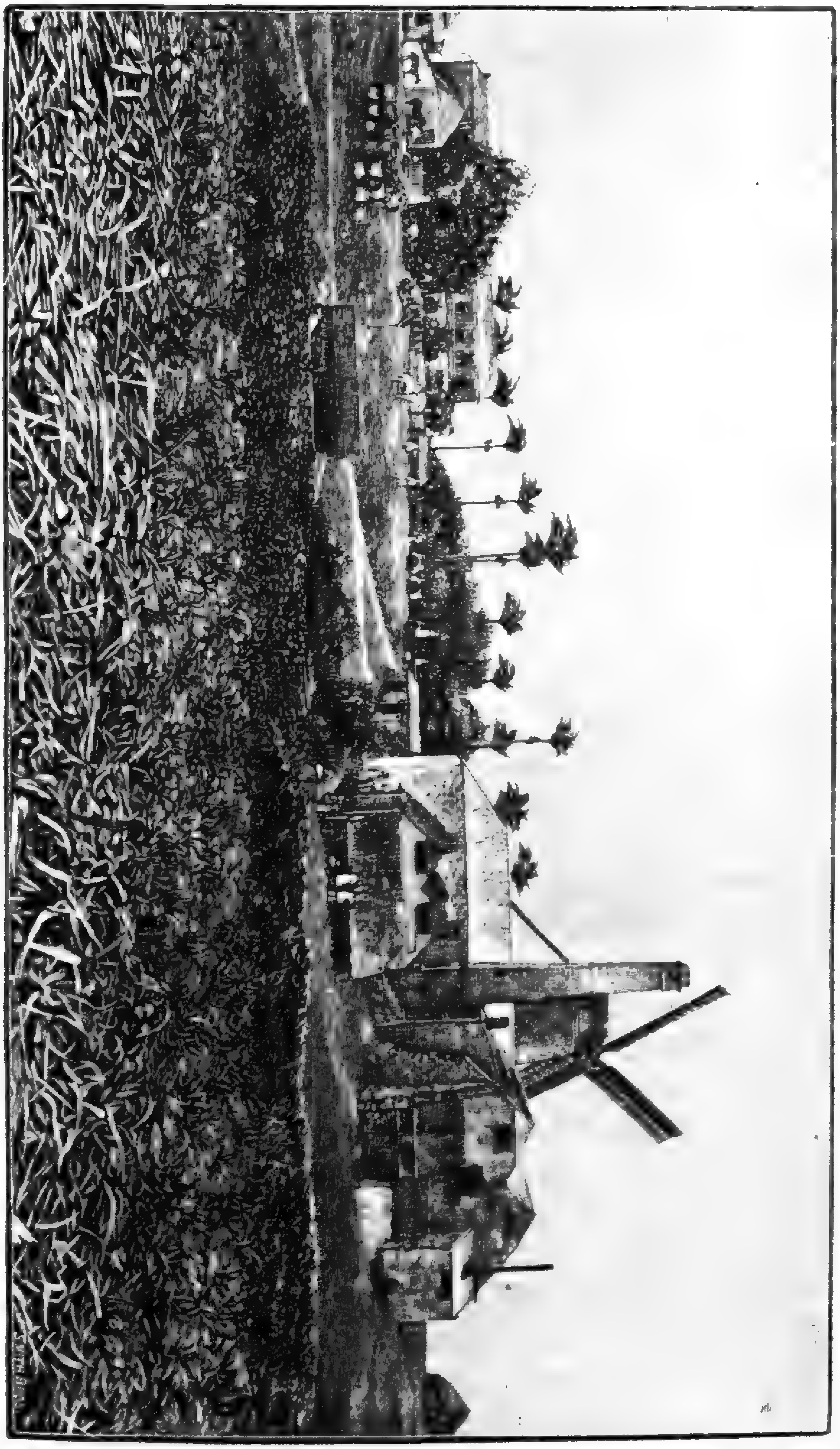
Bridgetown, on the leeward side of the island, is the capital of Barbados. Steamers of various lines stop within its harbor, exchanging freight and passengers. Dozens of lounging darkies, famous for their insolence, line the landing places, and protest to be most anxious to serve every new-comer in any capacity whatsoever. Disinterested as this excessive politeness and attention appears to be at first glance, it is soon changed to disappointment and loudly expressed anger when a successful competitor among them has secured a satchel or trunk and marches off in triumph. That much reviled class, so prominent in our more civilized country, the hackmen, would certainly blush at their own bashfulness and maidenlike shyness could they but join the band of vociferating darkies on the docks of Bridgetown. With the proverbial inconsistency of the children of this world, the rejected candidates turn their wrath upon the unfortunate stranger who has given offence by not employing the entire tribe. Recovering speedily, however, a new victim is attacked and the same scenes are rehearsed. Bridgetown is not well supplied with hotels, and the wanderers usually congregate at the hostelry where Mr. Kingsley is said to have met with so inhospitable a reception upon his arrival at night.

The island of Barbados, most prominent among the Windward

Group, was discovered early in the seventeenth century by Portuguese seafarers. It was taken possession of by British subjects, and settlements were started in 1625. Since that time it has been ruled under the British flag. Until 1627 the island was the property of the Duke of Marlborough, then was transferred to the Duke of Carlisle, and in 1652 was attached under colonial charter to the British crown. During the two and a half centuries that have passed over this flourishing colony its inhabitants have developed an independent, self-reliant character. Dissensions from the opinions of the home government, interior disturbances by insurrection of the colored population, earthquakes and hurricanes, have failed to disturb the proud, hospitable spirit of planters "to the manner born." In 1816 the most dangerous revolt of the negroes laid in waste more than sixty plantations in four days. At present the protection of life and property, by adequate provisions, is made an object of special consideration, and serious trouble is no longer apprehended.

Geologically speaking, the island is coralline in origin and rises to an elevation of about 800 feet above sea level. Gentle slopes, admirably fitted for a high degree of cultivation, characterize its general appearance. Seen from the sea the bright green canefields, separated from each other by roads of glistening whiteness, produce the impression of one great garden. This, indeed, is not lessened when traveling across country, where one estate joins the other, where dozens of sugar-mills in sight betoken the industry and prosperity of planters. But little timber remains on the island, having been removed for various economical purposes. "Parishes" represent the subdivisions of the total area, and a population of about 170,000 inhabitants testifies to the density of settlement.

Bridgetown contains about 50,000 souls. Narrow, irregular streets indicate the older portions of the town. Fine villas and country houses are located in the suburbs. Small wooden huts shelter large families of negroes, while but a short distance off, perhaps, may be the dwelling of an European, who has surrounded himself with everything that good taste and continental habits may require. Large gardens, indicating well developed horticultural ideas on the part of owners, surround the villas. Often the luxurious vegetation completely hides the dwelling from view, with a climate so admirably adapted to plant life, it is not surprising that many people should cultivate flowers and shrubs. To see plants which grow only in green-houses in the fatherland



Clifton Hall Estate.

scattered in profusion over broad grounds, is so fascinating a sight that its influence can hardly fail to affect individual taste. Prominent among the structures of the town is the "Government

Building." An excellent material for architectural purposes is obtained by simply quarrying the coralline rock. It is readily dressed, well adapted to withstand the effects of the moist climate, and is of dazzling whiteness. Trying as this latter property may be under a tropical sun, the effect is certainly imposing. Within the Government Building are located the legislative, judiciary and postal departments. The colonial parliament holds its sessions there, and often the proud spirit of the "true-born Barbadian" has found vent in impassioned speech, defending the colony from real or fancied encroachments upon its colonial rights and prerogatives on the part of the home government. Able minds have there espoused the cause of their native island, and more than once has the introduction of home-measures been withdrawn in consequence. In all matters, however, not pertaining directly to the colony, its citizens are intensely loyal. Frequent visits to the homes of their childhood, as well as the education of sons at the Alma Mater which once sheltered their fathers, tend to sustain the bond which distance and separate interests might gradually weaken. The executive is represented by a Governor, who is appointed from Great Britain, and to whom legal and other assistance is afforded by the Attorney General, the Colonial Secretary, and officers specially appointed. "Government House" is his residence. It is surrounded by grounds which must appear charming to the northern eye. Luxuriant tropical plants, fostered by the hands of skilled gardeners, a tasteful distribution of flowers, shrubs and trees render the park one of great beauty. Within the mansion the visitor meets with apartments typical of the tropics. Large, high rooms, spacious halls, and a subdued elegance at once denote comfort and judicious consideration for sanitary arrangements. The Governor of Barbados has under his charge several other British islands of the Windward Group. Although each one is relatively independent, this partial centralization of executive authority is productive of good results. Difficulties can thus be more readily adjusted, and the similarity of interests assures coöperation.

Strikingly in contrast with the sable hue and light colored garments of the natives are the bright scarlet coats of English troops. A garrison of 800 men is kept at Bridgetown. By their presence the more or less turbulent spirit of the negro population is subdued and the power is at hand to check any sudden insurrection.

Picturesque among the "Red-coats" is the uniform of native East Indian troops, several companies of which are quartered here. Turbans replace the cap or helmet, wide trowsers and leggings the more civilized pantaloons. Of strong build and finely formed, these troops certainly present the appearance of a foe not to be despised. The policy of retaining men of totally different nationalities is one which, in case of emergencies, must be productive of good results wherever applicable.

Higher educational institutions are represented at Bridgetown by Codington College. It is patronized by the sons of planters and merchants, and has furnished a number of men of considerable local prominence. The building is beautifully situated amidst tall palms and groves of flowering trees which only a tropical sun can produce.

Great interest is manifested by the inhabitants in religious matters. The leading denomination is the Church of England, but others are not wanting, notably the Wesleyan. Every "parish" has one or more churches, and Sunday is observed throughout with a rigor which would do justice to an old puritanical settlement. As is found to be the case elsewhere, so here, the colored population enters most zealously into the services.

Consistent with the character of the economic features of the island, is that of the settlers at the main port. Society in Barbados does not present many classes. Planters and merchants lead in wealth, while the government officials form a separate division distinguished for education and wide experience. Growers of produce are independent, and the complement is made up by workmen and not a few idlers. It is a noticeable feature that on the estates women are far better workers than men and are more reliable. Although a man may have no objections to pulling a heavy boat for several miles in a broiling sun for the compensation of but a few shillings, he would be indignant if requested to work in a canefield at regular and perhaps higher wages. Many of the colored women are tall, well-built, and they move through the streets in a stately manner, certainly never in a hurry. This effect is greatly enhanced by the long trains of their white or light-colored dresses, with which they conscientiously sweep the dusty streets.

Interesting material for study on evolutional development may be found in the growth of a small girl to the dignity of wearing a long white dress. No doubt, each successive step is to them of the same importance as to their more favored sisters of northerly climes. Covered with but the scantiest apology for a garment, or sometimes elaborately attired in nothing but a string of beads around the neck, the smallest members of the household attend to playing in undisturbed happiness. They are well treated by all and cry by far less than the average country children of our own homes. Entirely at liberty, they roam into the fields, secure a prize in the shape of a huge sugar-cane, and enjoy themselves in gradually chewing up several feet of it. As they grow up their wearing apparel improves. It would be difficult to draw the line sharply at which the most pronounced metamorphosis takes place. By the time they have arrived at an age of comparative usefulness, either at market or in the sugar-house, they have risen to the exalted position of wearing long dresses. While working or walking in the country a "reef" is taken in the dress below the waist. Huge earrings and bracelets begin to ornament the dusky skin and a tastefully draped turban of flashy color protects the head from the rays of a hot sun. The hair is plaited in short, stiff braids and is ornamented with beads and ribbons; a necklace, sometimes more than one, is added; rings with precious glass stones adorn the fingers, and the young woman is ready for an evening promenade. Her good figure and general ornamentation may attract the attention of some stalwart young boatman, and a deepening of color in the dark brown cheeks betrays the blush which his loudly expressed admiration has called forth.

An inconvenient narrowness of sidewalks in town forces pedestrians into the street. There may be found a motley accumulation of donkeys, men, women and children. Once in a while a team drawn by six mules wends its way through the crowded thoroughfare, causing a decided swerving and sudden scattering of the mass of humanity. Here, as on the plantations, women take a leading part in active work. While a great, overgrown darkey may be perched on the top of a cart and allow himself to be drawn by a donkey scarcely larger than a Newfoundland dog, a woman will walk alongside, staggering under a heavy load which she carries on her head. It is amusing to see the accuracy with which these women balance on their heads large wooden trays filled with fruit or vegetables. Both hands free to manage the folds of their ample, flowing dresses, they pass along with heads held high, ever ready for trade or for friendly gossip with some acquaintance they may chance to meet.

On Friday Bridgetown puts on its gayest colors. This day is devoted to the planters. From all parts of the island they enter the town, they buy and sell, exchange views and opinions with neighbors whom they see but once a week, and finish the day with a quiet rubber of whist or brandy and soda at their club-rooms. To them the news or the day is important, the fluctuations of the market value of sugar and its side-products become living figures. They have founded a "Commercial Exchange," where the latest dispatches and quotations are open to inspection. On this day, too, the "Ice House" becomes an important establishment. Essentially—in spite of the title—this is a restaurant. It is always supplied with ice, with the freshest and best viands, and with various luxuries as to which it seems to have the exclusive control. Every three months a shipload of ice arrives from Boston at Bridgetown. With it come fresh meats, vegetables, beer in casks, oysters in the shell (when in season), and other articles of food destined to tempt an islander whose thermometer usually ranges from 76 to 92 degrees.

For a long time Barbados has been one of the important sugar-producing islands. Every article of value is mentally compared with sugar; the weather is of no importance whatever, except so far as it may improve or injure crops, and the telegraphic news most eagerly read relate to the sugar market. To a stranger the singular unanimity of ideas upon this subject cannot but appear first ludicrous, then very much the reverse. Thorough cultivation of every available portion of the island, careful management and judicious treatment of both the growing canes and the cane-juice have resulted in a high average yield per acre and a total sugar production of about 60,000 tons a year. Molasses and rum are both manufactured as additional products and are exported in large quantities. Ginger is extensively cultivated and forms quite an important item in the trade. Driving over the smooth, white roads, fields of sugar cane are entered immediately after leaving the confines of the town. Prominent in the landscape are the gaunt arms of numerous windmills. Strangely as they may seem out of place at first, their appearance soon has a certain charm and awakens reminiscences of countries far removed from the tropics. Regular, constant winds render the mills a valuable and economical adjunct to the manufacture of sugar. Located upon rising ground, they furnish power for crushing the canes, thus extracting the juice. From this latter crystalized sugar is obtained by methods of boiling, more or less complex. Briefly reviewing the process of sugar manufacture, it may be stated as follows: The canes are cut, stripped of their blades, carted to the crusher, and the juice expressed. From there the latter is led into vats where an addition of lime assists clarification. It then passes to a series of kettles and is boiled down to a definite density. After being taken from the last pan the mass is allowed to cool and in part

Row of Noble Palms.

crystalize. As soon as the proper time arrives it is either filled into hogsheads and the molasses allowed to drain off, or the latter is removed in centrifugal machines. The article thus derived is directly marketable, but must be refined before acquiring the whiteness and firmness which the American retail consumer desires.

On the estates the planters with their families live in patriarchal comfort. Absence of means of rapid communication, the unforgotten usages of the mother country, and their innate kindness, render them the most courteous and hospitable of hosts. Surrounded by fields which soon will yield golden fruit, and working with an energy which wind, weather or a fluctuating market impose, they lead a regular life, interrupted only by questions of local government, and by attempts at sanguinary revolt on the part of idle or dissatisfied negroes. On high points, exposed to view, for long distances may be seen staffs with movable arms or other indicators. They serve as telegraphic signals, and a menacing attitude on any one plantation will soon be known all over the island. Thanks to good management, however, occurrences such as formerly devastated many plantations are becoming more infrequent from year to year.

Few places, perhaps, can be found which at one glance display so much quiet scenic beauty and at the same time so fully illustrate the power of man as expressed by his industry. Groves of mahogany trees, the slender, graceful form of the noble palm, the clearly cut shore line, and the blue sea beyond, are combined with highly cultivated fields and subservience of wind and water to the will of man.

The products of Barbadian industry are mainly the middle grades of sugar, which are largely exported to England. It seems strange to note, in view of this latter fact, that supplies and other materials are drawn from the United States to a great extent. American meats, canned fruits and vegetables, and even horses and mules, are met with everywhere. Owing to the climate, stock degenerates very rapidly, and neither serviceable animals nor good meat is raised on the island. An exception to this rule must be made in favor of the donkeys, however. Although of sorry appearance and presumably ready to lean up against the nearest post for support, these animals are capable of a prodigious amount of work. Disproportionate as the size of the little brutes and their loads may seem, they trudge steadily along, requiring only occasional physical admonition on the part of their drivers or riders.

On account of the thorough cultivation of the island but few wild fruits are found, and in consequence the table of the working classes is not the most varied one. Salt fish, bread and sugar cane form the staples. Codfish is imported in large quantities, and some of the native fish are prepared in a similar manner. Nearly every man, woman or child, returning from the fields, carries a long succulent cane. Often a small boy may be seen attached to one end of a cane twice as long as himself, munching away lustily; the hard rind is gradually overcome, and the juice furnishes him his favorite nourishment. In addition to the nutriment obtained in this manner, such process of demolition furnishes an excellent means for passing the time. Few scenes are more ludicrous than seeing half a dozen lazy darkies, of various sizes, lying in some shady corner while munching long cane-stalks with the utmost solemnity. Poor as the fare may be, the people seem to require no better. In part, the indolence of the colored population may be explained by the climatal conditions of the island. Though rains are frequent and cooling breezes are not wanting, the mean temperature is such as to require but very scant clothing. Children are clad at a ridiculously small expense, and shoes are luxuries unknown until the female wearer blossoms into stately maidenhood. By this means one great incentive to work—the supply of clothing for the family—is reduced to a minimum. A few pence per week are ample to keep body and soul together, rum can be stolen, and both may be acquired with but little labor.

Among the native fish the "flying fish" ranks high as an article of food. At certain seasons it may be quite rare, and again appear in abundance. (In March, 1880, flying fish were selling at four cents per hundred at Bridgetown). During our stay we decided to indulge in the sport of catching them, which had been represented to us as an highly enjoyable pastime. A small fishing boat was accordingly chartered, together with a skipper and two men to assist him. Early one morning, long before sunrise, four of us, respectively "England," "Nova Scotia," "Scotland" and "America," stood out to sea. With the usual forethought a sumptuous lunch had been packed into several baskets, rifles and shotguns were taken along to destroy sharks and secure seabirds. Fishing tackle and nets were supplied in abundance; also bait. Not many parties, perhaps, have started with more complete equipments. Our old, gray-haired skipper stood at the helm with imposing gravity while three poles were put up in the boat, and to each of them was attached a rag of triangular shape. Everything was shaky, the seats were very narrow, and our sporting accoutrements occupied by far the greater portion of available space. A brisk breeze, which had been blowing from the start, began to freshen up, the waves were gradually growing higher, and within the first hour we were all comfortably drenched. This part of the programme seemed in keeping with the expedition, and we silently congratulated ourselves upon so auspicious a beginning. Before long, however, the sea continued making efforts to stow away a portion of its surplus water in our boat, and all hands were requested to "bail out." By means of hollow calabashes this feat was accomplished. After having gone out to sea about twelve miles sails were lowered and we lay tossing about and waiting for fish. All around us we could see the bright bodies of flying fish flash out from the crest of a wave, pass with great rapidity for some distance over the water, and then drop down again. Eventually a few curious individuals arrived, apparently to inspect the sides of our boat. During their examination they encountered sundry hooks, quietly opened their capacious mouths and allowed them to float in. One or two "flops" when brought on board, and they settled down, seemingly resigned, in the water at the bottom of the boat. This sport was surely growing exciting—but slowly. Thanks to the outward trip and the constant motion of our boat—thanks, too, to our elaborate breakfast, which had consisted of a glass of water—we four ancient mariners were beginning to experience a feeling which a novice on board of a ship might designate as "faint." An inexplicable want of energy, a certain absent-mindedness as to the fascinations of fishing, and a decided disinclination to attack our lunch baskets, became painfully noticeable. In order to revive our sunken spirits somewhat (we will generously accord him the benefit of a lingering doubt) this august individual ordered the bait to be brought out. It was brought out. A basket of loose workmanship was filled with fragments of flying fish, which might have been alive two weeks before; at the time, however, they were very dead. This basket was hung over the side of the boat into the water. Evidently the fish appreciated the perfume which thus was spread far and wide, for they came in large numbers within easy reach of our nets. Whether it was the overpowering joy produced by our success, or whether it was grief at the sudden ending of so many fish lives, full of youth and full of promise, we must allow posterity to decide. It is enough to say that "Nova Scotia," "Scotland" and "America" ignominiously collapsed, and "the further proceedings interested them no more." Occasionally a cold, wet fish would alight on the pale face of one or the other, but beyond a mild protest no action was perceptible. After a sufficient number of fish had been stowed away in the boat by "England" and the natives, the latter proceeded to do full justice to three-quarters of our elaborate lunch. Once more the sails were set and we sped homeward. Wave after wave passed over the dancing boat until finally the shore was reached. Wet, not hungry, trying to look cheerful, but nevertheless with a cart-load of fish to speak for us, we arrived at our hotel near noon. Strange as it may appear, it proved to be a rash undertaking, for some time to come, to mention "flying fish" within hearing of three certain sportsmen.

Barbados has become a prominent health resort, more particularly for fever patients from more southerly regions. For many years the island has been free from serious attacks of epidemic or endemic diseases. South of Bridgetown, a suburb, Hastings, is located, where good sea-bathing and comparatively cool air can be enjoyed. The climate is necessarily enervating, and any stimulant of such character is a welcome change. Many of the planters and merchants have traveled extensively, and their experiences in foreign countries have borne fruit in their own colony.

Once more the gauntlet of officious porters and boatmen must be run, as the southward steamer has anchored off shore. Laden with trophies from the island, with coral shells and other equally bulky souvenirs, the traveler finds himself restored to his temporary floating home, and

"The ship drove past * * *
And southward aye we fled."

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COURTSHIP AND MARRIAGE AMONG THE CHOCTAWS OF MISSISSIPPI.

BY H. S. HALBERT.

THE two thousand Choctaws still living in their ancestral homes in Mississippi, retain, in all their pristine vigor, many of the usages of their ancestors. Among these are the methods employed in conducting a courtship and the marriage ceremony.

When a young Choctaw, of Kemper or Neshoba county, sees a maiden who pleases his fancy, he watches his opportunity until he finds her alone. He then approaches within a few yards of her and gently casts a pebble towards her, so that it may fall at her feet. He may have to do this two or three times before he attracts the maiden's attention. If this pebble throwing is agreeable, she soon makes it manifest; if otherwise, a scornful look and a decided "ekwah" indicate that his suit is in vain. Sometimes instead of throwing pebbles the suitor enters the woman's cabin and lays his hat or handkerchief on her bed. This action is interpreted as a desire on his part that she should be the sharer of his couch. If the man's suit is acceptable the woman permits the hat to remain; but if she is unwilling to become his bride, it is removed instantly. The rejected suitor, in either method employed, knows that it is useless to press his suit and beats as graceful a retreat as possible.

When a marriage is agreed upon, the lovers appoint a time and place for the ceremony. On the marriage day the friends and relatives of the prospective couple meet at their respective houses or villages, and thence march towards each other. When they arrive near the marriage ground—generally an intermediate space between the two villages—they halt within about a hundred yards of each other. The brothers of the woman then go across to the opposite party and bring forward the man and seat him on a blanket spread upon the marriage ground. The man's sisters then do likewise by going over and bringing forward the woman and seating her by the side of the man. Sometimes, to furnish a little merriment for the occasion, the woman is expected to break loose and run. Of course she is pursued, captured and brought back. All parties now assemble around the expectant couple. A bag of bread is brought forward by the woman's relatives and deposited near her. In like manner the man's relatives bring forward a bag of meat and deposit it near him. These bags of provisions are lingering symbols of the primitive days when the man was the hunter to provide the household with game, and the woman was to raise corn for the bread and hominy. The man's friends and relatives now begin to throw presents upon the head and shoulders of the woman. These presents are of any kind that the donors choose to give, as articles of clothing, money, trinkets, ribbons, etc. As soon as thrown they are quickly snatched off by the woman's relatives and distributed among themselves. During all this time the couple sit very quietly and demurely, not a word spoken by either. When all the presents have been thrown and distributed, the couple, now man and wife, arise, the provisions from the bags are spread, and, just as in civilized life, the ceremony is rounded off with a festival. The festival over, the company disperse, and the gallant groom conducts his bride to his home, where they enter upon the toils and responsibilities of the future.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The utterances of Professor E. DuBois Raymond, at the recent celebration of the birthday of Leibnitz, in Berlin,[1] should have a clearing effect on the intellectual atmosphere of the evolutionists. Professor Raymond exhibits in a marked degree the invaluable quality of intellectual self-control, one which is sometimes wanting to brilliant thinkers. It is perfectly natural for the pioneer, in penetrating a new and unexplored region, to advance with too great celerity, and without giving himself the requisite time to discover the obstacles that may lie in his course. Sometimes it has happened, that, bringing up at the edge of an unexpected precipice, he has made the most astounding leaps, and has been compelled to lay to and repair damages for sometime thereafter.

A good many evolutionists have been floored by a serious interruption to the continuity of their "high priori" road, and not a few of them do not yet know just what has hurt them. That such an evanescent and unsubstantial condition as consciousness should have the gravity necessary to throw a triumphant army of advance into confusion, could hardly be suspected. Does not one of the leaders say that consciousness is to the progress of evolution, what the whistle is to the engine, that makes a good deal of noise but does none of the work? And another says, "If the 'will' of man and the higher animals seems to be free in contrast with the 'fixed' will of the atoms, that is a delusion provoked by the contrast between the extremely complicated voluntary movements of the former and the extremely simple voluntary movements of the latter!" A slight difference of opinion, indeed! One authority tells us that consciousness does nothing, and the other will have it that it does everything, rising even to the autonomic dignity of a "will" for atoms! They agree in believing

[1] See translation in *Popular Science Monthly* for February, 1882.

consciousness to be a form of force; but they differ in that the first authority thinks it is all dissipated, while the other holds it to be a link in a continuous chain of metamorphoses equivalent to every other link. If this be so, and the continuity be unbroken, what iron-clad fingers must these doughty soldiers have, who by merely putting pen to paper open the mouths of so many cannon, inaugurate so many conflagrations, and explode so many magazines. Verily we should have a new anatomy of this five-barreled mitrailleuse, through whose chambers flash such world-moving forces. As to the source of all this power, well says Drysdale, that if the brain of man contains stored such tremendous potency, its escape should, on his leaving this earthly abode, blow the top of his head entirely off.

As usual, truth lies between these extremes; furthermore, a very fundamental truth has been neglected by both sides of the question. Says Raymond, "More temperate heads betrayed the weakness of their dialectics in that they could not grasp the difference between the view which I opposed, that consciousness can be explained upon a mechanical basis, and the view which I did not question, but supported with new arguments, that consciousness is bound to material antecedents." This position has been maintained by various writers, among them Professor Allman,[1] and some of the editors of this journal. But Professor Raymond has not found it to be acceptable to his nearest cotemporaries. He says, "The opposition which has been offered to my assertion of the incomprehensibility of consciousness on a mechanical theory, shows how mistaken is the idea of the later philosophy, that that imcomprehensibility is self-evident. It appears rather, that all philosophizing upon the mind must begin with the statement of this point." In stating this point some years ago, we used the following language:[2] "It will doubtless become possible to exhibit a parallel scale of relations between stimuli on the one hand and the degrees of consciousness on the other. Yet for all this it will be impossible to express self-knowledge in terms of force." And again,[3] "An unprejudiced scrutiny of the nature of consciousness, no matter how limited that scrutiny necessarily is, shows that it is qualitatively comparable to nothing else. * * From this standpoint it is looked upon as a state of matter which is coëternal with it, but not coëxtensive."

A second self-evident proposition is the following: There is no equivalency or correlation, between the force expended in the maintenance of conscious states, with the energy displayed in those acts which result from those conscious states. Parallel relations between ordinary forces are seen in cases of release.

[1] Address delivered before the British Association for the Advancement of Science, 18—.

[2] Consciousness in Evolution, *Penn Monthly*, July, 1875.

[3] The Origin of the Will, *Penn Monthly*, 1877, p. 439.

Thus the force that applies light to the fuse is little comparable to the explosion of the blast. The force required to raise the sluice is small compared with that which runs the mill. Still less is the relation of the force expended in planning a campaign to that required in executing it; or, of that used in directing a body of laborers to that expended by the laborers themselves. This is easily understood, but it is not so generally perceived by some of the correlators, that a process of exactly the same kind takes place in the mechanism of the acts which transpire within the animal organism. The amount of the primitive force may be very minute, for several releases may separate the thought from the ultimate result.

In the cases above mentioned the mind only serves as a release to the muscles which act, before the latter in turn release still mightier forces. But these facts do not permit the supposition that the original conscious state is not an equivalent of forces both antecedent and subsequent. For without the decomposition of arterial blood and the oxygenation of tissue, consciousness could not exist, and the beginning would not begin.

A third self-evident proposition is this: Movements determined by sensations cannot be compared to those which are not so determined. The former move towards the locality of pleasure, and away from the locality of pain. The latter move in the direct ratio of the product of the masses, and in the inverse ratio of the square of the distance. In the former case there is no equivalency between the force of the originating stimulus and the resulting act, and energy is generally gained in the process; in the second case the correlation is exact, and if there be any difference between the energy of the cause and that of the effect, that which has been dissipated by the way can be accounted for by proper search. But the biologist has much to do with a large class of designed movements, or acts, which are not performed in consciousness, and it is these which are likely to produce a confusion in the mind in regard to the relation between the movements of living and non-living masses. Thus a class of writers compare the hunger of the lowest animals to the affinities of chemical substances, etc., a supposition clearly inadmissable on physical grounds alone. The easiest solution of the problem lies in the well known ease with which conscious acts become automatic and unconscious, so soon as the structural lines which give direction to the force have become organized. Consciousness thus appears as the creator of designed movements, and the resulting organism their sustainer.—*C.*

RECENT LITERATURE.

Balfour's Comparative Embryology. Vol. ii, Vertebrates.[1]—After finding the first volume of this work so useful, accurate and suggestive, we were prepared to welcome the appearance of the second volume, which certainly fulfills the high expectations formed after reading and frequent reference to the first. Our anticipations are fully met, and the entire work for the first time places in the hands of the student a reliable and critical account of the general mode of development of members of each great class of the animal kingdom. The facts have been gathered and compiled from a great variety of sources, for the literature of embryology has multiplied excessively since 1860, the larger proportion of articles and memoirs having, indeed, been published within the last decade.

The first third of the volume is devoted to a general account of the development of each class above the Arthropods, with which the last volume closed—*i. e.*, the groups *Cephalochorda*, containing the single genus Amphioxus; the *Urochorda* or Tunicata, and the *Vertebrata*. This part of the volume contains a good deal of original matter contributed by the author and a few other embryologists, together with the most recent results of embryological studies, so that we will glance at some new points which meet one's eyes in the early pages.

The peculiarities in the development of the Teleostean egg, says Balfour, can best be understood by regarding it as an Elasmobranch egg very much reduced in size. "It seems, in fact, very probable that the Teleostei are in reality derived from a type of fish with a much larger ovum."

The lamprey is regarded as the type of a degenerated but primitive group of fishes, whose development, however, does not throw any light on its relationship. If so, we do not see why the author places it in his classification or phylogeny above so special and recent a group as the bony fishes. He then says that "the similarity of the mouth and other parts of Petromyzon to those of the tadpole probably indicates that there existed a common ancestral form for the Cyclostomata and Amphibia. Embryology does not, however, add anything to the anatomical evidence on this subject." On the other hand, he does not assent to Dohrn's view that the lampreys have descended from a relatively highly organized type of fish.

Had space been allowed we would like to have had fuller statements concerning the later stages of the lancelet, as well as of the ascidians. Concerning Myxine no reference is made to Steenstrup's paper, wherein the eggs are figured. Neither is a paper on Amphioxus in this journal (Jan. and Feb., 1880), by H. J. Rice, and containing new facts and drawings, noticed.

[1] *A Treatise on Comparative Embryology.* By Francis M. Balfour. In two volumes. Vol. ii. London, Macmillan & Co., 1881. 8vo, pp. 655. xxii.

We have in this work, for the first time in connected form, the comparative embryology of the Ganoids, the researches of Salensky on the sturgeon, and of A. Agassiz on the gar-pike, supplemented by those of the author, assisted by Professor W. K. Parker and his son, W. N. Parker, giving us a good idea of the development of two principal types. In the sturgeon the segmentation of the yolk is complete, but the embryo does not become folded off from the yolk in the manner usual in Vertebrates, while the relation of the yolk to the embryo is unlike that in any other known vertebrate. Before hatching the embryo has, to a small extent, become folded off from the yolk both anteriorly and posteriorly, and has also become, to some extent, vertically compressed. Owing to these changes, it resembles somewhat the embryo of a bony fish. According to Parker, in older larvæ a very rudimentary gill appears to be developed on the front walls of the spiracular cleft, while the gill-papillæ of the true branchial arches are of considerable length. There is a suctorial disk, with slender papillæ, which probably ultimately become the barbels, and a corresponding but temporary one arises in the gar-pike.

In the gar-pike, besides the discoveries, as respects the later stages, made by A. Agassiz, the segmentation is total; but the early stages of the embryo show a remarkable resemblance to those of bony fishes. Both the head and tail become early folded off from the yolk, as in bony fishes. The yolk in the gar forms a special external yolk sack, instead of an internal dilatation of part of the alimentary tract as in the sturgeon, and besides, in the gar it is placed behind instead of in front of the liver, as in the sturgeon. A knowledge of the mode of development of the Ganoids is, of course, most important, since from them the Amphibia are supposed to have been derived. But, as Balfour observes, there are no very prominent Amphibian characters in the development of either type, otherwise than a general similarity in the segmentation and formation of the germ-layers. So that no light is thrown by embryology on the origin of the Amphibia. In considering the development of the Amphibia a good deal of stress is laid on the resemblance between the mouths of the tadpole and the lamprey, and Balfour thinks that these are not merely the results of more or less similar habits. Says Balfour: "In dealing with the Ganoids and other types arguments have been adduced to show that there was a primitive vertebrate stock provided with a perioral suctorial disc; and of this stock the Cyclostomata are the degraded, but at the same time the nearest living, representatives. The resemblances between the tadpole and the lamprey are probably due to both of them being descended from this stock. The Ganoids, as we have seen, also show traces of a similar descent; and the resemblance between the larva of Dactylethra, the Old Red Sandstone Ganoids and Chimæra probably indicate that an extension of our knowledge will bring to light further affinities between the primitive Ganoid and Holocephalous stocks and the Amphibia."—*(To be continued.)*

Gill's Recent Progress in Zoology, for the years 1879 and 1880.[1]—Few indeed of the numerous students of zoölogy in this country have time or opportunity even to glance at the work done each year by English-speaking naturalists, and still fewer are able to become acquainted with the work of foreign naturalists except through notices in scientific journals. To all, therefore, the present pamphlet, written as it is by one who by long study of the subject is well qualified to undertake such a work, will prove most valuable,

After noting that the prominent feature of zoölogical progress during the period reviewed has been the discovery of numerous deep-sea types, and criticising the ordinal classification of Fishes and Birds put forward by certain zoölogists, Dr. Gill proceeds to give a short separate account or abstract of papers containing discoveries of importance.

Among the subjects treated of are the following relating to invertebrates: Anal respiration; the effects of variously colored light upon the development of ova; the effects of starvation upon the human system, from the studies of surgeons during the late famine in India; the Pheodaria, a new group of Rhizopods allied to the Radiolaria, but constituted a class by Haeckel, who enumerates more than 2000 species; the discovery of medusæ in brackish and even in fresh water; a new order of Holothuroids (the *Elasmopoda*); a curious ophiuroid, with asteroid characters, found near Madagascar; the Orthonectids; *Polygordius* and its relationships; parasitic Planarians and Nemerteans; the relations of the Chætognaths and of *Peripatus*; the resemblance between the eyes of Limulus and of Trilobites; aborted development in decapod crustacea; *Scolopendrella*; the phosphorescence of glow-worms; the relations of the Polyzoa; the range in depth of living Brachiopods; worm-like mollusks (*Neomenia* and *Proneomenia*); the regeneration of parts in Gastropods; *Gastropteron;* recent Pleurotomariids; the dentition of the Marginellidæ; the relation of the arms and siphons of cephalopods to structures found in gastropods; and recently described North American Cephalopoda.

Among the vertebrates Dr. Gill, as might be expected both from the general direction of his own labors and from the extensive work performed upon our coasts by the Fish Commission, devotes most space to the Pisces. The principal works published upon this branch are noted, and mention made of the numerous workers who have described new species, anatomized known species, or discovered fossil forms. Then follow notices upon the origin of sounds produced by fishes; the functions of the air-bladder; the temperature of fishes; the ovaries of teleosts; the

[1] *An Account of Recent Progress in Zoölogy, for the years 1879 and 1880.* By Theodore Gill. From the Smithsonian Report for 1880.

flight of flying fishes; the affinities of the fossil *Platysomidæ* and *Palæoniscidæ*, and of *Pleuracanthus;* and the sexes of eels. Among new discoveries are noted two species of *Pleuronectidæ* (in the sense given to the term by Dr. Gill) without pectorals upon the blind side; the genera *Icosteus* and *Icichthys*, curious soft-boned California fishes, which have been constituted a "family" by Professor Jordan; *Lopholatilus*, a new economical fish; the Rock-fish of California, and a deep-sea Sebastes found off Inosima, Japan.

The activity of ornithologists has produced numerous faunistic works, notably upon the birds of Papua and the adjacent islands, and several families have been monographed. After notes upon the Odontornithes, Archæopteryx, and the extinct parrot of Bourbon, Dr. Gill turns to the mammals, commencing, as in other groups, by enumerating the features of progress. Then follow a condensation of the views of various naturalists on the progenitors of mammals; a synopsis of Marsh's work on Jurassic Mammals; notes on the discovery of new Monotremes and Marsupials in New Guinea; on a plague of rats which occurs in Parana (Brazil) at intervals of thirty years; on the habitat of *Lophiomys imhausi;* on the gestation of the elephant and length of life of the hippopotamus; and lastly, a short account of Professor Cope's articles upon the extinct cat-like animals of America and the relations of the horizons of extinct Vertebrata in Europe and in North America.

Dr. Gill utters a warning, by no means without reason, against the use of the word "order" to define groups which have less value than the sub-orders of mammals, and is especially severe upon Dr. Sclater for the recognition of two sub-classes and twenty-six orders in the homogeneous class of Birds. It would be well for all systematists to remember the warning, and to remember also that the same criticisms apply to the undue multiplication of families and genera. Nor does our author neglect the opportunity of throwing another stone at Dr. Günther for the mistaken conservatism which impels that excellent ichthyologist to retain the Cuverian orders of the Teleosts, to include sharks and Chimeroids in the same order, and in various other ways to ignore broad morphological facts.

THORELL'S SPIDERS OF MALAYSIA AND PAPUA.[1]—A third part of this extensive work has just been received. It forms a bulky and handsomely printed work of 720 pages, but without any plates. It forms volume XVII. of the Annals of the Civic Museum at Genoa, one of the most active scientific societies in Europe, and is another evidence of the scientific awakening now pervading the kingdom of Italy, and which is undoubtedly due largely to the freedom and political progress of the Italian nation resulting from the loss of the temporal power of the Pope. The collections which form the base of the present descriptions were those made

[1] *Studi sui Regni Malesi e Papuani.* Per T. THORELL. III. Genoa, 1881. 8vo.

by Professor O. Beccari at Amboina and by this explorer, who went in company with D'Albertis to New Guinea, together with collections from other parts of the Malay Archipelago. Dr. Thorell prefaces his work with valuable remarks on the geographical distribution of the spiders of this region and gives a full account of what has been done in the field by his predecessors.

THE DISTRIBUTION OF NORTH AMERICAN FRESH WATER MOLLUSCA.[1]—Professor Wetherby's endeavor, in this interesting article, is to trace the causes which have led to the great differentiation of the fresh-water mollusks and to distinguish the various faunæ. The Limneidæ, circumpolar in their distribution, are most abundant in the lake region of the Archæan lands, and are essentially lacustrine, although a few are fluviatile. The Unionidæ are most abundant in the region drained by the Ohio, and the typical Ohio forms are continued across the Mississippi to the Rocky Mountains and southward to Texas, but in vastly diminished numbers. South of the Ohio and east of the Mississippi, both within and without the Ohio drainage, many of the Unionidæ are evidently closely related to Ohio types, but along with them, principally in small mountain streams, occur species which have a very different facies, and belong to a different fauna. Such are *U. spinosus* and *U. collinus*, the only spinous Uniones.

The Strepomatidæ first appear in New York, and are almost confined to the district occupied by the peculiar Unionidæ just mentioned. They do not cross the Mississippi, and are chiefly found in mountain streams.

The Unionid genus Anodonta is abundant with the Limneidæ of the Archæan lake regions, and plentiful over the northern part of the region occupied by the Uniones, but gives way southward to Unio. Most of the described species of Anodonta and Unio are mere varieties, and even Dr. Lea has to confess that he can find no satisfactory anatomical differences in the latter genus, yet there are many types that must be called species.

Reviewing these facts, Professor Wetherby concludes that the Limneidæ form the oldest fauna, and that the typical Ohio forms spread from the Palæozoic lands of the Northern States, and are older than those found in the Mesozoic and Tertiary regions of the South.

These latter he refers to a Palæozoic ancestor whose home was in the western archæan region.

All fresh-water mollusks were originally lacustrine, adapted themselves first to the change from salt to fresh water, and afterwards to the more rapid change caused by the elevation of mountain ranges, and the conversion of lakes into flowing water. Hence the most striking and peculiar forms are found in the mountain streams of newer regions and have not yet had time to

[1] *On the Geographical Distribution of Certain Fresh Water Mollusks of North America.* By A. G. WETHERBY, A. M. Jour. Cincin. Soc. Nat. Hist., July, 1881.

spread. All the species, originating in the head-waters, propagated down-stream, and thus arose the overlapping of faunas, and probably the disappearance of many faunæ as peculiar as is that of the Alabama, which contains, besides some distinctive Unios and a singular Goniobasis, two Strepomatid genera, Schizostoma and Tulotoma, with thirty species, none of which were found elsewhere.

ZITTEL'S HANDBUCH DER PALÆONTOLOGIE.[1]—This standard and fresh work on general palæontology is slowly appearing in numbers, the present one beginning the treatment of the Mollusca. One important feature of the present number are the two hundred excellent wood-cuts of fossil Lamellibranchs. The orders, families and leading genera are briefly described and the typical species mentioned. The systematic portion is succeeded by a brief section on the distribution of Lamellibranchs in geological time. It appears that of all fossil mollusks the Lamellibranchs constituted a fourth part in the palæozoic period, in the Jura and chalk periods one-half, and in the Tertiary period a third part.

MARTIN AND MOALE'S HOW TO DISSECT A CHELONIAN[2].—This little book is the first of a series designed to form a handbook of vertebrate dissections. The directions given are meant for use in connection with lectures, and the reading of a good text-book and some knowledge of human osteology on the part of the dissector is assumed by the author. The species dissected is the red-bellied, slider terrapin *(Pseudemys rugosa).* After stating the zoölogical position of this terrapin in general terms, taken, with slight modifications, from Huxley, the student is then led to examine briefly the general external appearance of the animal, and then clear, succinct, and, we should think, sufficiently full directions how to dissect the creature are given. The method pursued is not comparative, but special; we should look for the introduction of the comparative method in the succeeding parts. No illustrations of the soft parts are given. A frontispiece is devoted to good figures, showing the different parts of the skull. The book is useful, and one which is needed.

PACKARD'S ZOOLOGY, THIRD EDITION[3].—The changes made in this edition consist mainly in the correction of errors, the results of suggestions and criticisms from naturalists and teachers. Among the changes and additions are references to Ryder's *Symphyla,*

[1]*Handbuch der Palæontologie.* Herausgegeben von KARL A. ZITTEL. I. Band. 2. Abtheilungen. I. Lieferung, mit 200 original-holz-Schnitten. München und Leipzig, 1881. 8vo. Preis Marks 7.

[2]*Handbook of Vertebrate Dissection.* Part I. How to Dissect a Chelonian. By H. NEWELL MARTIN, Professor in the Johns Hopkins University, and WILLIAM A. MOALE, M.D. New York, Macmillan & Co., 1881. 12mo, pp. 94. 75 cts.

[3]*American Science Series.* Zoölogy for High Schools and Colleges. By A. S. PACKARD, Jr. Third edition, revised. New York, Henry Holt & Co., 1881. 12mo, pp. 719. $3.

which is regarded as a sub-order of Thysanura, while the recent views of Semper and Moseley as to the formation of coral reefs are briefly referred to. The index has been altered to correspond with changes in the text.

VERRILL'S CEPHALOPODS OF THE NORTHEASTERN COAST OF AMERICA[1].—This is a memoir of 267 pages, with 44 plates, upon the species of Cephalopods which have been collected upon the Atlantic coast of the United States, mostly within a few years, by the United States Fish Commission and the United States Coast Survey. It is a monographic account of these animals, accompanied by most excellent plates from drawings by Mr. Emerton. While the bulk of the work is devoted to careful descriptions of the species, the gross anatomy of a number is given and illustrated, and the habits of some of the common species described. Besides the descriptions of gigantic squids and the excellent drawings illustrating them, the point of most interest brought out by the author is the description of the cone discovered by Mr. W. H. Dall in *Moroteuthis robusta* Verrill. It is figured on Pl. XXIII, and thus described by Professor Verrill: "This genus will have, as known characters: A long, narrow, thin pen, terminating posteriorly in a conical, hollow, many-ribbed, oblique cone, which is inserted into the oblique, anterior end of a long, round, tapering, acute, *solid*, cartilaginous terminal cone, composed of concentric layers and corresponding to the solid cone of *Belemnites* in position and relation to the true pen."

This is a most interesting discovery, for we are now able to understand the relation of the cones described as Belemnites, which have usually been homologized with the pen or bone of cuttle-fishes. The Moroteuthis is a gigantic calamary, but the ordinary Belemnites may have been closely related in form to our hooked calamary, and a cone three inches long may have been worn by individuals not over two feet long, and not differing essentially in form from our common Ommastrephes. The cone is present or absent apparently in quite closely allied forms. We wish the author had made a little more of a subject of so much palæontological interest.

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[1] *The Cephalopods of the Northeastern Coast of America.* Parts I, II, 1879–1881. From the Trans. Connecticut Academy of Sciences, Vol. V.

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GENERAL NOTES.

BOTANY.[1]

GORDONIA PUBESCENS L'HER (FRANKLINIA ALTAMAHA MARSHALL).—This tree, so far as I can learn from the records, has not been found in the uncultivated state since 1790, when Dr. Moses Marshall saw it near Fort Barrington, on the Altamaha river, in Georgia.[2] It was first discovered by John Bartram in the course of his travels (as botanist to the king) through the Carolinas, Georgia and Florida in 1765. His son William, then only a lad,

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

[2] See his letter to Sir Joseph Banks, p. 563, in Darlington's "Memorials of Bartram and Marshall."

accompanied his father in his travels. Afterwards, in 1773, William Bartram undertook, in the interests of Dr. Fothergill, of London, a journey through the same region. His book of travels was published in London in 1794. He states that he found it as he journeyed southwards in the summer of '73 near Fort Barrington, where he had seen it ten or twelve years previously as he traveled with his father. After concluding his travels, which extended as far west as the Mississippi, and occupied several years, he returned to Fort Barrington in the autumn of 1778, to collect and send off seeds, roots, etc., of such plants as he had seen in his way. He there found it again in mature fruit, and states that he saw "two to three acres covered with the tree." The seeds collected by the Bartrams were distributed in this country and in Europe, and the trees growing from these seeds are all that we have left of the original discovery a hundred years ago.

In March last I was requested by Professor C. S. Sargeant, who is in charge of the Forestry Department of the Tenth Census work, and also agent for the American Museum of Natural History in New York, to make an effort to rediscover the long lost tree, wood specimens of which were wanted to complete the series of forest trees of the United States for the Government, and also for the museum; to investigate its habits in the wild state, and to learn more of its geographical range. For that purpose I made a visit to Darien about the middle of March. At that time my only guide to the locality was the simple reference in our botanical books—"*found at Fort Barrington, on the Altamaha.*" I supposed at first it was to be sought for in the river swamp, but on consulting Mr. Bartram's Travels and learning more of the topography of the country I became convinced that it was not in the river swamp, it was to be looked for but in the flats and pine land branches.

Barrington stands on the north side of the Altamaha and about 16 miles from Darien, where the river has bluffs on its northern banks, thus throwing the whole swamp on the south side. The road from Darien, the same as it was a hundred years ago, passes mostly through damp, flat pine woods, until within about three miles of the fort, where commences a succession of dry and rolling sand hills, which extend up to the river. The site of the old fort is still to be seen, with its ditches and embankments marking the outlines. It retains the old name, and is now known as one of the ferry crossings of the Altamaha river.

I went up to Darien in company with a friend, traveling the same old road which the Bartrams and Marshall had used. We made diligent search on the way, but could not find it. This season of the year was unfavorable for the search for an unknown tree, as leaves, flowers and fruit had all disappeared. During the summer my friend, who has good knowledge of the flora of that region, went up three times—in June, July and September—making careful examinations along the road and the flats and branches near by, but failed to find it. He saw an abundance of *G. lasianthus* and *Pinckneya pubens* in bloom, but the object of our search could not be found. I made a recent visit to Darien in November. We went together again, making the fifth visit to the supposed locality. The following paragraph from William Bartram's account of his discovery of this tree furnishes the clue by which I was guided in my search. After detailing the events of his journey southward from Philadelphia to Darien he says: "I set off early in the morning (from Darien) for the Indian trading house on the river St. Mary, and took the road up the north-east side of the Altamaha. I passed through a well-inhabited district, mostly rice plantations on the waters of Cat Head creek, a branch of the Altamaha. On drawing near the fort I was delighted at the appearance of two beautiful shrubs in all their blooming graces. One of them appeared to be a species of Gordonia, but the flowers are longer and more fragrant than those of the *Gordonia lasianthus*.

Now this paragraph gives a clue to the situation. 1st. As he journeyed from Darien, it was, of necessity, *on the north side of the river;* 2d. "As I drew near to the fort." This is ambiguous, and may mean a few hundred yards, or even two or three miles, in a ride of 16 miles; 3d. The tree was evidently *in sight from the road, and probably not far off*, so as to be readily seen by any one passing that way; 4th. It was growing in company with another showy, flowering shrub. This other flowering shrub was most probably *Pinckneya pubens* (which was finely in bloom in June and July when my friend went up). The only other showy, flowering shrub which I saw in that region was *G. lasianthus*, and as Bartram knew that very well, the probability of its being Pinckneya is increased.

Now about two miles from the fort, and just at the commencement of the sandhills, the road passes between two pine land branches within 40 or 50 yards on either side, spreading out into flats which approach almost up to the road. Here was an abundance of Pinckneya on both sides, in fact the principal growth, and also the *only specimens seen from the road between Darien and the fort.* I suppose, at a rough estimate, there may have been "two or three acres covered with the tree," as Mr. Bartram states. They are so near the road, and so conspicuous when in bloom, as to arrest any one's attention, and especially one who was looking out for new plants. All the indications seemed to point to the spot as the one where the Franklinia was discovered. If, as I suppose, Pinckneya was the accompanying shrub, it reduces it almost to a certainty, as we saw Pinckneya nowhere else on the route. We stopped here, and my friend and I made a close and exhaustive search on both sides of the road. We saw plenty of *G. lasianthus*, and I gathered seed vessels of Pinckneya, but Franklinia was not to be seen. After satisfying ourselves that it was not there we rode on towards the fort, and then returned from the fifth unsuccessful search.

Whilst in Darien I met Mr. Cowper, a son of Hon. J. Hamilton Cowper, who was well known some forty years ago among scientific men for his culture and refined hospitality, and for the great interest he took in the natural sciences. Mr. Cowper informed me that his father had collected in his grounds all the trees and shrubs indigenous to that section of the country, but *did not have Gordonia pubescens* among them; that he himself had been hunting for it for several years past, having been up frequently to Barrington looking both in the river swamp, on the south side, and in the woods and branches on the north side. I also heard whilst there that a collector of seeds from some Northern house had come on from Florida to hunt for the Gordonia near Barrington, and that he was also unsuccessful.

What are we to think of all this? The two Bartrams and Moses Marshall saw it 100 years ago, without any doubt, for the trees growing from the seeds which they distributed give conclusive proof of its existence at that time, and in considerable quantity, in that locality. Since then it has been lost, even to the people of that region, and, as far as I can learn, has never been seen elsewhere. Was it confined to that single locality, and has it become extinct? This supposition is scarcely admissible without very strong proof. I confess I am at a loss for any explanation of its disappearance. I have thus given a minute and detailed account of my unsuccessful efforts, in the hope that it may assist any future explorer to solve the mystery of *Franklinia altamaha.*—*H. W. Ravenel, Aiken, S. C., Jan. 6, 1882.*

Diatrype disciformis (Hoff) Fr.—It has been noted that the American specimens referred to this species differ somewhat from the common European type, though the difference has not hitherto been considered sufficient to warrant a specific distinction. European specimens from Cooke, Winter, De Thümen and Plowright are on beech, but, according to Fries, it occurs also, though more rarely, on oak and birch. American specimens in Rav. Fungi Car. and F. Americani are on *Magnolia glauca*, on the dead trunks and branches of which it seems to be very common from Southern N. J. to Florida. It is the form on Magnolia of which I wish to speak. In the spring of 1875 I sent specimens of this fungus to Baron de Thümen, who distributed them in his Mycotheca Universalis (No. 359), and afterwards in the Bull. of the Torr. Bot. Club, Vol. VI, page 95, published it as *Diatrype disciformis* Fr. var. *magnoliæ* Thm., noting that it differed in its smaller disk and indeterminate ostiola from the European form. Some years ago I had noticed that occasionally a magnolia trunk would be found on which the specimens of this fungus all presented a concave disk, depressed even below the general surface of the bark with white, dot-like punctures marking the place of the ostiola, and differing so much from the ordinary form that it might readily be taken to be a different species. The asci and sporidia, however, did not differ from those of the more common form.

In the autumn of 1874 a single magnolia trunk was found thickly covered with what was taken to be an old Diatrype, with the disks covered with little circular orange-red tremelloid caps of the same size as the disks and hiding them completely from sight. This was at that time supposed to be a species of Tremella, but it did not show the internal structure of that genus, nor could it be referred to any described species. So the matter remained till last November, when, on a collecting trip in the swamp, I again found a magnolia trunk covered with the little orange-red tremelloid disks. On removing one of these carefully with the point of a knife, behold the concave disk of *Diatrype disciformis* (?) with the white dot-like punctures marking the place of the ostiola! On further examination it was found that on some parts of the trunk the tremelloid disks had already fallen away, laying bare the white punctured stroma of the Diatrype. Another specimen on the same trunk had still further developed into the well-known form of *D. disciformis* var. *magnoliæ*. On looking further there were found a dozen or more trunks, all bearing specimens covered with the tremelloid disks as above described, showing plainly the various stages of development and demonstrating beyond the shadow of a doubt that *D. disciformis* var. *magnoliæ* has in the young state its stroma covered with the aforesaid tremelloid disks. I could not at first see why I had not noticed this before, as the magnolia and the Diatrype in question are very common: but this may be due to the fact that the little tremelloid disks do not long endure, but soon turn black and fall off.

The origin of the fungus is beneath the epidermis, which is soon ruptured and thrown off, revealing the red disk, which soon rises up even with or a little above the surface of the bark, soon after which, as already stated, it also falls off, revealing the true disk of the Diatrype, which, in the different stages of its growth, presents at least three different forms—first, concave and slate color, with white dot-like punctures; then convex and brown, the surface being slightly cracked and the ostiola scarcely visible; and finally the disk becomes black and the ostiola distinctly prominent. When it reaches this stage the asci have mostly disappeared.

It is further to be noted that in the European specimens of *D. disciformis* the epidermis does not adhere to the margin of the disk but forms a loose, free border around it, while in the specimen on magnolia the epidermis is closely adherent to the margin of the disk, and is also split in a stellate manner around it. In view of the facts now stated, it appears to me that *Diatrype disciformis* var. *magnoliæ* is worthy of specific distinction, and I have prepared specimens to be distributed in the next Century of North Am. Fungi, under the name of *Diatrype tremellophora*.—*J. B. Ellis, Newfield, N. J., Jan. 3, 1882.*

Botanical Notes.—Dr. Sternberg has seen "prehensile filaments" of protoplasm in a species of Navicula, and is thus able to confirm Dr. Wallich's views as to the motions of diatoms. In a letter to the *American Monthly Microscropical Journal* he says: "I have seen them frequently in certain diatoms [Navcula] found in abundance in the gutters of New Orleans." He used a 2-5 per cent. solution of iodine for suddenly killing and staining the filaments.——It is announced in English journals that B. D. Jackson, Secretary of the Linnean Society, will shortly bring out a new edition of Steudel's *Nomenclator Botanicus.*——Dr. Thurber is to publish a new edition of "American Weeds and Useful Plants," and asks for notes upon new weeds, directing attention especially to the aggressive grasses. Specimens are desired, and should be sent to 751 Broadway, New York.——S. E. Cassino, of Boston, announces for publication, at an early date, "A Manual of the Mosses of the United States," by Leo Lesquereux and Thomas P. James. It will contain nine or ten copper-plates illustrating the genera.——The same publisher announces also a "Manual of the Lichens," by Professor Tuckerman.——A. H. Curtiss' Fascicle v. of his southern plants is one of the most interesting yet sent out by him. Several of the specimens represent new species, some of which are curious. Some are new to our flora, as *Catesbæa parviflora*, a remarkable shrub from Southern Florida. This year (1882) Mr. Curtiss intends to spend in collecting in the Smoky mountains of East Tennessee.——M. E. Jones, of Salt Lake City, has recently sent out his catalogue of specimens of California Plants, to be issued in fascicles. Many interesting species are represented, and this, with the low price ($30 per fascicle of 500 species), will make these sets very desirable.

ZOOLOGY.

Nesting Habits of the Horned Lark.—In the November number of the Naturalist, Mr. Aldrich, of Webster City, Iowa, notices the finding of a bird's nest with eggs, near the Agricultural College, on the last day of March, which he ascribes to the snow-bunting *(Plectrophanes nivalis)*. In this he must be mistaken, as no bird of that species probably ever nested within a thousand miles of Iowa. There are, I believe, only two records of its breeding in the United States, and both of those were in New England. The bird to whom the nest that he discovered really belonged, was probably the horned lark *(Eremophila alpestris)*. This bird habitually winters in Iowa in great numbers, and many remain to breed, which they always do very early in the season, with little apparent regard to temperature. Professor Arthur, of Charles City, Iowa, tells me that he has seen the snow blowing over the nest and mother-bird when the weather was as severe as midwinter. Some specimens that I shot in February and dissected, showed by the condition of the sexual organs, that the breeding season was at hand, in fact they were evidently mating when killed. I will add that a short time after Mr. Aldrich's visit I obtained for the college museum a nest with eggs from that same "little knoll" of which he speaks, while another nest was found with young, which was very likely the one that he saw, which may satisfy him that the bird had made no mistake.—*F. E. L. Beal, Ag. College, Ames, Iowa.*

NOTES ON SOME FRESH-WATER CRUSTACEA, TOGETHER WITH DESCRIPTIONS OF TWO NEW SPECIES *(Continued).* — *Crangonyx gracilis* Smith. — (*C. gracilis* Smith S. I., Crustacea of the Fresh-waters of the U. S., Report U. S. Fish Commission for 1872–3, 654; S. A. Forbes, Bulletin Illinois Museum Nat. Hist., No. 1, 6.) Numerous specimens of the Western variety of this species were obtained in the ponds and slow streams around Irvington during the winter and early spring of 1879–80. They differ in no appreciable way from specimens of the same species obtained at various localities in Illinois.

Crangonyx mucronatus Forbes.—(*C. mucronatus* Forbes, S. A., Bull. Ills. Mus. Nat. Hist., No. 1, 6.) Two males of this curious species were obtained from a well in Irvington during the latter part of the year 1879. On the anterior edge of the sternal portion of each of the last two thoracic segments, I have observed two appendages, no mention of which is made in the original description cited above. They call to mind the appendages mentioned by Prof. S. I Smith (op. cit. 647) as occurring on some of the anterior segments of *Pontoporeia hoyi.* In form these appendages are elongated, oval, and pointed. They are as long as the branchial sacs, or longer, and seem to be corneous. They may occur on the sternal portion of other of the thoracic segments; but in the very few specimens that I have had the opportunity to examine, I have not observed this.

Asellus communis Say.—(*A. communis* Smith, S. I., op. cit. 657 *A. militaris* Hay, O. P., Bulletin Ills. Mus. Nat. Hist., No. 2, 90.) This species is very common in the streams about Irvington, during the early months of spring. I am now pretty well convinced that the form that I described as cited above is the same as the Eastern species. It differs certainly from Eastern specimens in the armature of the hand, in the form of the genital plates, in size, and in some other respects; but I do not believe that these characters are sufficiently marked and constant to enable us to found species on them. The specimens obtained at Irvington differ in the details of the hand and genital plates from all others that I have seen; but these differences are accompanied by no others of importance. As I now recognize this species, it extends in its distribution from Massachusetts and Connecticut on the east to the Mississippi on the west, and to Central Mississippi on the south. About the middle of August of the present year I was at Jackson, Miss., collecting fishes and, incidentally, other animals. While engaged in searching in the mud and among the fallen leaves in a pool formed by a spring along the Pearl river, I found some specimens that prove to belong to *Asellus communis.* The individuals are all of small size, none exceeding about 7^{mm} in length. That they are mature, however, is shown by the fact that several of the females bear numerous eggs beneath their oostegites. They appear almost as pigmies beside the Illinois variety, *militaris.* The discovery of these specimens in this locality shows that this species has a very wide geographical distribution.

Mancasellus tenax Harger.—(*Asellus tenax* Smith, S. I., Amer. Jour. Sci., 1871, 453. *Asellopsis tenax* Smith, S. I., Freshwater Crustacea U. S. 659. *Mancasellus tenax* Harger, Amer. Jour. Sci., 1876, 304.) Along with the species of *Asellus* mentioned above as occurring in the neighborhood of Irvington, and in equal abundance, is found *Mancasellus tenax.* It was originally described from specimens obtained about the great lakes of Michigan, and I am not aware that it has hitherto been noticed anywhere else. The specimens that I have collected here apparently belong to Mr. Harger's variety *dilata;* but are in some respects different both from this variety and from the typical forms. The flagellum of the antennæ may have as many as forty-five segments. The propodite of the first thoracic foot is oval, swollen, and armed with three teeth, being in these features like *dilata,* but differing in that the larger tooth is the one at the posterior angle, instead of the middle one. This largest tooth is fully one-third as long as the dactyl. There is a prominent lobe or tooth on the concave side of the dactyl, about the middle of its length. On the outer surface of the mandible I have observed a small tubercle, situated apparently in a slight depression and armed with a hair. This I have been inclined to regard as a rudiment of the mandibular palpus.

Eubranchipus vernalis Verrill.—(*Eubranchipus vernalis* Verrill, A. E. ——— ——— Packard, A. S., Jr., Hayden's Rep. Geolog. and Geog. Sur., 1874, 622.) Large numbers of this crustacean, so interesting on account of its curious form and structure, its habits, its beautiful colors, and its graceful movements, were taken from ponds in Irvington, during the winter of 1879–80. During this period the weather was unusually mild, and the waters remained unfrozen during the greater part of the season. About the first of December I caught a single specimen of what was evidently an Eubranchipus. It was but partially developed, and I supposed that it would turn out to be *E. serratus* Forbes. On the 10th of January I collected several full grown specimens of the same animal in the same pond, and a careful examination showed that they belonged to Professor Verrill's *E. vernalis.* The ponds in which I have taken specimens here are, some of them at least, dried up every summer. Not many individuals could be captured by merely sweeping the net through the water; but when it was used to stir up the soft mud at the bottom, they could be taken in great numbers. In the March number of Vol. XII. of the AMERICAN NATURALIST occurs a note by Professor A. S. Packard, Jr., stating that this species had been captured at Danvers, Mass., Jan. 10, 1878, and had been seen even earlier. So far as I am aware, no one has hitherto reported this species as having been observed outside of Massachusetts and Connecticut. —*O. P. Hay, Irvington, Ind.*

ALBINISM IN A CRUSTACEAN. — To-day I found under a log an albino specimen of *Porcellio.* It was of a uniform yellowish white color, and was among other sow-bugs of the ordinary gray and brown colors. It is the only one I have ever seen.—*Henry Ward Turner, Ithaca, New York, Dec. 18th, 1881.*

May 23, 1881.

LONGEVITY OF THE TURTLE.—Enclosed I send you a slip cut from "*The Clayton Independent,*" published at Clayton, N. Y., Sep. 8th, 1881. The article was copied by some of the local papers in that vicinity, viz: "*Watertown Times,*" and "*Watertown Reformer.*" For the truth of these statements I can vouch so far as the matter concerns myself. A. D. Percy is a brother-in-law of mine and a gentleman to be relied upon. At the second capture the first markings were not very distinct, but sufficiently so to be easily read. Very truly yours,

C. D. ABBEY,

Principal of the High School, Wausau, Wisconsin.

"In 1864 C. D. Abbey found a large mud turtle on his father's farm, and cut his name and the date on the shell and then put it into the river. In 1874 he found the same turtle near the same place and again cut his name and date in the shell and then released it. Last Friday the same turtle made its appearance, and A. D. Percy cut his name on the back, and placed it in the river, when it started directly for Canada, evidently displeased with such treatment."

HABITS OF THE BORING SPONGE.—N. Nassonon finds, states the Journal of the Royal Microscropical Society, that the Clione lives on the shells of living oysters as well as on empty shells. They give off from the surface very delicate pseudopodia-like processes, which pass in all directions into the substance of the shell; these processes may branch, and even anastomose with one another. The author, by placing in the aquarium fine transparent lamellæ of oyster shells, saw the young Clione push its processes into the calcareous lamellæ; when they had reached a certain depth they united with one another and forced out hemispherical calcareous particles; these were by contraction carried into the interior of the body, and then cast to the exterior. The ectoderm is reported to consist of flat, colorless epithelial cells, with processes by means of which the cells are connected together; the mesoderm is formed by a mass of layers of oval, yellow cells.

Color Sense in Crustacea.—M. Paul Bert has made some interesting experiments on a small fresh water crustacean belonging to the genus Daphnia, from which he concludes that they perceive all the colors known to us, being, however, specially sensitive to the yellow and green, and that their limits of vision are the same as ours; but Sir John Lubbock, says the Journal of the Royal Microscopical Society, as the results of his own experiments with Daphnia under different parts of the spectrum, considers that the limits of vision of Daphnia do not, at the violet end of the spectrum, coincide with ours, but that, like the ant, it is affected by the ultra-violet rays.

Hairs of the Anterior Antennæ of Crustacea.—S. Jourdain, after a few words on the auditory hairs of this group, proceeds to point out the arrangement and structure of the processes found on these antennules, which were regarded by Leydig as having an olfactory function. Before describing the arrangements which obtain in the representatives of different orders, he says that in all cases we find a very delicate chitinous sheath, which is penetrated by an offshoot from the hypodermic layer, and which at its base is found to be in relation with a branch of the antennary nerve; the free end is truncated and carries a hyaline body, which appears to be comparable to the rods found at the sensory ends of sensory organs. These may be known as the "poils á bâtonnet." The hairs are cylindrical in some cases, and then the chitinous cylindrical sheath is made up of a number of joints; the basal ones have thicker walls and are shorter than those which are more distal. In other cases the hairs are *stipitate*, and then the joints are ordinarily reduced to three, and the basal one, which is of some length, is constricted in its middle. A detailed study shows that the former arrangement is confined to the Podophthalmate crustacea; the hairs are found in the young, though in less number than in the adult; and, similarly, they are more numerous in the higher than in the lower forms. Although there seems to be no doubt that these organs respond to stimuli which are something else than tactile, we are not yet in a position to definitely assert that they have an olfactory function. The author concludes by remarking that the characters of these parts have a value for the systematist.—*Journal of the Royal Microscopical Society.*

Bythinia tentaculata.—My friend, Mr. Henry Prime, has just called my attention to an error in The Naturalist for September, 1881 (p. 716), in introduced species of shells. Instead of W. H. Ballou, it should have been W. M. Beauchamp, as in the notice to which reference was made.

Permit me to make a little fuller statement about this shell. I met with it in great numbers at Oswego in June, 1879, and finding no description of an American shell corresponding to it, referred the matter to Dr. James Lewis, who was equally puzzled with myself until he saw the shell. He at once pronounced it a Bythinia, the first he had known in this country, and thought it *B. tentaculata* Linn., but, as it varied locally, he was not sure but it might prove a new and native species. Mr. Tryon at once pronounced it *B. tentaculata*, but it is interesting for comparison with the European shell.

Dr. Lewis had successfully colonized Western mollusks in the Mohawk river and Erie canal, and I sent him several hundreds of this species for that purpose. How they have thriven I do not know. I put some in the Seneca river, but have seen none of them since, and think they require still waters. In the Erie canal at Syracuse, west of the Oswego canal only, there are a good many. At Oswego they adhere to the wooden piers and stones near the mouth of the river, and I found them nowhere else there.

Soon after these shells were brought to Dr. Lewis' notice he showed some of them to Mr. Charles E. Beecher, of the New York State Cabinet, and found that he had frequently observed them in the canals near Albany, but had mistaken them for another native shell. Mr. B. certainly saw them before I did, though I happened to report them first. Dr. Lewis thought this species would spread rapidly, and it seems inclined to follow the canals, but not the streams. In ponds it would probably increase fast. Although it must have reached Oswego and Troy by way of the St. Lawrence, I am unable to learn of its presence on that river, or in Lake Champlain.—*W. M. Beauchamp.*

Zoological Notes.—The species of orangs, which have been placed at from one to four, have been examined by Mr. F. O. Lucas, of Professor Ward's establishment, who reports in the Proceedings of the Boston Society of Natural History that all four forms must be referred to one.——Professor Ward has returned from a collecting journey to New Zealand and Australia with a large collection of marsupials, Ornithorhynchus, specimens of Echidna from New Guinea, and of Hatteria from New Zealand. His account of the habits of the latter very rare lizard, given in Ward's Natural Science Bulletin for January 1, is well worth reading.——The mollusca of H. M. S. *Challenger* are being described in the Journal of the Linnæan Society, London, in a a series of papers, by Rev. R. B. Watson, of which we have thus far received eight parts. The deep sea mollusks of the Gulf of Mexico and the Caribbean sea obtained by the U. S. Coast Survey steamer *Blake* have been described by Mr. W. H. Dall in Bulletin No. 11, Vol. IX, of the Museum of Comparative Zoölogy, at Cambridge, Mass. The collections made by the *Blake* in one winter

(1877–78) is very rich, containing perhaps three times as many species as the results of the whole three years' voyage of the *Challenger*.

ENTOMOLOGY.[1]

LIST OF NORTH AMERICAN CYNIPIDÆ.

Genus 4. RHODITES Hartig.
- *verna* O. S.
- *radicum* O. S.
- *bicolor* Harris.
- *dichlocans* Harris.

Genus 9. PERICLISTIS Forst
- *sylvestris* O. S. = *Aulax sylvestris* O. S.
- *pirata* O. S. = *Aulax pirata* O. S.

Genus 12. SYNERGUS Hartig.
- *lignicola* O. S.

Genus 15. DIASTROPHUS Hartig.
- *nebulosus* O. S.
- *radicum* Bass.
- *cuscutæformis* O. S.
- *potentillæ* Bass.

Genus 17. ANDRICUS Hartig.
- *singularis* B.
- *Osten-Sackenii* B.
- *ignotus* B.
- *californicus* B.
- *concinnus* B.
- *capsula* B.
- *acinosus* B.
- *petiolicola* B.
- *flocci* Walsh.
- *tubicola* O. S.

sub. gen. CALLIRHYTIS Forst.
- *agrifoliæ* B.
- *cornigera* O. S.
- *Suttoni* B.
- *punctata* B.
- *seminator* H.

sub. gen. CALLIRHYTIS Forst.
- *similis* B.
- *futilis* O. S.
- *tumifica* O. S.
- *scitula* B.
- *clavula* B.
- *operator* O. S.
- *palustris* O. S.?

Genus 18. CYNIPS (L) Hertig.
- *strobilana* O. S.

Genus 20. ACRASPIS Mayr, nov. gen.
- *pezomachoides* O.S.
- *erinacei* Walsh.

Genus 22. BIORHIZA Westwood.
- *forticornis* Walsh.

Genus 25. LOXAULIS Mayr, nov. gen.
- *mammula* B.

Genus 27. HOLCASPIS Mayr, nov. gen.
- *globulus* Fitch
- *duricoria* B.
- *rugosa* B.

Genus 28. DRYOPHANTA Forst.
- *gemula* B.
- *nubila* B.
- *bella* B.
- *polita* B.?

Genus 29. NEUROTERUS Hartig.
- *batatus* B.
- *noxiosus* B.
- *vesicula* B.
- *majalis* B.
- *minutus* B.
- *floccosus* B.
- *Rileyi* B.

BIBLIOGRAPHY OF GALL LITERATURE.—The study of galls belongs to the domain of entomology as well as botany, and no one is more capable of reviewing the literature on the subject than Dr. Fr. Thomas, of Ohrdruf (Germany). Dr. Thomas has for some years past prepared the chapter, "Durch Thiere erzeugte Pflanzengallen" (Galls produced on plants by animals) of the Botanischer Jahresbericht, and we have just received his report from Vol. VII of that periodical. This latest record comprises the literature of the year 1879, including a few publications of the year 1878, not mentioned in the Jahresbericht for 1878, and is arranged as in the previous volumes; the titles are first given alphabetically by authors, a key to the subjects treated

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

of follows, and finally the review is given of the publications. There are 107 publications recorded in this volume, of which number more than one-third treat directly or indirectly of the grape Phylloxera. The record is an evidence of the increasing interest felt in this branch of natural history. The most important contribution of the year 1879 appears to have been L. Courchet's "Etude sur les galles produites par les Aphidiens."

A NEW DEPREDATOR INFESTING WHEAT-STALKS.—Under the title of *Isosoma allynii*, Professor G. H. French, of Carbondale, Ill., describes what he believes to be a new wheat pest, in the *Prairie Farmer*, for Dec. 31, 1881. He has been kind enough to send us types of this new species, which, as we suspected from the description, prove to be not Isosoma, but a species of Eupelmus parasitic doubtless on some of the wheat-stalk feeders and probably on some species of Chlorops. A detailed description published in the *Canadian Entomologist* (Jan., 1882) of this "*Isosoma allynii*," shows also that Professor French drew it from the Eupelmus. The error would have less significance but for the existence of a true Isosoma affecting wheat much in the manner related by him, and undescribed.

We have been studying this last insect for nearly two years past from specimens received from Tennessee and Missouri. The larvæ were first received in June, 1880, passed the winter in the pupa state, and issued as adults in March and April, 1881. Specimens received the present season have issued in December, induced doubtless by the long protracted warm weather which generally prevailed in those sections. Although congeneric with the Joint-worm *(Isosoma hordei)* of Harris and Fitch, it differs widely from the latter in habits and appearance. The Joint-worm forms a gall-like swelling at a joint near the base of the stalk, while the species under consideration feeds on the interior of the stalk between the joints higher up without causing a swelling. The adult insect is more slender and much more hirsute than is the joint-worm fly, and is perfectly smooth upon the dorsum of the thorax, while the latter presents a marked punctation; moreover, the customary pronotal spot in the new species is large and yellow, while in *hordei* it is almost indistinguishable. We have recently characterized the insect in the *Rural New Yorker*, and append the following description:

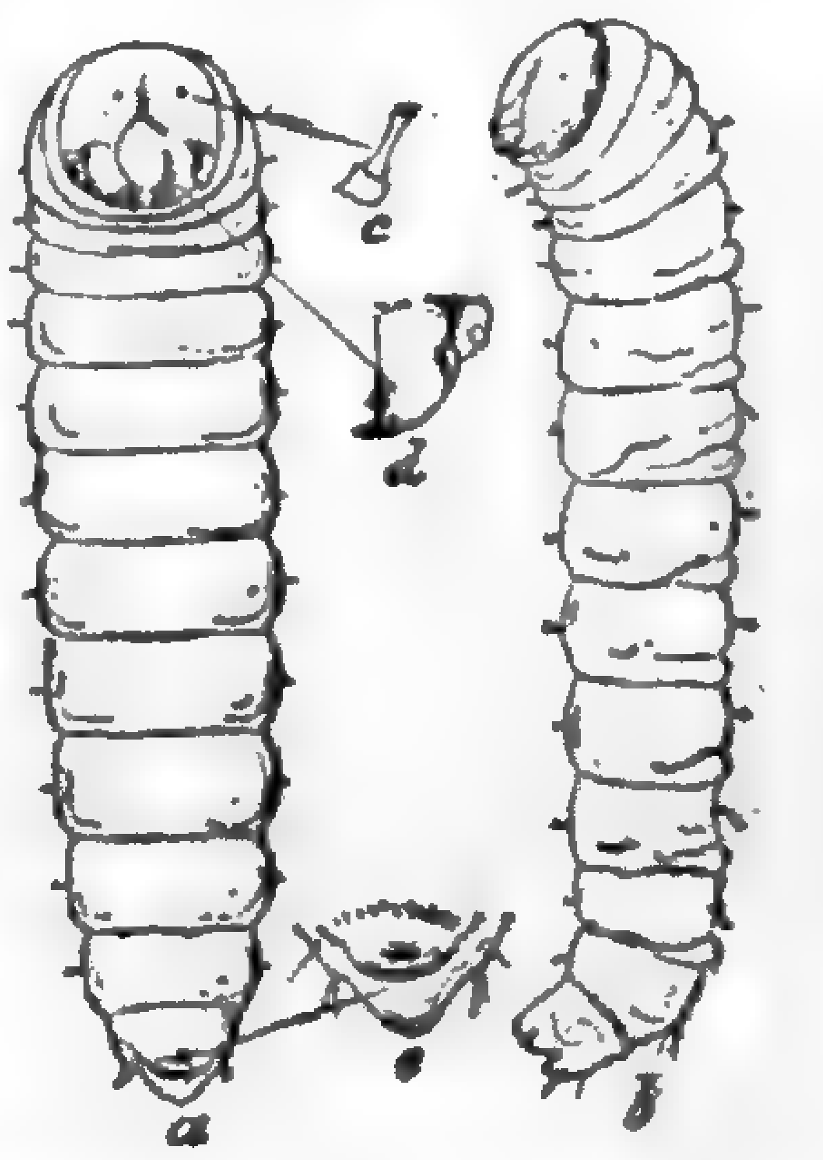

FIG. 1.—Larva of *Isosoma tritici* Riley. *a*, ventral view; *b*, side view; *c*, antenna; *d*, mandible; *e*, anal joint beneath.

ISOSOMA TRITICI, n. sp. *Female*.—Length of body, 2.8 mm. Expanse of wings, 4 mm. Greatest width of front wing, 0.7 mm. Antennæ sub-clavate, ¾ the length of thorax. Whole body (with the exception of metanotum which is finely punctulate) highly polished, smooth and sparsely covered with long hairs most dense toward end of abdomen. Color, pitchy-black without metallic luster, the scape of antennæ, occasionally a small patch on the cheek; mesoscutum, femoro-tibial articulations and tarsi (except last joint) tawny; pronotal spot large, oval and pale yellowish in color. Wing veins, dusky-yellow, and extending to beyond middle of wing; submarginal three times as long as the marginal, postmarginal very slightly shorter than marginal, and stigmal also shorter than marginal.

Described from 24 ♀ specimens; ♂ unknown. Of these 24 specimens only one was fully winged, two were furnished with hind wings only, while the rest were wingless.

It is worthy of remark that the species seems to be quite closely related to the European *Isosoma linearis.* This species was bred from wheat by Dr. Giraud, who considered it inquilinous in the swellings formed by the Dipterous *Octhiphila polystigma* of Meigen. Kaltenbach remarks, however, that although obtaining the Isosoma many times from the wheat, he never succeeded in seeing the Dipteron—a very suggestive fact.

Walker (Notes on Chalcididæ, p. 7) states, in reference to the "humeral spot" that although present in all European species of Isosoma, it is absent in American and Australian representatives of the genus. In *tritici*, however, it is a prominent feature of the markings, and even in *hordei* it is as evident as upon the European *I. verticellata* which we have from Walker himself.—*C. V. Riley.*

* FURTHER NOTES ON THE IMPORTED CLOVER-LEAF WEEVIL *(Phytonomus punctatus).*—During a recent visit to our friend, Dr. LeConte, in Philadelphia, we learned that he had received a beetle from Canada, as long ago as 1853, from Mr. D'Urban, who was then connected with the geological survey of that country, and another specimen from the late Dr. Melsheimer, from Pennsylvania, and that these specimens had been described by him as *Phytonomus opimus* (Rhynchophora, p. 124). He had recognized, from what we had published in the NATURALIST, regarding *Phytonomus punctatus*, that his *opimus* was identical, and upon receiving specimens from us he wrote that after a careful examination there was no doubt in his mind as to the identity of the two species. *Ph. punctatus*, in its typical and most common form, is so easily recognizable by its coloration (the suture and margins of the elytra being yellowish-white) that one would not suspect its identity with *Ph. opimus* from the description of this last. It would appear, however, that *opimus* is identical with a variety of *Ph. punctatus* described by Capiomont *(Annales de la Société Entomologique de France*, 1868, p. 123), in which the scales of the elytra are almost uniformly gray, and which is not rare in Europe. The specimen from Melsheimer is, moreover, evidently rubbed. It is a strange coincidence that the numerous specimens we collected on Mr. Snook's farm were all identical in coloration with the typical form, and that just those described by Dr. LeConte as *opimus* should belong to a comparatively rare form.

The identity of the two forms once established, it becomes probable that the insect had made a permanent lodgement in this country years ago, and that it was simply overlooked as an injurious insect till the present year. That a beetle is quite liable to be overlooked by coleopterists, although quite injurious to some cultivated plants, is not only probable, but has often occurred. *Coccotorus scutellaris* which injuriously affects the plum; *Tyloderma fragariæ* which depredates on the strawberry plant; and *Hylesinus trifolii* which is so injurious to clover, are examples among many which occur to us of species very common on cultivated plants, yet rare in collections. The same is equally true in other orders of insects. A notable instance is found in the Hessian fly which, though more or less injurious every year in some of our wheat-producing sections, is yet so rare in collections that Dr. Packard had difficulty in procuring specimens to figure for his bulletin on the species.

There is the other alternative, however (which is also not so improbable), that the two specimens that have remained solitary so many years in the largest American collection of Coleoptera, may really have come into the country through European exchanges, especially as it is known that Dr. Melsheimer did, in some instances, mix up European with American species.

It is impossible to say whether this Phytonomus will spread further west or not. The encouraging presumption, however, is, if we may predicate upon analogy, that it will not, since we recall no very injurious beetle introduced from Europe (excluding those feeding upon stored products) which has spread over the whole country, the most prominent examples of such introduced species, *Crioceris asparagi*, *Galeruca xanthomelæna*, etc., being yet confined to the Atlantic coast.

Our experience and observations this winter confirm the opinion already expressed, that this Phytonomus hibernates principally in the young larva state, and that any mode of winter warfare that would crush or burn these larvæ hibernating in the old stalks would materially reduce the depredations of the species the ensuing summer. Clover stubble is, however, not so easily burned in winter, and whether rolling could be advantageously employed will depend very much on the smoothness of the field and other conditions.

As an interesting fact in connection with imported clover enemies we would mention that several species of the Curculionid genus Sitones, especially *S. flavescens* and *lineellus*, which in Europe are injurious to clover and lucern, and which have long since become naturalized in our country, have never been reported here as injurious though they occur quite commonly in some localities.[1]—*C. V. Riley.*

Silk-worm Eggs; Prices and where obtained.—We daily receive applications for silk-worm eggs and inquiries as to where

[1] *Sitones tibialis*, in Europe is a dangerous enemy to young peas, and though likewise introduced into the United States and Canada, does not appear to be injurious in either.

they can be obtained, the number of such applications indicating that interest in silk culture is fast increasing through the country. A small supply of silk-worm eggs will probably be at the disposal of the Department of Agriculture early this spring, and will be distributed upon application. We learn also, from circulars received from Crozier & Co., Bayou Sara, La., that they are prepared to furnish eggs at the following prices: Annual Japanese, $5 per ounce, $1 per 1000 eggs; the best yellow breed, warranted free from disease, $6 per ounce, $1 per 1000. The eggs ought to be ordered early, or else there is great danger of their hatching prematurely while on the way. A few eggs of a special race, fed for eleven years on osage orange *(Maclura aurantiaca)* by the editor, will be sent to a limited number of applicants who desire to feed with this plant, upon application to him.

ANTHROPOLOGY.[1]

Professor Rau on Cup-shaped Stones.—The distinguished curator of the archæological treasures of the National Museum has just published a paper upon cup-shaped and other lapidarian sculptures in the Old World and in America, which will form a part of Volume v. in Major Powell's series of Contributions to North American Ethnology. This monograph is in 4to, and consists of 102 pages of printed matter, illustrated by 61 figures on tinted paper.

In archæology, as in natural history, form and function have to be studied separately, and each class of objects may be considered from the point of view of either. Furthermore, in all anthropological investigations analogies are to be distinguished from homologies. The work under consideration treats of a certain form in ancient sculpture, occurring in very interesting connections in various parts of the world, viz., certain cup-shaped excavations called *pierres à écuelles* in French, and *Schalensteine* in German. Part I. is taken up with a comprehensive review of the work of Professor E. Desor, entitled "Les Pierres à Ecuelles" (Genève, 1878); that of Sir James Y. Simpson entitled "Archaic Sculptures of Cups, Circles, &c., upon Stones and Rocks in Scotland, England, and other Countries" (Proc. Soc. Antiq., Scotland, 1867); Mr. J. H. Rivett-Carnac's "Prehistoric Remains in Central India" (Calcutta, 1879); and scattered references to these sculptures occurring in Scotland, England, Ireland, France, Switzerland, Germany, Austria, Denmark, Sweden, and India. One-half of the illustrations are taken from the works above mentioned.

Professor Rau is very careful, while describing and figuring excavations very similar in form and grouping, to keep in view the fact that slight differences in detail combined with great differences of location may point to widely separated functions. In-

[1] Edited by Professor Otis T. Mason, 1305 Q. street, N. W., Washington, D. C.

deed the *mahadeos* and *yonis* of India can hardly be said to have had their counterparts in America.

While the first part of the volume exhibits a vast deal of research and painstaking, the truly original portion and that for which a lasting obligation will be due the author, is Part II., relating to cup-cuttings in America. These sculptures occur on hammer-stones, boulders of various sizes, paint mortars, stationary mortars, &c. They are not all alike in execution; some are single, others in groups. The Professor, both in his descriptive portion and in the closing remarks, enters quite minutely into the discussion of functions, and a few of his conclusions are herewith given:

I. The so-called hammer-stones were not flint nappers; many of them show no mark of use as hammers. There is great probability that they were nut-crackers.

II. Many of the pitted boulders were paint mortars, and those with several pits have their analogues in the compound paint cups of the Pueblo Indians.

III. They were not anvils for shaping copper disks.

IV. They were not spindle sockets. Following this discussion is an extended allusion to several large pitted stones, notably one found by Dr. H. H. Hill, of Cincinnati.

V. The deep depressions in large rocks were stationary mortars.

VI. Certain sculptures found in Pennsylvania and elsewhere resemble the cup and ring cuttings of the Old World.

In Part III. Professor Rau discusses the significance of cup-shaped and other primitive sculptures, giving particular attention to Professor Nillson's "Phœnician Baal-worship theory," Canon Greenwell's "map theory," Professor Simpson's "dial theory," and many other speculations. The author is very much inclined to admit Mr. Rivett-Carnac's views respecting the "reciprocal principle" in many European examples. The question as to the authorship of the sculptures is also considered, as well as the superstitions connected with them, and the evidence afforded by them of migrations from the Old World to the New.

MEXICAN ANTHROPOLOGY.—The fourth and fifth parts of *Anales del Museo Nacional de Mexico* contain the following papers relative to this department:

Codice Mendozino: Ensayo de descrifacion geroglifica, por el Sr. D. Manuel Orozco y Berra. (Continuacion) pp. 223–232.

La Piedra del Sol: Estudio arqueologico, por L. Sr. D. Alfredo Chavero. (Continuacion) pp. 234–266; 291.

Mitos de los Nahoas, por el Director del Museo, Sr. D. Gumesindo Mendoza. pp. 271–278; 315–322.

Dos Antiguos Monumentos de Arquitectura Mexicana, ilustrados por el P. Pedro José Marquez. Tracudido para los "Anales del Museo," por F. P. T. pp. 279–290.

Anales de Cuauhtitlan, appendix, 33–40; 41–48.

THE IMPLEMENTS OF THE TRENTON GRAVELS.—Mr. Henry W. Haynes, of Boston, read a paper before the Boston Society of Natural History last January upon the argillite implements found in the gravels of the Delaware river, &c., compared with the palæolithic implements of Europe. The communication is published in Vol. XXI of the Proceedings. The author comes to the following conclusions: The objects have come from the gravel beds of the Delaware valley, and only occasionally have they been found upon the surface. They show incontestable marks of human workmanship. The general appearance of the country is similar to that of the palæolithic gravels of the Old World. Dr. Abbott has sent us a pamphlet reprint from the Society's Proceedings reviewing the whole subject.

ANTIQUITIES OF NEW MEXICO AND ARIZONA.—Dr. W. J. Hoffman, of the Bureau of Ethnology at Washington, sends us a revised edition of a pamphlet on the above named subject, which first appeared in the Proceedings of the Davenport Academy of Natural Sciences. The author has had a great deal of experience in the Indian country as a physician, is a man of great tact and address, and has been connected with the government surveys for a long time. We have in the brochure before us an excellent epitome of our knowledge of the Pueblos. The subject of glazed pottery is treated at length and several analyses given. On the subject of crania and deformations the treatise is especially full and the bibliography invaluable.

ASIATIC TRIBES IN NORTH AMERICA.—From the Proceedings of the Canadian Institute, we are in receipt of a brochure of 38 pages from the pen of Professor John Campbell, on the Asiatic Tribes of North America. In this the author indicates the origin of three Indian families: the Tinneh or Athabascans, the Iroquois, and the Choctaws. The Tinneh family are associated with the Tungusians of Siberia and Northern China, and the Iroquois and Choctaws (who with the Cherokees are simply disguised Iroquois) with the populations of Northeastern Asia, classed by Dr. Latham as Peninsular Mongolidæ. With respect to the Tinneh, Professor Campbell, at the close of his argument remarks, "Certainly, no two families representing the Old World and the New present closer affinities in name, vocabulary, grammar, physical appearance, dress, arts, manners and customs, than do the Tungus of Asia and the Tinneh of America."

Under the term Choctaw is included the entire Muscogee family, together with the Cherokees, the Choctaws representing the Tehuktchi or Tshekts, and the Cherokees the Koriaks or Koraeki. The Tuscaroras of the South are taken as the oldest and purest form of the Wyandot-Iroquois and through them the last named family are brought into relationship with the Choctaw-Cherokee, and by this path with the Koriak in Northeastern Asia.

Anthropology in France.—The unusual amount of matter relating to our own country precludes giving more than a brief outline of what is doing abroad. The *Bulletins de la Société d' Anthropologie de Paris* reports the following discussions in the 1st fasciculus for 1881:

Bordier, M.—Calotte cérébrale d'un Esquimau, p. 16.
Chudzinski, M.—Splanchnologie d'un orang, p. 19.
Vinson, Jules.—Procédé de calcul du jeune Jacques Inaudi.
Soldi, Emile.—De l'emploi du fer en Egypte pendant les premières dynasties, p. 34.
Tenkate, H. F. C.—Crânes de musée de Leyde, p. 37.
De Torok, A.—Crâne du jeune gorille de musée Broca, p. 46.
Bordier, A.—Rapport sur un mémoire de M. Petitot, p. 57.
Hayem, Professor.—Du sang au point de vue anthropologique, p. 72.
Millet, —.—Menhirs et bassins taillés dans le grès en Algérie.
Rabourdin, Lucien.—Age de pierre dans le Sahara central, pp. 115–160,

The Revue d'Anthropologie, vol. IV., part IV., contains the following original papers and reviews:

Broca, Paul.—La torsion de l'Humerus et le tropomètre, p. 577.
Quatrefages, M. de.—Les voyages de Moncatch-Apé, p. 593.
Ledouble, M.—Sur certain muscles communs aux animaux et a l'homme, p. 635.
Nadaillac, M. de.—La poterie chez les anciens habitants de l'Amérique, p. 639.
Hervé, Georges.—Du poids de l'encéphale, pp. 681–698. [A review of "Das Hirngewicht des Menschen; eine Studie," von Th. von Bischoff, Bonn, 1880, and "Sul peso del cervello dell'uomo," studio di Giustiniano Nicolucci, Napoli, 1881.]
Zabarowski, —.—Revue prehistorique. [Includes the following works: Emile Soldi's "Les arts méconnus;" Dr. Nehrings's "Nouvelles fouilles dans le diluvium de Thiede," and other works of a more local character.]
Topinard, Paul.—Revue des livres. [Résumé of recent literature upon the aborigines of Australia.]
Manouvrier, L.—Review of French and Italian journals.
Deniker, —.—Review of Dr. Hortel's "De la queue chez l'homme."
Vars, Ed.—Revue russe. [Examines M. Bogdanoff's craniological works.]

At the close of the number is an extended bibliography, too long to be reproduced here; but the important titles will appear in the next Smithsonian Annual Report.

Correction.—By an oversight, for which we are extremely sorry, the title of the paper by Professor Cyrus Thomas on the Manuscript Troano, read at the American Association, was omitted from the list.

GEOLOGY AND PALÆONTOLOGY.

Marsh on the Classification of the Dinosauria. — Professor Marsh regards the group as a sub-class, and divides it into five orders, viz.; *Sauropoda*, *Stegosauria*, *Ornithopoda*, *Theropoda* and *Hallopoda*; the first three herbivorous, the last carnivorous. The *Sauropoda* include *Atlantosaurus*, *Camarasaurus*, *Cetiosaurus* and other forms having five digits on each of the limbs, and limbs nearly equal; *Scelidosaurus*, *Hylæosaurus* and others having also twenty digits, but with small fore limbs and a post-pubis, form the order *Stegosauria*; *Camptonotus*, *Laosaurus*, *Iguanodon*, etc., having five digits in manus and three in pes, with small fore limbs, are included in the *Ornithopoda*; while *Megalosaurus*, *Altosaurus*, *Zanc-*

lodon, *Amphisaurus*, and other species with digitigrade feet, small fore limbs, and prehensile claws, form the order *Theropoda*, which has also two sub-orders—*Cœluria* and *Campsognatha*. The *Hallopoda* are doubtfully referred to the sub-class, and have the hind feet specially adapted for leaping.

In the preparation of his papers on this subject Professor Marsh has had very extensive material, and has had excellent opportunities for investigation. He had added more to our knowledge of this division of reptiles than perhaps any other single person. His demonstration of the structure of the pelvis in various genera, of the feet in many forms, including *Campsognathus*, and the discovery of the clavicle in *Iguanodon* and other genera, are among the most important points gained. It is, however, not evident that the Dinosauria constitute a group of higher rank than an order, or that the subdivisions proposed by Professor Marsh are of higher rank than sub-orders or families.

The "personal equation" is observable in this work, in as marked a degree as in any of Professor Marsh's papers. This is is seen—

First. In his failure to characterize his genera on first publishing them—a proceeding which is apparently intended to warn others off the field. The publication of *nomina nuda*, without the definitions which enable others to use them, is, to say the least, very inconvenient to cotemporary students.

Second. In his failure to recognize the labors of others, except to point out supposed errors. Thus three of his orders had received names long before Professor Marsh wrote, and had been defined, less completely, it is true, but, as far as the material went, correctly. Thus his Sauropoda was named by Owen, in 1841, *Opisthocœla*; his Ornithopoda by Cope, in 1869, *Orthopoda*; and his Theropoda by Cope, in 1869, *Goniopoda*. The numerous genera described from the American Jurassic by American authors, are all ignored or stated to be founded on error.[1] Some of them are identical with those proposed by Marsh, and of earlier date.

Thirdly. In his failure to credit others with their discoveries, and permission of the inference that they are his own. Such is the discovery of the hyposphen articulation, by Cope, which he renames the diplosphen. Such is the discovery of the sternum in the Dinosauria, which was made by Cope in the Laramie genus *Monoclonius* in 1877 (Proceedings Philadelphia Academy). His reference of some discoveries to other than their authors is not less frequent. Thus it is well known that Professor Cope first showed the bird-like affinities of some of the Dinosauria, and affirmed

[1]As *e. g.*, *Amphicœlias* Cope, which Marsh states, in effect, was founded on the characters which belong to lumbar vertebræ of other genera, ignoring the fact that other distinctive characters were given at the same time, which are entirely sufficient.

that the bird-like tracks of the Triassic formation were made by Dinosauria, at least a year before Professor Huxley; yet these observations are credited to the latter writer.

It cannot be said in defence of these defects in an otherwise excellent memoir, that the papers in question have been written by Professor Marsh's assistants, since the latter are not made responsible on the title-page.—*E. D. Cope.*

The Dinosaurs of Bernissart[1].—In the year 1878 numerous bones of fossil reptilia were discovered in the St. Barbe mine of the Bernissart coal district, and ultimately several Iguanodon skeletons were taken out from a depth of three hundred and fifty metres, as complete and almost as well preserved as though they had come straight from a slaughter-house. In a notice submitted to the Royal Academy of Belgium, M. Boulenger founds a new species on these skeletons, on account of their possession of six sacral vertebræ instead of five, the number possessed by that in the British Museum. M. P-J. Van Beneden, however, in reviewing M. Boulenger's work, states his belief that the remains belong to the well-known *I. mantelli* of England and Western Europe, and that the difference in the number of sacral vertebræ is merely an individual one. In support of this opinion he cites the facts that another Iguanodon, described by M. Hulke, has only four sacrals, and that the number of sacrals is subject to variation in many animals, especially in birds, the additional ones being taken from the caudal or the lumbar series.

M. Dupont has also written upon the Bernissart Iguanodons, and agrees with M. Van Beneden in referring them to *I. mantelli.* M. Van Beneden adds some interesting particulars relating to the limbs and pelvic arch of Iguanodon.

All palæontologists agree that the Iguanodons had on the hind feet three toes used in walking, but it is not generally known that the metatarsal bones of these three toes were completely separate, alike at both ends, and capable of leaving their imprint upon the soil behind the toes, so that the Iguanodons were plantigrade when compared with most birds, or, to speak more accurately, were *herpetigrade*, like the penguin's.

The fore limbs, which are as little developed as in kangaroos, have five fingers; three middle ones equally developed and having three phalanges, as also has the fifth, and a thumb consisting of a single large phalanx and a rudimentary metacarpal. The fifth finger is small, and opposable to the thumb, so that the Iguanodons had two hands with which to gather the fruits of the cycads and conifers that flourished in the same epoch.

The impressions of the footsteps of these animals, well preserved

[1]Sur l'Arc Pelvien des Dinosauriens de Bernissart; par M. G. A. Boulenger. Rapport de M. P-J. Van Beneden. Bruxelles. Imprimerie de l'Academie Royale de Belgique, 1881.

both in England and in Hanover, teach us that they did not make use of their tail for support, either when walking or when at rest, since up to this time no trace of a caudal impression has been found. This is also what might be inferred from the structure of the processes of the caudal vertebræ and from the tendons, which are so distinctly ossified that with a little trouble the myology of the tail could be made out.

There has been considerable difference of opinion among naturalists as to the homologies of the pelvic bones of saurians, especially with regard to the pubis, which is incomplete and does not take part in the formation of the cotyloid cavity. The pelvic basin of *Comptonotus dispar* (Marsh) is, according to that author, nearest to that of the Iguanodon, but has the post-pubis more bird-like than in the latter.

HULKE ON POLACANTHUS FOXI[1].—Dr. J. M. Hulke has at last given us a description of this species, whose name has been on our lists for some years, but of which it has been impossible to get any information. In proper concession to mnemonic convenience Dr. Hulke has adopted the name given without description by Professor Owen, but the species will stand *Polacanthus foxi* Hulke. The animal is nearly allied to *Hylæosaurus*, and is one of the most thoroughly defended of the Dinosauria. Its body supported huge spines, and its tail was enclosed in an armor of bony plates. The species was large and powerful, but not one of the gigantic forms of the order. It was found in the Wealden of the Isle of Wight by Dr. Fox, who has made so many important discoveries in that region.

RUSSIAN SAUROPTERYGIA.—M. Kiprijanoff has communicated an important memoir on the genus *Ichthyosaurus* to the Imperial Academy of St. Petersburg[2]. The motive for the memoir was found in the discovery of the genus in the Cretaceous greensand of European Russia. This threw the genus into a later geological epoch than its range in Continental Europe had included. The author takes occasion to analyze the species of the genus, a work which will be of great service to extra-European palæontologists in their studies. The Russian species is the *I. campylodon* of Carter. Besides describing the bones of the skeleton, M. Kiprijanoff investigates their histology, and especially the minute structure of the teeth. The plates illustrating this part of the subject are beautiful specimens of art.

THE GEOLOGY OF FLORIDA.—Prof. E. A. Smith, of Alabama, summarizes the geological history of the Peninsula of Florida as follows:

(1.) Since no rocks have been found in Florida older than the

[1]From the Transactions of the Royal Society, London. Part III, 1881.

[2]Studien ueber die Fossillen Reptilien, Russlands von M. Kiprijanoff. I Theil, Galtieng Ichthyosaurus. Mem. de l'Academie Imperiale de Sciences de St. Petersbourg. 1881.

Vicksburg limestone, it follows that until the end of the Eocene period, this part of our country had not yet been added to the firm lands of the continent, but was still submerged.

(2.) During the period of disturbance which followed the deposition of the Vicksburg limestone, Florida was elevated nearly to its present height above the sea-level, which elevation was maintained without material interruption until the Champlain period.

(3.) In this upward movement the axis of elevation did not coincide with the present main dividing ridge of the peninsula, but lay considerably to the westward, probably occupying the position very nearly of the western coast of to-day.

(4.) After the Miocene (or possibly the Pliocene) period, there was again an elevation of Florida, as is shown by the presence of a Miocene limestone of the eastern slope of the peninsula, some distance (not less than thirty feet) above the present sea-level.

(5.) We have evidence in the distribution of the beds of the Champlain period (stratified drift of orange sand) that Florida and parts of the adjacent States were during this time submerged sufficiently to allow the deposition over them of a mass of pebbles, sand and clay, varying in thickness from a few feet to two hundred. From the peculiar mode of stratification of most of these beds, it is concluded, with reason, that they were sediments from rapidly-flowing, ever-varying currents. In the State, the beds of yellow and red loam lie directly upon the stratified drift. These beds of loam are devoid of stratified structure, as well as of fossils. and were probably deposited from slowly running or nearly stagnant waters.

(6.) Following the submergence during the Champlain period, was a re-elevation, which brought the peninsula to approximately its present configuration.—*Scientific News.*

Geological News.—The Trans. N. Y. Acad. of Sciences contain a paper by Mr. J. H. Purman upon the "Geology of the Copper Region of Northern Texas and the Indian Territory," giving the first accurate description of the geological structure of the district.——S. A. Miller (Jour. Cincin. Soc. Nat. Hist.) concludes his article on Mesozoic and Cænozoic Geology by considering the "Drift of the Central Part of the Continent." He describes the character of these deposits, their situation, altitude, magnetic bearings, fossils, etc., and concludes by the assertion that the facts collected tend to prove that "there is no marine or other deposit which represents a glacial period." In a second paper he describes two new crinoids from the Niagara group, and two new shells.——In the Geneva Archives des Sci. Phys. et Nat., July, 1881, Mr. F. A. Forel has an important article on the periodical variations of glaciers, based upon observations in the Alps. The Rhone glacier has retreated from 1857 to 1880 at a rate varying from twenty-three to seventy-one metres annually. The retreat or advance of a glacier depends "on changes of long periodicity in meteorological conditions—heat, moisture, winds."——In the *Am. Journal of Science* Dr. R. W. Coppinger has some interesting observations upon the movement of the soil-cap on the shores of Western Patagonia. Evergreen forests and brushwood cover the shore hills to a height of one thousand feet, and gravitation, acting on this mass of vegetation and the soil beneath, resting on a surface already planed by ice-action, causes the whole to slide downward to the water, which removes its free edge in much the same way that the end of a Greenland glacier is removed.——The Report on the Geological and Natural History Survey of Minnesota, for 1880, contains a descriptive list of rocks, descriptions of three new Lower Silurian Brachiopods, and a note on the Cupriferous series by Professor Winchell; also an account of the Glacial phenomena of the State and the district north and west of it, by Warren Upham.

GEOGRAPHY AND TRAVELS.[1]

DR. LENZ ON THE SAHARA.—Dr. Oscar Lenz gives in the last number of the *Zeitschrift* of the Berlin Geographical Society[2] an account of the results of his journey across the Sahara, from Tanger to Timbuktu, and thence to Senegambia. The following good abridgement of his paper we take from the *Nature*:

"The real journey was begun at Marrakesh, at the northern foot of the Atlas mountains, where Dr. Lenz laid in his store of provisions and changed his name and dress, traveling further under the disguise of a Turkish military surgeon. He crossed the Atlas and the Anti-Atlas in a south-western direction. The Atlas consists, first, of a series of low hills belonging to the Tertiary and Cretaceous formations, then of a wide plateau of red sandstone, probably Triassic, and of the chief range, which consists of clay-slates with extensive iron ores. The pass of Bibanan is 1250 metres above the sea-level, and it is surrounded with peaks about 4000 metres high, whilst the Wad Sus valley at its foot is but 150 metres above the sea. The Anti-Atlas consists of Palæozoic strata. On May 5, 1880, Dr. Lenz reached Tenduf, a small town founded some thirty years ago, and promising to acquire great importance as a station for caravans. The northern part of the Sahara is a plateau 400 metres high, consisting of horizontal Devonian strata which contain numerous fossils. On May 15 Dr. Lenz crossed the moving sand-dunes of Igidi, a wide tract where he observed the interesting phenomenon of musical sand, a sound like that of a trumpet being produced by the friction of the small grains of quartz. But amidst these moving dunes it is

[1] Edited by ELLIS H. YARNALL, Philadelphia.

[2] Kurzer Bericht über meine Reise von Tanger nach Timbuktu und Senegambien. Von Dr. Oscar Lenz. *Zeitschrift der Gesellschaft für Erdkunde zu Berlin.* Nos. 94, 95, p. 272. It is accompanied by a large map of his route. Scale 1 : 1,500,000. Drawn by Dr. R. Kiepert.

not uncommon to find some grazing places for camels, as well as flocks of gazelles and antelopes. At El Eglab Dr. Lenz found granite and porphyry, and was fortunate enough to have rain. Thence the character of the desert becomes more varied, the route crossing sometimes sandy and sometimes stony tracts or sand-dunes, with several dry river beds running east and west between them. On May 29 he reached the salt works of Taudeni and visited the ruins of a very ancient town where numerous stone implements have been found. Here he crossed a depression of the desert only 145 to 170 metres high, while the remainder of the desert usually reaches as much as 250 to 300 metres above the sea level; and he remarks that throughout his journey he did not meet with depressions below the sea-level. The schemes for flooding the Sahara are therefore hopeless and misleading. The landscape remained the same until the wide Alfa fields which extend north of Arauan. This little town is situated amidst sand-dunes devoid of vegetation, owing to the hot southern winds. Four days later Dr. Lenz was in Timbuktu, whence he proceeded west to St. Louis. During his forty-three days' travel through the Sahara Dr. Lenz observed that the temperature was not excessive; it usually was from 34° to 36° Celsius, and only in the Igidi region it reached 45°. The wind blew mostly from north-west, and it was only south of Taudeni that the traveler experienced the hot south winds [*edrash*] of the desert. As to the theory of north-eastern trade winds being the cause of the formation of the desert, Dr. Lenz remarks that he never observed such a wind, nor did his men; it must be stopped by the hilly tracts of the north.

"Another important remark of Dr. Lenz is what he makes with respect to the frequent description of the Sahara as a sea-bed. Of course it was under the sea, but during the Devonian, Cretaceous and Tertiary periods; as to the sand which covers it now, it has nothing to do with the sea; it is the product of the destruction of sandstones by atmospheric agencies. Northern Africa was not always a desert, and the causes of its being so now must be sought for, not in geological but in meterological influences."

Arctic Exploration.—Up to the middle of June last the edge of the ice extended in an east and west direction at a distance of only sixty to one hundred miles from the coast of Finmark. It trended north-eastward toward Novaya Zemlya, and swept round at a distance of about thirty miles from Matyushin Strait, towards the entrance of the White Sea. With the probable exception of 1867, the ice was then nearer to the northern coast of Norway than it was ever known to be before. After the middle of August the ice disappeared off Novaya Zemlya, and there was probably open water to Franz-Josef Land. It is stated in the Royal Geographical Societies' *Proceedings* that "the collective evidence shows that the prevailing northerly and north-westerly winds of last winter packed the ice in a broad belt across the Spitzbergen and Barent's Seas.

The southern edge of this belt was exceptionally low down along the north coast of Norway, while the northern edge nearly reached the south point of Spitzbergen. The southern pack-edge showed little alteration during May and June, but gave way rapidly when it fairly began to melt—about the beginning of July—as the ice was on the whole of no great thickness. The climatic conditions north and south of the belt seems to have differed considerably during the winter. In the north of Norway heavy falls of snow were unusually frequent, while north of the belt the fall was comparatively slight. So early as the end of June the winter snow had in great measure disappeared even from the highlands of Spitzbergen and Novaya Zemlya, while in the northern part of Norway it lay thickly, down to the very water's edge. On arriving at Spitzbergen the walrus hunters also found vegetation unusually far advanced. Thus since large masses of ice were blown southward during the winter of 1880–1, it is highly probable that the Polar regions were fairly free from ice early in the summer, while the autumn must have offered exceptionally favorable conditions for an advance to the northward or north-eastward. This supposition is strongly confirmed by reports from the walrus grounds northward of Spitzbergen. With regard to the Kara Sea, it seems that it was not accessible from the westward till about the beginning of August. But while a heavy, solid pack extended northward from the Kara Strait along the east coast of Novaya Zemlya, the eastern part of the Kara Sea was certainly free from ice by the beginning of August, and very probably by the middle of July. In August and September, therefore, vessels from Europe could undoubtedly have reached the mouth of the Yenisei."

It is probable the *Eira* took advantage of the disappearance of the ice in August, as mentioned above, to make her way to Franz Josef Land.

Lieutenant Berry, of the *Rodgers*, found the sea becoming deeper as he sailed to the north-eastward from Wrangell Island. His observations off Herald Island indicate that there is no regular current flowing to the north-west, as previously supposed. No perceptible current was noticed at low and high water—the only movement being caused by the tidal action.

The expedition sent out by the Danish Government last summer to Greenland, has returned home. It proceeded to the southernmost part of Greenland and succeeded in circumnavigating the large islands on the southern coast and in determining the exact position of Cape Farewell. Investigations were conducted on the mainland from the Tasermint Fjord on the west coast to the Lindenows Fjord on the east coast.

There are high mountains and enormous glaciers on the west side. The eastern section is of lower elevation, and covered with a layer of ice and snow with the exception of a few mountain peaks.

Mr. Dall, in an elaborate paper on the hydrology of Behring Sea, in *Petermann's Mittheilungen*, concludes that the warm surface water which enters the Polar Sea through Behring Strait is, at most, capable of melting 5100 square inches of ice, and that its influence is consequently insignificant. No branch of the Kuro Siwo enters the Behring Sea, and the currents in the Polar basin to the north of it, are mainly dependent upon the winds. There is no reason to suppose that these drift currents are capable of opening passages through the pack-ice which would enable exploring vessels to reach the Pole or even a very high latitude.

The British Government are considering a plan for the establishment of a meteorological station at Fort Simpson, on the Mackenzie River, to be conducted on the system adopted by the International Polar Conference.

Lake Onega may be considered to mark the natural boundary between Northern Russia and Finland, as regards their geological structure, topographical features, fauna and flora.

MICROSCOPY.[1]

THE ACME MICROSCOPES.—These really excellent instruments, combining good workmanship with moderate cost, and built upon a model which comprises many of the most convenient and serviceable of recent improvements in the construction of stands, have passed into the hands of James W. Queen & Co., of Philadelphia, who will act as business agents for their sale, and whose great business facilities cannot fail to secure for them a more general and adequate appreciation and attention than they have yet received. A "No. 4" stand, simpler and smaller than those formerly made, and a "lithological," specially adapted to the examination of rocks, are among the recent additions to the Acme series.

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SCIENTIFIC NEWS.

— A French naval doctor, M. Crevaux, has lately made important explorations in the northern parts of South America, more especially in the valley of the Orinoco and its affluents. Among other facts of observation, he states that the Guaraunos, at the delta of that river, take refuge in the trees when the delta is inundated. There they make a sort of dwelling with branches and clay. The women light, on a small piece of floor, the fire needed for cooking, and the traveler on the river by night often sees with surprise long rows of flames at a considerable height in the air. The Guaraunos dispose of their dead by hanging them

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

in hammocks in the tops of trees. Dr. Crevaux, in the course of his travels, met with geophagous, or earth-eating tribes. The clay, which often serves for their food whole months, seems to be a mixture of oxide of iron and some organic substances. They have recourse to it more especially in times of scarcity; but, strange to say, there are eager gourmands for the substance, individuals in whom the depraved taste becomes so pronounced, that they may be seen tearing pieces of ferruginous clay from huts made of it, and putting them in their mouths.

— Wasps are such an obstacle in the way of English fruit growers that one of them, Mr. William Taylor, thinks it worth while to pay three pence each for queens. And this season he bought and destroyed no less than 1192; about 230 nests have been annihilated within a mile of his premises, and still there is enough left for seed. He declares that the price named is not too high, "since it takes considerable skill to catch them," and because of their enormous fecundity, of which he says in the *Cottage Gardener:* "Understand that every wasp seen before the middle of June is a queen, and liable to have a nest of 10,000 at least. I lately estimated the number of cells in a rather large nest, and made out 9000 of them. A great many of the young had flown, and fresh eggs were laid in their places, and I have reason to believe that there is often more than one succession of young insects from the same cells, therefore 10,000 is a comparatively small family."

— It has been found by M. de Lacerda that permanganate of potash is very efficacious as an antidote to the poison of snakes. He experimented on dogs, injecting a one per cent. solution of the substance into the cellular tissue or into the veins, after the poison, and the usual effects of the latter were strikingly obviated. In one series of experiments the poison was allowed time to take some effect before the permanganate solution was injected, the dogs showing dilatation of the pupil, respiratory and cardiac derangements, muscular contractions, &c. Two or three minutes after the antidote was given these troubles disappeared, and after 15 to 25 minutes of some measure of prostration, the animal would be able to walk and even run about, and recover its normal aspect. The same dose of poison, not counteracted, caused death, more or less rapidly.

—Mr. J. M. Swanks' Statistics of the Iron and Steel Productions of the United States, 1881, is issued by the Census Bureau, and bears the marks of careful preparation. The historical sketch is interesting reading. The statement is made that "we are to-day the second iron-making and steel-making country in the world. In a little while we shall surpass even Great Britain in the production of steel of all kinds, as we have already surpassed her in the production of Bessemer steel and in the consumption of all iron and steel products. The year 1882 will probably witness this consummation. We are destined also to pass Great Britain in the production of pig iron.

—Under the title of "Zoölogy in the University of Tokio," Professor C. O. Whitman, late professor of zoölogy in the University of Tokio, discourses in a pamphlet of forty-four pages on the needs of a more complete endowment of a zoölogical department, and the natural advantages enjoyed by the Japanese zoölogist for the study of this science. It contains interesting facts regarding the land leech, the land planarian, the jumping fish, and other animals. Professor Whitman is at present in Naples, studying at the Zoölogical Laboratory, founded by Dr. Dohrn.

—In the Iowa Legislature, on the 20th of January last, a petition from the citizens of Pottawatomie county, and another by Messrs. Henderson and Calkins, were presented, asking for a thorough geological survey of the State. Both petitions were referred to the Committee of Ways and Means, which reported favorably on the project. Another move has been made looking toward the establishment of a Bureau of Agriculture, which shall sustain an entomologist, an office which is sadly needed.

—Queen, one of the group of elephants connected with Barnum's circus, at Bridgeport, Conn., gave birth to a baby elephant last night (February 3) at eight o'clock; weight, forty-five pounds. The other baby elephant weighed one hundred and twenty-six pounds at birth. At last reports mother and daughter were doing well.

— M. Pasteur has resolved to continue his researches into the means of preventing diseases by destroying or nullifying the virulence of the germs, and is about to visit the Bordeaux lazaretto, with a view of studying yellow fever, which he hopes to conquer by means of inoculation.

—A new and most valuable feature of the Census Reports for 1880 are the Forestry Bulletins, prepared by Mr. C. S. Sargent. Each number is accompanied by a map of some State, showing the distribution of forests, with special reference to the lumber industry.

—*Humboldt* is the title of a new monthly illustrated magazine of science in all departments, published at Stuttgart and edited by Dr. G. Krebs.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, Jan. 18, 1882.—Mr. Wm. M. Davis discussed the classification of Lake Basins, and Mr. F. W. Putnam spoke of the use of copper and bronze by the early races of America.

Feb. 1.—Professor Henry W. Haynes gave some indications of an early race of men in New England, and Mr. F. W. Putnam showed some interesting stone implements from Marshfield, Mass.

Mr. S. W. Garman spoke of a case of bird reasoning (?), and remarked on certain features of interest in the formation of cabinets.

New York Academy of Sciences, Jan. 9.—Dr. L. Johnson described the parallel drift hills of Western New York, and Professor J. S. Newberry remarked on hypothetical high tides as agents of geological change.

Jan. 30.—The following papers were read: The discovery of emeralds in North Carolina, illustrated with remarkable specimens, by Mr. Wm. Earl Hidden. Mr. George F. Kunz exhibited a series of ancient obsidian knives found near the city of Guatemala, C. A.

Feb. 6.—Professor J. S. Newberry remarked on the origin and relations of the carbon minerals.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science, February.—The flood of the Connecticut river valley from the melting of the Quaternary glacier, by J. D. Dana. Geology of the diamond, by O. A. Derby. A Cercaria with caudal setæ, by J. W. Fewkes. Notice of a remarkable marine fauna occupying the outer banks off the southern coast of New England, by A. E. Verrill.

Quarterly Journal of Microscopical Science, January.—On the morphology of *Hemileia vastatrix* (the fungus of the coffee disease of Ceylon), by H. M. Ward. On the nature of the organ in adult Teleosteans and Ganoids, which is usually regarded as the head-kidney or pronephros, by F. M. Balfour. Observations on the resting stage of *Chlamydomyxa labyrinthuloides*, by P. Geddes. Review of recent researches in karyokinesis and cell division, by J. T. Cunningham. The micro-organisms which occur in septicæmia, by G. F. Dowdesnell. Pringsheim's researches on chlorophyll, translated and condensed by B. Balfour.

Zeitschrift für Wissenchaftliche Zoologie, December 30.—On the structure of the bird-inhabiting Sarcoptidæ, by G. Haller. On *Scoloplos armiger*, by W. Man. Comparative-embryological studies, by E. Metschnikoff. *Dimorpla nutans*, a connective form between the Flagellata and Helliosa, by A. Gruber. Contributions to a knowledge of Amœbæ, by A. Gruber. Contributions to a knowledge of Radiolarian shells, by O. Bütschli.

Zoological Magazine, January.—Traces of a great post-glacial flood, by H. H. Haworth.

Annals and Magazine of Natural History, December—.On certain points in the morphology of the Blastoidea, by P. H. Carpenter.

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MOUND PIPES.

BY EDWIN A. BARBER.

It is impossible to determine what was the earliest form of the tobacco-pipe. The oldest examples of which we possess any knowledge, have been exhumed from some of the mounds of the Mississippi valley. These are usually made of stone of great hardness, but we have no reason to believe that this material was always employed in their manufacture. It is not to be supposed that the symmetrical and highly-finished specimens which the mounds have produced were the results of the first savage conception of the narcotic utensil. Indeed, it is more than probable that the most ancient pipes were rudely fashioned from wood or other perishable substances, all traces of which have long since disappeared.

The earliest stone pipes from the mounds were "always carved from a single piece, and consist of a flat curved base, of variable length and width, with the bowl rising from the center of the convex side. From one of the ends, and communicating with the hollow of the bowl, is drilled a small hole, which answers the purpose of a tube; the corresponding opposite division being left for the manifest purpose of holding the implement to the mouth."[1] It would be difficult to conceive of any other form so admirably adapted to the purpose for which it was designed. Such pipes are not only models of compactness, but are, in many instances, highly ornamental, and in all probability totemic. In the majority of these "platform" pipes, the stem perforation, which is always straight, is so minute as to preclude the possibility of the insertion of an additional stem. The

[1] Ancient Monuments of the Mississippi valley, p. 228.

implement was complete in one piece, so that all parts were equally durable. The facts that such pipes had expended upon them all of the ingenuity and skill at the command of the sculptor, and that they were usually placed in association with human remains, go far to prove that they were invested, to a considerable degree, with a religious, or at least a mortuary, significance. "The remarkable characteristics of their elaborately sculptured pipes, and their obvious connection with services accompanying some of the rites of sacrifice or cremation, tend," as Dr. Wilson observes, "to suggest very different associations with the pipe of those ancient centuries from such as now pertain to its familiar descendant. Embodying, as these highly-finished implements did, the result of so much labor, as well as of artistic skill, there are not wanting highly suggestive reasons for the opinion, that the elaborate employment of the imitative arts on the pipe-heads found deposited in the mounds, may indicate their having played an important part in the religious solemnities of the ancient race."

The typical mound pipe is of the "*monitor*" form, as it may be termed, possessing a short, cylindrical, urn, or spool-shaped bowl, rising from the center of a flat and slightly curved base. Fig. 1 is an illustration of an example from a mound in Ross county, Ohio, which is now deposited in the National Museum at Washington. Pipes of this form average three or four inches in length, but an extraordinary specimen formerly in the collection of Mr. O. A. Jenison, of Lansing, Mich., measures six and five-eighths inches.

The most important and interesting discovery of mound pipes was made by Messrs. Squier and Davis, during their explorations in the valley of the Mississippi, about a third of a century ago. From a small sacrificial tumulus in the vicinity of "Mound City," Ohio, they obtained nearly two hundred stone pipes. Many of these, according to the report of the discoverers, "were much broken up, some of them calcined by the heat, which had been sufficiently strong to melt copper, masses of which were found fused together in the center of the basin. A large number have nevertheless been restored, at the expense of much labor and no small amount of patience. They are mostly composed of a red porphyritic stone, somewhat resembling the pipe stone of the *Coteau des Prairies* excepting that it is of great hardness and interspersed with small variously colored granules. * * * *

The bowls of most of the pipes are carved in miniature figures of animals, birds, reptiles, etc. All of them are executed with strict fidelity to nature, and with exquisite skill."[1] With the exception of this large deposit of these objects, comparatively few of them have been brought to light; yet a number of them are scattered through public and private museums in the United States and Europe, some of which will be described hereafter. It is a matter for sincere regret that the greater portion of the original collection of Dr. E. H. Davis was sold to the Blackmore Museum at Salisbury, England, some years ago. In the Museum of Natural History in New York City, however, thirteen of the original specimens, formerly owned by Mr. E. G. Squier, may yet be seen, including the remarkable example represented in Fig. 142 on page 244 of *Ancient Monuments.* In the magnificent collection of pipes recently owned by Mr. William Bragge, F.S.A., of Birmingham, England, are three broken bird-shaped pipes from "Mound City," Ohio. A set of casts of the entire Squier and Davis collection is preserved in the National Museum at Washington. Amongst the pipes of the original series were a number supposed to represent animals not indigenous to the United States. Seven representations of the lamantin, or sea-cow, were found in the mounds, three of which were nearly perfect. "The sculptures of the manatus," remark the explorers, "are too exact to have been the production of those who were not well acquainted with the animal and its habits."[2] Though frequenting the mouths of tropical rivers, the "big beaver," as the Florida Indians called this curious animal, has been found within the boundaries of the United States. Bartram states that it occurs in Florida, in a spring a few miles below Tallahassee.[3] The manati are comprised in three or four species, two of which are found in the Gulf of Mexico. The more northern species *(Manatus latirostris)* is found in 25° N. lat., and Harlan states that during the first quarter of the present century it was so abundant near the capes of Eastern Florida that one Indian sometimes captured ten or twelve specimens with a harpoon in a single season.[4] This species, which sometimes attains to a length of fifteen or twenty feet, bears a striking resemblance to the smaller *M. senegalensis* of

[1] Ancient Monuments, p. 152.

[2] Ibid, p. 254.

[3] Travels in North America, Dublin, 1793, p. 229.

[4] Fauna Americana, 1825, p. 277.

Western Africa. In both of these species the caudal fin is rounded, and the fingers on the swimming paws of the former species are provided with rudimentary nails. The Indians were extravagantly fond of the flesh of the manatee, the tail being considered the most savory portion. The following quaint description of the species inhabiting the Indian ocean is interesting as given by an early writer: "It is good Meat, because using the Shoar it hath a flesh taste, resembling Veal, which also it shews like; the Face is like a shrivelled Buffalo or Cow, the Eyes are small and round, and has hard Gums instead of Teeth; the Intrals also are like a Cow's: there is a Stone generated in the Head, which is very valuable, being a soveraign remedy (as some report) against Cholick, Stone-Cholick, and Dysentery, being beat small, infused in Wine, and drunk fasting: the Body of this Fish is three Yards long and one broad, thick-skinned, and without Scales, narrow towards the Tail, which is very nervous, slow in swimming, because it wants Fins, in lieu of which it has two Paps, which it can use either to suckle its young withal, or creep ashoar, where it grazes, and where it delights to lie and sleep; for it can't keep half an Hour under Water. It is very teachable and apt to be made tame, being famed like the Lizzard for their love to Man, whose Face they delight to look upon, and in weakness have refreshed them."[1]

One of the sculptures referred to above, is represented with a flat, truncated tail, which may possibly have been intended for the South American species *(M. australis)*, though it is not probable that the ancient mound-builder was familiar with exotic models of this animal. I am inclined to believe that this feature was the result of an inaccuracy in detail on the part of the sculptor, especially as all of the other representations exhibit the rounded tail of the Floridian species.

Another carving of ruder execution has, with some hesitation, been described as the toucan, a bird not found in the northern part of the western continent. Since the Indians of Guiana and Brazil, according to the statements of travelers, formerly domesticated this bird, the fact that the sculpture in question is represented in the act of taking food from a human hand, "would favor the conclusion," according to the discoverers, that it was

[1] Sir Thomas Herbert's Travels in 1626. From Navigantium atque Itineratium Bibliotheca, by John Harris, F.R.S. London, 1705, Vol. 1, p. 408.

intended to represent the toucan. The shape and proportions of the beak and the number and position of the toes, however, are sufficient evidence that the bird which formed the model of the artist, did not belong to the zygodactylous order. The pipe shows three toes in front and the bill is short and stout. The builders of the mounds probably possessed their aviaries which, like those of the ancient Mexicans, doubtless supplied a number of species which were capable of domestication.

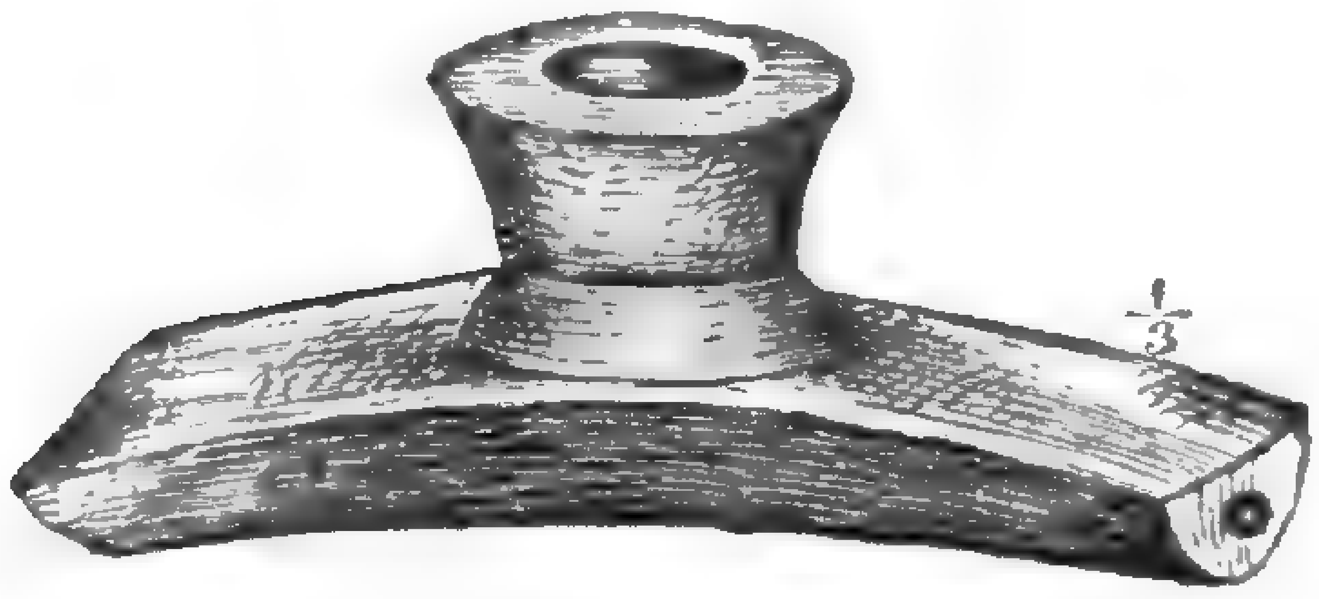

FIG. 1.—Monitor Pipe.

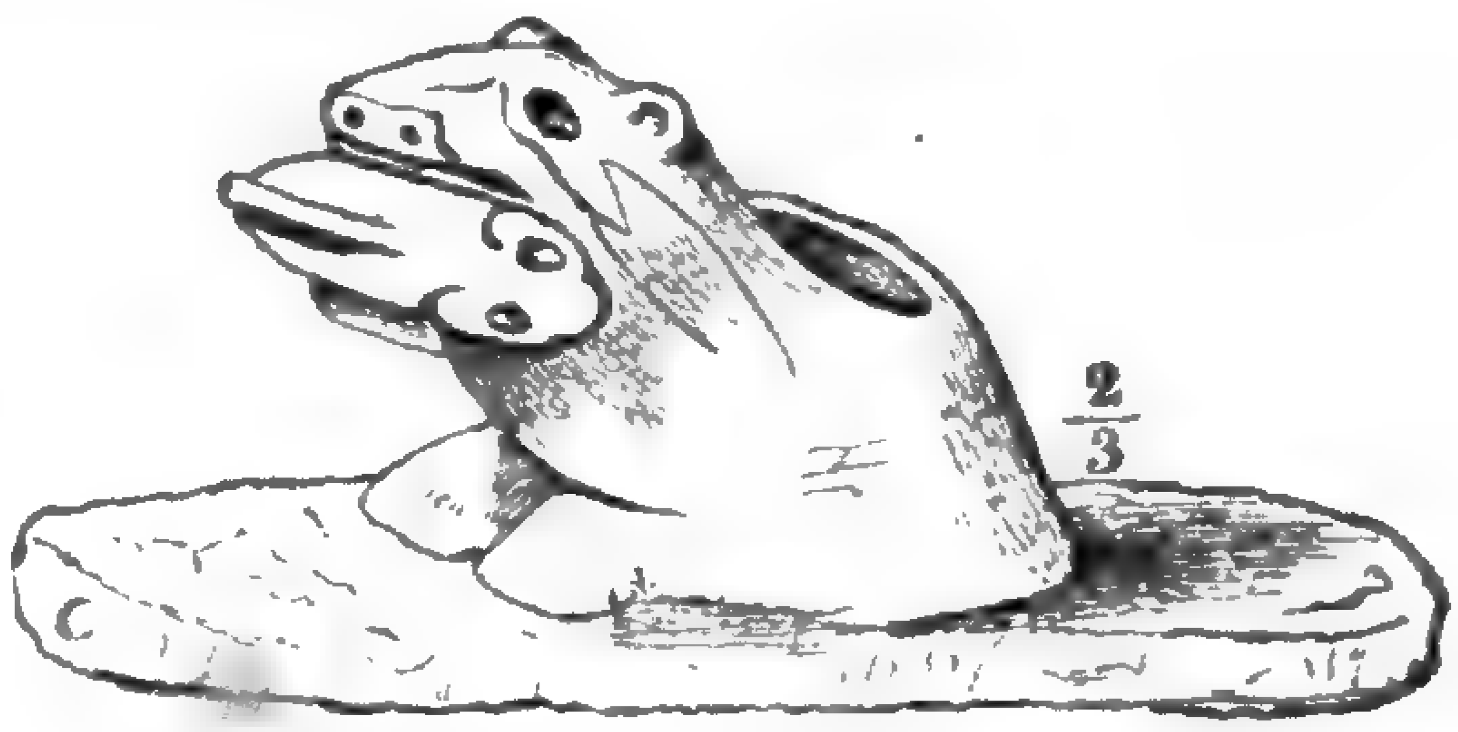

FIG. 2.—Otter Pipe.

Several of the images, however, are undoubtedly portraitures of familiar animals. "Not only are the features of the various animals represented faithfully, but their peculiarities and habits are in some degree exhibited."[1] In one pipe we recognize the otter with a fish in his mouth (Fig. 2). The tufted heron is seen in the position of devouring a fish (Fig. 3). "Nothing can surpass the truthfulness and delicacy of the sculpture. The minutest feathers are shown; the articulations of the legs of the bird, as

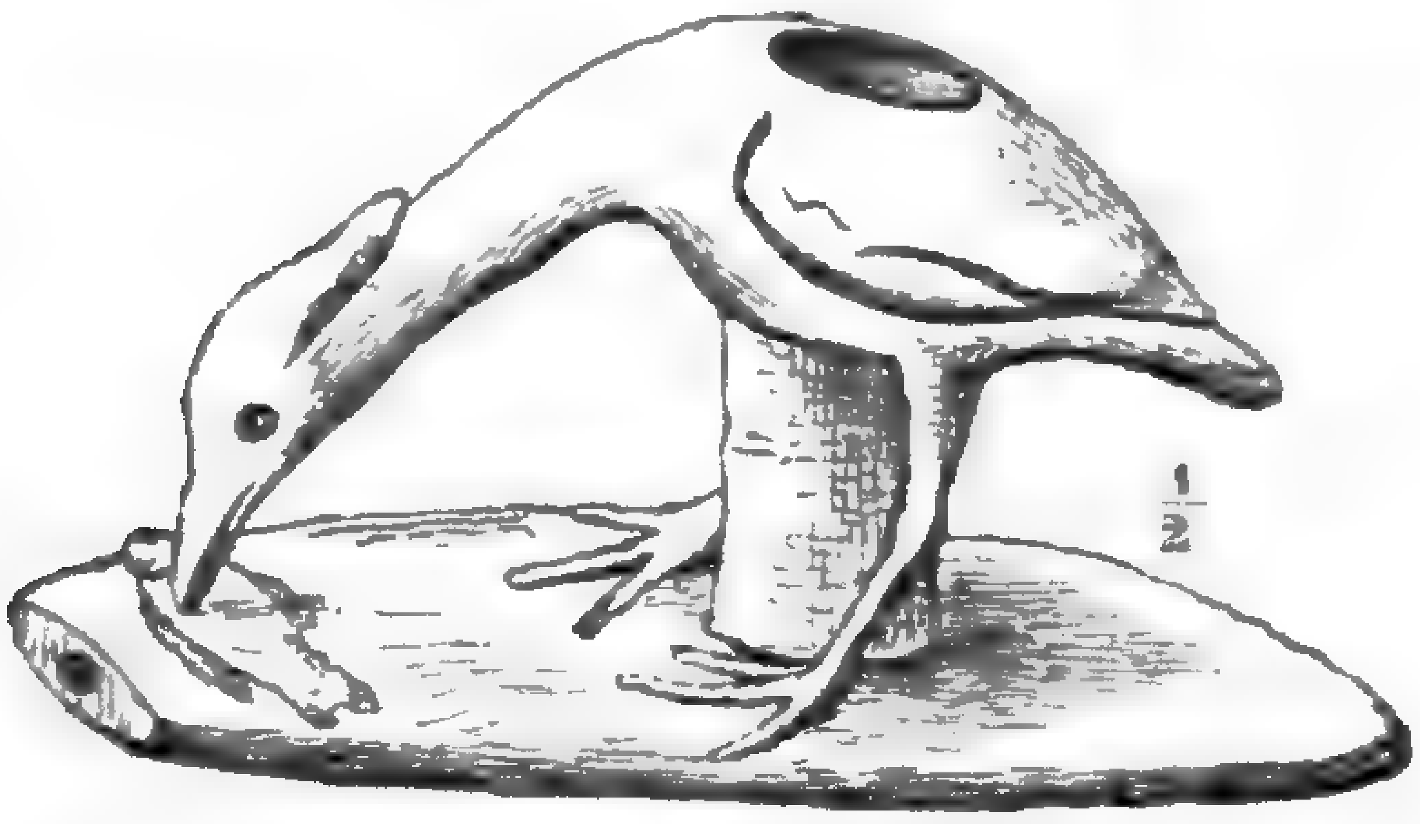

FIG. 3.—Heron Pipe.

FIG. 4.—Beaver Pipe.

also the gills, fins and scales of the fish, are represented."[2] The hawk is shown in the act of tearing a smaller bird.[3] The beaver also figures in the collection (Fig. 4), as also do the bear, panther, wolf, wild-cat, elk, opossum and squirrel; the buzzard, crow, eagle, falcon, owl, raven, duck, grouse, parroquet and swallow; the serpent (rattlesnake), turtle, frog, toad and a number of other animals which have been readily recognized. The sockets of the

[1] Ancient Monuments, p. 152.

[2] Ibid, p. 259.

[3] For illustration of this sculpture, see *Harper's Monthly Magazine*, June, 1855.

eyes in the majority of the bird pipes were set with pearls from the margaritiferous Unionidæ.

The most valuable specimens of the series, however, are those in the form of the human head, probably "faithfully representing the prominent physical features of the ancient people by whom they were made."[1] Fig. 5 illustrates the most interesting example in this valuable collection.[2]

Next in importance to the discoveries of Messrs. Squier and Davis, is the collection of mound pipes deposited in the Davenport Academy of Natural Sciences, and for the greater part taken from mounds by members of that learned body. The series number forty-three specimens of the platform type, consisting of twenty-two with plain or zoned bowls of the "monitor" pattern; one human head; seven birds, and thirteen other animal forms, of which Mr. W. H. Pratt has kindly sent me photographs.

FIG. 5.—Pipe from Squier and Davis collection.

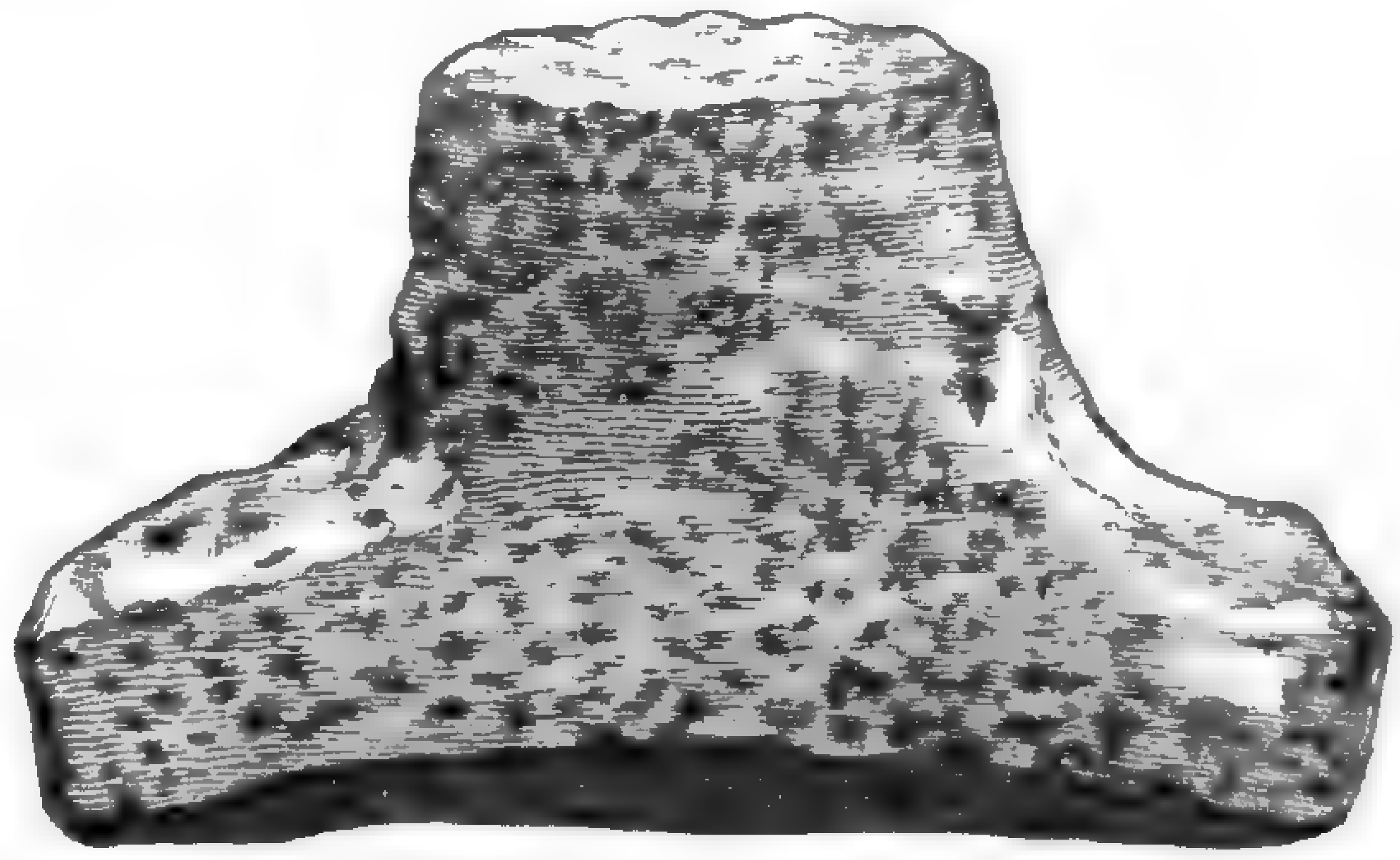

FIG. 6.—Unfinished Pipe.

An interesting and instructive specimen, in the form of an unfinished pipe, was taken from a mound at Toolsborough, Louisa county, Iowa, which serves to show, to a certain extent, the manner of fashioning such objects. The material is a coarse, soft, cream-colored stone, which has been roughly hewn into the desired shape (Fig. 6). The inference to be drawn from the presence of an incomplete pipe in one of the mounds, is either that it was discarded on account of the unsuitableness of the material, or that it was placed in the tumulus as a substitute for a perfectly finished specimen which could not be procured at the time when the body it was intended to accompany was deposited. An

[1] Ancient Monuments, p. 153.

[2] The illustration of this pipe and those which precede, have been furnished through the courtesy of Professor S. F. Baird, secretary of the Smithsonian Institution, from Dr. Charles Rau's work on the Archæological Collection of the United States National Museum.

incomplete object, somewhat resembling this, in which the cavity of the bowl is merely indicated, is figured in Mr. E. G. Squier's "Aboriginal Monuments of the State of New York."[1] It is made of steatite and was found near Mount Morris, Livingston county. The original of Fig. 7 is a bird-shaped pipe carved from

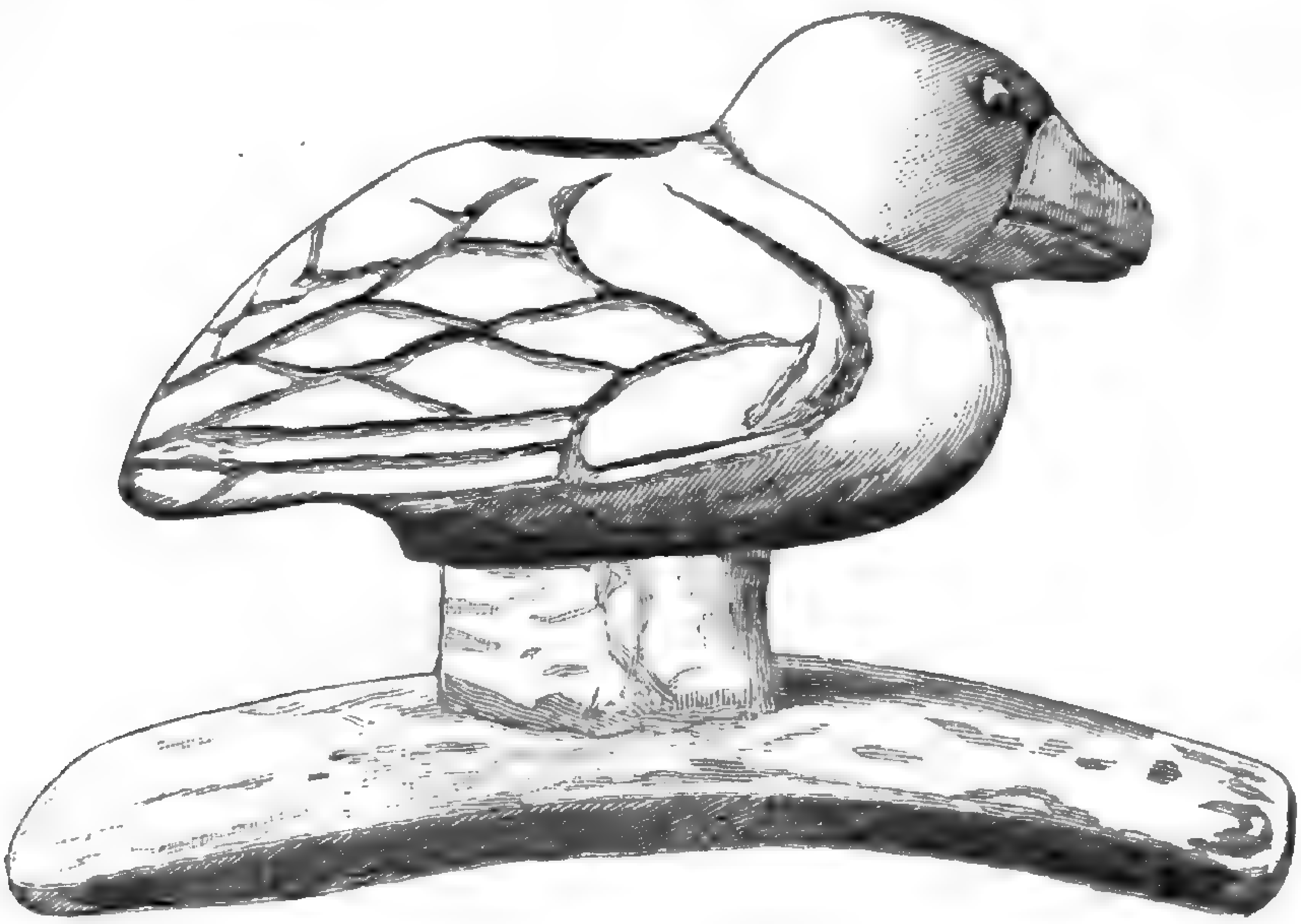

FIG. 7.—Bird Pipe.

a bluish-gray pipe stone. It was found associated with portions of several human skeletons and a four-sided, bent copper "awl," about six inches in length, in a mound of the same group as the last one figured. This was possibly intended to represent a spe-

FIG. 8.—Grouse Pipe.

cies of wild duck, the eyes of which were globules of pure native copper. From another mound of the same group was taken a second bird pipe of the same material, which is shown in Fig. 8,

[1] Smith. Cont. to Knowl. Vol. II, p. 76 (Fig. 12).

and is believed to portray the male of the pinnated grouse. In the same mound were found portions of several human skeletons, about two hundred shell beads, five copper axes, one of them "a very smoothly wrought specimen, showing very distinct traces of the cloth in which it had been wrapped, and some portions of which were still adhering to the copper,"[1] and another bird-shaped

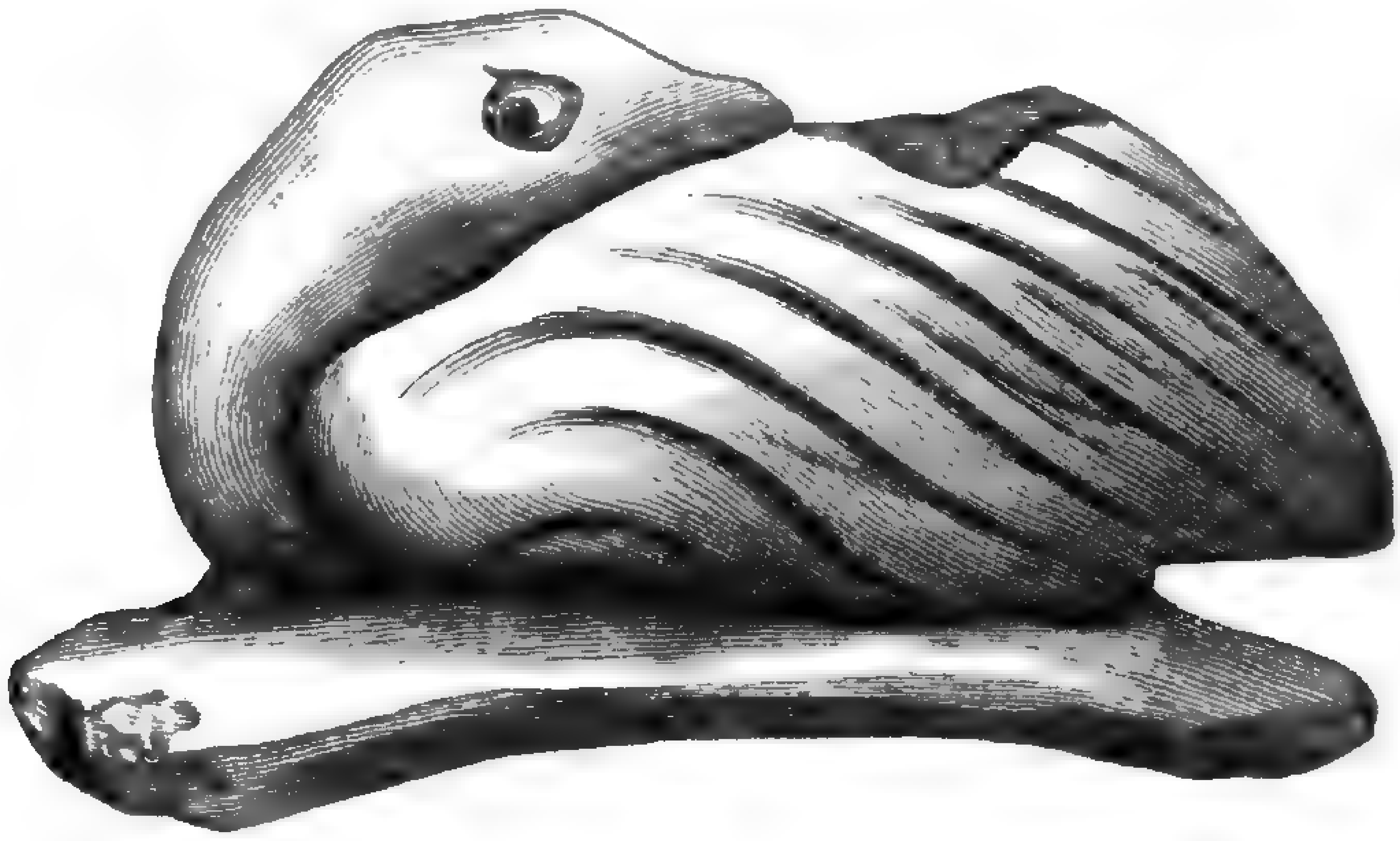

FIG. 9.—Goose (?) Pipe.

pipe of *red pipe stone*, furnished with eyes of pearl. The specimen shown in Fig. 9 may have been meant for the wild goose, or possibly the loon. It is formed of sandstone, and was found in Louisa county, Iowa.

About one mile below Davenport, on the right bank of the Mississippi, the original of Fig. 10, fashioned from a light-gray pipe stone, was discovered in a mound at a depth of six feet,

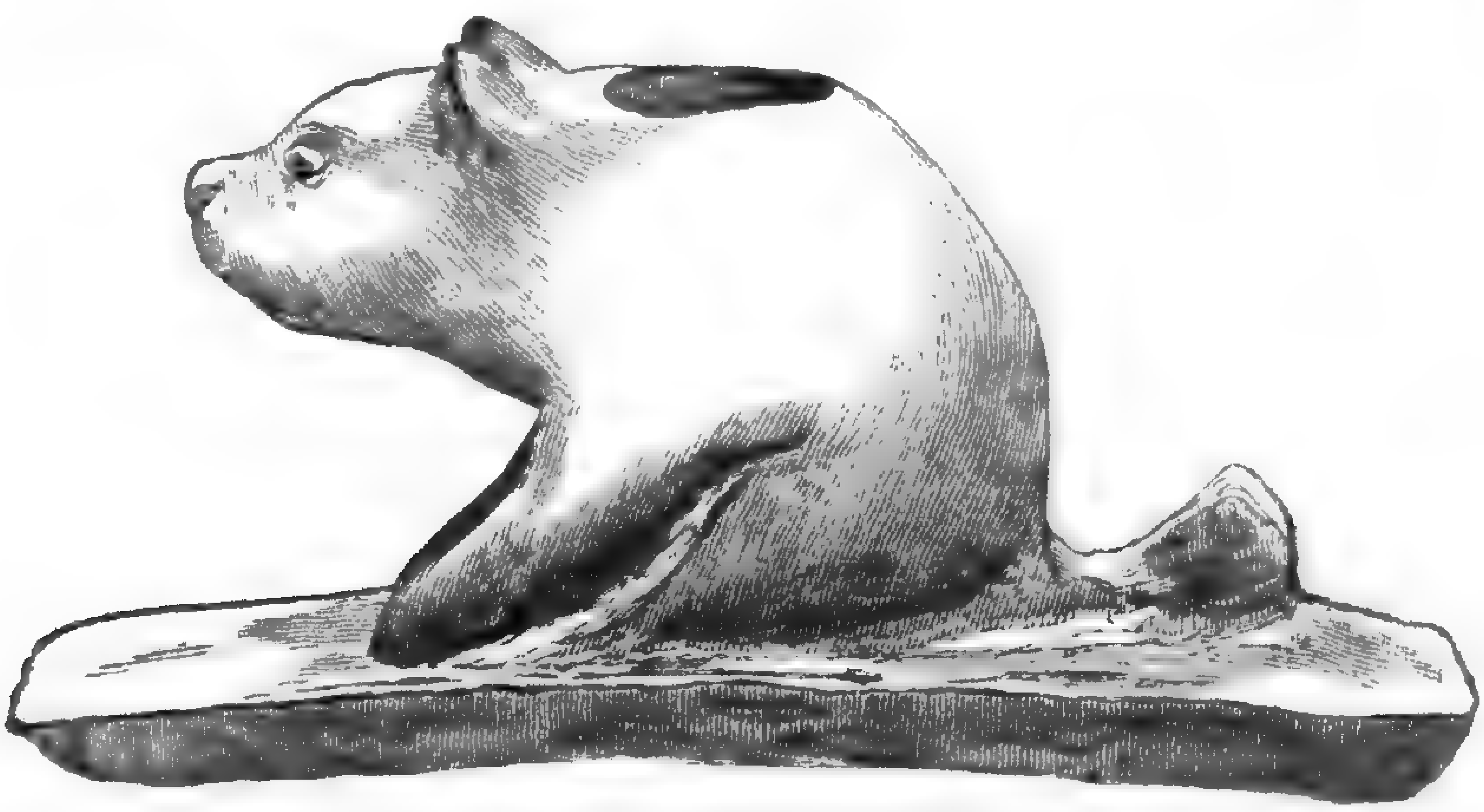

FIG. 10.—Ground Hog Pipe.

associated with five very old copper, cloth-wrapped axes and two pieces of galena. Above these objects, one and a half feet from the top of the mound, were found two adult skeletons, evidently belonging to an intrusive burial, as they were accompanied by

[1] Vide Proceedings of the Davenport Academy, Vol. 1, p. 108.

European relics, such as glass beads, etc. It is difficult to determine what animal was intended, the wolf, ground-hog and prairie-

FIG. 11.—Howling Wolf (?) Pipe.

dog having been variously suggested. The "howling wolf" (?) pipe (Fig. 11) is from a sand hill in Rock Island county, Illinois.

FIG. 12.—Lizard Pipe.

The sculptured lizard (Fig. 12) and the turtle (Fig. 13) are from mounds in Mercer county, Ill. The last three are made of a

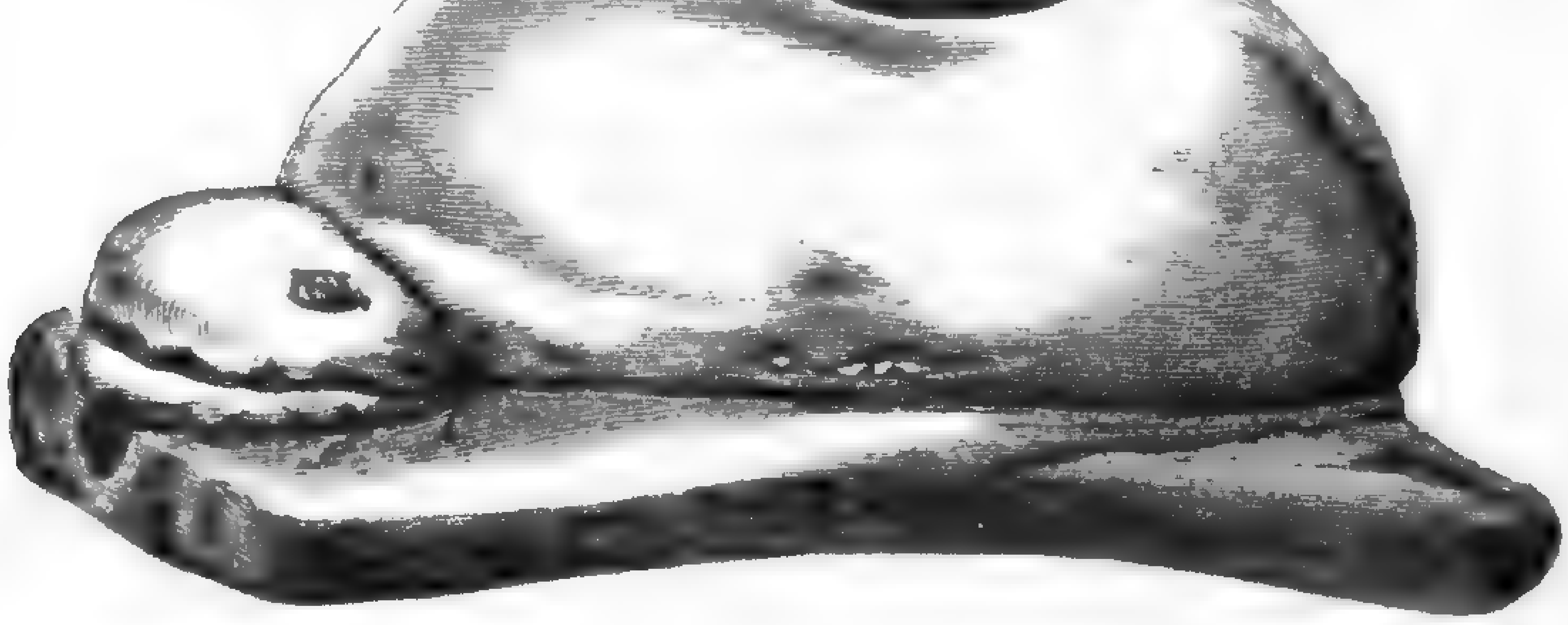

FIG. 13.—Turtle Pipe.

soft, dark slate-colored talc. The serpent pipe (Fig. 14) comes from the same locality, and is formed of a sort of clay slate. In close contiguity, in the same mound, a lump of galena, considerably ground down, was discovered, and the pipe presented the appearance, when found, of having been lightly coated with a plumbiferous substance. Another example carved in the form of

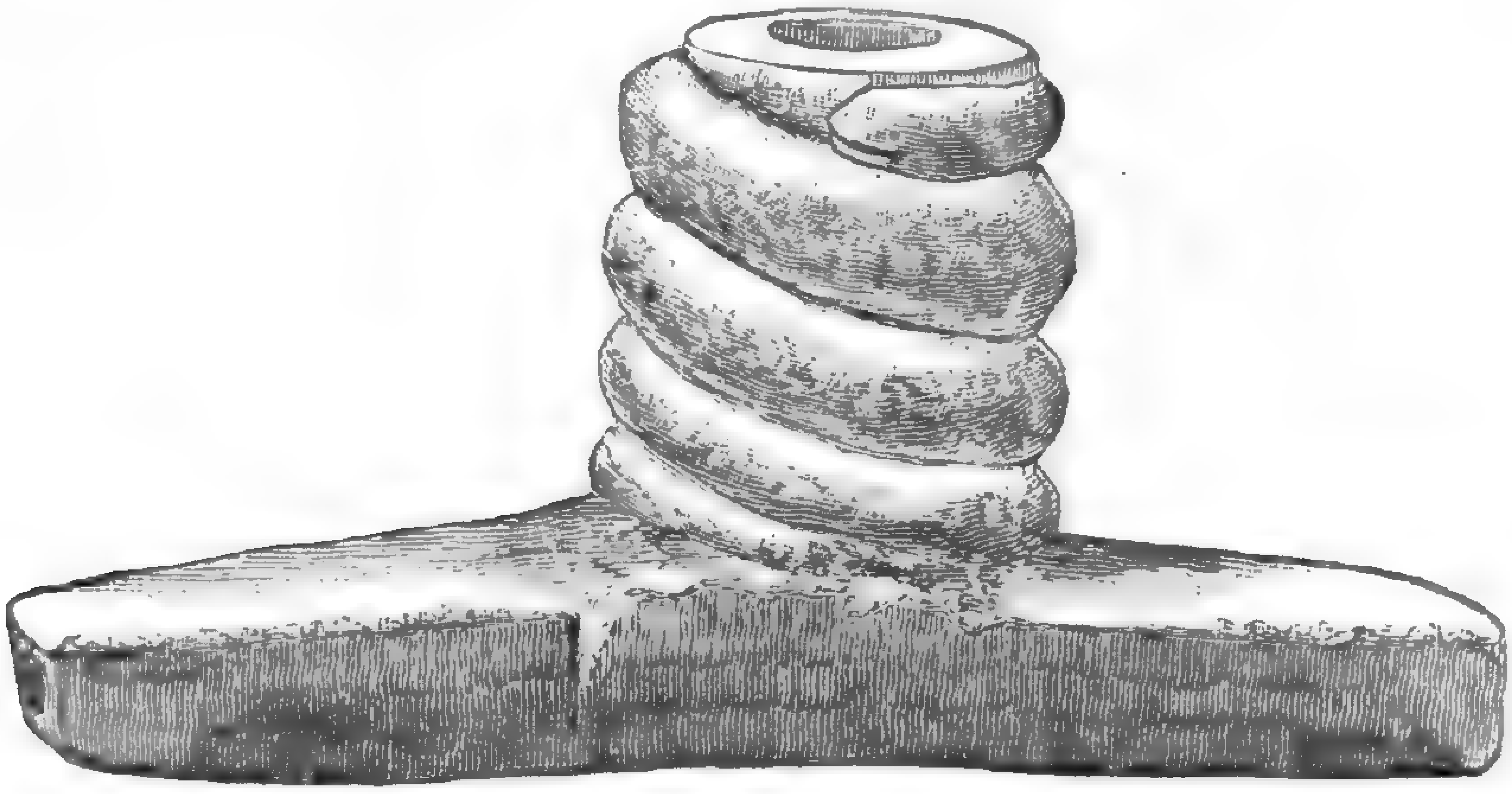

FIG. 14.—Serpent Pipe.

a frog (Fig. 15) from a light-gray pipe stone, was exhumed from a mound in the same group with that which yielded the original of Fig. 10. Associated with the former were two copper axes and five skeletons, of which three faced the east and the others the west. The pipe was found with the latter two.

Having incidentally heard of a pipe in the form of a bear, which was said to have been found in a mound in Muscatine county, Iowa, by a laboring man, the Rev. Mr. J. Gass, a member of the Academy, finally, with some difficulty, discovered the

FIG. 15.—Frog Pipe.

owner and succeeded in purchasing the specimen from him for a paltry sum (see Fig. 16). The peculiarity of this pipe, which is made of a gray trap rock, unpolished, is that, unlike most other platform pipes, it possesses a *straight* base which is not drilled and of which the front projection is lacking, the mouth of the animal forming the mouth-piece for the smoker.

The most remarkable specimens in the Davenport collection, however, are the two elephant pipes recently brought to light, and which have been too hastily pronounced spurious by critics who have had no opportunity of examining them. The circumstances of the discovery of these two examples are contained in the following extracts from a letter which I have received from

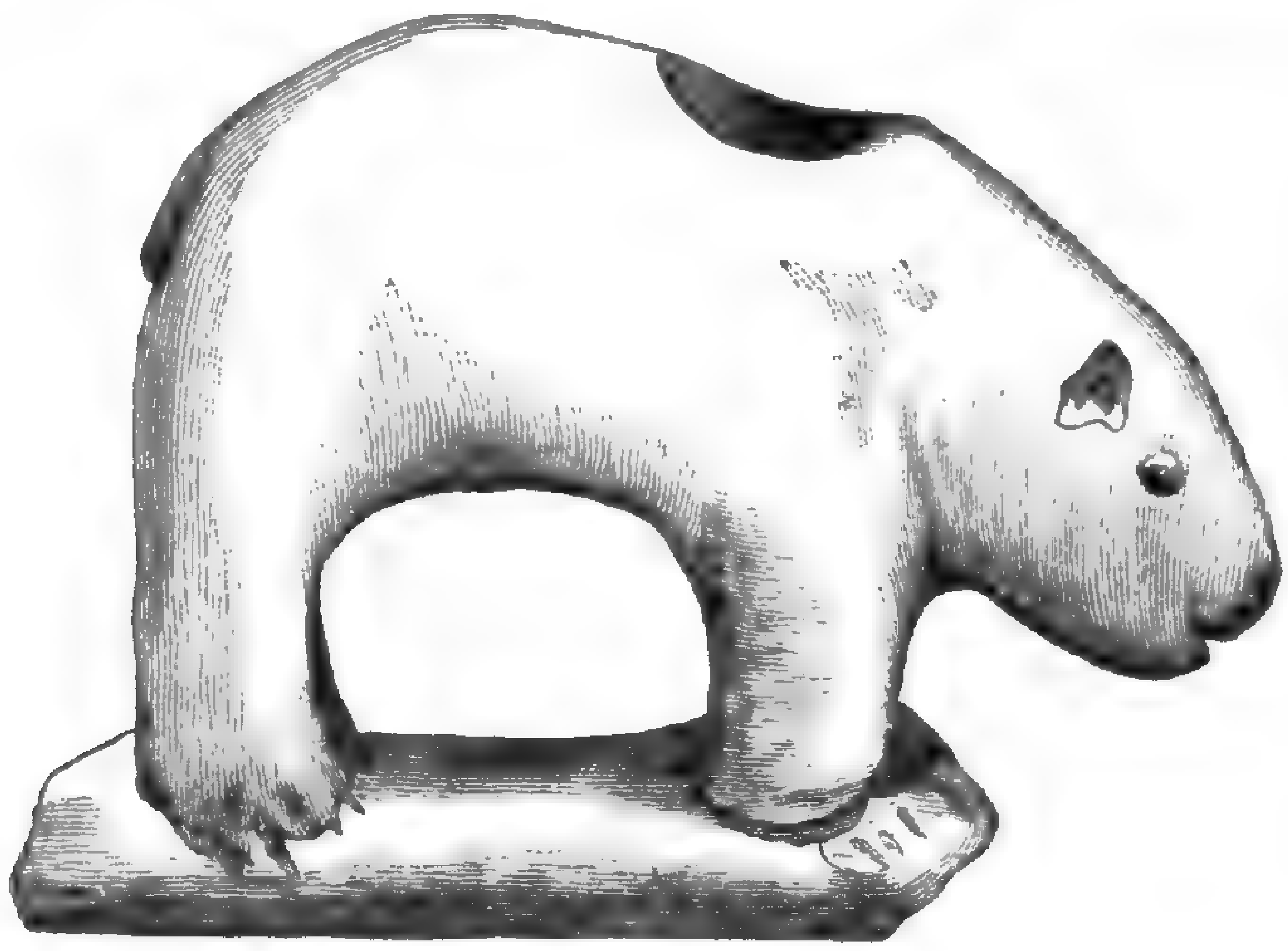

Fig. 16.—Bear Pipe.

Mr. W. H. Pratt, president of the Academy, under date of April 24, 1880: "The first elephant pipe which we obtained (Fig. 17) a little more than a year ago, was found some six years before by an illiterate German farmer named Peter Mare, while planting corn on a farm in the mound region, Louisa county, Iowa. He did not care whether it was elephant or kangaroo; to him it was a curious 'Indian stone,' and nothing more, and he kept it and smoked it.

Fig. 17.—Elephant Pipe, Iowa.

In 1878 he removed to Kansas, and when he left, he gave the pipe to his brother-in-law, a farm laborer, who also smoked it. Mr. Gass happened to hear of it, as he is always inquiring about such things, hunted up the man and borrowed the pipe to take photographs and casts from it. He could not buy it. The man said his brother-in-law gave it to him and it was a curious thing—

he wanted to keep it. We were, however, unfortunate, or fortunate, enough to break it; that spoiled it for him and that was his chance to make some money out of it. He could have claimed any amount, and we would, as in duty bound, have raised it for him, but he was satisfied with three or four dollars. During the first week in April, this month, Rev. Ad. Blumer, another German Lutheran minister, now of Genesee, Illinois, having formerly resided in Louisa county, went down there in company with Mr. Gass to open a few mounds, Mr. Blumer being well acquainted there. They carefully explored ten of them, and found nothing but ashes and decayed bones in any, except one. In that one was a layer of red, hard-burned clay, about five feet across and thirteen inches in thickness at the center, which rested upon a bed of ashes one foot in depth in the middle, the ashes

FIG. 18.—Elephant Pipe, Iowa.

resting upon the natural undisturbed clay. In the ashes, near the bottom of the layer, they found a part of a broken carved stone pipe representing some bird; a very small, beautifully formed copper 'axe,' and this last elephant pipe (Fig. 18). This pipe was first discovered by Mr. Blumer, and by him, at our earnest solicitation, turned over to the Academy."

Mr. J. Duncan Putnam, corresponding secretary of the Academy, writes me that the former pipe "is of a light-colored sandstone, but has been much greased and smoked, so as to appear of a dark color." The material of the latter is the same. There seems to be no flaw in the history of these pipes, which, coming from sources of unquestioned integrity, is evidence that there has been no attempt at deception on the part of the Davenport Academy.

It is not within the province of this paper to discuss the question of the contemporaneousness of man and the mastodon in the western hemisphere. The existence of an artificial mound in Wisconsin, 135 feet in length, *in the form of an elephant*,[1] adds much to the probability of the genuineness of the pipes above described. It is worthy of note, however, that no representations of the male elephant have as yet been found amongst the remains of man in North America. It is, to say the least, a singular fact that the most characteristic features of this pachyderm, the prominent tusks, should have been omitted both in the pipe sculptures and the "big elephant mound," if the ancient Americans were acquainted with the model. The long, slender, curved tusks, however, would be difficult to imitate either in the miniature stone sculptures or the embankments of earth, and might have been purposely ignored. These likenesses of fossil mammals acquire an additional interest, however, when we read the remarkable accounts of the discoveries in the State of Missouri and elsewhere, of deposits of bones of the mastodon in association with flint arrow-heads and fragments of pottery.[2] "Such contiguity of the works of man with those extinct diluvial giants," observes Dr. Wilson, "warns us at least to be on our guard against any supercilious rejection of indications of man's ancient presence in the New World as well as the Old. * * * * Whether or not those huge mammals had been known to man, during his occupation of the American continent, as his living contemporaries, their remains were objects of sufficiently striking magnitude to awaken the curiosity even of the unimpressible Indian; and traditions were common among the aborigines of the forest relative to the existence and destruction of the strange monster, whose bones lie scattered over the continent from Canada to the Gulf of Mexico. * * * * In all that relates to the history of man in the new world, we have ever to reserve ourselves for further truths."[3]

Pipes of the platform type are confined almost exclusively to the section north of the Ohio and Missouri rivers, or to the States of Ohio, Indiana, Illinois and Iowa. A few specimens of the curved-base form have been picked up in other localities, but

[1] Vide Smith. Report, 1872, p. 416. The Big Elephant Mound in Grant county, Wisconsin, by Jared Warner.

[2] See Foster's Prehistoric Races of the U. S., p. 63.

[3] Prehistoric Man, London, 1862, Vol. 1, p. 112, et seq.

generally, so far as I can ascertain, on the surface, having in all probability been carried from the mound region by roving bands of Indians of a more recent period. In the National Museum at Washington, are three examples, which were derived respectively from Ohio, Maryland and Illinois. Another was discovered in the valley of the Delaware river in the State of New Jersey. It is of the plain "monitor" form, made of a light-brown or chocolate-colored stone, and is now owned by Mr. Wm. S. Vaux, of Philadelphia, Pa. Hon. R. S. Robertson, of Fort Wayne, Indiana, possesses a pipe of the same form, from a mound in Laport county of the same State, which was found in connection with a copper chisel, two copper needles, four flints, some fragments of pottery and a single skeleton. Two other pipes from Southern Ohio, in the same collection, are cylindrical bowls which have been broken from the curved platforms and put to further use by drilling stem-holes in the sides. One of these shows an opening in the base where it was broken from the stem, the hole being plugged to render it serviceable. The other example has a portion of the platform still attached, which has been smoothed or polished at the point of fracture. In the collection of Dr. C. S. Arthur, of Portland, Ind., are also three curved base pipes with plain bowls, two of which were ploughed up, and the third taken from a mound, in that State.

FIG. 19.—"Dog" (?) Pipe.

In a mound at Prairie du Chien, Wisconsin, associated with pieces of mica, an interesting platform pipe was discovered. Hon. Horace Beach, who sends me the original, regards it as decidedly Egyptian in general appearance, and terms it the "dog (?) pipe." It represents the head of some animal, possibly the mountain sheep or goat, and is made of a soft, heavy, dark-brown stone, somewhat resembling Catlinite. The peculiarity of this specimen is that the face looks away from the smoker. As may be seen in the illustration (Fig. 19); the anterior end of the platform, constituting the handle, is wanting. On the upper part of the nose, and on the base, front and back of the neck, hieroglyphical lines are inscribed, which may have possessed some symbolical significance, or perhaps were simply ornamental. In a few examples of pipes of this class, the *platforms* have been carved in imitation of animals. Dr. J. Schneck, of Mount Carmel, Illinois, sends me a sketch of a curious specimen which was found about two feet below the surface of the earth in a mound in Wabash county, Ill. (Fig. 20). It represents a small bird about the size of, and somewhat resembling, the chimney swallow (*Chætura pelasgia* Steph.), which, in those distant days, attached its nest, doubtless, to the cliffs and rocky crags. The material is a soft, yellow slate; the bird is represented on its back with wings crossed beneath, the cylindrical bowl rising from the breast, and the smoking orifice passing through the tail. Dr. Elliott Coues,

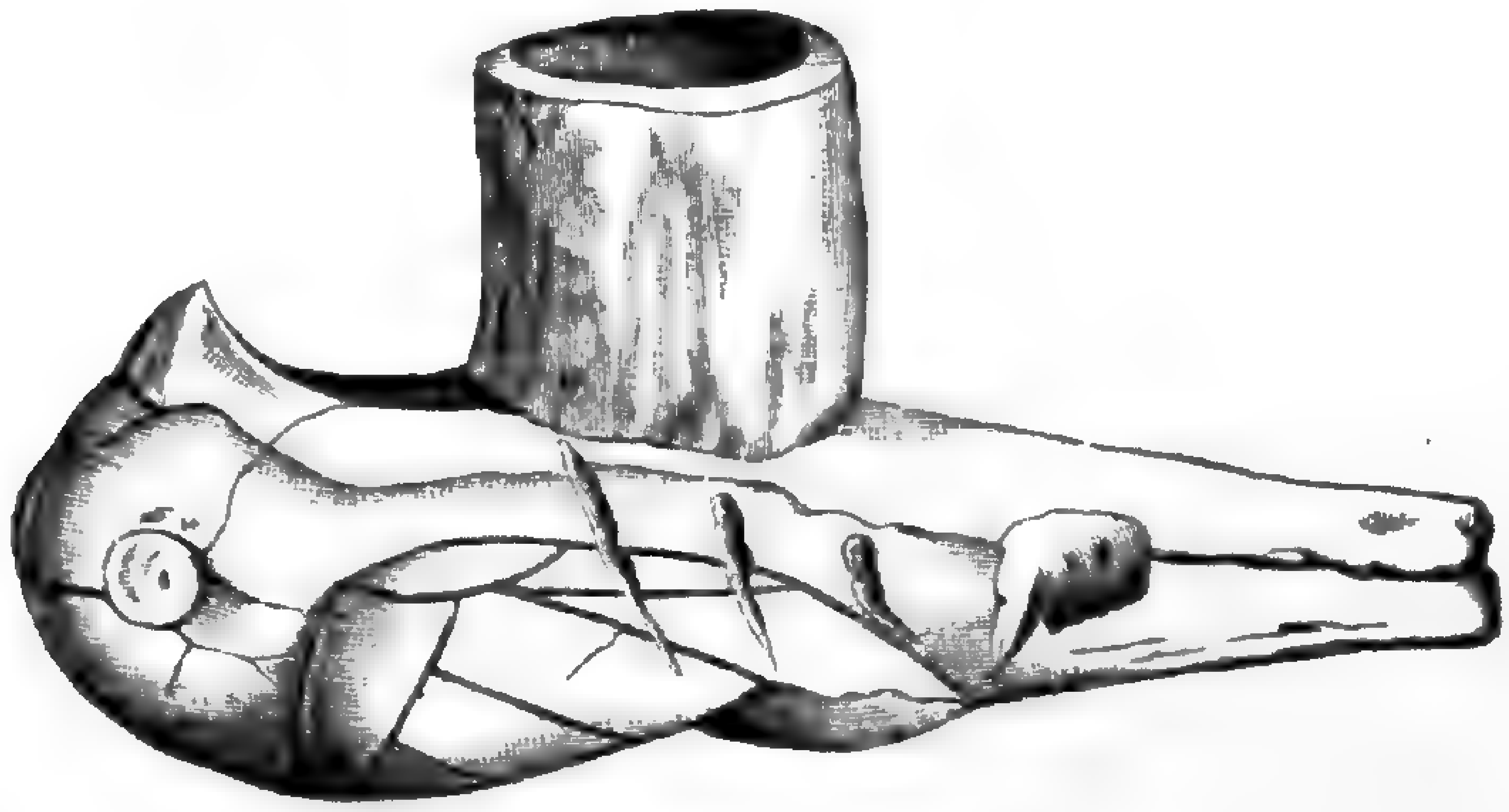

FIG. 20.—Bird Pipe, Illinois.

to whom I sent a sketch of this pipe, writes: "As is so frequently the probable case in such matters, I am inclined to think the sculptor had no particular bird in mind in executing his rude carving. It is not necessary, or indeed permissible, to suppose that particular species were always intended to be represented. Not unfrequently, the likeness of some marked bird is so good as to be unmistakable, but the reverse is oftener the case; and in the present instance I can make no more of the carving than you have done; excepting that if any particular species may have been in the carver's mind, his execution does not suffice for its determination."

Another specimen, in the collection of Mr. N. V. Johnson, of Brookville, Indiana, was found in a marsh a few miles north of that place. The material is a bluish-green stone, very hard and highly polished. Mr. Edgar R. Quick, who sends me a well-executed colored drawing of this object, writes: "The general form of this beautiful piece of work is that of a crescent with a protuberance on the outside, which forms the bowl of the pipe. The horns of the crescent form respectively the handle and stem or mouthpiece. The handle or front part is beautifully carved in the semblance of a lizard's head." (Fig. 21.)

Although many of the miniature sculptures already described are characterized by a remarkable accuracy of detail, and are faithful representations of well-known animals, the ancient artist was not always true to nature. In some of the carvings, prominent or characteristic features were often exaggerated; the heads of birds and mammals were sometimes disproportionately enlarged; in some instances to such an extent as to suggest to us the idea of caricature. Many of these sculptures were evidently

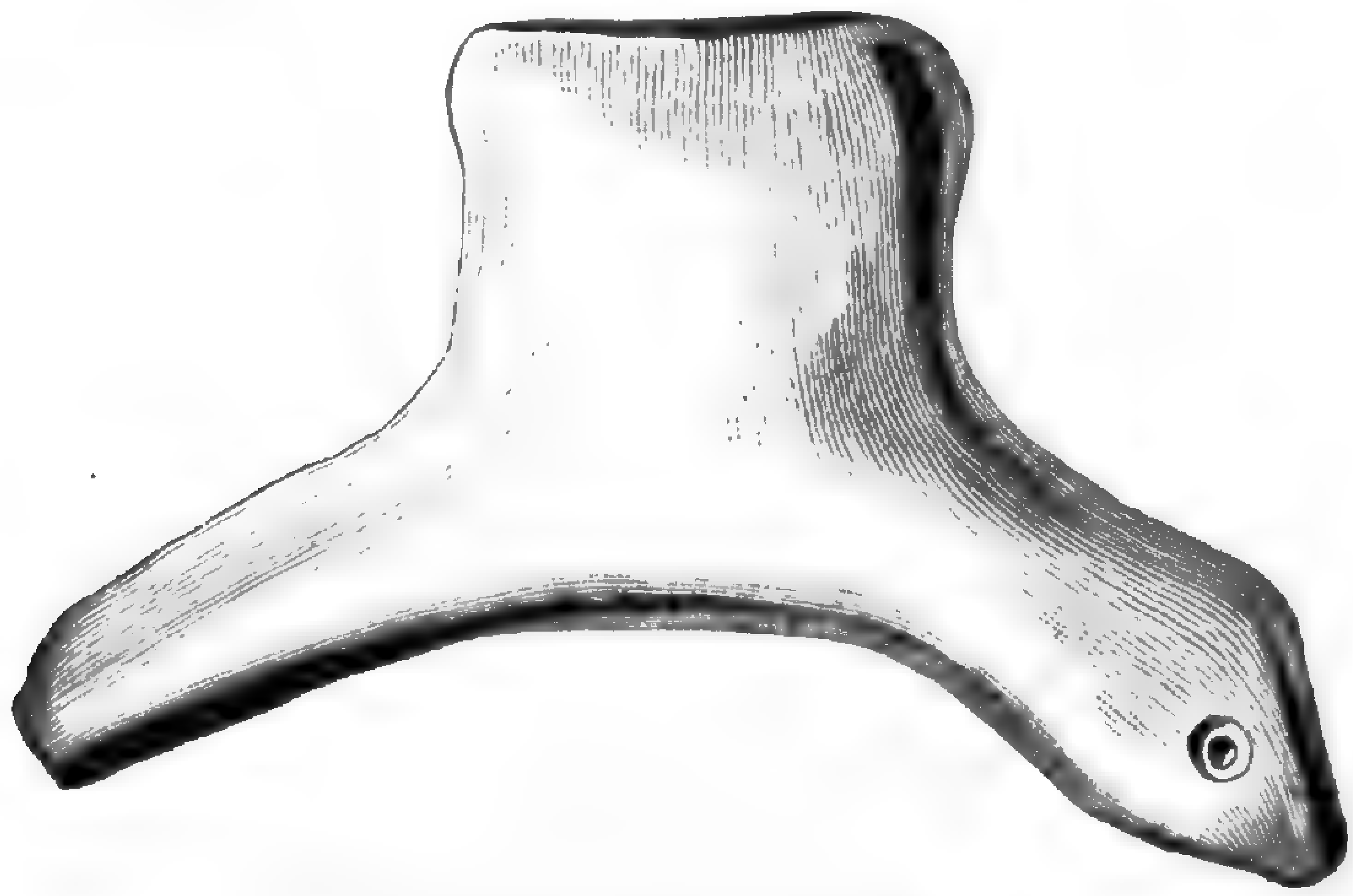

FIG. 21.—Bird Pipe, Indiana.

carved from memory, and errors of execution appear more frequently in the representations of those animals which obviously could not have been perfectly familiar to the sculptor. Indeed, many of these portraitures are scarcely recognizable, and it is often impossible to determine what animal the artist intended to copy. The body of the elephant pipe (Fig. 17) is much elongated and the legs shortened; defects which may be attributed to the inexperience of the workman or his lack of personal knowledge of the model; yet, notwithstanding the fact that certain archæologists have advanced the opinions respectively, that the peccary, the tapir and *the armadillo* were intended to be portrayed, a careful study of the image will confirm us in the belief that the elephant was the animal which the prehistoric artisan had before his mind. It may be asserted with a considerable degree of confidence that no representative of an exclusively exotic fauna figured in the pipe-sculptures of the mound-builders. If we accept the presence of the mammoth or mastodon amongst these carvings, the species which served as models, though now extinct, must be classed with our indigenous fauna. Their knowledge of such animals as the parroquet, the manatus, and possibly the seal and Rocky mountain sheep, does not necessarily indicate any particular migration on the part of that ancient people, but serves to show that their intercourse and commercial relations with other peoples were extensive. As has been previously remarked, however, the artists were apparently well acquainted with some of the birds, mammals and amphibia whose geographical limits were far removed from the upper portion of the Mississippi valley, but which, nevertheless, might have been met with by some of the people in their expeditions. On the other hand, many of the representations were evidently executed from descriptions or rude delineations furnished by those who had seen the originals. The mounds have produced galena from Missouri and the adjacent territory; mica from the spurs of the Alleghany or Rocky mountains; Catlinite from Minnesota; copper from the Lake Superior region; obsidian from Mexico and the Pacific slope of the United States, and marine shells from the Gulf of Mexico, the Atlantic ocean, and also the Dentalium of the Pacific coast.[1] Thus it will be seen that the trade relations of the mound-builders extended over a great extent of territory, in fact, covering the greater portion of the present United States and probably penetrating into British America and Mexico.

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ON THE FLOWERS OF SOLANUM ROSTRATUM AND CASSIA CHAMÆCRISTA.[2]

BY PROFESSOR J. E. TODD.

WITHIN a few years, a plant has been introduced into Southwestern Iowa, which is as unwelcome as it is interesting. It bristles all over on stem, leaves and fruit, with stout, rigid prickles. It is commonly called Texas nettle, as it is supposed to have been brought by the herds of Texas cattle, which in

[1] Vide Ancient Aboriginal Trade in North America, by Dr. Chas. Rau. Smith. Rep., 1872, p. 383.

[2] Read before the Biological Society of Washington, March, 1881.

recent years have been fattened in that region. It is found abundantly in Western Nebraska at present, and although it may have been introduced there in like manner, I presume it is indigenous. It is so put down, I believe, in Coulter's Flora of Colorado.

It has rather conspicuous flowers, of a pure sulphur-yellow color, and of the form represented in the figure. It is a *Solanum*, but very unlike the more familiar forms of the genus. The essential organs are quite unsymmetrical. Four of the stamens are of the normal or usual form, but the fifth, which is on the lower side of the flower, is about twice the length of the others, and has a large, tapering anther, which about the middle is crooked to one side, and its slender apex curved upward as is represented in the figure. This irregularity, doubtless earned for the plant, its cognomen *rostratum.*

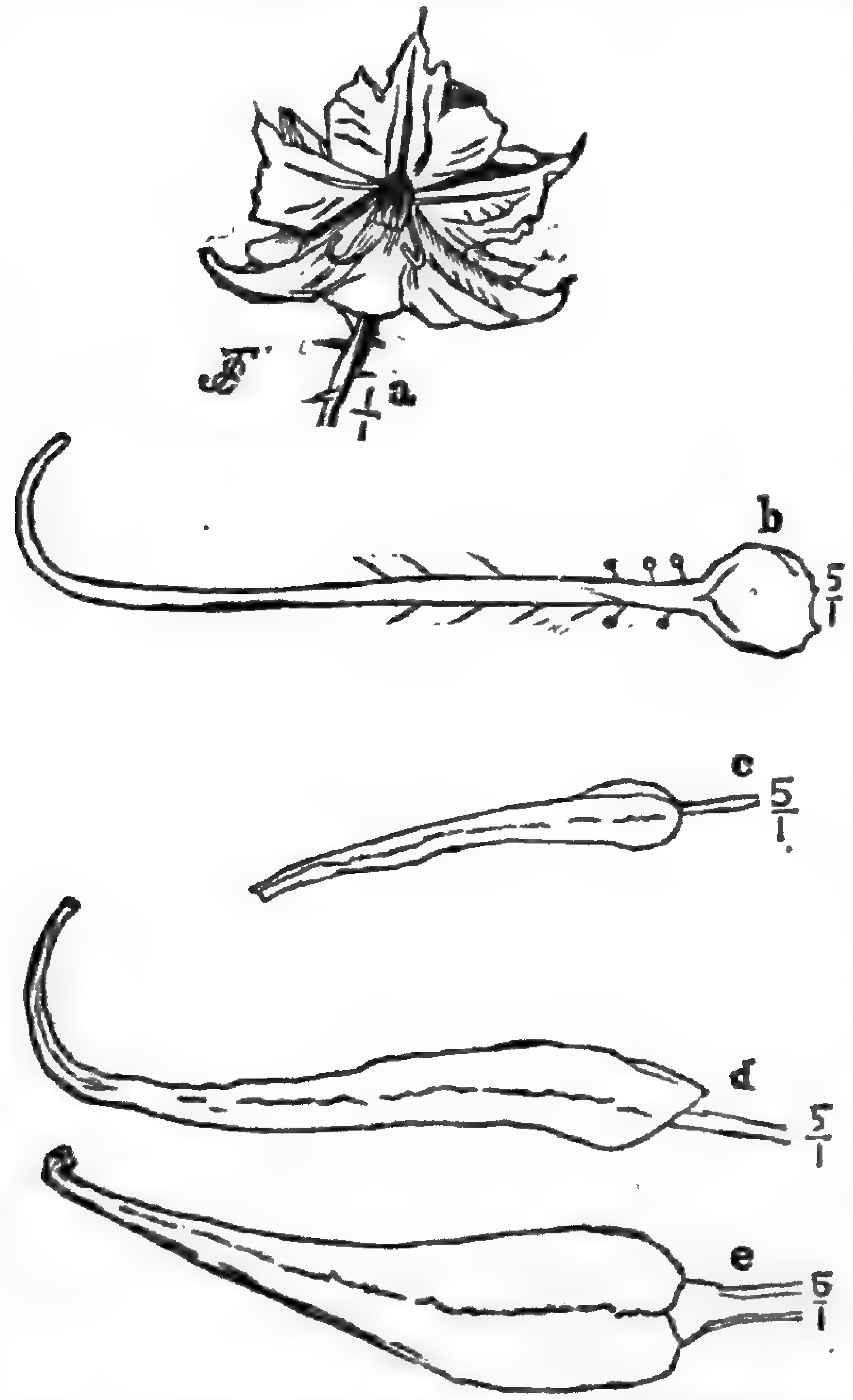

FIG. 1.—*Solanum rostratum.* *a*, flower (natural size); *b*, pistil; *c*, a short stamen; *d*. lateral view of the long stamen, and *e*, view of the same from above.

The anthers open by terminal chinks or pores, as is common to this genus. The long anther shows considerable elasticity, and in its movements throws a puff of pollen from its apex, which, as will be seen, is turned upward and at right angles with its axis.

The pistil, as will be seen from the figure, is turned so as to resemble in general form, size and position, the long anther just described, with this exception, that it turns toward the opposite side of the flower. Moreover, the pistil and longer stamen, in different flowers, exchange directions, so that in some the pistil turns to the right hand, and the stamen to the left, and in others *vice versa.* We will, for convenience, call the flowers in which the pistil turns to the right hand, facing as the flower, right-handed, and those in which it turns to the left, left-handed. The figure represents a left-handed flower. With a little examination, it is found that there is a very simple law deciding whether any given flower, from its position, should be right-handed or left-handed. In the examination of scores of flowers I found no exception to this law. The flowers are arranged in simple, bractless racemes, which extend in a horizontal position. The flowers, consequently, are arranged on each side of the axis.

The law referred to is this. The pistil, in any flower, turns towards the axis of the raceme. It follows from this, that successive flowers on the same raceme have their pistils turned toward opposite sides. It is also a fact of observation, that the flowers of a cluster on any one branch, and opening about the same time, are either all right-handed or all left-handed. Any plant, however, if it is at all large, exhibits right and left-handed flowers in about equal numbers.

Of five plants observed:

No.	1	had	5	pistils	left-handed	and	4	right-handed.		
"	2	"	3	"	"	"	"	1	"	"
"	3	"	1	"	"	"	"	2	"	"
"	4	"	3	"	"	"	"	3	"	"
"	5	"	3	"	"	"	"	4	"	"

The advantage in all this is so obvious that it scarcely needs explanation. It is like most irregularities in flowers, a contrivance for cross-fertilization. After considerable watching, I had noticed no insects visiting the flowers, except a small humble-bee, and this seemed quite attentive. The weight of the bee so springs down the flower, that it is quite difficult, on account of the large flexible corolla, to see just what is done, but repeated observations led me, quite satisfactorily, to this conclusion. The bee seeks the pollen—for the flowers have neither nectar nor odor—and this she uniformly gets from the four shorter stamens; never, so far as I could determine, from the larger one. This she does by seizing each one, near its base, between her mandibles, and with a sort of milking motion crowds the pollen out of the terminal pores; meanwhile, by the movements of her feet, the larger stamen is repeatedly sprung backwards, and as often throws a cloud of pollen on one side of her body; this in a right-handed flower. When she passes to a left-handed flower, which, as was explained above, is very likely not to be on the same plant, the pollen is carried directly to the pistil of that flower, and so on. We have here, therefore, a novel apparatus for cross-fertilization, quite distinct from those that have been most commonly noticed.

A few days after having noticed the peculiarities of *Solanum rostratum*, my attention was attracted to the asymmetry of the flowers of the more common plant, *Cassia chamæcrista*. Its appearance, when fully open, as in early morning, is shown in the figure. The points that are of special interest to us, are the sickle-shaped pistil, the stamens with long, rigid anthers, opening by terminal pores, and most of them pointed toward the incurved petal, which is always on the opposite side from the pistil, as is shown in the figure. A vertical line let fall across the flower, in its natural position, uniformly falls midway between the two. So we may here speak of the flowers as right-handed or left-handed, as before, according to the position of the pistil. As the inflorescence is less regular than in *S. rostratum*, we have been unable to discover any definite law, as in that case, but different plants have about an equal share of right and left-handed flowers. Observations on some plants that were in rather a dilapidated condition, resulted as follows:

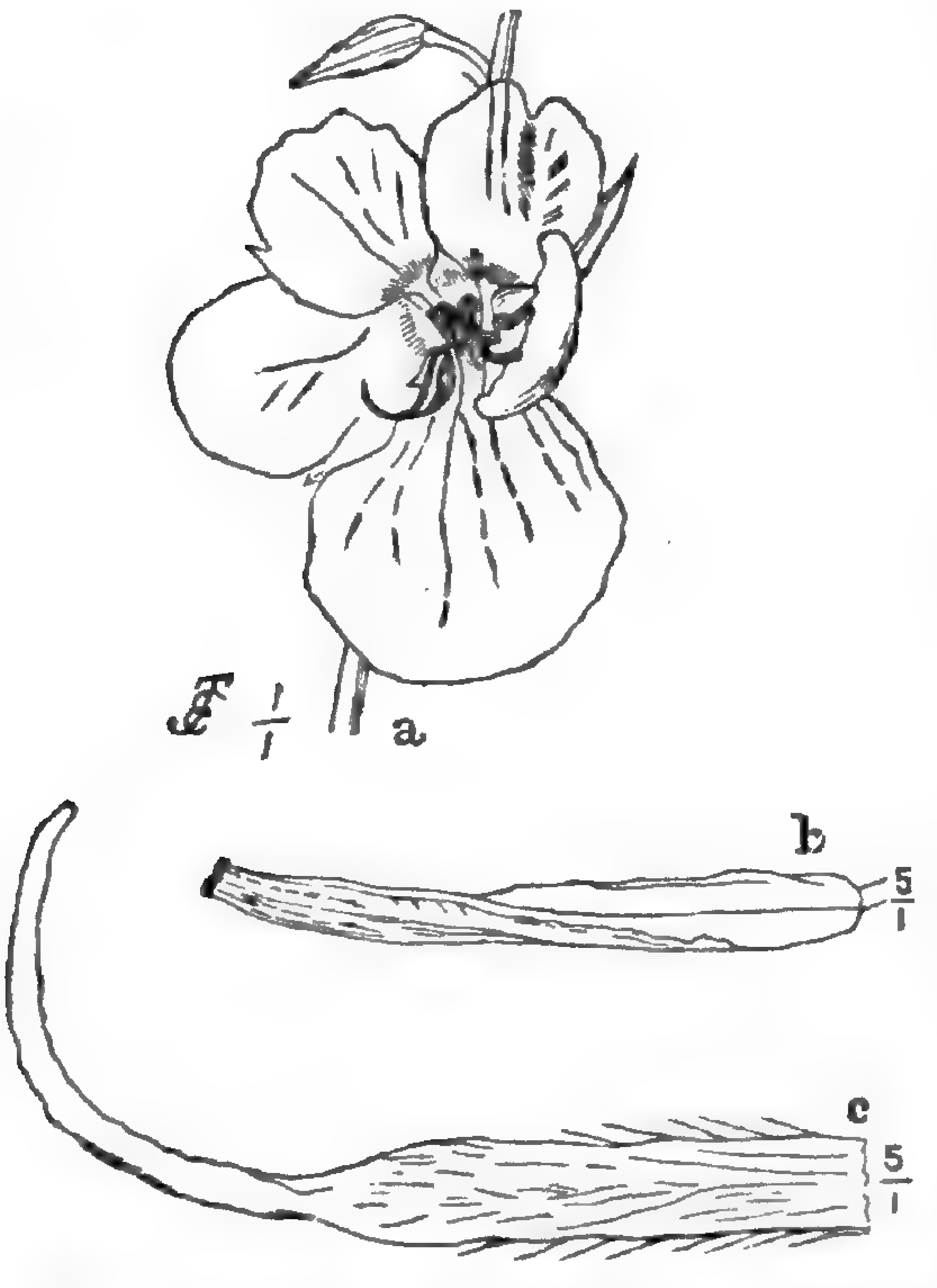

FIG. 2.—*Cassia chamæcrista*, *a*, flower (natural size); *b*, a stamen; *c*, pistil.

Plant	No.	1	had	6	right-handed	flowers	and	4	left-handed.	
"	"	2	"	4	"	"	"	"	2	" "
"	"	3	"	2	"	"	"	"	0	" "
"	"	4	"	1	"	"	"	"	2	" "

I found these flowers also visited mainly by a small humble-bee, and judge that they gather pollen in a similar way to that noticed in the *Solanum*. The flowers are nectarless and odorless. The advantage is not so obvious in this arrangement as in the *Solanum*, and I have not had opportunity to study it quite as closely and carefully, but I consider the following explanation the most probable.

In gathering the pollen, some grains are dropped on the incurved petal, and by it made to adhere to parts of the bee, and to such parts in a right-handed flower as will carry it to the stigma of a left-handed flower, and *vice versa.*

So much for the observations upon the plants themselves. Let us trace their more marked peculiarities in related plants, and, if possible, find some hint as to their origin.[1]

In *Solanum rostratum* the particulars in which it differs from the normal form of the genus, are three, viz: (1) The long recurved style; (2) the elongation and enlargement of the lower stamen; and (3) the crooking of them toward opposite sides of the flower. In examining kindred species of this most numerous genus, we find that in our common *S. nigrum* in Southern California, there appears a variety, *S. Dillenii,* which sometimes has its style exerted, and sometimes has it short as in the common *nigrum.* Another, *S. nodiflorum,* in Arizona, which "generally has this feature," passes into *S. Douglassi* which is found at Santa Barbara, Cal. The development of this character seems to attend, and perhaps depends upon, the change of the flowers from a drooping attitude, as in the typical *nigrum,* to a more erect position. The obliquity of the stamens, or their vertical asymmetry, as it might be called, appears in *S. tuberosum* sometimes. I have observed it in the "peach-blow" variety; I have observed it more frequently in *S. Carolinense.* The extreme form, however, which we have found in *S. rostratum,* is confined to the sub-

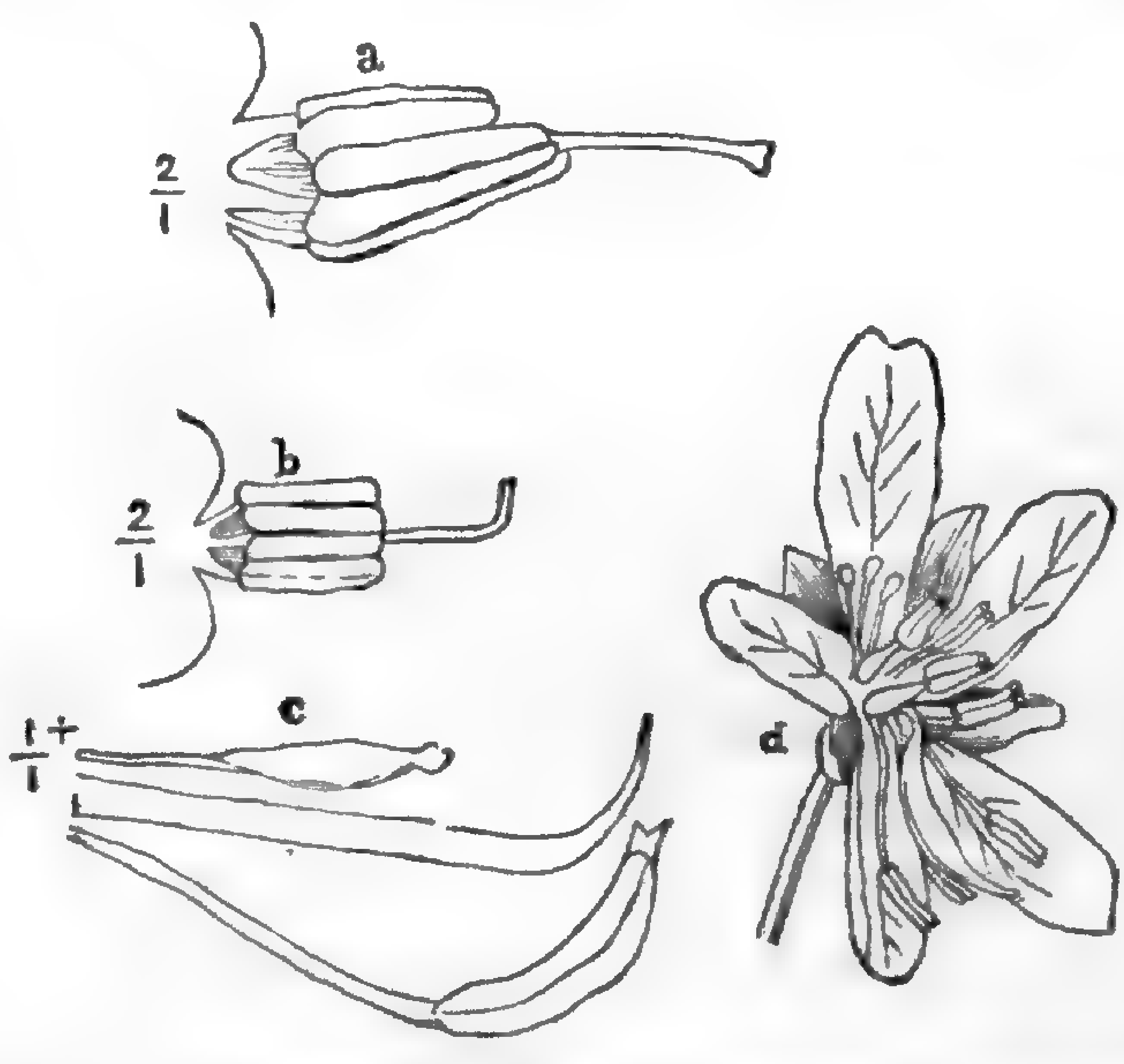

FIG. 3.—*a*, stamens and pistil of *Solanum tuberosum,* unusual form; *b*, do. of *S. nigrum* var. *Dillenii*; *c*, do. of *Cassia occidentalis*; *d*, flower of *C. acutifolia,* after J. Murray. Note.—*b* and *c* were drawn from dry specimens.

[1] This work would necessarily have been very incomplete, had not the library and herbarium of the U. S. Department of Agriculture been freely opened to me by the kindness of Dr. Vasey, to whom I would thus acknowledge my indebtedness.

genera *Androcera* and *Nycterium.* The first has but one long stamen, and *S. rostratum* may be taken as its type. This sub-genus is confined to tropical America. *Nycterium* contains species most of which have three long stamens, but some have only one. A table of the species and their distribution is as follows:

tridynamus, obtusilobum and amazonum	3 lower stamens longer,				Mexico.
Wrightii	3	"	"	"	East Indies.
vespertilio	1	"	"	"	Canaries.
dubium	1	"	"	"	Arabia and North Africa.

Of the lateral asymmetry I cannot speak, for so far as I can learn, it has not been noted. In the case of *Cassia chamæcrista*, the unsymmetrical features are (1) the curved style, (2) the oblique stamens, (3) their abnormal number, and (4) the incurved petal. The first is not peculiar, but is found in nearly all representatives of the order *Leguminosæ.* The second and fourth peculiarities are such as are easily overlooked, and have not, so far as I find, been noted of other species. The third peculiarity becomes significant when we compare this species with a typical one of the genus, such as the one shown in the figure of *C. acutifolia*, which may also represent in general, *Marylandica* and *occidentalis.* Here (Fig. 2) we usually have seven fertile stamens; in that (Fig. 3 *d*) we find the other three of the normal number ten, present, but sterile, as if to indicate that some of the seven are derived from the longer ones of the typical form. One or two of them in *chamæcrista*, instead of following the oblique position of the rest, sometimes stretch out on the side of the pistil.

The advantages of the arrangement in *chamæcrista* for securing cross-fertilization over the more common form of the *Cassiæ*, as in *acutifolia* and *occidentalis*, I think may be seen without further explanation. Moreover, if the insects visit the flowers for pollen, we can readily see the advantage in having the stamens of unequal length, and hence the development by natural selection, of the *Androcera* form of *Solanum*, and the typical *Cassia* from among the *Cæsalpinieæ*

Before leaving the subjects suggested by these flowers, I would indicate several points, and not having time to discuss them more fully, we will leave them in the form of queries.

1. These similar modifications occur in utterly diverse families, having similar geographical distribution, viz: in tropical regions, and perhaps the limitations may be further narrowed to the drier

parts of these regions. May this not indicate that certain physical influences have primarily induced the variations which have been developed into perfect adaptations?

2. May not heliotropism, or the retarding effect of light upon the formation of tissue, partly explain the greater development of the lower stamens, the shortening of the middle, and the abortion of the upper; and may it not also explain the upward curving of the styles and lower stamens in these plants?

3. May not the mechanical action of the insect have some connection with the obliquity of the *C. chamæcrista* flower, and the divergence of the styles and stamens? *C. chamæcrista* is like the typical form turned downward and to one side.

4. In these plants we have found a lack of bilateral symmetry, and we have found it attended with a regular exchange of sides, and that to accomplish a special purpose. Is this commonly so in plants thus irregular, such as the *Cannaceæ* and *Zingiberaceæ?*

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IS LIMULUS AN ARACHNID?

BY A. S. PACKARD, JR.

IN an article by Professor E. R. Lankester in the *Quarterly Journal of Microscopical Science*, for July and October, 1881, entitled "Limulus an Arachnid," the author, distinguished for his histological and embryological papers especially relating to mollusks and Cœlenterates, takes the ground that Limulus, or the horse-shoe or king crab, "is best understood as an aquatic scorpion, and the scorpion and its allies as terrestrial modifications of the king crab," and on p. 507 he makes the following startling announcement: "That the king crab is as closely related to the scorpion as is the spider has for years been an open secret, which has escaped notice by something like fatality." While appreciating the thorough and critical nature of the learned author's work, especially observable in his excellent paper on the structure of Apus, we venture to assert that in regard to the systematic position of Limulus, Professor Lankester has mistaken interesting analogies for affinities, and has on quite insufficient and at times wholly hypothetical grounds rashly overlooked the most solid facts, and safe inductions from such facts, and arrived at very forced and it seems to us strange and quite untenable conclusions.

At the outset, it will be remembered that Limulus differs from the Tracheates, including the Arachnids, in having no tracheæ, no spiracles, and no Malpighian tubes. It differs from Arachnids in these characters; also in having compound eyes, no functional mandibles or maxillæ, the legs not terminating, as is generally the case in Tracheates, in a pair of minute claws; while its brain does not as in Arachnida supply both eyes and first cephalic appendages. On the other hand, Limulus agrees with Crustacea in being aquatic and breathing by external gills attached to several pairs of biramous feet; in having a simple brain, which as in some groups of typical Crustacea (Branchiopoda, etc.), does not supply any of the appendages, while the structure of the circulatory, digestive and reproductive organs agrees with that of the Crustacea; and, as we have shown in our Embryology of Limulus (this journal for 1870), the development of Limulus is like that of certain other Crustacea with a condensed metamorphosis, the possession of an amnion being paralleled by that of Apus. In all essential points Limulus is a Crustacean, with some fundamental features in which it departs from the normal Crustacean type, and with some superficial characters in which it resembles the scorpion. The importance of these superficial characters Mr. Lankester exaggerates, and upon them with a number of suppositious, *a priori*, pseudo facts he constructs, by a process quite the reverse of the inductive method, a new classification of the Arachnida.

We will now briefly criticise some points insisted upon by Professor Lankester: and first on p. 510, as regards the ensheathing of the nervous cord by an actual arterial vessel. This is to be met with in a less marked degree in the insects (Lepidoptera) as well as scorpions. As regards the comparison of the nervous system of Limulus with that of the scorpion, the comparison and statement made in our second memoir, which Lankester sets aside, was based on a month's careful study and dissection of the nervous system, particularly the brain of the scorpion, while our author draws his inspiration from Newport's account and figures. The differences between the brain and thoracic ganglionic mass of the scorpion, and that of Limulus are not even correctly stated by our author. The brain of the adult scorpion, as we stated on p. 7 of our second memoir, sends off nerves to the simple eyes *and to the first pair of appendages;* in Limulus the brain supplies the eyes alone; the first pair of appendages being supplied from the commissures, as in all Phyllopod Crustacea. Had Mr. Lankester examined for himself the brain of the scorpion, he would not have given the strangely incorrect account on p. 511. In the first place, the nerves to the first pair of appendages arise from the brain itself, as we have seen and as has been stated by other authors,[1] and not as Lankester says from the œsophageal collar. Moreover, as we stated, the brain is situated in the top of the head of the Arachnida, and not on the same plane as the œsophageal collar as in Limulus. In regard to the morphology (not the internal structure) of the brain, Limulus much more nearly approaches Apus and other Phyllopods than the scorpion and other Arachnida.

In discussing the external anatomy of Limulus, Mr. Lankester claims that between the sixth abdominal segment and the spine there are six segments. We venture to suggest that four of these segments are purely imaginary. Embryology, as we have indicated in our figures, shows that there are but nine segments in the abdomen of Limulus, the spine forming the ninth. Our author speaks of the "post-anal spine," when the anus is plainly situated in the base of the spine itself. It is a general law in the Arthropods that the anus opens in the terminal segment of the body. There are fifteen segments in the body of Limulus, as embryology abundantly shows. In order to compare the body of Limulus with its fifteen segments or arthromeres to that of the scorpion with nineteen, Mr. Lankester conjures up four additional segments, which are pure metaphysical inventions. The cephalothoracic plate or carapace is more than once styled a "sclerite." The author here (as usual) sets aside the embryological proof that the carapace is composed of the tergites of six segments, and allows, apparently as the results of his own independent observations (as if no one had previously *proved* it[2]), that

[1] Newport, whom our author quotes, expressly states that "immediately beneath the nerves to the eyes a large nervous trunk passes forwards, from the front of the brain on each side, to the small prehensile organs (*a*), which, in the scorpion, are modified antennæ." Balfour's embryological observations shows that originally the brain of the spider is a double ganglion; the two forming the adult brain; our embryology of Limulus shows that the brain is from the beginning a single ganglion.

[2] In a preliminary paper on the Embryology of Limulus Polyphemus, read before the Amer. Assn. Adv. Science, August 1870, and printed in the AMERICAN NATURALIST for October, 1870, which our author has apparently not seen, the six segments of the embryo Limulus when in the trilobite stage are figured, and the number of thoracic segments is stated in the text. This paper is a summary of the memoir printed in the Memoirs of the Boston Society of Natural History, and contains a general account of the embryology of Limulus, and appeared with figures over a year in advance of any other account of the embryology of Limulus.

the carapace may "be considered as representing six coalesced tergites." Partly on metaphysical grounds, and partly from the presence of moveable spines on the sides, which, however, are situated on the anterior limb-bearing segments of the abdomen, as well as on the 7th and 8th limbless segments, our author is encouraged in the belief that these four hypothetical segments really exist. We prefer the plain teachings of observed facts, which are capable of demonstration and proof, and would ask for better evidence than this article affords of the existence of such segments. We would also continue to regard the anal spine as the telson. Lankester's "telson" is made up of the consolidated thirteenth and fourteenth segments of the body *plus* the anal spine or fifteenth (or ninth abdominal) segment.

Our author sets out with the foregone conclusion that he "must" find in the "abdominal carapace" of Limulus the representatives of the twelve abdominal segments of the scorpion, and so with a method of his own he creates them out of his inner consciousness.

In like manner he feels compelled to offer a new interpretation of the scattered, individual, simple eyes of the scorpion, and attempts to show that after all they are compound eyes like those of Limulus, with the difference that in Scorpio they are "in a less compact form." Now the compound eye of Limulus, like that of the lobster or any other Crustacean or insect, possesses a common basally undivided retina, in Limulus a common undivided outer cornea, while the two simple eyes in Limulus have each a separate cornea, a separate retina, and each ocellus is supplied by a separate nerve arising independently from the brain.

In like manner our author labors to diminish the importance of the differences between the cephalothoracic appendages of the Arachnida and those of Limulus.

Professor Lankester then ventures, we think, somewhat hastily, to homologize the first pair of abdominal appendages of Limulus with a little triangular median sternite in the scorpion. Then he fancifully homologizes the comb-like organs of the scorpion with the second pair of abdominal legs of Limulus, and also homologizes the respiratory lamellæ with the "lamelliform teeth of the scorpion's comb-like organs." The author farther seriously attempts to homologize the four pairs of stigmata of the scorpion with the four last pairs of biramous respiratory feet of Limulus.

On the same principle the stigmata of any insect are the homologues of its legs. What will Mr. Lankester do with the gill-plates of the Eurypterida, which are not arranged, according to Woodward, like those of Limulus, but are placed like the teeth of a rake?

Another surprise is added to the already long list, by Mr. Lankester's discovery (of which he makes great account), of what he calls "parabranchial stigmata" in Limulus. He places them on the "sternal area of the segments," but his statements on the succeeding page, and his figures plainly show that these little muscular pits are situated at the base of the biramous abdominal legs. Is there an instance in nature of stigmata being borne on the legs? Is there the slightest possible reason for regarding these pits as stigmata? We are then treated to a long series of suppositions accompanied by a series of elaborate hypothetical lithographic drawings designed to "illustrate the hypothesis as to the derivation of the lamelliferous appendages of Limulus and Scorpio from a common ancestral form." The late appearance of the lamellæ on the feet of the embryo Limulus, should teach any naturalist of sound judgment that they are most probably very special and late differentiations of the appendages. Besides this, palæontology shows that in the Carboniferous period there were scorpions almost generically the same as the existing ones, and with them Bellinurus, closely resembling the Mesozoic and recent Limuli, which indicates that the latter type has always been a marine one, without any possible use for stigmata. Moreover, the Eurypterine Merostomata, with crustacean gills, flourished as early as the Lower Silurian period.

Passing over for want of space and time, the three or four pages of trivial criticisms of our own views by Professor Lankester, we are thus brought to the close of Mr. Lankester's article, and to his tabular view of his new classification of the Arachnida, one which is calculated at least to take away the breath of the ordinary systematist.

Any attempt at reasoning with our author, whose methods are so opposed to the inductive mode of scientific reasoning, and whose views are often founded on baseless hypotheses, would probably be fruitless. He is "surprised" that we should persist in believing that Limulus is a Crustacean.

We will in reply and to close this criticism, simply quote some statements of the late Dr. Von Willemoes-Suhm, whose important discoveries have been overlooked by all writers on Limulus. Our attention has been called to them through Mr. E. Burgess by Professor Walter Faxon, who has kindly sent us the subjoined extracts from Von Willemoes-Suhm's Letters.

The first reference by Von Willemoes-Suhm was in the Zeitschrift für wissenschaftliche Zoölogie, XXIX, 1877, writing from Yeddo under date of May 7, 1875, he says: "I have in the meantime discovered in the Philippines that the Limulus living there develops from a free-swimming larva, viz., a Nauplius stage, a fact of great significance to the whole doctrine of crustacean development. The preliminary notice concerning it, which I soon send to the Royal Society, will soon come to your notice. Packard and Dohrn have had to do with an animal which, like the crayfish, has a condensed development." (p. CXXXII.)

A fuller statement is in a postscript to a letter written aboard the *Challenger* to Professor Kupffer, dated "Zamboanga, Mindaua, 4 Februar, 1875," printed in "Challenger-Briefe von Rudolf von Willemoes-Suhm, Dr. Phil., 1872–1875. Nach dem Tode des Verfasser herausgegeben von seiner Mutter," Leipzig, 1877, pp. 157, 158. I am indebted to Professor Faxon for the extract of which I give the following translation:

"I send you this postscript in order to forward early information that it has befallen to me to find on the surface of the water here, about five stages of development of *Limulus rotundicauda*, which does not, like the North American species, according to Packard and Dohrn, directly develop, but passes through a Nauplius stage, with one, afterwards with three eyes, wholly like a Phyllopod. A tail spine is present, but jointed above, and in this stage shows a parallel with Eurypterus. Packard's mode of development is a condensed one, and as would appear, his as well as Dohrn's and Van Beneden's generalizations on the position of Limulus are throughout untenable, in so far as they remove this from the Phyllopods (*Apus* and *Branchipus*). They rather become closely allied through their common Nauplius with three pair of appendages; and a part of the 'Gigantostraken,' especially the Eurypteridæ, should be added to them."

"As soon as I reach Japan, I hope to also examine the Limulus there. The larvæ here are unfortunately very rare and difficult to isolate but I have good preparations of the most important stages. I hope to fall in with the northern species."

A PATHOGENIC SCHIZOPHYTE OF THE HOG.

BY PROFESSOR H. J. DETMERS.

(Continued from March number.)

A LITTLE over a year ago I had a chance to make an incidental investigation of a few cases of Texan fever, and besides other bacteria found several large bacilli, several micros in length. These bacilli developed large helobacteria, containing each one or two lasting spores. If the observations of others are correct, and I have no doubt they are, these lasting spores, when their time comes, burst, and discharge a cloudy mass, which is supposed to consist of exceedingly minute germs, too small to be distinctly seen with the very best objectives at our disposal. These minute germs, it is further supposed, develop and grow, and finally form the micrococci of the Schizophytes to which the helobacteria and the lasting spores belong. The helobacteria, which I found in swine-plague, bear, as to size, about the same relation to the swine-plague Schizophytes, as the helobacteria found in Texan fever to the bacilli, which presented themselves in that disease; consequently, as the former were found so often, and frequently in perfectly fresh material, before any other Schizophytes except those of swine-plague, and particularly before any putrefaction bacteria had made their appearance, there is, in my judgment, just cause to suppose that these helobacteria are but another stage of development of the bispherical swine-plague Schizophytes, and that the germs of the swine-plague micrococci are the product of the lasting spores. At any rate, if such is the case, the whole cycle of development and propagation is complete, and a great many things are at once explained which otherwise cannot be accounted for.

These lasting spores, undoubtedly, like those of some other Schizophytes, possess great vitality; are able to withstand degrees of heat and cold and other adverse influences absolutely destructive to the Schizophytes in any other form or stage of development. I have abundant proof—the same has been published in my reports to the Commissioner of Agriculture—that the vitality of the infectious principle of swine-plague, or what is the same, of the Schizophytes of swine-plague, can be preserved under certain conditions, or in certain media—in an old straw stack for instance—a whole year, and possibly much longer. If the swine-plague Schizophytes did not develop helobacteria or lasting spores, such a long preservation, to say the least, would be difficult to comprehend, even if an indefinitely continued and uninterrupted propagation of the Schizophytes by fission should be possible, for an old straw stack, although affording excellent protection on account of its porosity, and by being a poor conductor of heat, does not seem to be capable of providing the necessary pabulum for innumerable generations for a whole year, or longer, without changing the malignant character of the Schizophytes, while, when cultivated in fluids, foreign to the body of the hog, the same Schizophytes undergo an observable change as to their malignancy—become less capable of producing mischief—in a few generations. Further, the swine-plague Schizophytes, while in the state of a single or double micrococcus, of a coccoglia, or of a micrococcus chain, are known to succumb in a comparatively short time to adverse influences, and it is very much to be doubted whether they possess vitality enough to be preserved a whole year, or longer, in a dormant state, even if protected by such a porous body as an old straw stack. Moreover, for reasons already stated, it would be impossible to account for the multitude of single micrococci invariably present in all infectious material, unless the swine-plague Schizophytes develop helobacteria and lasting spores, which produce germs developing to micrococci. If animal fluids, lung-exudation for instance, containing swine-plague Schizophytes, are filtrated through several papers, the latter, if fine enough, retain the micrococcus-chains, the zoöglœa-masses, most, or nearly all of the double, and a good many of the single micrococci, while some of the latter, no matter how fine the papers may be, will pass through. But as the single or spherical micrococci of swine-plague are not a product of fission — do not proceed from micrococcus-chain, zoöglœa-masses, or double micrococci—and do not come from other single micrococci, which, as far as I have been able to observe, develop to double or bispherical bodies, in as well as out of the zoöglœa-mass, the fact that in a few hours or, at any rate, in a day after the filtration, the number of single micrococci contained in the filtrate is much larger than immediately after the filtration, cannot be explained, unless something finer than the micrococci, in other words, some micrococcus germs or the products of the lasting spores, too fine to be distinguished by the human eye through the best lenses in use, must have been contained in the lung-exudation, and must have passed through the filtering papers. Still, when the filtrate containing the micrococci, was filtrated again and again, each time through four papers, and at such a time, at which most or nearly all of the micrococci had become double, or developed to chains, but before any helobacteria had formed or could be found, the filtrate finally became free from micrococci, and an inoculation with the same proved to be ineffective, while an inoculation with the filtrate containing micrococci, produced a mild form of disease. Hence, it must be supposed, time and repeated filtrations finally exhausted the existing supply of micrococcus-germs or lasting spore products. Some French investigators, indeed, have found that in Anthrax not only the bacilli, but also their products (?), if used for inoculation, produce the disease. Does it not seem probable that these products are nothing but the germs discharged by the lasting spores, which are contained in the infectious media, invisible to the human eye even through the best objectives, because too small?

Finally, as single micrococci do not develop from other single micrococci, and are not a product of fission, they cannot increase in numbers in the animal organism—for instance, after an inoculation—unless we accept spontaneous generation, or unless there is another link in the cycle of metamorphosis, a helobacterium or lasting spore, which produces and disseminates the germs or seeds of the new micrococci. Therefore, as such helobacteria or lasting spores are of frequent occurrence, and can very often be found in perfectly fresh material, such as lung-exudation, blood serum, etc., before any other bacteria besides swine-plague Schizophytes have made their appearance, and also correspond in size to the swine-plague Schizophytes the same as the helobacteria found in Texan fever to the bacilli found in that disease, it will be pretty safe to conclude that the helobacteria in question are simply an advanced and matured form of the swine-plague Schizophytes. The discharged contents of such a lasting spore, though undoubtedly granular, are too fine to be resolved by our present objectives.

But what proof is there that these Schizophytes, which I call swine-plague Schizophytes, really constitute the cause and the infectious principle of that disease, and are not the products of the morbid process, or merely accidental attendants. To show that their presence is not accidental, may not need much proof, although an abundance can be furnished. It will probably suffice to say, if the Schizophytes were accidental, that is, had no relation to the disease, neither as cause nor as effect, it would be very strange that they are found in every case of swine-plague and nowhere else. It may be said that some investigators did not find them, but that proves nothing. They are easily overlooked. If one, for instance, has blood or blood serum under the microscope, and focusses on the blood corpuscles, the microphytes, and especially the micrococci, are easily overlooked, particularly if the objective has a short focus and a large aperture, and therefore but little penetration, but the same will come into view if the focus is very slightly raised, or just enough to make the outlines of the blood corpuscles a trifle less distinct, because the Schizophytes, it seems, have a tendency to crowd as close to the cover as they possibly can. Some of them also crowd to the slide, and may therefore be brought to view by lowering the focus just a trifle. Besides, to distinguish under all circumstances, Swine-plague micrococci from small granules, and *vice versa*, requires some experience, a very good objective, good light and careful handling. Further, if one attempts to find Schizophytes in undiluted blood he will very often not succeed, because the blood corpuscles, if very thick or numerous, are apt to hide them from view.

In all my examinations of blood, blood serum, lung-exudation and other morbid products of swine-plague, I never found the swine-plague Schizophytes absent, while on the other hand, I never found them anywhere else. It is true I have found similar single and double micrococci and micrococcus-chains in other substances; for instance, in wine, but the same differed in size, and behaved differently in forming zoöglœa-masses and micrococcus-chains. Those which I found in some substances were considerably smaller, while in some others I found larger ones.

If the possibility of spontaneous generation is admitted, it will be difficult to advance direct proof that the swine-plague Schizophytes are not the product of the morbid process, because in a certain sense they are; they multiply within the animal organism, and multiply very rapidly, and probably in the same ratio, in which the morbid process progresses, if once introduced from the outside. If, however, the possibility of a spontaneous generation is not admitted, the Schizophytes cannot be produced, or be called into existence by the morbid process.

As evidence that the swine-plague Schizophytes constitute the true cause of the morbid process, and the infectious principle of the disease, by which the latter is communicated from animal to animal, from herd to herd, and from one locality to another, I can offer the following facts, which may not constitute absolute proof, but, if considered in toto, make it reasonably certain that the Schizophytes, and nothing else, constitute the cause and the infectious principle of the disease.

1. Every inoculation of healthy pigs which never had become infected with swine-plague, when made with material containing swine-plague Schizophytes—lung-exudation for instance—proved to be effective, and produced the disease in due time, between three and fifteen days, or on an average in five to six days, notwithstanding the very small quantity, usually not exceeding the fourth part of one drop, with which the animal was inoculated on the outer surface of the ear, provided no measures of prevention were applied. For particulars I have to refer to my published reports. Further, even an inoculation with filtrated lung-exudation, in which no visible solid bodies whatever, except Swine-plague micrococci, could be discovered, proved to be effective, and produced a mild form of the disease, while filtrated lung-exudation, destitute of micrococci, when used to inoculate a healthy animal, proved to be ineffective, and did not even cause a visible reaction.

2. Inoculations with swine-plague Schizophytes cultivated in an innocent fluid, such as fresh cow-milk, albumen of a hen's egg, etc., invariably produced the disease, though usually in a comparatively mild form; a fact which corresponds with the results of the experiments, made by Toussaint, Pasteur, and Buchner with *Bacillus anthracis*, and by Pasteur with chicken-cholera microbes, and shows that the malignancy of pathogenic Schyzophytes depends largely upon the nature of this pabulum.

3. Swine, which survive an attack of swine-plague and recover, possess afterwards either perfect, or what is more frequent, partial immunity from further infection. In other words, subsequent inoculations, or a subsequent exposure to the influence of the infectious principle, have either no effect whatever, or have only a

comparatively slight effect, that is, are productive of a mild and not fatal form of the disease, or cause only a scarcely observable reaction. All this cannot find an explanation, if the infectious principle consists in a chemical virus, but is fully explained, if Schizophytes constitute the cause and the infectious principle of the disease, for it is a well known fact that these minute bodies, by passing through a certain cycle of changes or metamorphoses, and propagating to a certain extent exhaust in that medium, in which they are existing, the conditions necessary to their further development and propagation. They then render their medium sterile, and do not undergo any further changes, and do not multiply, unless, and until they are transferred to a fresh and otherwise suitable medium, when again they begin another cycle of metamorphosis and propagation, and multiply with great rapidity. In an animal, which has recovered from an attack of Swine-plague, some of the conditions necessary to the further metamorphosis and propagation of the Schizophytes, it seems, have become either partially or fully exhausted, and are not very soon restored, hence the partial, or as the case may be, perfect immunity. Still, as will be mentioned again, such an animal is usually able, at least within two months after its recovery, to transmit the disease, from which the same itself is not any more suffering, to other healthy animals, though in most cases only in a mild form.

4. It is a well known fact, and has been observed everywhere, not only by myself, but by nearly every one who has any experience in regard to swine-plague, that healthy hogs, which have access to a creek or a small stream of running water, which is further above accessible to, and defiled by, diseased hogs, or polluted with morbid products of swine-plague, or the carcasses of dead hogs, will almost invariably contract the disease; a fact which plainly shows to every thinking man that the infectious principle must be something corporeal, endowed with life, and able, like the swine-plague Schizophytes, not only to withstand the influence of water, but also to live and to multiply in the same. A chemically acting, and invisible fluid, or volatile virus, one should suppose, would become diluted by the water of a creek, small river, or running stream to such an extent as to be perfectly harmless and unable to communicate the disease, because there is no known chemical of an organic nature, but what

can be sufficiently diluted to lose its efficiency. With living germs it is different; if conditions are favorable, a few of them will suffice to develop innumerable generations, and may thus become a source of incalculable mischief. Further, it is also well known that the disease can be communicated through the air, and that the infectious principle which may happen to be floating in the air is absorbed by wounds, scratches, sores, abraisions, etc., in skin and mucous membranes, which would hardly be possible if a chemical virus constituted the cause and the means of infection.

5. The temperature of the atmosphere, and also the weather have considerable influence as to the spreading of the disease, but apparently have no influence whatever upon the morbid process or the development of the disease, after an animal has become infected. Frost, cold weather, lasting snow, frequent heavy rains, and continued drought and sunshine retard, and mild, warm and cloudy weather, heavy dews, and now and then a light rain considerably promote the spreading of the disease. Such would not be the case if the infectious principle consisted in a chemical virus, indestructible by water and air, but all this is natural, easily explained and self-evident, if living germs which require a certain degree of warmth and moisture, constitute the infectious principle, because frost, lasting snow, cold weather, heavy rains, and continued drought are inimical to organic life and vegetation, offer but little opportunity to the Schizophytes for a change of place, and necessarily retard their development and propagation; while, on the other hand, mild and warm weather, heavy dews, light rains, etc., are not only favorable to vegetation in general, and to the development of minute organic bodies in particular, but also offer a great many chances for a change of place and medium, and thus promote the propagation of the Schizophytes. The latter which are discharged in immense numbers with the excrements, urine, discharges from the nose, and other secretions and excretions of the diseased animals, rise into the air, perhaps mostly as micrococcus-germs and micrococci, probably only to a limited height, when the moisture contained in the dung and other excretions, and the urine evaporate, and come down again in the dew, and when it rains. At any rate, where swine-plague is prevailing, the swine-plague micrococci can often be found in dew-drops on the grass early in the morning, and also in exposed pools of

water. If the rain is a light one, the Schizophytes are apt to remain where the rain-drops deposit them, till evaporation once more carries them up into the air, but if the rain is very heavy or pouring, and temporarily flooding the ground, the Schizophytes, it seems, are washed away, for it can be observed that after light rains the spreading of the disease is accelerated, while immediately after each heavy or pouring rain a temporary diminution, often almost amounting to a cessation, can be noticed.

6. As already mentioned, it is an established fact that external wounds, especially such as are caused by ringing, castration, cutting of tails, and slitting of ears, external sores, scratches, and even abrasions, attract and absorb the infectious principle, and that the disease is also communicated, though not as readily as through wounds, etc., if the infectious principle is introduced with food or water for drinking into the digestive canal, while I have never yet been able to observe, or to obtain any evidence, that the infectious principle does enter, or can enter, the animal organism through a healthy skin, or through the respiratory organs, if the mucous membranes are in a perfectly healthy condition, or free from any sores, wounds, or abrasions. It has even been repeatedly observed that an animal whose skin and mucous membranes are whole and healthy, will not contract the disease, and is perfectly safe, if separated only by a fence, a board fence, or a board partition from diseased animals, provided, of course, an introduction of the infectious principle through the alimentary canal is prevented. All this shows that the infectious principle must be something that is very minute, but corporeal, and endowed with life and power of propagation, and not an invisible poisonous fluidum, for the latter, most assuredly, if dissolved in air, would find its way through the lungs, and, very likely also through the healthy skin into the animal organism.

7. If the morbid process is taken into consideration—for particulars I have to refer to my published reports, as going into details would consume too much time—it also becomes evident that something corporeal and endowed with life and power of propagation must constitute the cause of the disease. The morbid process in all parts and organs, in which it may develop, essentially the same, is best studied in the skin, subcutaneous tissues, and particularly in the lungs. At first the finer capillaries become obstructed, as a consequence, more or less blood serum transudes

through their walls into the tissues, or if the pressure is a great one some of the capillaries will yield, and become dilated or break behind the obstruction, and thus small specks of blood are extravasated. These extravasations are sometimes, especially in younger animals, exceedingly numerous, and present themselves as tiny red, or reddish-brown specks of the size of a pin's head, or smaller. To mention the further, or subsequent changes which are taking place, will not be necessary, for the same have but little bearing upon the subject. The question is what obstructs the capillaries? It, of course, must be something solid or corporeal, and I have not been able to find anything, except the swine-plague Schizophytes. It is true, the single and double micrococci, and the micrococcus-chains cannot and do not do it, for they are abundantly small to pass everywhere with the greatest facility where a blood corpuscle can pass, but these micrococci form zoōglœa-masses or coccoglia, which frequently are many times the size of a blood corpuscle, and therefore sufficiently large to clog the finer capillaries. Besides, some of the micrococci enter, or are taken up by the white blood corpuscles, and swell the latter not seldom to an abnormal size, or a size large enough to obstruct some of the finest capillary vessels. In all my examinations of diseased lung-tissue, and lung-exudation, these zoōglœa-masses and white blood corpuscles invaded by micrococci, have never been found missing, but always presented themselves in great, though somewhat variable numbers. No matter, in which way, or by what means the Schizophytes enter the animal organism, and get into the blood by being absorbed by the veins or by the lymphatics, the first capillary system to which they come, is in the lungs, which may account for the fact that in swine-plague morbid changes in the lungs, consisting in exudation, extravasation of blood, and finally hepatization are never absent. At least I found them at every post-mortem examination, and in the last three years I made about 300. Dr. James Law, of Ithaca, N. Y., in his report to the Commissioners of Agriculture, records the lungs of some of his experimental pigs as "healthy," "sound," "normal," etc., which simply shows that those pigs were *not* affected with swine-plague, and did *not* die of that disease. It may here also be mentioned that in all cases of swine-plague most of the lymphatic glands are more or less enlarged, and that comparatively more Schizophytes can be found in the enlarged or swelled lymphatic glands, than in any other part of the animal's body.

8. In one and the same affected herd the older or more fully matured animals often recover, while nearly every young animal and particularly nearly every young pig under three months old, if once infested, will succumb to the disease, and is almost sure to die. This also may be considered as proof that the Schizophytes, or rather their zoōglœa-masses cause the disease by obstructing the capillaries. In older, and otherwise robust hogs the heart and the walls of the blood vessels are much stronger than in young pigs, and so it often happens that in the former the force of the blood current is strong enough to break and to disperse the zoōglœa-masses, and thus to free the obstructed passages, while in young, and especially in very young animals the pressure or the force of the blood current is insufficient, and then the passage is not freed, and exudation takes place, or the walls of the blood vessels are too weak, and then the latter yield and break and blood is extravasated. Usually both processes occur. Hence, while blood-extravasations in the lungs, are, as a rule, more frequent in young animals, other morbid changes brought about by Schizophytes, which have passed the capillary system in the lungs, and are forming their zoōglœa-masses in other parts or organs of the body, are on the whole more frequently met with in older hogs. Still, the latter, notwithstanding, have a much better chance of recovery than the former.

9. An animal which is recovering from an attack of swine-plague, or in which the morbid process has ceased to be active, will yet for sometime discharge swine-plague Schizophytes with its excretions, and is able to communicate the disease to other healthy animals by polluting their food or water for drinking, consequently the organism of such an animal is not destitute of the infectious principle, but contains an abundance of the same in a potent condition, while its own tissues have become sterile, or are not any more acted upon, because some of the conditions required by the Schizophytes to form zoōglœa-masses and to propagate have become exhausted. In the lungs of an animal which was butchered two months after recovery, I found an abundance of swine-plague Schizophytes, but no zoōglœa-masses. These facts, too, will be difficult of explanation, if a chemical poison or

virus, and not the Schizophytes constitute the infectious principle and the cause of the disease.

10. Swine-plague has a well-marked period of incubation, or as it has more appropriately been called stage of colonization, lasting from two to fifteen days, during which no morbid symptoms, with the exception, perhaps, of a somewhat higher temperature, can be observed. The average time which elapses after an inoculation or infection has taken place till plain symptoms of disease make their appearance, or till the morbid process has sufficiently advanced to produce external symptoms, or a visible disturbance of health, may be set down as from five to six days. All this is easily explained if Schizophytes constitute the cause, because those introduced from without are insufficient in numbers to cause at once important morbid changes; they must have time to undergo the necessary metamorphoses and to multiply within the animal organism, and this time varies according to the number of Schizophytes originally transferred to the condition or stage of development in which they are transferred, and to the degree of so-called predisposition or favorableness of conditions existing in the infected animal. As a rule, the larger the amount of the infectious material introduced and the richer the same in swine-plague Schizophytes, the shorter the period of incubation, or stage of colonization.

On the other hand, if the infectious principle were a chemical poison or virus, its action, one should suppose, would, under all circumstances be exactly the same, and the malignancy of the morbid process and the time required for its development would not be influenced by, or be dependent upon so many conditions, such as the individuality, age and temperature of the animal, the time and season of the year, the number and stage of metamorphosis of the Schizophytes contained in the infectious material and other yet unknown conditions. A poison or virus, indestructible by water and air, and not affected by dilution, no matter how far it may be carried, one should suppose, would act with great uniformity. Consequently one is obliged to conclude that the Schizophytes, and not a chemical virus, must, and do, constitute the cause.

11. The infectious principle undoubtedly consists in something that is destroyed and made ineffective by putrefaction, because infectious material, such as blood, blood serum, lung exudation,

other morbid products, etc., if putrefied, can be consumed by healthy animals without communicating the disease, and if used for inoculation, such putrefied material may cause septicæmia, but never produces a genuine case of swine-plague. Further, as has been previously mentioned, swine-plague Schizophytes cannot any more be found in the blood, blood serum, morbid tissues and morbid products, etc., of hogs which are diseased with, or have died of, swine-plague after putrefaction has set in, or in other words, after putrefaction bacteria, and particularly *Bacterium termo*, have made their appearance in large numbers. So, for instance, blood which has become sufficiently putrefied to assume a purplish color, is destitute of swine-plague Schizophytes. If these two facts are connected, it becomes evident that infectious substances or media lose their efficacy, or their power to communicate the disease to healthy animals simultaneously with the disappearance of the swine-plague Schizophytes, and *vice versa*, the latter disappear at the exact time at which the infectious substances or media cease to be infectious. Does this indicate a close relationship between the swine-plague Schizophytes and the infectious principle, or can such a remarkable coincidence be rejected as merely accidental? Further, is it more rational to accept as the cause and infectious principle of swine-plague, an unseen virus or something which nobody has ever produced, nor ever will produce, but which, notwithstanding, is indestructible by water, air and dilution, and possesses the remarkable property of making its exit at the *very* moment at which the swine-plague Schizophytes are destroyed, or caused to disappear by putrefaction, than to regard the latter, the Schizophytes, which do exist, are present, can be seen, have been shown and, moreover, possess all the properties and peculiarities manifested by the infectious principle, as the true cause of the morbid process and the propagators of the disease? I, for one should not think so.

12. It is an established fact that the morbid process, which invariably affects the lungs, will also develop in all such other parts or organs as may happen to be wounded, inflamed, or in a state of congestion—for particulars I have to refer to my reports—and thus some other parts besides the lungs may sometimes become just as much, or even more affected than the latter. So, for instance, if a pig has been ringed, or been castrated, and a perfect healing has not yet taken place when the animal becomes infected,

the parts yet more or less inflamed invariably become a prominent seat of the morbid process. All this is explained if the Schizophytes constitute the cause, as all recently wounded parts are comparatively rich in blood, and their capillaries, on account of the yet existing congestion or inflammation, are easily obstructed; but I should find it very difficult to give an explanation, if a poison or chemical virus constitutes the infectious principle and the cause of swine-plague. A chemical poison or virus, one should suppose, would possess special affinity to certain parts or tissues, and therefore cause the morbid process either to develop invariably in one and the same part of the body, or to attack in all cases the whole animal organism.

13. Antiseptics, or medicines, which are either directly poisonous to the lowest forms of organic life, or destructive to some of those conditions necessary to the metamorphoses and propagation of the simplest forms of organic life, such as Schizophytes, and among those antiseptics particularly carbolic acid, iodine, hyposulphite of soda, benzoate of soda, thymol, etc., have proved to be almost sure prophylactics. Their use, combined with strict separation, will prevent the outbreak of swine-plague in animals which have been inoculated or have undoubtedly become infected. As one of the conditions necessary to the development of swine-plague, it seems, must be considered a certain degree of animal heat. At any rate, after or while the animal heat of a pig is reduced by a continued treatment with carbolic acid from the normal 102 or 103° F., to an abnormally low temperature of a few degrees below 100—in several cases it was reduced to 96° and 97°—nearly every inoculation with fresh infectious material has proved to remain ineffective, and the few which did not remain ineffective were followed by an unprecedentedly long period of incubation and a very mild form of the disease. Comment will not be necessary. The various antiseptics which have proved to be good prophylactics, are very dissimilar in their chemical action and affinities, and therefore their prophylactic effect cannot very well be explained if the infectious principle consists in a chemical poison or virus, but admits explanation if something endowed with life and power of propagation constitutes the cause of swine-plague.

MEXICAN CAVES WITH HUMAN REMAINS.

BY EDWARD PALMER.

NEAR the western border of the State of Coahuila, Mexico, are to be found several caves in the limestone formation of the mountains. In these caves human remains were found. This section of country under consideration is commonly called the Lajona, which means overflowed. During the rainy season, which is the months of July, August and September, the river Nazas overflows its banks, and inundates the valley. Of late years cotton and corn has been cultivated. To prevent the excess of water from destroying the plants, large canals are dug round the fields, and connected with the river. These canals are used for irrigating the crops. Previous to the advent of the Spaniards this section could not have been much cultivated, as the good land was overflowed at the growing season, and previous to the rains it was too dry for crops to mature before the wet season, when the overflow would destroy them.

It presents to the eye of an observer a country unfit to sustain a large permanent people without modern appliances. Its numerous mountains are dry and rocky, without trees, though having a few stunty bushes and plants in the shady recesses. The valley also is as dry and barren except immediately about the receding waters. The plants naturally produced in a country of this character are the cactus, agave, yucca, mesquite, *Larrea mexicana*, and allied forms. These are either armed with thorns, or are so excessively bitter that neither wild nor domestic animals using them for food can exterminate them.

Animals are scarce; deer, two species of rabbits, skunk, badgers, ground squirrels, and rats, with snakes, lizards, birds and fish, are limited in number, except rabbits and blackbirds.

The food products of a country determines its capacity to sustain life, especially when without domestic animals, and situated as these people were in the midst of a desert waste without any productive country immediately near from which to draw food supplies from, moving from place to place as the food and water supply admitted during the dry season, in the wet they could with pack-animals move their effects to the near mountains in which water is then to be found. During the dry season there are but two plants in that section, which could be counted upon for a supply of food, game being merely incidental.

In the spring the center or crown of the agave was roasted, when it became a nutritious article of food, and in summer the mesquite beans are ripe. After the flood of waters had subsided, annual plants, like the sunflower, would produce abundance of seeds, which the inhabitants could return and gather.

As to the dead found in the caves, they had their knees drawn to their chin, also the hands, and so encased in their robes, and so securely bound with bands made of net-work, that they formed a convenient bundle for handling. Some had but one wrapping around the bones, others two; these during life were clothing and bedding, one worn round the waist and fastened by a belt; the other, worn over the shoulders, was fastened by two strings, attached thereto for that purpose. Those with only one wrapper, which was worn on the shoulders by day, wore around the waist in two parts appendages made of fringe or cloth; sometimes feathers were attached to the fringed ends to make the fringe longer and more showy; one division was worn behind the other in front. The heads of the dead were variously cared for. One had drawn over it a worked bag, another had a cap of net-work to which was fastened a profusion of feathers; this head rested in a collar of braided cat-tail rushes; other heads were placed in round pads that are usually worn on the heads of females to support the jars of water while carrying them. Sandals of various qualities were used, made of agave fibers. The ornaments worn were seeds of plants, vertebræ of snakes, roots of medical plants, pieces of shell, bone or stone cut into suitable shapes.

Caves as depositories of the dead were very suitable, and saved the labor of digging graves in the earth. In the caves the dead were laid therein without any earth being placed over them.

Raw materials for clothing was supplied mainly from the different agaves and yuccas; in fact, all the fabrics and sandals found with the cave dead were made from the fibers or leaves of those plants. Skins of animals seem only used to a limited extent for clothing, these plants furnishing a cooler and more durable fabric for hot climates.

The remains found in the cave have their hair done up in one bunch behind, and bound very tight by cords; they are very short in length, very unlike the hair of many of the Indians of the United States, whose hair hang down to and below their waists done up in two bundles, one on each side, larger than the bunch found with the cave dead.

The wooden handles and tools were cut by stone tools, and when they were required to be sharp, smooth and round, they were rendered so by rubbing with stones.

As no ruins of ancient dwellings are to be found in the cave district, it is to be inferred that they lived in dwellings of very perishable materials.

Baskets, plain and ornamented, were made from the split twigs of the Rhus or split roots of the mesquite bound over small rolls of grass. Dress goods were all made by hand-loom, or made of skins, and all garments of the same fashion were as plain as could be made. Only two pieces of pottery were found. If the war-like character of the people is to be inferred from the implements found, they should be considered very peaceable, for only two arrow-heads, parts of two bows, and one arrow shaft, to which is attached a piece of reed, having inserted in it a piece of a wooden arrow, the kind often used to kill small game; knives of fine finish made of stones, which by their size and shape would indicate they were used in cutting the maguey plant for roasting, and for dividing it after being cooked, were found.

For beds, small sticks and twigs of plants, over which were laid grasses, leaves, hides of animals, or mats, were used, as indicated by the remnants found in the caves. For covering by night, their clothing answered admirably, being long and of a width sufficient to cover them; their garments may be called long, narrow blankets, retaining their strength to the present time; bands, parallel lines or simple diamonds or squares were used in ornamentation. The colors used in dyeing are yet bright and perfect, being black, yellow, brown, red, and orange.

Easily constructed from the small pools, and sticks for the side and frame; for a roof, grass and earth, or yucca leaves were used. These simple huts were airy and cool, suited to the wants of a people living in a state of nature, and the requirements of a hot climate.

Are the native inhabitants of the country under consideration, descendants of those whose remains are found in the caves? Though they have been modified to some extent by the Catholic religion, and introduced customs from Spain, they present very much in their customs which compel the belief that they are yet more truly Indian than any thing else. They live in their simple huts with a household paraphernalia of Indians, often without the least furniture. Beds, blankets, belts, shoes, baskets, crockery, hand-looms, and metates or stone mills with which they prepare their seeds and grain for food are still used; and the present inhabitants use many native plants and seeds for food that were used by the cave dead, while cotton and wool have taken the place of the agave and yucca fiber for clothing, and leather is substituted for plant fibers and leaves for shoes; it is only change of materials, not of mode of manufacture or superiority of workmanship that make a difference. The fiber of the agave though not now in use for clothing, is yet used to make ropes, mats, &c., the mode of preparing the fiber is handed down by cave people, and the knife now used for the cutting up of the agave plant for domestic uses though of iron, is fashioned after the stone knife found with the dead in the caves. As one sees the people in their domestic relations, in their daily avocations, when engaged in their dances, in their desire for idleness, taking into consideration all the above mentioned traits, one comes to the conclusion that they are the descendants of the cave people. The influence of the Catholic church has caused them to bury their dead in the ground. The present race not of Spanish origin is Indian.

Glancing over the physical geography and the natural productions of the country about the caves, the question may be asked, how high in the scale of advancement did the former inhabitants of this section rise? The clothing and utensils found with the dead answers the question. A race of Indians, without commerce, dependent upon the natural productions of a desert country to supply their daily want; long practice in the use of their simple arts had created that perfection, which has given rise to the belief that only a superior race could produce like results. A people in nature, in a climate with nine months drouth, without domestic animals and modern civilization could not become rich or civilized according to modern views. Studying closely this section with the evidences found with the cave dead, and comparing other lands with a similar production, and one finds there a like race with corresponding manners and customs. Take for instance ancient Peru and its people; the Territories of Arizona, New Mexico and Southern California with their inhabitants as found at the Spanish Conquest, and compare them with that portion of Mexico formerly inhabited by the race whose remains are found in the caves, and one will find not only a resemblance of productions from the soil, but the people possessing the same ability to take nature's gifts, and adapt them to their every day wants in a highly satisfactory manner. We are astounded in beholding their workmanship, they simply took nature's gifts and made the best of them. Comparing the cave clothing with that of the ancient Peruvians, we find a close alliance; both made by a hand-loom, the same as is used by the Indians of Peru, Mexico, Arizona, New Mexico and Southern California to-day. The rude Navajo Indian makes a blanket upon one of these hand-looms, which commands not only a good price from white men, but their admiration—yet he is considered a savage—lives in a hut. It is not necessary to live in palaces, in order to perform great works, and it is shown by our ancient and modern American Indians, that they were equal to emergencies, until compelled to face Europeans with their civilization.

In the New and Old World, it is customary to consider those that lived in caves to be a distinctive people from those called Pueblos or town-dwellers. The evidences of these kinds of habitations are to be found in many places. There was another class of dwellings: the perishable huts made of tree branches and thatched, of which nothing is left. The dwellers in each of these three classes of buildings might be of the same race. In the winter living in caves, in summer or while attending to crops they might live in temporary stick-huts. Some caves contain human remains, these have been put there as the easiest means of disposing of the dead. If surrounded by enemies, as the industrious and peaceful Indians of ancient times were, they had become Pueblos or dwellers in towns as a means of defence, yet they could be of the same people as the cave-dwellers, or those who inhabited brush houses. There was a distinctive race from the above which lived in brush huts; they lived by the chase, and roamed at will over the land, always warring against the town-dwellers. In some sections many stone implements are found, in others those of bronze. The finding of these tools of different materials is no evidence of their being made by distinctive people or in remote periods from each other, for sometimes one finds both together. Ancient and modern people in nature use whatever their section afforded. There is no reason to suppose that the so-called mound-builders were different from the cave-dwellers. Town-dwellers, makers of flint or bronze implements, they were all of the same great division; *i. e.* buryers of the dead. Their war-like enemies compelled them to live in brush huts, built together in a wooded country in winter, and in the openings in summer; thus the mounds with human remains therein occur in these sections.

A difference in the kind of dwellings or tools do not of themselves warrant the conclusion of some writers that each distinctive class was an evidence of tribal or race difference. We might as well consider the makers of pottery a distinct people; but they were not, for every race of Indian made and used pottery in ancient times, and at the present time, even the warlike Indian, without fixed habitations, has his though of a plainer kind. There are some who think that the kind of pottery argues a different race origin; this is not so, the different qualities of pottery and forms are designed to suit the different purposes for which they were made, and not for a display of race distinctions. In Mexico and the United States in ancient times, the Indians used the same method of rendering their pottery hard and smooth as is now practiced by the Indians of Mexico to-day. A pebble of agate or jasper is used to rub over the surface of the pottery as soon as the new made article is dry; a fine, hard, smooth surface is the result; it has been considered a varnish. I saw it in general use; it is a new fact not known to writers before my visit to Mexico in 1877 and 1878.

In conclusion, I would say that there are two races of Indians to-day, as there were in ancient times, circumstances causing various interminglings, resulting in differences in manners and customs.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Professor E. DuBois Raymond has recently delivered a lecture before the physicians of the German army, on exercise or use, in which he makes some important admissions. We hope to give an abstract of the lecture, but content ourselves, at present, with the following extracts: "We should be, therefore, free to admit, with some appearance of reason, that the vigor of the muscles of wings and of digging feet; the thick epidermis of the palm of the hand and of the sole of the foot; the callosities of the tail and of the ischia of some monkeys; the processes of bones for the insertion of muscles; are the consequences of nutritive and formative excitation, transmitted by heredity." In this position Professor Raymond is in strict accord with the American school of evolutionists. He then goes on to say: "It is necessary to admit along with development by use, development by natural selection, and that for three reasons. First, there are innumerable adaptations—I cite only those known as mimetic coloration—which appear to be only explicable by natural selection, and not by use. Second, plants which are, in their way, as well adapted to their environment as animals, are of course incapable of activity. Thirdly, we need the doctrine of natural selection to explain the origin of the capacity for exercise itself. Unless we admit that which it is impossible to do from a scientific standpoint, that designed structures have a mechanical origin, it is necessary to conclude that in the struggle for existence, the victory has been secured by those living beings who in exercising their natural functions have increased, by chance ("par hasard") their capacity for these functions more than others, and that the beings thus favored have transmitted their fortunate gifts, to be still further developed by their descendants." In these three propositions, Professor Raymond still clings to the obscurities of the Darwinians, though Darwin himself is not responsible for them.

To take up first the second and third of these propositions. Professor Raymond does not for the moment remember that movement (or use) is an attribute of all life in its simplest forms, and that the sessile types of life, both vegetable and animal, must, in view of the facts, be regarded as a condition of degeneration. It is scarcely to be doubted that the primordial types of vegetation were all free swimmers, and that their habit of building cellulose and starch, is responsible for their early-assumed stationary condition. Their protoplasm is still in motion in the limited confines of their walls of cellulose. The movements of primitive plants have doubtless modified their structure to the extent of their duration and scope, and probably laid slightly varied foundations on which automatic nutrition has built widely diverse results. We may attribute the *origin* of the forms of the vegetable kingdom to three kinds of motion which have acted in conjunction with the physical environment; first, their primordial free movements; second, the intracellular movements of protoplasm; third, the movements of insects, which have doubtless modified the structure of the floral organs. Of the forms thus produced, the fit have survived and the unfit have been lost, and that is what natural selection has had to do with it.

The *origin* of mimetic coloration, like many other things, is yet unknown. An orthodox Darwinian attributes it to "natural selection," which turns out, on analysis, to be "hasard." The *survival* of useful coloration is no doubt the result of natural selection.

But this cannot be confounded with the question of origin. On this point the Darwinian is on the same footing as the old time Creationist. The latter says God made the variations, and the Darwinian says that they came by chance. Between these positions science can perceive nothing to choose.—*C.*

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RECENT LITERATURE.

THE DEVELOPMENT OF AMPHIOXUS BY HATSCHEK.[1]—The entire organic world does not contain a more interesting animal than the lancelet, Amphioxus or Branchiostoma, the lowest vertebrate, the link which, though far removed from either, indicates a common origin, or at least a remarkable structural similarity between the Vertebrata and the Ascidians or Tunicates.

The literature upon this creature, extensive but incomplete, is now enriched by the present exhaustive memoir by one of the most careful and accurate of European biologists. In this memoir, which forms the greater portion of a late issue of the *Arbeiten* of the Zoölogical Institute of the University of Vienna, and is illustrated by nine large plates, carefully drawn and colored, the development of the lancelet is traced with the greatest minuteness from the ovum to the adult. The ovum of Amphioxus contains, between the germinal portion and the enclosing membrane a remarkably large water space, forming by far the greater portion of its bulk, and the cleavage is very near regular, the difference between the size of the cells separated by the first equatorial fissure being very small. The "blastula" stage with its large segmentation cavity, and the gradual formation of a "gastrula," are abundantly illustrated; two plates are devoted to the more advanced development, plainly showing the hollow structure and alternate position of the muscle-plates or myocommas, and three colored plates are filled with transverse sections.

Until an advanced period of embryonic life, the digestive tract is continuous with a dorsal canal, which terminates at an opening upon the upper surface of the head. At a later period the vent is formed, connection between the digestive tract and the dorsal canal is cut off, the anterior opening closes, and the dorsal canal becomes the neural canal.

The hollow form of the muscular segments is shared by the lancelet with the Selachians (sharks and rays), Cyclostomes (hags and lampreys) and Batrachia, and tends to prove their primary origin as diverticula from the digestive cavity.

In the notochord vacuoles are developed, which become larger,

[1] *Studien über Entwickelung der Amphioxus.* Von B. HATSCHEK, pp. 88. 9 double 8vo plates. Arbeiten aus Zool. Inst. Univ. Wien und der Zool. Station in Triest. Tom IV. 1 Heft, 1881.

obliterating the structure of the original notochordal cells, until finally the notochord consists of a series of clear spaces separated by hyaline partitions. These vacuoles are traceable also in tunicates, and in the teleosts or bony fishes.

In conclusion, we have to say that Hatschek has given to the world a most valuable addition to its stock of embryological knowledge.

TROUESSART'S CATALOGUE OF RECENT AND FOSSIL MAMMALS.[1]—Catalogues of animal forms are as necessary to a student of zoölogy as are catalogues of books to the frequenters of a library, or directories to dwellers in cities. No zoölogist can carry in his brain, ready at an instant's notice, the accepted name, synonymy, etc., of all the species included in the department he specially studies, and thus such works as Gray's Hand-List of Birds, and the present are great boons to him; they save him hard work, and leave him free to exercise his mind upon purely scientific work.

Dr. Trouessart's catalogue, which has already progressed to the completion of the Primates and Rodentia promises to be to mammalogists what Gray's Hand-List is to ornithologists, with the added recommendation that it contains also all known species of fossil mammals, and will therefore prove equally useful to the palæontologist.

The classification adopted is to a great extent that of modern authors with the addition of the orders proposed by Professor Cope, and is based upon the structure of the feet and teeth, except in the division of all mammalia into the universally accepted sub-classes Monodelphia (placental) and Didelphia (non-placental).

The Prosimiæ (Lemurs) are separated as an order from the Simiæ; Cope's order Bunotheria, with four extinct sub-orders *(Mesodonta, Creodonta, Tillodonta, Tæniodonta)*, and one recent sub-order (Insectivora), is placed among the *Secundates*, or unguiculates; the Toxodonta are considered a sub-order of Rodentia, and the Zeuglodonta has the same rank among the Pinnipedia. The line of hoofed animals or *Ternates* is concluded by the *Amblypoda*, with two sub-orders, *Dinocerata* and *Pantodonta;* the porcine group is separated as a sub-order from the ruminants, and the order Sirenia is intercalated between the Edentata and the Cetacea. The last mentioned three orders form the group *Homodonta*, of equal rank with the Heterodonta, which includes the remaining monodelphian orders.

The catalogue gives, besides genera, sub-genera, and species, the habitat, the synonymy, and all varieties on which species have been founded. When these varieties are merely local, or perhaps based on individual characters, they are marked with the

[1] *Catalogue des Mammifères Vivants et Fossiles.* Par le DR. E. L. TROUESSART. June, 1878.

letters a, b, c, etc., but these letters are doubled when the varieties have the weight of races or geographical species, while fossil species and genera are marked by the sign †.

There are points in the classification adopted that may reasonably be objected to. The most important of these is the creation of the group *Homodonta* to include the sirenians, whales and edentates, orders not closely allied, and differing much in the structure of the teeth.

The terms *Secundates* and *Ternates* are new, and are no improvement upon the older terms Unguiculata and Ungulata, the last of which should be understood to comprehend four orders, viz., *Proboscidea*, *Artiodactyla*, *Perissodactyla*, and *Amblypoda*. It is not possible to discover anatomical characters of sufficient importance to warrant the separation of the Bimana from the Simiæ, and it is probable that the Prosimiæ should be placed in the bunotherian series of sub-orders. This last probability is hinted at in the prospectus.

Bettany's Practical Botany.[1]—This useful little book should have been called First Lessons in the Practical Botany *of the Flowering Plants*, as it does not even mention the non-flowering plants. In the words of its author "its aim is to aid students in schools and colleges in the practical work of describing flowering plants." Some excellent suggestions are given under "How to Describe Plants." The "Cautions," too, are to the point. Under the successive topics, (1) Root system, (2) Stem and branch system, (3) Leaf system, (4) Inflorescence and floral receptacle, (5) Floral envelopes, (6) Stamens, (7) Pistil and ovules, (8) Fruit and seeds, short definitions and practical directions for the study of specimens are given, which if followed step by step will enable the pupil to observe accurately, and to record what he has seen in proper order and in plain language. Special directions are given in a later chapter for the study of the plants of the principal natural orders, which will doubtless prove useful to the student.

While we do not think it profitable to begin the study of botany with such complex organisms as the flowering plants, we nevertheless welcome this little volume because it can do good service in directing pupils to study *plants* rather than books on plants. The "laboratory method" is so fully carried out that the book can scarcely be studied by itself; the pupil *must* study the plant.—*C. E. B.*

Balfour's Comparative Embryology (Second Notice).—The chapter on the development of the birds is quite long, and the embryology of the chick has been more thoroughly studied than that of any other animal. In the brief chapter on reptiles, the de-

[1] First Lessons in Practical Botany, by G. T. Bettany, M.A., B.Sc., F.L.S. Macmillan & Co., London and New York, 18mo, 104 pp.

velopment of the lizard is chiefly discussed. In the longer chapter on the mammals, several pages are devoted to the early stages in the development of man.

The remaining two-thirds of the book are, in the present stage of embryological science, of much value to the student, as Professor Balfour here attempts the difficult task of stating the general conclusions derived from a survey of all authentic known facts regarding the embryology of animals in general. This is done successfully, the work well deserving the name of a comparative embryology.

In chapter XI, we are presented with a comparative sketch of the mode of formation of the germinal layers, and the notochord, with a notice of the mode of origin of the allantois and amnion. We notice here a little discrepancy in the author's statement regarding the allantoic bladder of the *Amphibia*, which leaves us somewhat in doubt as to the author's final opinion respecting its nature. On p. 108, the author states that the allantoic bladder of the frog "is probably homologous with the allantois of the higher Vertebrates;" on p. 587 he says that it "is homologous with the allantois of the amniotic Vetebrata," on p. 256, it is stated that there is "ample evidence" that the allantois "has taken its origin from a urinary bladder such as is found in Amphibia."

Chapter XII, observations on the ancestral forms of the Chordata, is mainly speculative. The author claims that it is clear from Amphioxus "that the ancestors of the Chordata were segmented, and that their mesoblast was divided into myotomes, which extended even into the region in front of the mouth. The mesoblast of the greater part of what is called the head in the Vertebrata proper was therefore segmented like that of the trunk." In the Amphioxus also the only internal skeleton present is the unsegmented notochord; a "fact which demonstrates that the skeleton is of comparatively little importance for the solution of a large number of fundamental questions." We have for some time inclined to the view that there was a general analogy between the head of an Arthropod and a Vertebrate, more intimate than generally stated, and Balfour's views on this point are of much interest. As to the differentiation of the Vertebrate head, he says on p. 260, "In the Chætopoda, the head is formed of a præoral lobe, and of the oral segment, while in Arthropods a somewhat variable number of segments are added behind to this primitive head, and form with it what may be called a secondary compound head. It is fairly clear that the section of the trunk, which, in Amphioxus, is perforated by the visceral clefts, has become the head in the Vertebrates proper, so that the latter forms are provided with a secondary head like that of Arthropods." Hence Balfour considers that the part of the head containing the fore-brain is probably "the equivalent of the præoral lobe of many Invertebrate forms, and the primitive position of the Vertebrate mouth on the ventral side of the head affords a distinct support for this view."

Gegenbaur's theory that the pairs of cranial nerves represent so many segments, and his segmental theory of the skull, which has replaced the old-fashioned vertebrate theory of the skull, is apparently endorsed by Balfour, who states that "the posterior part of the head must have been originally composed of a series of somites like those of the trunk, but in existing Vertebrates all trace of these, except in so far as they are indicated by the visceral clefts, has vanished in the adult. The cranial nerves, however, especially in the embryo, still indicate the number of anterior somites," etc.

Part I is concluded by a chapter on the mode of origin and homologies of the germinal layers of animals in general, and with a discussion of larval forms.

Part II, or the second half of the book is devoted to *Organogeny*, or the mode of origin of the different organs of the vertebrate body, and this important part is characterized by the same full, critical treatment as in the first part, with consideration of the theoretical bearings of facts, such as seem at least in the main warranted by our present knowledge of the facts.

The work is a most stimulating one, and will greatly advance in English-speaking countries the study of what is the most difficult field of research in biology.

ELLIOTT'S SEAL ISLANDS OF ALASKA.[1]—This entertaining and unusually well illustrated monograph of the fur-seal, hair-seal, sea-lion, and walrus is exceptionally well done. The story is really a fascinating one, and the author's sketches of these animals in various ages and altitudes are apparently by far the best that have ever been executed. A number of important hitherto doubtful points have been cleared up by Mr. Elliott, especially those relating to the breeding habits of these creatures. The report, while of particular economic value, is also one of the most important works on natural history which has been published by our Government, containing as it does the results of several years of arduous study and close observations on the bleak, out-of-the-way Prybilov group of islands.

Although the seal is not a fish, the volume not inappropriately appears as a special Bulletin under the direction of the Commissioner of Fish and Fisheries.

[1] U. S. Commission of Fish and Fisheries. Spencer F. Baird, Commissioner. 176. Special Bulletin. A Monograph of the Seal Islands of Alaska. By Henry W. Elliott. Reprinted with additions, from the report on the Fishery Industries of the Tenth Census, with engravings and maps. Washington, Government Printing Office, 1882. 4to, pp. 176

Recent Books and Pamphlets.—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs, in wort u. Bild. Von C. H. Hoffmann. Sechster Band III Abtheilung—Reptilien 25 u. 26 Lieferung. 8vo, pp. 79, 4 plates, colored. Leipzig und Heidelberg, 1881.

Papers by Dr. W. Peters in the Sitzungs-Bericht der Gesellschaft naturforschenden Freunde zu Berlin.

1. Mittheilung über vier neue Fische. 15 February, 1881.

2. Uber das Vorkommen schildförmeger Verbreiterungen der Dornfortsätze bei Schlangen und neue oder Wenïger bekannte Arten dieser Abtheilung der Reptilien. 15 Marz, 1881.

3. Uebersicht der zu den Familien der Typhlopes und Stenostomi gehörigen Gattungen oder untergattungen.

4. Uber eine neuen Art von Tachydromus aus dem Amurlande.

5. Uber die von Herm. Dr. Finsch aus Polynesien gesandten Reptilien. 19 April, 1881.

6. Uber drei neue Eidechsen, zu der Familie der Scincoiden gehörig, eine Lipinia (Mit geckonenählicher Bildung der Zehen!) aus Neu-Guinea und zwei Mocoa aus Neuholland. 17 Mai, 1881.

7. Uber die Excrescenzen des Männchens von Rana gigas Blyth (=Rana liebigii Günther), während der Poarungszeit.

8. Uber zwei Arten der Schlangengattung Psammophis und über die synonymie von zwei Arten der Lycodonten.

9. Uber den Bau des Schädels Uræotyphlus oxyurus (Dum. Bibr). 21 Juni, 1881.

10. Uber die Verschiedenheit von Syngnathus (Belonichthys) zambezensis Pths., und S. (B.) mento Blecker, und über eine neue Art der Schlangengattung Callopsis von den Philippien.

11. Die Beschreibungen von neuen Anneliden des zoologischen Museums zu Berlin, welche sich in dem Nachlasse des Staatsraths Prof. Dr. Grube in Breslau gefunden haben, der ihm von der Frau Staatsräthin Grube Mitgetheilt War. 19 Juli, 1881.

12. Uber die von Herrn Major von Mechow von Seiner letzten Expedition nach Westafrika Mitgebrachten Säugethiere und legte darunter ein Wohlerhaltenes Exemplar der merkwürdigen Insectivorengattung Potamogale (P. velox Duchaillu) vor. 18 October, 1881.

13. Zwei neue von Herrn Major von Mechow Während seiner letzen Expedition Westafrikas entdeckte Schlangen und eine Uebersicht der von ihm Mitgebrachten herpetologischen Sammlung. 15 November, 1881.

14. Uber die Verschiedendeit der Lenge der äusseren Spalten der Schallblasens Merkmal zur Unterscheidung besonders Afrikanischer Froscharten. 20 December, 1881. Berlin, 1882. From the author.

Uber die Chiropterengattung Mormopterus und die dahin gehörigen Arten. W. Peters. 8vo, pp. 6, 1 plate. Auszug aus dem Monatsbericht der Königl. Akademie der wissenschaften zu Berlin. 19 Mai. Berlin, 1881. From the author.

Palæontographica. Beiträge zur Naturgeschichte der Vorzeit. Wilhelm Dunker und Karl A. Zittel. Achtundzwanzigster Band. Der dritten Folge Viertes Band, Dritte Lieferung. Die Medulloseæ. Eine neue Gruppe der Fossilen Cycadeen. Von Dr. H. R. Göppert und Dr. G. Stenzel. 4to, pp. 40, 10 plates. Nov. 1881. Die Fauna des Kelheimer Diceras-Kalkes. (Zweite Abtheilung.) Bivalven von Dr. Georg Boehm. 4to, pp. 130, 26 plates. (Vierte und fünfte Lieferung.) December, 1881. Mittheilungen über die Structur von Pholidophyllum loveni E. und H., und Cyathophyllum sp. ?, aus Konieprus. Von G. von Koch. 4to, pp. 37, 6 plates. (Sechste Lieferung.) Jan., 1882. Cassel, 1882. From the publishers.

Undersökningar öfver Molluskfaunan. I Sveriges Aldre mesozoiska Beldningar, af Bernhard Lundgren. 4to, pp. 37, 6 plates. Aftryck ur Lunds univsitetes Arsskrift. Tom. XII. Lund, 1881. From the author.

Studien über die Fossilen Reptilien Russlands. Von W. Kiprijanoff. (Gattung Ichthyosaurus König. aus dem Severischen Sandstein oder Osteolith der Kreide-

Gruppe.) 4to, pp. 106, 19 plates. From Memoires de L'academie Imperiale des Sciences de St. Petersbourg. St. Petersburg, 1881. From M.

Du Role des Courants Marins dans la déstribution geographique des Mammiféres Amphibies et particulierement des Phoques et des Otaries. Par le Dr. E. L. Trouessart. 8vo, pp. 4. Extrait du Bull. de la Societie d'Etudes Scientifiques d'Angers (Anne, 1881). Paris, 1881. From the author.

Association Française pour L'avancement des Sciences, Congres de Reims. La Grotte de l'Albanea. 8vo, pp. 8, 4 plates.

Nouvelles Recherches dans les Alpes-Maritimes en 1879. M. Emile Riviere. 8vo, pp. 10. Paris, 1880. From the author.

Deux Plesiosaures du Lias Inferieur du Luxembourg. Par P. J. Van Beneden. 4to, pp. 46, fol. plate. Extrait du Tome XLIII des Memoires de l'Academie royal des Sciences, des letters et des beaux-arts de Belgique, 1881. Brusells, 1881. From the author.

Polacanthus foxii, a large undescribed Dinosaur from the Wealden formation in the Isle of Wight. By J. W. Hulke, F.R.S. 4to, pp. 14, 7 plates. From the Philosophical Transactions of the Royal Society. Part III, 1881. London, 1881. From the author.

List of the Geological Society of London, November 1, 1881. 8vo, pp. 79. London, 1881. From the society.

Report on the mode of Reproduction of certain species of Ichthyosaurus from the Lias of England and Wurtemberg, by a committee consisting of Professor H. G. Seeley, F.R.S., Professor W. Boyd Dawkins, F.R.S., and Mr. C. Moore, F.R.S. Drawn up by Professor Seeley. 8vo, pp. 8, fol. plate. Reprint from the Report of the British Association, 1880.

The following is a list of papers by Professor H. G. Seeley, extract from the Quarterly Journal of the Geological Society :

Note on the Cranial characters of a Teleosaur from the Withby Lias preserved in the Woodwardian Museum of the University of Cambridge, indicating a new species, Teleosaurus eucephalus. 8vo, pp. 8, quarto plate. Nov., 1880.—

On the skull of an Ichthyosaurus from the Lias of Withby apparently indicating a new species (I. zetlandicus Seeley), preserved in the Woodwardian Museum of the University of Cambridge. 8vo, pp. 16, quarto plate. Nov., 1880.—

Note on Psephoporus polygonus V. Meyer, a new type of Chelonian reptile allied to the leathery turtle. 8vo, pp. 10, plate. Aug., 1880.—

On the remains of a small lizard from the Neocomian rocks of Comén, near Trieste, preserved in the Geological Museum of the University of Vienna. 8vo, pp. 6, plate. February, 1881.

The reptile fauna of the Gosau formation, preserved in the Geological Museum of the University of Vienna, with a note on the geological horizon of the fossil at Neue Welt, west of Wiener Neustadt. By Edw. Suess, Ph.D. 8vo, pp. 82, 5 fol. plates.

The history and present condition of the Fishery Industries. The Oyster Industry. By Ernest Ingersoll. 4to, pp. 252, 22 plates, cuts. Department of the Interior. Tenth census of the United States. Government Printing Office, Washington, 1881. From the department.

A monograph of the Seal islands of Alaska. By Henry W. Elliott. 4to, pp. 176, 39 plates, cuts. U. S. Commission of Fish and Fisheries. Government Printing Office, Washington, 1882. From the commissioner.

GENERAL NOTES.

BOTANY.[1]

Motility in the Flowers of Draba verna.—As is well known this plant flowers during any open time in spring, say from February to June, with us. In the early part of the season the petals expand about 9 A. M. and close about 2 P. M. Surprised that I had not noticed this opening and closing years before, I was led to observe it from day to day, and many times a day. If there was the least cloudiness, no matter how great the volume of light, the petals would not expand. During nearly a week of cloudiness no flowers expanded. On the least burst of sunlight, however, the flowers opened, provided always, it was before 2 P. M. I felt little hesitation in deciding that sunlight was the immediate agency in expansion. One day we had a heavy thunder shower. The next day was wholly cloudy, but strange to say they expanded during this warm moist cloudy day, as well as under the previous sunlight! They seem to expand every day since, sunlight or not, through all these variations, however, up to to-day they close regularly about two o'clock. To my mind it leaves the cause of motion more obscure than ever. It is evidently not light alone, and it is a gain is know what it is not. Yet if we had reflected we might have learned this lesson before, for there are some flowers opening at every hour of the twenty-four. Under the same light when one expands another may be closing; what is one man's meat is another one's poison. It is not the food, but the internal arrangements, it is not the light, but the ability to make use of it.—*T. Meehan, May 7th, 1881.*

New Work on the Fungi.—Prof. Saccardo writes me that the first part of his *Sylloge Fungorum Omnium* is now in press and will soon be ready, embracing the *Erysipheæ*, *Perisporiaceæ* and *Capnodiæ*. This will be followed by the *Sphæriaceæ*, so that it is expected all of the Pyrenomycetes will be finished this year.

It will be recollected that the Sylloge is to include diagnoses of all the species of fungi published up to the present time, thus doing to some extent for the fungi, what De Candolle's Prodromus is doing for the Phanerogams.

The importance of such a publication will at once be evident, bringing together and rendering accessible the *disjecta membra* of mycological literature, which, lying as it now does scattered through various publications and in the transactions of the scientific societies in different parts of the world, is to the ordinary student for the most part inaccessible.

The work can be obtained by addressing Professor P. A. Saccardo, Padova, Italy. The expense will be from eight to ten dollars per year, and the work will require probably four years for completion.—*J. B. Ellis, Newfield, N. J.*

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

De Thümen's Mycotheca universalis.—This valuable mycological collection, which was begun in 1875, now includes 2000 species; the 20th century having been issued towards the close of 1881.

The work is very neatly gotten up, and including as it does species from all parts of the world, many of which are rare and valuable, is well worth the moderate price at which it is sold.

An index to the first twelve centuries has been published, from which it may be noted that among these 1200 species there are of the

Hymenomycetes	105
Discomycetes	60
Sphæriacei	185
Uredinei	300

These different orders are apparently represented in about the same relative proportion in the remaining centuries of the collection (XIII–XX).

The preponderance of the Uridinei is noticable, comprising as it does one-fourth of the whole number of species. Of these 237 were collected in Europe, 33 in America, 21 in Africa, 7 in Asia, and 2 in Australia.

The bulk of the species, as would be expected, are European, but as at least three collections at different points in the Middle and Southern States have contributed more or less, the proportion of American species is comparatively very small and naturally leads to the enquiry whether the Uredinei are really represented by a less number of species here than in Europe.

That this may be the case is further indicated by the fact that in the "North Am. Fungi" of which the material for nine centuries is now collected, there are, after throwing out from cent. III 25 species not belonging to this order and adding 50 species since collected, only 125 species of Uredinei or about 1/7 part of the whole number thus far collected.

It is to be borne in mind, however, that in the Report of the N. Y. State Museum of Nat. History, nearly 200 species of Uredinei have already been enumerated, and it is altogether probable that on a thorough exploration of our territory, the list of American species of this order will be largely augmented.—*J. B. Ellis, Newfield, N. J.*

Notes on N. American Grasses, based on Mr. Bentham's recent paper on Gramineæ.—

Series 1st—Panicaceæ.

Polypogon is placed by Mr. Bentham in this series because of the disarticulation of the spikelets below the glumes. Otherwise its relationship is with Agrostis.

Thurbera, a new genus by Bentham, to include two N. A. species which have been variously referred to Limnas, Greenia, and Streptachne. The first named is an Arctic grass to which ours are not related, and the two other names are preoccupied. The genus is very properly named after Prof. Geo. Thurber, as "the genus formerly dedicated to him by Asa Gray, has since proved not to be distinct from Gossypium."

Pleuraphis Torr., is very properly referred to Hilaria H.B.K. Mr. Bentham says our Texan species, which has been called *Hilaria cenchroides* H. B. K., is apparently distinct.

Ægopogon is placed in Panicaceæ.

Andropogoneæ is subdivided into four groups or sub-tribes: Sacchareæ, Arthraxeæ, Rottbœllieæ and Andropogoneæ proper. Sacchareæ comprise seven genera: Imperata, Miscanthus, Saccharum, Erianthus, Spodiopogon, Pollinia and Pogonatherum; the second and seventh not represented in N. America. The group Arthraxeæ also not represented in N. America.

Rottbœlliaceæ. The American genera of this group are Elionurus, Rottbœllia and Manisuris. *Andropogon Nuttallii* Chap., is an Elionurus nearly related to *E. ciliaris* H. B. K.

Euandropogoneæ compose nine genera, of which we have Ischæmum (introduced), Trachypogon, Heteropogon, Andropogon, Chrysopogon and Sorghum. Andropogon is divided into five sections: Schizachyrium, Cymbopogon, Gymnandropogon, Amphilopsis and Vetiveria. Our species of Sorghum, as *S. nutans* and *S. arenacea*, are species of Chrysopogon. Sorghum includes only the cultivated *S. vulgare* and *S. halapense*.

Series 2d—POACEÆ.

Tribe 1st—Phalarideæ: Phalaris, Anthoxanthum and Hierochloa.

Tribe 2d—Agrosteæ. We have Aristida, Stipa, Oryzopsis (which includes Piptatherium and Eriocoma), Millium, Muhlenbergia (which includes Vaseya and Podosæmum), Brachyelytrum, Perieilema, Lycurus, Phleum, Coleanthus, Phippsia (an Arctic genus) and Sporobolus. Sporobolus includes Vilfa, Beauv. In this tribe we have also Epicampes, which includes *Cinna macroura* Thurb. (which is not *E. macroura* Kunth, but *E. rigeus* Benth). Of Cinna we have two species, *C. arundinacea* and *C. pendula*.

In Deyeuxia are included all our species of Calamagrostis except two or three which go into Ammophila Host. Arctagrostis is an Arctic genus of this tribe.

The tribe Isachneæ is represented in the West Indies and perhaps in Mexico.

Tribe Aveneæ—16 genera. All our native species of Aira are referred to Deschampsia.

Tribe Chlorideæ—27 genera. Chloris includes Eustachys Desv. Trichloris Fourn. includes two Texano-Mexican species.

Lepturus paniculatus Nutt., is referred to Schedonnardus Steud.

Bouteloua has four sections: Chondrosium, Atheropogon, Triathera and Polyodon. Eleusine includes Dactylotænium Willd.

Leptochloa dubia and *L. fascicularis* are referred to Diplachne in the tribe Festucaceæ, as also the following:

Triodia includes Uralepis and Tricuspis. Triplasis Beauv. has two N. American species. Stenochloa Nutt., is now Dissanthelium Trin. Pleuropogon Br., includes Lophochlæna Nees. Our Brizopyrum is Distlichlis Raf. Briza includes Calotheca Desv. Graphephorum Desv., contains seven species, as arranged by Dr. Gray. Atropis Rupt., is referred to Glyceria. Bromus includes Ceratochloa D. C.

Hordiaceæ; Our native Triticums are referred to Agropyrum. Gymnostichum Schr., or Hystrix Moench., is referred to Asprella Willd.

—*Geo. Vasey, Washington, D. C.*

BOTANICAL NOTES. — Romyn Hitchcock, of New York, has merited the gratitude of botanists by undertaking the publication of Habirshaw's "Catalogue of the Diatomaceæ," which contains full references to the published descriptions and figures. Every botanical library should secure a copy of this valuable work at an early date, as the edition is limited to two hundred and fifty copies. Part I of this work has just appeared.—— The same publisher has on sale Dr. Henri Van Heurck's "Synopsis des Diatomées de Belgique," of which four of the six fascicles have appeared. The excellent plates which constitute the substance of the fascicles include many hundred species, a large proportion of which are common in our waters. This work, with the catalogue noted above, will go far to render easier the systematic study of the diatoms.——Professor C. H. Peck re-describes, in the January *Torrey Bulletin*, a curious fungus, *Secotium Warnei*, which constitutes "a connecting link between the Hymenomycetous Agaricini, and the Gasteromycetous Trichogasters." The close resemblance of some of the stipitate forms to an unexpanded Agaric was, in specimens from Iowa, quite remarkable, and the writer of this note was for a time puzzled to determine whether it might not be an Agaric after all.——The Forestry Bulletins issued from the Census Office, and prepared by Professor Sargent, are of great interest and value to botanists. When the series of bulletins is completed we shall have a most excellent and reliable map of the forest distribution of the United States.——Wiley & Sons, of New York, have, at the request of some of their patrons, reprinted the edition of "Lindley's Horticulture," which they brought out many years ago, and which had long been out of print. We are glad to see the old book again, and hope that ere long it may be honored with a revision, bringing it up to the present status of vegetable physiology.

ZOÖLOGY.

The Cell-parasite of the Frog.—The *Revue Scientifique*, of January 28, 1882, contains an abstract of the discovery by Dr. Gaule, in the frog's red blood corpuscle, of certain bodies which he considers to be derived, under certain circumstances, from the protoplasm of those corpuscles. On treating the red corpuscles with a solution of six per cent. of chloride of sodium, there appeared, beside the nucleus, mobile corpuscles, elongate and pointed at the extremities. These issued from the cell, which they could drag after them for some time, but after a little while became motionless, and finally died and disappeared.

These mobile particles are not met with in all frogs, the season, locality, size, and general state of the animal seeming to have considerable influence on their production, which is most abundant in the season when the frog takes no food, and depends for sustenance upon the reserves stored up in the season of activity. In the cells of such organs as the spleen, the liver, and the marrow of the bones, these particles develop at the expense of the red blood corpuscles more easily and quickly than in the blood itself, and they are more readily obtainable from the spleen than from any other organ. The addition of the saline solution to the sugar of that organ, without the application of heat, caused them to appear. When the violet of gentian was added to the solution only these bodies and the nucleus were colored and this fact led Gaule to suspect that they were derivatives of the nucleus.

In a last series of observations, Dr. Gaule experimented on tissues taken from the living animal. When these were treated with a solution of corrosive sublimate or of nitric acid of three per cent., bodies which he considered identical with those before spoken of were found, like little accessory nuclei, and these behaved with coloring reagents in precisely the same manner as nuclei. Dr. Gaule states that if the cellules of *fresh* tissue are disassociated by means of osmic acid, these bodies do not appear; but if the cellules are dead, these bodies can be preserved in osmic acid.

Dr. Gaule's observations were originally published in two articles in the *Archiv für Physiologie;* the first article without figures, the second illustrated.

He first named the bodies "little worms" *(Würmchen)* but afterwards gave them the title of Cytozoa, and his ultimate conclusion as to their nature was the singular one that they are the *result of death,* one portion of the protoplasm dying, while the other *becomes more active,* frees itself from the dead portion and survives awhile. It is probable that the first name given by Gaule foreshadowed the true nature of these bodies.

Professor E. Ray Lankester (Quar. Jour. Mic. Sci., 1882, 53) considers these bodies to be cell-parasites. He says that in 1871 he described in the same journal certain sausage-like parasites from the blood of *Rana esculenta,* and suggested that they might be connected with the life-cycle of *Trypanosoma sanguinis* (Gruby), at the same time pointing out their resemblance to certain peculiar spores found in cysts of a gregarine parasitic in *Tubifex.*

As Dr. Gaule gave no figures in his first article, it was supposed that he had been studying some of those curious phenomena of disintegrating blood-corpuscles that attract the attention of histologists; but the figures accompanying the second paper showed at once that they were cell-parasites belonging to the Gregarinidæ and identical with the organisms described by Lankester in 1871. Certain Gregarinidæ (Sporozoa) are now known to be cell-parasites during a portion of their lives, and those organisms have of late been considerably studied. One of these sporozoa *(Gregarines velues)* inhabits the sperm polyblasts of the earth-worm. Butschli has shown that sometimes the gregarines of the earth-worm penetrate epithelial cells of the ciliated funnels of the spermatic duct, and will continue attached to the cell by one extremity when they have attained fifty times the linear dimensions of the cell.

Eimer observed oviform psorosperms *(Coccidium* Leuckart*)* in the house-mouse, and Aimée Schneider has discovered in the pseudonaviculæ of *Monocystis lumbrici* and other gregarines falciform corpuscles resembling those figured by Gaule. Schneider's observations establish the relationship between these curious bodies, such as Eimer's *Coccidium,* and the typical gregarines.

The bodies found in the frog resemble Eimer's *Coccidium* of the mouse both in form and size; and also bear a close likeness to the falciform corpuscles found in the spores of a gregarine which occurs in the striated muscular fibers of the pig, sheep and man. The cattle plague of 1865 was at one time attributed to this gregarine.

Taking into consideration all these points, Professor Lankester believes the bodies found by Gaule, and afterwards again observed by himself, to be a stage in the life-cycle of a gregarine to which he gives the name of *Drepanidium ranarum*.

Professor Lankester disposes of Gaule's statement that these bodies were formed on the stage of the microscope after the application of the saline solution; as well as of that observer's failure to discover them in living tissue, by showing that it is difficult to see the nucleus in living tissue, so much so that not long ago it was thought that the red blood-corpuscle of the frog contained no nucleus during life. The parasite is difficult to see because its angle of refraction is the same as that of the corpuscle, but it becomes visible *just at the same time and to the same degree* that the nucleus does.

Dr. Gaule's studies, however, establish two facts not before known; these are, 1st, that the parasite is not only found *attached* to the cell, but also *within* it; 2d, that it is capable of active movement by bending and straightening its body; these movements are excited by a heat of 30°–35° C., but are stopped by a heat of 70° C.

The active motions of these bodies, exhibited in cells as well as in fluids; the cessation of these movements at a temperature of 70°; the fact that they are found in some frogs and not in others, as well as at some seasons and not in others; their power to penetrate cells and escape from them; and their presence in *R. temporaria*, as well is *Triton*, sp., all point to their animal nature.

To Gaule's assertion that these bodies did not appear in fresh tissue, Lankester opposes the statement that he obtained them from spleen pulp spread when fresh in osmic acid, and suggests the possibility that the particles treated in this manner by Dr. Gaule were free from the parasite, while those treated otherwise contained them.

VITALITY OF THE MUD PUPPY.—The observations on the Menopoma in your February number, call to mind several instances of its remarkable vitality which have come under my own observation. One specimen, about eighteen inches in length, which had lain on the ground exposed to a summer sun for forty-eight hours, was brought to the museum, and was left lying for a day longer before it was placed in alcohol. The day following, desiring to note a few points of structure, I removed it from the alcohol, in which it had been completely submerged for at least twenty hours, and had no sooner placed it on the table before it began to open its big mouth, vigorously sway its tail to and fro, and give other undoubted signs of vitality.

On another occasion desiring to kill one of these creatures, which had been out of water for a day, I made a little slit in the back, hoping to be able to penetrate between the cervical vertebræ with a stout scalpel, and cut the spinal cord. After several trials, in which I succeeded only in breaking the scalpel, I gave up the attempt; but with all my cutting and pushing, it manifested not the slightest signs of pain or irritation, while if I but touched the tip of its tail with my finger, it would make a vigorous protest by lashing its tail and snapping its jaws. I doubt if even the redoubted snapping-turtle could show signs of a more "rugged" constitution.—*Wm. Frear, University of Lewisburg.*

THE FIRST CALIFORNIAN EEL CAUGHT.—The San Francisco *Chronicle* of February 8th, reports the catching by George Bird of the first eel, resulting from the plant of 12,000 made by the California Fish Commissioners. It was caught on the easterly shore of San Francisco bay, and measured three feet in length.—*R. E. C. Stearns.*

WILD GEESE AS PESTS.—In the latter part of January, the farmers of the Upper San Joaquin valley in California, were fighting the wild geese, which in vast numbers were devastating the grain-fields of that region, pulling up the young wheat by the roots.—*R. E. C. Stearns.*

ZOOLOGICAL NOTES.—The Proceedings of the National Museum contain notes on a collection of fishes from the west coast of Mexico, by D. S. Jordan and C. H. Gilbert, while Mr. T. H. Bean gives a preliminary catalogue of the fishes of Alaska. Mr. C. H. Boyd records the discovery of the remains of a walrus near Addison Point, Washington county, Me., in a bed of blue clay two feet above high water mark. A few years ago a nearly perfect skeleton was found in the marine clays at Portland, Me.——Excellent zoölogical work is now being done in Japan by students educated in the United States and Europe. In the *Quarterly Journal of Microscopical Science* Mr. Mitsukuri recently published an article on the structure of the gills of Lamellibranchs, and in the January number a paper on the development of the supra-renal bodies in Mammalia. In the *Zoölogischer Anzeiger*, January 9, Mr. Jijima gives an abstract of a memoir on the structure of the ovary, and the origin of the egg and the egg-strings in Nephelis, and Mr. T. Iwakawa gives the results of studies on the genesis of the egg in Triton.——A revision of the Crustaceous family *Idoteidæ*, by E. J. Miers, with full descriptions of the species, is published in the Journal of the Linnean Society, XVI.

ENTOMOLOGY.[1]

Possible Food-plants for the Cotton-worm. — One of the most interesting characteristics of the Cotton-worm is that it is so strictly confined to cotton as its food-plant. All attempts hitherto made to discover additional food-plants have proved futile; nor have we been able to ever make it feed successfully on other plants allied to Gossypium.[2] We have, however, long felt that there must be some other wild plant or plants upon which the species can exist, and this belief has been all the stronger since it was demonstrated two years ago from observations made by Dr. P. R. Hoy, that the larva may occur in Wisconsin and consequently out of the range of the cotton belt.[3] We have given special directions to those in any way connected with the cotton-worm investigation to search for such additional food-plants, but so far no additional food-plant has been discovered. Last November we received from Dr. J. C. Neal, of Archer, Fla., specimens of a plant with eggs and newly hatched larvæ which he believed to be those of Aletia but which belong to an allied species—the *Anomis erosa* Guen. The plant proved to be one of the Malvaceæ (*Urena lobata* Linn.), which is reported as quite common in that part of Florida and further south, being a tall branching and straggling weed with annual stems and perennial root, from which new shoots arise in January. It blooms from February to December, and is, in addition, a valuable fiber plant, the bark of both stem and root being very strong, and used very generally for whip and cording purposes. The leaves have three very conspicuous saccharine glands on the principal veins toward the leaf stem, and the plant, Dr. Neal reports, is much less sensitive to cold or frost than Gossypium. We find that the plant has been received by Dr. Vasey, botanist of the Department of Agriculture, from several parties in Florida, with inquiries as to the value of the fiber. *Urena lobata* was, until very recently, not known to occur in the United States. It is common on dry hill pastures almost everywhere in the West Indies and southward to Guiana and Brazil, and is also reported from Western Africa, East Indies, China and some of the Pacific islands. It seems to thrive very well in Florida, and is likely to spread to other adjacent States.

The *Anomis erosa*, the eggs and young larvæ of which were not uncommon on the leaves of the Urena, may be distinguished from Aletia by the paler, more translucent character of both egg and larva, and by the first pair of prolegs being quite obsolete, in which character it resembles the *Anomis exacta* that affects cotton in Texas. Aletia larvæ that had been fed on cotton,

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

[2] The only partial success in this line is that mentioned in our Bulletin on the Cotton-worm, p. 12.

[3] See Report on Cotton Insects, Department of Agriculture, 1879, p. 89.

when placed upon the Urena refused to feed upon it, and finally perished.

We recently took occasion to carefully examine the Malvaceous plants in the herbarium of the Department of Agriculture with some quite interesting results, although a herbarium is naturally the least favorable place one can choose for an entomological investigation of this character, as plants that are least injured by insects are most apt to be collected, and the mode of preserving the plants still further reduces the chances of finding traces of Aletia, because only one side of the leaf is available for examination. How small this chance is, may be illustrated by the fact that on the specimens of Gossypium in the herbarium, no Aletia eggs or egg-shells could be discovered, and that only one specimen showed any trace of being injured by any insect whatever. Nevertheless a number of eggs or fragments of such—some of them from their structure very closely related to Aletia were found on the following plants:—*Malvastrum spicatum* from Florida and Nicaragua; *Urena ribesia* (which is considered a form of *U. lobata)*, from Southern Florida; *Pavonia typhaleoides* from Cuba; *Sida glomerata* from Cuba.

One object of this examination was to discover, if possible, the particular Malvaceous plant upon which Aletia feeds in the States north of the cotton belt, but this proved to be an almost complete failure, because the herbarium contained only six specimens of such plants from the more northern States, not counting sixteen specimens cultivated in the agricultural grounds at Washington. However, on a specimen of *Sida spinosa* from York county, Penna., an egg was found which has every appearance of that of Aletia.

We would earnestly call upon entomologists who may read these pages to aid us in obtaining evidence of the food-plant of the insect in the more northern States by an examination of the plants indicated by an asterisk in the following list, as it is upon such that the insect will probably be found at some future time, but only late in the season:

LOCALITIES FOR MALVACEOUS PLANTS FROM GRAY'S FLORA.

Althæa officinalis L.—Salt marshes coast of New England and New York. (Nat. from Eu.)

Malva rotundifolia L.—Waysides and cultivated grounds, common. (Nat. from Eu.)

" *sylvestris* L.—Waysides. (Adv. from Eu.)

" *moschata* L.—Has escaped from gardens to wayside. (Adv. from Eu.)

" *alcea* L.—Has escaped from gardens in Chester Co., Penn. (Adv. from Eu.)

Callirrhoë triangulata Gray.—Dry prairies, Wisconsin, Illinois, and southward.

" *alcæoides* Gray.—Barren oak lands, Southern Kentucky and Tenn.

Napæa dioica L.—Limestone valleys, Pennsylvania and southward to the valley of Virginia, west to Ohio and Illinois, rare.

**Malvastrum angustum* Gray.—Rock island in the Mississippi, Ills.

* " *coccineum* Gray.—Abounds on the plains from Iowa and Minnesota westward.

**Sida napæa* Cav.—Rocky river banks, Penna., York Co., Kanawha Co., Va. (Cultivated in old gardens.)

Sida elliottii T. & G.—Sandy soil, Southern Virginia and southward.

* " *spinosa* L.—Waste places, common southward.

Abutilon avicennæ Gærtn.—Waste places, escaped from gardens. (Adv. from India.)

Modiola multifida Mœnch.—Low grounds, Virginia and southward.

Kosteletzkya virginica Presl.—Marshes on the coast, New York to Virginia and southward.

Hibiscus moscheutos L.—Brackish marshes along the coast, sometimes extending up rivers far beyond the influence of salt water (as above Harrisburg, Penna.), also Onondaga lake, N. Y., and westward, usually within the influence of salt springs.

" *grandiflorus* Michx.—Illinois and southward.

" *militaris* Cav.—River banks, Pa., to Ill. and southward.

" *trionum* L.—Escaped from gardens or grounds. (Adv. from Eu.)

" *syriacus* L.— " " " " "

Of these twenty-two species, eight of which are introduced, at least eleven are not likely to occur in Wisconsin, so that the number of plants upon which the insect will probably be found is very limited if, as is most probable, the plant really is one of the Malvaceæ.—*C. V. Riley.*

Arrangement of N. A. Cynipidæ by Dr. Mayr.—I published in the March Naturalist[1] a list of American Cynipidæ as generically arranged by Dr. G. L. Mayr, of Vienna. The list contains less than half of our species, I think, and it does not include all that I sent to him. Several species differ from established genera so far that they will probably form the types of new genera.

I was surprised to find that he recognizes but one American species as belonging to the genus *Cynips*, for this genus contains eighteen European species. His new genera, *Acraspis, Loxaulus, Holcaspis* and *Belenocnema* are, so far as known, exclusively American. The last named genus is founded on a Floridian species sent him by Mrs. Mary Treat. He describes it, and gives it the name of the discoverer, *B. Treatæ*. *Loxaulus* contains only my *C. q. mammula*, described in the *Canadian Entomologist* last summer. Of the twenty-nine genera recognized by Dr. Mayr, I have mentioned only those containing American species found in his collection. Probably other genera will be found represented here when our fauna shall have been thoroughly worked out. The three Californian and the four Arizonian species which I sent him, fall into European genera, while the seven species included in the four new American genera, are all from the region east of the base of the Rocky mountains.

Andricus palustris O. S. and *Dryophanta polita* B. are placed by Mayr only provisionally in their genera.—*H. F. Bassett, Waterbury, Conn.*

[The list is a valuable addition to the literature of our Cynipidæ. Dr. Mayr has been for some time engaged upon his

[1] The editor does not see page proofs and this list was unfortunately separated from its connections in the March number.

revision of this family, and its appearance has been anxiously awaited. It will, so far as it embraces our species, replace the list given by Baron Osten Sacken, in the *Proceed. Entomolog. Soc. Phila.*, IV. pp. 379–80, published in 1865, since which time, many new species have been discovered, and generic rearrangements necessitated. The list given above numbers fifty-two species, and from the statement made by Mr. Bassett, that "it contains less than half of our species," it appears that a full list of our Cynipidæ will consist of at least a hundred species. Such a list, Mr. Bassett hopes to publish ere long, when he shall have determined the generic position of such species as are not included above.—Ed.]

MODE OF FEEDING OF THE LARVA OF DYTISCUS.—Mr. Edward Burgess, in a paper on the mouth in the larva of Dytiscus[1] gives an interesting illustrated account of the mode of taking food through the sickle-like jaws, and shows conclusively that instead of being mouthless, as ordinarily assumed, this larva has a very wide mouth, though the lips are locked together by a dove-tailed groove joint. The food is sucked into an oval opening at tip of the jaws, and drawn along a canal on the inside to a basal outlet which, when the jaws are closed on a victim, is brought into the corner of the mouth, so that the larva sucks up its victim's fluids "as a man inhales the smoke of a pipe stuck in the side of his mouth."

ENTOMOLOGICAL NOTES.—Mr. Wm. H. Edwards argues in the December number of the *Canadian Entomologist*, that *Limenitis arthemis* is single-brooded, and not double-brooded, as Mr. Scudder has maintained.——Dr. J. A. Osborne has recently recorded further experiments proving the occurrence of parthenogenesis in *Gastrophysa raphani*, but believes that it has no place in the economy of the insect analogous to that of bees and wasps, but that it is concomitant of a prevalent species supplied with abundant food of a stimulating character.—— Professor Fernald, in the December number of *Papilio*, gives reason to believe that the Tortricid genus Exartema is equivalent to Eccopsis Zeller, which has priority.——We regret very much to learn that Mr. A. R. Grote has returned from Europe in quite poor health, and hope he may soon recover. While abroad he sold his collection of Noctuidæ to the British Museum at a price variously stated from $3000 to $5000. It is greatly to be regretted that the collection should ever have left this country.——The news of the death of Mr. Jules Putzeys, on January 2d, will be received with regret by coleopterists. Putzeys is well known as the author of several careful monographs of some of the most difficult groups and genera of Carabid beetles. In accordance with the wishes of the deceased, his valuable collection has been donated to the Entomological Society of Belgium.

[1] Proc. Bost. Soc. Nat. Hist. XXI, pp. 223–8.

ANTHROPOLOGY.[1]

The Maya-Kiche Gods.—After a few years of cessation from literary labor, Dr. Daniel G. Brinton takes up his polished pen to illuminate the thrilling history of the Maya-Kiche tribes of Central America, in a paper read before the American Philosophical Society, November 4, 1881, and entitled "The names of the Gods in the Kiche Myths, Central America." The communication is published in a separate pamphlet of 37 pages octavo by McCalla & Stavely, of Philadelphia.

The Maya-Kiche stock is divided into sixteen dialects and spoken at present by half a million persons. These people formerly used mnemonic signs approaching an alphabet to record and recall their mythology and history. Fragments of their traditions have been preserved, the most notable being the *Popol-Vuh*, the national legend of the Kiches of Guatemala. This story was translated by Ximenez and by Abbé Brasseur (de Bourbourg), but so imperfectly as to throw suspicion upon the authenticity of the original. As contributing to substantiate the mythical portion, Dr. Brinton has undertaken, in the paper before us, to analyze the proper names of the divinities therein mentioned, assisted by two manuscript vocabularies of the Cakchiquel dialect presented to the library of the American Philosophical Society by the Governor of Guatemala, in 1836, and by original papers from the collection of the late Dr. C. H. Berendt. With much new light thrown upon the labors of his predecessors, Dr. Brinton then takes up the following names of Kiche deities:

Hun-Ahpu-Vuch—The One master of supernatural power, the Opossum.
Hun-Ahpu-Utiu—The One master of supernatural power, the Coyote.
Zaki-Nima-Tziz—The very active White Badger.
Nimak, Nim-tzyiz—Great Hog, White Great Hog (a totemic god).
Tepeu, Tepex, Tepal—The god who had sufficient, the syphilitic god.
Gucumatz—The feather plumed god, the feathered serpent.
{ Qux cho, Qux palo—Heart of the Lake, Heart of the Sea.
{ Qux cah, Qux uleu—Heart of the Sky, Heart of the Earth.
Ah-Raxa-Lak, Ah-Raxa-Sel—He of the green dish.
Xpiyacoc, Xmucanè—The paternal and maternal powers of life.
Cakulha Hurakan }
Chipi-Cakulha } The storm and-earthquake gods.
Raxa-Cakulha }
Qabauil—The Divinity.
Chipi-nanauac, Raxa-nanauac—The Spirit of Knowledge, the Genius of Reason.
Voc—The parrot messenger of Hurakan.
Tohil the Just, Avilix and Hacavitz—Tribal gods.
Xbalanque's descent into Zibalba, the underworld, his victory over its inhabitants and triumphal return to the world of light.
The Xbalamob of Yucatan—Very ancient men who guard the towns.
Hun-Batz, Hun-Choven—Patrons of the fine arts.

The paper closes with a short discussion of affinities with Aztec myths and color names.

[1] Edited by Professor Otis T. Mason, 1305 Q. street, N. W., Washington, D. C.

THE WESTERN RESERVE AND NORTHERN OHIO HISTORICAL SOCIETY.—Tracts 54 and 55 contain the report of the thirteenth annual meeting, and the address of the venerable president, Col. Charles Whittlesey. The address, although seemingly without connection with ethnology, is after all a very interesting piece of work. Indeed, Col. Whittlesey makes the State of Ohio the arena for the drama of five distinct populations: 1. The Symmes purchase, with Cincinnati as a center, settled by the Swedes and Dutch of New Jersey; 2. The Virginia military district, with Chilicothe as its metropolis, settled by Virginians; 3. The Ohio Company, around Marietta, recruited from Massachusetts; 4. The seven ranges of townships next to Pennsylvania, populated from that State; 5. The Western Reserve, about Cleveland, designed to be called New Connecticut, because settled from that State. Alluding to the five most prominent men at the inauguration of the late President (the Shermans, Waite, Hayes and Garfield), the speaker said: "Was it not the result of a long train of agencies which by force of natural selection brought them to the front on that occasion?"

ANTIQUITIES OF ANDERSON TOWNSHIP, HAMILTON COUNTY, OHIO.—The archæologists of the American Association, who visited the Madisonville cemetery last summer, will not soon forget the small, delicate, enthusiastic and modest gentleman who contributed so largely to their happiness. The editor of these notes spent one entire day with him, in company with Mr. C. F. Low, visiting the mounds and earthworks of Anderson township. We suspected at that time something was brewing, and was not surprised to receive a few days ago, "The Prehistoric Monuments of Anderson township, Hamilton county, Ohio," by Charles L. Metz, M.D. [From the Journal of the Cincinnati Society of Natural History, Vol. IV, December, 1881.] The description is a pamphlet of twelve pages, prefaced by a map, in which the Smithsonian symbols are used. For this and for all his self-denying labors, Dr. Metz deserves the unqualified praise of archæologists.

THE ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN.—The August and the November numbers appear in the same binding, and contain the following papers:

1. Foote, J.—Note on Carib chisels.
2. Lewis, A. L.—Notes on two stone circles in Shropshire.
3. Buckland, Miss A. W.—Surgery and superstition in Neolithic times.
4. Wake, C. Staniland—Notes on the origin of the Malagasy.
5. Christison, David—The Gauchos of San Jorge, Central Uruguay.
6. Peal, S. E.—Note on platform dwellings in Assam.
7. Woodthorpe, R. G.—Notes on the wild tribe inhabiting the so-called Naga hills on the north-east frontier of India. Part I.
8. Flower, W. H.—On a collection of monumental heads and artificially deformed crania from the Island of Mallicollo, in the New Hebrides.
9. Wylie, A.—Notes on the Western regions. Translated from the Tsëen Han Shoo, Book 96, Part 2.

10. Flower, W. H.—Report on the bones found in a Roman villa at Morton near Brading, April, 1881.
11. Lewis, A. L.—Remarks on some Archaic structures in Somersetshire and Dorsetshire.
12. Atkinson, G. M.—On a new instrument for determining the facial angle.
13. Gooch, W. D.—The stone age of South Africa.
14. Flower, W. H.—Address to the Department of Anthropology of the British Association, York, Sept. 1, 1881.

1. Mr. Forte's brief note refers to the discovery of an ancient cave workshop for the manufacture of Carib shell chisels.

2. The paper of Miss Buckland is a pleasant review of Dr. Broca's book on Prehistoric trepanning and cranial amulets.

4. In a former communication Mr. Wake had held the Malagasy to be autochthonous. The object of the present writing is to correct this notion and to prove that the origin of this race was from the region inhabited by the Siamese and cognate peoples.

5. The term Gouch-os, so often seen in books on S. America, is not a race name, but implies rather a certain mode of life, and at San Jorge is given to negroes, Brazilians, pure Spaniards, and even to northern Europeans. The paper of Mr. Christison is one of absorbing interest.

6. Mr. Peal essays to connect the pile structures of India with the Swiss lake dwellings.

7. The Naga hills are south-east of Assam, dividing that province from Burma, between 25° and 28° north, and 93° and 97° east. The frequent conflicts of these people with the British army in the east, afforded the officers in Her Majesty's army the opportunity of studying their sociology.

8. By "monumental heads" is meant artificial deformation practiced upon the heads of children at a very early age, by means of circular constriction. Professor Flower takes advantage of a recent collection by Mr. Boyd to bring together the history of this practice in the New Hebrides, a custom not met with in any other islands of the Pacific.

12. The instrument of Mr. Atkinson was invented to measure the angle formed between the ophryo-alveolar line and the plane of the visual axis, so much insisted on by Broca.

13. In a paper extending over sixty pages of the journal, Mr. Gooch, from a large personal experience and by the aid of local colaborers, minutely describes the types, distribution, geological horizon and material of the stone implements of South Africa. American archæologists cannot afford to miss this paper.

14. The only noteworthy utterance for us in Professor Flower's address, is the much-to-be-regretted fact that the Anthropological Institute is far from flourishing.

Necrology.—It is with profound sorrow that we record the death of Professor Carl Engelhardt, late secretary of the Society of Northern Antiquaries. He was profoundly versed in the antiquities of Scandinavia and Denmark, and was the author of many archæological works. Among them we would mention "Denmark in the early Iron age, illustrated by recent discoveries in the peat mosses of Slesvig-Holstein," a splendid quarto profusely illustrated and dedicated to the Princess of Wales. It was published in London in 1866.

GEOLOGY AND PALÆONTOLOGY.

NEW CHARACTERS OF THE PERISSODACTYLA CONDYLARTHRA.—Besides the characters of this group given in the NATURALIST for December, 1881 (page 1017), there are some further points of importance. The humerus in the two species of *Phenacodus*, where it is known, is much like that of the *Creodonta*, having a supracondylar foramen, and a simple condyle, without intertrochlear ridge. This is the only group of Ungulata where the supracondylar foramen occurs.

Numerous specimens of the species of *Meniscotherium* show that that genus belongs to the *Condylarthra*, and must be referred to a new family characterized by its more complex molar teeth. It is also possible that the number of the digits is different. The astragalus and humerus have the characters of those of *Phenacodus*, that is of the *Creodonta*. The two families of Condylarthra will be contrasted as follows:

Phenacodontidæ, Dentition tubercular. *Meniscotheriidæ*, Dentition lophodont, with external and internal crescents and deep valleys.—*E. D. Cope.*

MESONYX AND OXYÆNA.—In *Mesonyx ossifragus* the anterior limbs are much shorter than the posterior ones. This is especially marked in the humerus, which resembles in its form that of the otter. The ulna has a wide deep groove on its superior face, whose elevated external bounding ridge indicates a powerful extensor of the pollex, and supinator muscles. But the supination of the hand was impossible since the head of the radius is transverse and firmly fixed to the ulna. The greater length of the posterior limbs would indicate that the animal frequently rested on those extremities alone, in a position intermediate between those used by the bears and kangaroos. The species is as large as a bear, and has a very large head.

In *Oxyæna* the posterior foot has some characters like those of the seals. The cuboid bone is exactly like that of those animals, and it is evident that the external toes of the hind foot diverged extensively and were probably constructed for swimming.—*E. D. Cope.*

THE RHACHITOMOUS STEGOCEPHALI.—The segmented vertebræ characteristic of this order have been found in the genera *Eryops*, *Zatrachys* and *Trimerorhachis* in America, and *Actinodon* in

Europe. It was first pointed out by myself in *Eryops (Rhachitomus)* and *Trimerorhachis*, in the NATURALIST, May and Sept., 1878 (p. 633), and soon after by Gaudry in *Actinodon*. An examination of the figures and descriptions given by Von Meyer (Palæontographica) of the rather imperfect specimens of *Archegosaurus*, led me to believe that the vertebræ of that genus possess the segmented character also. I therefore included *Archegosaurus* in the same natural division with *Eryops*, etc., and employed for it the name *Ganocephala* which had been created by Owen for its reception.[1] It now appears from the descriptions of Dr. Fritsch that the vertebræ of *Archegosaurus* are not of the segmented type, but that they are discoidal, as in the *Labyrinthodontia*. Under these circumstances, the suborder *Ganocephala* must be given up, and a new name given to the suborder represented by *Eryops*, *Actinodon*, etc., and which I characterized in the Proceedings of the American Philosophical Society, for June, 1880. This suborder may be called the *Rachitomi*, and will include the following genera. *Trimerorhachis* ; *? Parioxys* ; *Eryops* ; *Actinodon* ; *Zatrachys* ; *? Pantylus*. There are two families, defined as follows :

Occipital condyle concave, undivided........................ *Trimerorhachidæ*
Occipital condyle divided into two lateral condyles.................... *Eryopidæ*

But one genus can yet be referred to the first family; to the second belong *Actinodon* and probably *Zatrachys*, besides *Eryops*.—*E. D. Cope*.

MARSH ON THE DINOSAURIA.—Professor Marsh has published a more complete systematic arrangement of these reptiles than the one noticed in the March NATURALIST. In this he includes many of the genera described by European and American authors, and gives them their appropriate positions. Genera whose characters cannot be ascertained are omitted, and some synonymes are included.

GEOLOGICAL NEWS.—The Geology of Frenchman's bay, Maine, is treated of by W. O. Crosby in the Proc. Bost. Soc. Nat. Hist. The rocks consist of a schistose silver-bearing group, and a slate of Cambrian or Primordial age. A few fossils have been found in the same slate at other localities.——M. Daubree (Bull. Soc. Geol. de France) gives details of the two directions taken by joints or fractures in the cretaceous strata near Paris. These joints are usually parallel to the reliefs of the region, and the two systems are nearly at right angles to each other.——The *Geological Magazine* for December, 1881, contains descriptions of some fossil Crustacea from the Stonesfield slate of Oxfordshire, England, by Hy. Woodward. Three species of *Eryon* and one of the curious larval-looking genus *Palæocaris*, hitherto known only from the *P. typus* of Meek and Worthen, are for the first time published.——The same magazine includes articles on the Brid-

[1] Proceeds. Amer. Philosoph. Soc., 1880, June.

lington and Dimlington (East Yorkshire) shell-beds, by G. W. Lamplugh; and on the "Parallelism of the Hanoverian and English Upper Jurassic," by C. Struckmann, translated by W. S. Dallas. One hundred and twenty-five fossil species are common to this formation in the two countries, nearly half of them bivalves. The North German Upper Jura is poor in Cephalopoda, and the small number of corals known to be common is most probably owing to the fact that the German corals are not yet worked out monographically.——A late issue of the Annales des Sci. Geologiques contains a malacological history of the Hill of Sansan, department of Gers, one of the richest deposits of fossils in France. The article includes a notice of the geology, with colored sections, and a dissertation upon the climate and topography of the region at the epoch of the deposit.——In the *Geological Magazine*, January, 1882, E. T. Newton, F. G. S., has some notes on the Birds, Reptiles and Amphibia of the Preglacial Forest Bed series of the East of England. Most of the birds are indeterminable, but the genera *Anser*, and, doubtfully, *Anas*, are identified. Reptiles and amphibia have never previously been noted from those beds.——In the same number H. H. Howorth, F. S. A., writes of the "Traces of a Great Post-glacial Flood," as shown by the loess, the shells of which are land shells, while the relics of man and animal remains tell the same tale.——A. G. Nathrost (Kongl. Svenska Vetenskaps-Akad. Hand.) shows that it is not improbable that many markings referred to algæ are really trails of animals. He especially refers *Eophyton* to the trails of Medusæ.——In the Reports, British Association, Section C. York Meeting, J. Prestwich argues against the generally accepted theory of volcanic action, the first cause of which he believes to be the welling up of the lava in consequence of pressure due to slight contraction of a portion of the earth's crust; this lava vaporizes the waters in the crevices of the volcano as well as those that afterwards flow into the cavities, and thus explosions are produced.——The last issue of the *American Journal of Science* contains an article by J. D. Dana, upon the "Flood of the Connecticut River valley from the melting of the Quarternary Glacier." The author refers the "kames" in the Connecticut valley, and terrace formations in general, to conditions at variance with those of Mr. Upham.——In the same journal Mr. A. O. Derby shows that, under the name of itacolumite, two very distinct geological series have been confounded, the newer of which is almost exclusively quartzite, but in places contains pebbles of all the rocks of the older series, including the diamond. Diamonds have also been taken from clay *(barro)*. The original diamond formation of Brazil is stated to be probably Cambrian.——The International Geological Congress of Bologna decided during the session of one week in September last that a chart of Europe should be published at Berlin on a scale of 1 : 1,500,000. The terms employed are to be Group for the highest divison, System for the next, Series for the third, Stage for the fourth, for the fifth Assize or Couche. Formation was not adopted because it has other meanings.——M. St. Meunier has succeeded in artificially forming enstatite, a mineral which is common in meteorites, and in a section shows fan-shaped or star-shaped forms. It is out of those forms, producible (as M. St. Meunier remarks) in a porcelain tube heated to redness, that the fancy of Mr. Otto Hahn constructed the crinoids and sponges which form the subject of his work.——At a recent meeting of the New York Acad. of Sciences, Dr. Alexis A. Julien read an able paper upon the volcanic tuffs of Idaho and other western localities.

MINERALOGY.[1]

HELVITE FROM AMELIA COUNTY, VIRGINIA.—Among some minerals recently obtained from the mica mine near Amelia Courthouse, Virginia, already famous for its microlite, was a yellow, crystalline substance which upon examination has proved to be *Helvite.* The mineral occurs in crystals and friable crystalline masses imbedded in bluish-white orthoclase, and is generally associated with pale red topazolite. While no crystals were found sufficiently perfect to allow of measurement, the absence of any action upon polarized light proved their isometric character.

The mineral has a hardness of about 6, a specific gravity of 4.306 (Haines), a sulphur-yellow color, a somewhat resinous lustre, and is partially translucent. It fuses at about 4 with intumescence to a brown glass, gives no water in the closed tube, and with the fluxes gives the reactions for manganese. Fused on charcoal with soda, it gives a hepar. It is soluble in hydrochloric acid, evolving sulphuretted hydrogen and leaving a residue of gelatinous silica.

My friend, Mr. Reuben Haines, has been kind enough to contribute the following analysis:

Gangue (SiO_2 insoluble in $NaCO_3$)	9.22
SiO_2	23.10
BeO	11.47
MnO	45.38
Fe_2O_3	2.05
Al_2O_3	2.68
CaO	.64
K_2O	.39
Na_2O	.92
S	4.50
	100.35

The mineral was dissolved in HCl, and the "gangue" found by repeatedly washing the total SiO_2 on the filter with a hot concentrated solution of $NaCO_3$, which removed all the soluble SiO_2. By

[1] Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

regarding the sulphur as combined with the iron and part of the manganese, the total percentage would be reduced by 2.25 per cent.

Helvite has not previously been found in America.—*H. Carvill Lewis.*

A NEW MANGANESE MINERAL.—Mr. M. W. Iles has examined an efflorescence which occurs upon an ore vein in Park county, Colorado. The efflorescence is of a pure white color, is very soft, has a specific gravity of 2.16, and occurs in friable crystalline masses. It is soluble in water, and has a bitter, astringent taste. The aqueous solution has an acid reaction, indicating an admixture of free sulphuric acid. The following mean composition was obtained:

FeO	ZnO	MnO	SO_3	HO.
4.18	5.97	22.31	36.07	31.60

The mineral appears to be a hydrous sulphate of manganese, containing perhaps admixtures of sulphatite, melanterite and goslarite. It should have further examination.

GALENA WITH OCTAHEDRAL CLEAVAGE.—About twenty years ago, Dr. John Torrey noticed at the Pequea mine, Lancaster county, Penna., a remarkable variety of galena, which had an eminent octahedral cleavage. The usual cubical cleavage was very indistinct, but was made more prominent after heating. He supposed the galena either to be pseudomorphous after fluorite or to be a dimorphous variety. Dr. Cooke, however, showed that by pressure, traces of an octahedral cleavage may be developed in galena from many localities, and Dr. Genth holds that such cleavage may be a natural result of octahedral crystallization.

A few months ago a similar variety of galena was found near Mont Blanc, Switzerland. A large crystal formed of two cubo-octahedrons united by an octahedral face was found to give perfect and brilliant octahedral cleavage faces when struck by a hammer. The cleavage faces had a slightly undulating surface. The specific gravity of the crystal was 7.67. No alteration in cleavage was produced by heating.

THE CONDITION OF SULPHUR IN COAL.—Dr. W. Wallace[1] has made some analyses of coal, which lead him to the conclusion that the sulphur found in coal, usually regarded as due to pyrite, exists frequently as an organic compound. He finds the amount of sulphur in many coals to be greatly in excess of the amount necessary to form bisulphide with the iron which is present.

At the recent meeting of the Amer. Inst. of Mining Engineers, Dr. Thos. M. Drown, probably not aware of these researches, contributed an interesting series of analyses of coals, which lead to

[1] Proc. Phil. Soc. Glasgow, 1879–80, p. 223.

the same conclusion. He shows, moreover, that the "organic sulphur" in coal is not affected by the process of coking.

Spiral Figures in Crystals.—Students in optical mineralogy will be interested in an article by L. Wright, in a recent number of the *Philosophical Magazine*, entitled "Some Spiral Figures observable in Crystals, illustrating the relation of their Optic Axes." The author places a section of the mineral to be examined between a quarter-wave plate and a thick plate of quartz and examines this arrangement in a polariscope with converging rays. Beautiful spiral figures are produced, resembling the well known "Airy's spirals." A uniaxial crystal, as calcite, shows a system of double spirals, mutually enwrapping each other (Fig. 1.). A single axis of a biaxial crystal shows a simple spiral (Fig. 2), while if the section includes both axes of the biaxial crystal, as muscovite, two series of single spirals are observed, which, while separated from each other, finally enwrap one another (Fig. 3).


Fig. 1.


Fig. 2.


Fig. 3.

This a beautiful demonstration of the well known fact that the optic axis of a uniaxial crystal has a two-fold character. Fig. 1, representing a uniaxial crystal is seen to be composed of the same two spirals seen in Fig. 3, a biaxial crystal. A uniaxial crystal must therefore be regarded as a case in which the two axes of a biaxial crystal coincide.

Mineralogists will here perceive how slight a distinction exists between a uniaxial crystal and a biaxial crystal of small optic axial angle and will understand how, for example, a biotite having often no appreciable biaxial character may yet be regarded as monoclinic with an optic axial angle of nearly 0°.

Native Silver.—Several interesting occurrences of native silver have recently been described.

The first of these is in the province of Almeria, Spain, where it has been found in iron ore. A bed of hematite of considerable thickness forms a hill, at the base of which is a deposit of miocene marl containing occasional beds of argentiferous galena. The galena has long been worked for silver, and it is said that the Phœnicians and Romans once mined in that locality. Recently native silver has been found in the hematite itself, and in a bed of flint which overlies it. Veins of barite which traverse the hematite bed are also rich in native silver. The silver is said to occur in rounded grains.

Another interesting occurrence of silver has been described by Kœnig and Stockder. They found it at a Colorado locality as clusters of crystals surrounded by or implanted in coal. The association of native silver with coal is a good demonstration of the accepted theory that organic substances play an important role in the reduction of metals from their salts.

According to a note in a recent number of the *Engineering and Mining Journal*, native silver has been discovered in small specks and scales at the copper mines near Somerville, N. J.

Some Virginia Minerals.—The students in the laboratory of the University of Virginia, have contributed to the *Chemical News* several valuable notes upon Virginia minerals.

S. Porcher describes a native alloy of gold and silver occurring in rounded grains in Montgomery county. The grains have the color of gold on the exterior, but are almost white within. The specific gravity is 15.46, less than that of gold. Allowing for the partial removal of silver from the surface, the composition is shown to be represented by single atoms of gold and silver, AgAu.

T. P. Lippit has analyzed an epidote of clear pistachio green color, and finds that the iron is all in the ferric condition and that the mineral is about two-thirds aluminium epidote and one-third iron epidote.

B. E. Sloan has examined the beautiful bluish-white felspar which accompanies the microlite, columbite and beryl of Amelia county. This felspar resembles oligoclase, but is now shown to be a true orthoclase.

B. H. Heyward describes a zinc-bearing clay from Pulaski county; and A. L. Baker found that iodine was present in the salt brines of West Virginia.

New Minerals.—*Nocerine* is a double fluoride of magnesium and calcium, which occurs in white acicular crystals in the volcanic rocks of Nocera.

Neocyanite is an anhydrous silicate of copper, which occurs in small deep blue crystals upon the lava of Vesuvius.

Tritochorite is a vanadate of lead and zinc, of a dark brown color and yellow streak, occurring in columnar cleavable masses.

Melanotekite is another massive, cleavable mineral of dark color. It is a silicate of lead and iron, occurring at Longban, Sweden. It has a metallic lustre, and is nearly as hard as quartz.

MINERALOGICAL NOTES.—A "crystalline bitumen" is found in trap at Port-a-Port bay, Newfoundland. It seems to have resulted from the heating action of the igneous dyke upon bituminous shales and limestones. These latter yield petroleum.——Artificial pseudomorphs of calcite after gypsum have been made by placing a crystal of gypsum in a cold, saturated solution of carbonate of ammonia. The change takes place gradually, and requires several days unless the gypsum is in fine powder, when a few hours suffice.——The beautiful amianthus from Canada is found to be much finer than any asbestos for the manufacture of asbestos fabrics. It is said that the fabrics made from it are light, soft, and white. It is also felted into sheets, which are flexible, and unctuous to the touch. It is known in commerce as "Bostonite" or "Canadian fiber."——An examination of a white slime which covered the bottom of a mine in Westphalia showed that it was composed of a mixture of Aluminite, Allophane and Hydrargyllite.——A recent analysis of the water of the Dead sea showed it to have a spec. grav. of 1.186, and to contain the following number of grams of solid matter in one litre:

KCl	$NaCl$	$NaBr$	$MgCl_2$	$CaCl_2$	$CaSO_4$
16.90	74.05	5.02	128.10	35.36	1.21

——Gold is reported as having been found in a ledge of quartzite near Amity, Orange county, New York. This is a locality already well known to mineralogists as having afforded many rare and beautiful species.——In a specimen of Cerussite from Leadville, Col., analyzed by M. W. Iles, a small percentage of Massicot and a trace of chlorine was detected.

Mineralogists should beware of artificial moss-agates. They are being manufactured of great perfection at Oberstein, Germany. The coloring matter is introduced in chalcedony to form artificial dendrites.

GEOGRAPHY AND TRAVELS.[1]

EXPLORATIONS IN EQUATORIAL AFRICA.—*Makua Land and the Interior of Mozambique.*—Makua Land, the unexplored region lying between Masasi and Mozambique and south of the Rovuma river has recently been traversed in different directions by three Englishmen. The Rev. Chauncy Maples, of the Universities Mission, advanced as far as Meto, about S. lat. 13° 25′ E. long. 37° 58′. He was prevented by the cowardice of his native followers from continuing his journey to Mozambique. He heard reports of the existence of a snow-capped mountain called Irati, about 130 miles south-south-east of Meto and visible from that point in very clear weather.

Mr. H. E. O'Neill, British Consul at Mozambique, has recently undertaken the exploration of a route to Lake Nyassa which starts from Kisanga, opposite the island of Ibo. He found the country

[1] Edited by ELLIS H. YARNALL, Philadelphia.

for the first forty miles of his march from the coast at Mokambo Bay thinly timbered with thick undergrowth, including quantities of the India-rubber vine, fairly cultivated and populous. The country then becomes rocky and broken with hills and peaks of bold shapes and precipitous sides from 200 to 1000 feet in height. At the one hundred and forty-second mile of his march he speaks of coming into view of the exceedingly beautiful Shalawe plain, which, dotted with villages, stretches away for many miles to the west and south where the vista terminates in a range of splendid hills 2000 to 4000 feet high. Mr. O'Neill made a successful journey of 600 miles, returning at the end of November last, and we hope shortly to give some details of his explorations.

Mr. Joseph Thomson, who was sent by the Sultan of Zanzibar to examine some so-called coal beds on the Lujende river near its junction with the Rovuma, passed through the northern portion of this region and has sent an interesting account of his journey to the Royal Geographical Society. The "coal" turned out to be some irregular layers of bituminous shale of no practical use. Mr. Thomson's report so much displeased the Sultan that he at once broke the engagement he had made for a period of two years with Mr. Thomson, who has returned to England.

One of the members of the Universities Mission, the Rev. W. P. Johnson has also recently visited a lake; the source of the Lujende branch of the Rovuma. On reaching the banks of the lake he could see it stretching away to the south-east, the lofty hill Mangoche, near Nyassa, east of Mponda, being visible at the same time to the north-west. He supposes the lake to be the Lake Shirwa of Livingstone, the northern part of which has never before been visited.

Mr. Schuver's Expedition to Central Africa.—Petermann's Mittheilungen has received an account of the progress of Mr. J. M. Schuver on his journey from the Nile to Central Africa. He reached Fadassi on June 12, 1881. The source of the Termat affluent of the Blue Nile is in the Sori mountains west of Fasuder. Another stream of the same name near Belletafa is an affluent of the Jaboos river. He left Fadassi, on July 30th, on a trip of thirty-eight days to the south, during which he reached the country of the Légha Gallas near the source of the Jaboos. He also explored the Amam country which is watered by two affluents of the Jaboos. The water-shed between the two Niles was defined as far as the eighth parallel. He saw far away to the south-west the great lake and river Baro flowing towards the west and situated a degree further south than as shown on Petermann's map. The Wallel mountain rises to the east to the height of 11,000 feet.

The Légha Gallas are a powerful tribe numbering 20,000 warriors, and inhabit a country far to the westward of the Galla country proper. Mr. Schuver proposed to leave Fadassi on January 1st, to explore the unknown regions down to the equator.

Dr. Stecker in Abyssinia.—Dr. Stecker, the former companion of Dr. G. Rohlfs, has recently visited Lake Tana. He has explored all the lake, visited the mountains on its shores, and prepared a detailed map of this basin. Lake Tana has a superficial area of 1150 square miles, and is at an elevation of 6370 feet above the sea-level. The greatest depth ascertained is 38 fathoms. Dr. Stecker has made interesting collections of plants, insects, fishes and mollusks, and he discovered in the Gorgora mountains, situated north of the lake, unmistakable proofs of volcanic activity; eruptive cones, a crater and a mighty lava stream, all probably recent, as in the volcanic rocks he has found inclosed remains of a mollusk which still inhabits the waters of Lake Tana. Dr. Stecker, since he completed the survey of the lake in July last, visited Zobul, a province only recently conquered by King Johannes, and never before visited by an European explorer. It lies to the east of Lake Ashangi and is inhabited by Azebu Galla. Dr. Stecker's last letter is written from that lake, the environs of which he had surveyed. If all goes well, he proposes to explore the countries to the west of Lake Tana as far as Fazokl, and then to visit Enarea and Kaffa.

De Brazza on the Congo.—M. Savorgnan de Brazza, when last heard from, had arrived on the Alima river and was then preparing to launch his small steamer to begin the exploration of the Congo. M. Mizon, who was sent out to assist him reached Franceville, the station on the Upper Ogowé, on September 22, 1881. In his report to the French Committee of the International African Association he mentions among the products of the Upper Ogowé country caoutchouc and palm oil. There are forests of wild pine, the fiber of which is used by the natives for various purposes, including nets for catching game and fish.

Pögge and Wissmann.—Doctor Pögge and Lieut. Wissmann, owing to the disturbed condition of the country, have decided not to attempt a visit to Mossumba, the residence of the Muata Yanvo, but will endeavor to reach Tushilango-land. To do this they must follow the Kassai river to its junction with the Lulua, near to which they expect to find a great lake. They will thus advance, if successful, into an entirely unexplored portion of the Congo basin near the fifth degree of south latitude and several hundred miles north of Schütts's furthest point.

Doctor Buchner.—The German traveler, Dr. Buchner, in an address made at St. Paulo de Loanda on his return from the interior of Africa, after giving a brief account of his journey to, and residence at Mossumba, the capital of the Muata Yanvo, stated that in his endeavors to push northwards after leaving Mossumba, he had crossed fifteen rivers, thirteen of them in canoes. With the exception of two, all these rivers have parallel and northerly courses. In this respect Dr. Buchner fully agrees with the views of his predecessor, Herr Schütts, as to the Kassai water system, but he does not think that, even after it has received all its tributaries, the Kassai can be in any way compared with the Lualaba. Where he passed it the last time, in 8° S. lat. in the dry season, the Kassai had only a breadth of 394 feet, and a depth of ten feet, with a current of rather less than two miles.

Notes.—A relief map of the equatorial region of Africa on the horizontal scale of one inch to twenty-five miles, and the vertical scale of one inch to five thousand feet has recently been exhibited in London.——The French Government has undertaken to make a railroad between the Upper Senegal and the Niger rivers. The surveying expeditions reached the starting point of the road on the Senegal at Khay, seven or eight miles below Medina on November 6th last.——Commander V. L. Cameron, sailed from Liverpool on December 31, 1881, for Axim to join Capt. R. F. Burton in his exploration of the country at the back of the western portion of the Gold Coast colony.——A Russian expedition for the exploration of Western Equatorial Africa is to leave Europe in April. The Cameroons mountains are proposed as the base of operations, and the exploration of the reported lake region to the east of them is the chief aim of the expedition.——Dr. Josef Chavanne estimates the mean altitude of the continent of Africa to be 2169.93 feet or double the mean altitude of the continent of Europe, which is estimated at 971.41 feet.——Since the return of the three native envoys from England, King Mtesa has been much better disposed to the English missionaries in Uganda.

MICROSCOPY.[1]

American Society of Microscopists.—The Proceedings of the fourth annual meeting of this Society, held at Columbus, Ohio, August 9th to 11th, 1881, have been issued in a pamphlet of 102 pages and seven plates. Perhaps the most generally interesting of the ten papers published, is "A Study of Blood," by Lester Curtis, M.D., of Chicago. This paper describes a very careful study, with one-tenth and one-sixteenth objectives, of fine definition and high resolving power, of pus corpuscles, and of white corpuscles, and bleached red corpuscles of human blood, with a view to determining the reality or otherwise, of the net work of fine fibers described as occurring in such structures, by Dr. Carl Heitzmann, of New York, in 1873, and subsequently by Dr. Louis Elsberg, of the same city, Dr. Klein, of London, in his Atlas of Histology, and other writers. Although Dr. Curtis easily recognized (what, indeed, it is not difficult to see) a more or less distinct appearance resembling a net-work, when the field was somewhat blurred and the outlines of objects indistinct, he uniformly by such change of adjustment as would secure a fine definition and distinct outlines, found the appearance of net-work replaced

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

by a quite distinct view of the surface of the corpuscle covered with small nodules of unequal size and placed at irregular intervals, clearly defined, and capable of casting shadows in various directions. No net-work could be seen between or below these nodules, though in some cases their shadows might seem to resemble one. Aside from the opinion of so competent a judge of appearance as Dr. Curtis, it may be added that the appearance of nodules in the absence of a net-work, as figured in the drawings representing his observations, indicates clearness of definition and reality of structure as distinguished from optical illusion. The only real question is whether a net-work of fibers, on another plane underlying this could have escaped detection by the same means which rendered the nodules so distinct. While the author's experience may not be considered absolutely conclusive in so difficult a question, contested by so competent authority, still it is a valuable and interesting contribution to the subject, and it is quite sufficient to teach caution in adopting a theory which may yet be discarded along with the hexagonal markings of *Pleurosigma angulatum*.

An interesting paper by C. M. Vorce, of Cleveland, on "Forms observed in water of Lake Erie," discusses the various vegetable and animal organisms obtained by filtration, through a muslin bag tied over a faucet, from the water supply of the city of Cleveland. Besides casual observations made at other times, regular weekly examinations were made for a year or more. Nearly 200 forms are figured upon a folded plate. The following general conclusions are of special interest: "Surprising to the writer was the discovery that the winter season was the most prolific of the whole year in number and variety of forms observed. * * * The most noticeable peculiarity of the filterings taken at this season is the abundance of infusoria, rotatoria and crustacea, which in small bodies of water are warm-weather forms; and next in attracting attention is the remarkable activity of reproduction in vegetable life. Indeed, it is soon apparent to the observer that while the advent of wintry frosts almost suspends the course of growth and reproduction in most allied forms in small and shallow waters, in these vast watery worlds the course of life with these minute organisms goes unceasingly on without a rest, and with, indeed, no perceptible check or stay. When the change in volume is imperceptible, and the change in average temperature but a few degrees, there is for the forms in these great waters little or no need for nature to resort to 'winter eggs' and 'resting spores,' although they are sometimes found, more, probably, from organic idiosyncracy than from climatic or local causes, such as chiefly contribute to cause such life changes in usual circumstances. In the lake waters the advent of spring exhibits no other effect upon the organisms we are considering than to cause an acceleration of the processes of multiplication and reproduction in many of the forms, so that these accelerated forms eventually become so much more numerous than the others that the latter are frequently looked upon as missing, although usually to be found if carefully searched for. In addition to this cause, the same effect is increased as spring advances and summer approaches, by the shallow water forms being swept in from the streams and continuing their reproduction in the lake waters. And in the cases where examinations are made from water supplies passing through storage reservoirs, the influence of the still water in the reservoir, and of its bottom of sluicy mud, is also to be considered. As summer wanes and cold weather again approaches, the winter forms increase in activity and abundance, while summer forms become more inactive, and the preponderance is again reversed."

Under the caption of "A Tumor of the left auricle," D. N. Kinsman, M. D., of Columbus, gives an excellent clinical report of a rare and interesting medical case. Though chiefly valuable to physicians, the microscopical portion is sufficiently prominent to justify its appearance in the proceedings.

The nature of "muscular contractility" is treated at length by Jacob Redding, M. D., of Falmouth, Ind. The author's theory seems to rest partly upon plausible but not altogether safe reasoning as to what would be likely to be found; his description of the tissues studied is not likely to be fully accepted by histologists, who will approve still less his free statements as to the superficial view of former authors, and of their having completely ignored, or, at least, remained silent upon the subject of the interior of the muscular "cells." The article will repay a careful study. It is illustrated with a diagrammatic plate, which delineates with great distinctness the author's theory.

Shorter articles occur upon the "Innervation of the lungs," by A. M. Bleile, M. D.; "Gregarina in the American lobster," by Professor A. H. Tuttle, and "Destruction of Acari by a fungus," by C. M. Vorce. Also, a review of different kinds of "Binocular microscopes," by George E. Fell; an argument in favor of making "Homogeneous-immersion objectives adjustable," by George E. Blockhan, M. D., and a description, by E. L. Shurley, M. D., of "An improved slide for the examination of gaseous matter." This is a glass slide with an attached cell and cover-glass, the center of the bottom of the cell being raised by a glass disk, so that the bottom of the cell will be within reach of the focal capacity of the objective used. The gas is introduced through an opening in the side of the cell by means of a fine metallic canula and a small flexible rubber tube, supplied from a compressible rubber bag or globe, such for instance, as in the instruments used in medical practice for the insufflation of powders, or in the chemical laboratory for operating wash-bottles and other apparatus. The method is capable of further usefulness in microscopy.

Bausch's Homogeneous Immersion Objectives.—The Bausch & Lomb Optical Company, Rochester, which, under the able supervision of Mr. Edward Bausch, is making remarkable progress in the construction of lenses, has added to its list a series of homogeneous immersion objectives, from $\frac{1}{4}$th to $\frac{1}{25}$th inch, claiming an angular aperture of 140° in medium equivalent to crown glass. They are made adjustable, and up to $\frac{1}{12}$th inch cost from $70 to $100. By a change of adjustment they are capable of use as water or glycerine immersion. An immersion illuminator of ingenious construction is made for use with them. New ¼th, dry, of 140° is also made, with long working focus, and so well corrected that it will resolve No. 18 or No. 19 of Möller's test-plate in balsam.

Lehigh Valley Microscopical Society.—This new society held its February meeting in Easton, with a good attendance. Dr. Isaac Ott described and illustrated Dr. Stohrer's (of Leipsic) plan for registering the growth of plants, and confirmed that author's hypothesis that during the day plants do not grow as rapidly as at night. Mr. F. Wolle exhibited specimens of filamentous alga, illustrating a growth in some instances of from one-half to three-quarters of an inch per hour. Mr. E. A. Rau also exhibited botanical specimens illustrating the growth of the lower orders. Other objects were shown by E. P. Seip and Breinig, and Mr. G. W. Stout.

Pigeon-post Films.—Having obtained a supply of the gelatine films used for transmission of news by pigeon-post during the siege of Paris (the expedient of posting despatches in the form of microscopic photographs, by the way, having been suggested by Sir David Brewster nearly fifty years ago), the editor of this department of the Naturalist will take pleasure in sending an unmounted specimen, sufficient for a microscopic object, to any person sending him a stamped and directed envelope for that purpose. Return exchange optional.

Blood Stains on Steel.—Dr. M. C. White, of New Haven, has been able to recognize and measure, by means of the vertical illuminator and a eighth objective, blood-corpuscles upon a steel instrument that had been exposed during two winters in the woods.

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SCIENTIFIC NEWS.

— The annual report of the Boston Society of Natural History for 1881, while recording progress in the arrangement of the museum and the issue of its publications, shows the amount of general interest felt by the citizens at large in the popular work of the society in the diffusion of science. Two ladies have generously paid the entire expenses of the Teachers' School of Science established by the society, lectures having been delivered by Professors Cross, Hyatt, Goodale and Mr. W. O. Crosby. The average attendance on these lectures was at first 400. As the result of these lectures Mr. Augustus Lowell recently sent word that the society would receive an annual donation of $1500, to be expended in the Teachers' School of Science. The laboratory of the society has been used the past year by a Saturday morning class for teachers in zoölogy, a class in zoölogy for the Boston University, a class in zoölogy and palæontology from the Massachusetts Institute of Technology, a special class in biology, and also in physiology, under the exclusive control of Mr. Van Vleck. Other donations for educational purposes under the auspices of the society are recorded.

— The reports of the Tenth Census are concerned much more with the material resources of the country, and has invited the coöperation of expert scientists to a far greater extent than heretofore. This is good evidence that scientific ideas have as never before impressed themselves upon the people and government. This will lead to a truer economy and a wiser administration of all subjects relating to the natural resources of the country. Besides the admirable report on the fur seal, which is noticed elsewhere, we have received an elaborate report on the Oyster Industry, prepared by Mr. Ernest Ingersoll, under the direction of the Commissioner of Fish and Fisheries. It consists of 250 quarto pages, with suitable illustrations. The account of the mode in which the starfish feeds upon the oyster is in some respects new to us. The excellent researches of Dr. Brooks upon the embryology of the oyster are given in full with his original drawings, and this illustrates how often what at first sight appears to be abstruse science and most remote from any practical issue, becomes available and necessary in such a practical matter as the oyster fishery.

— The eminent physiologist and anatomist, Professor Theodor Schwann, who in 1839 published his famous "cell theory," which made such a revolution in biology, and has done so much to simplify our conceptions of the general structures of organized bodies, died at Liége in February. Although active as a teacher, in late years Professor Schwann did not publish much, but he held to biology very much the same position maintained by Faraday in physics. He was born in 1810, was an assistant of J. Müller, the great anatomist, and afterwards was appointed to a professorship in the University of Liége, which he held until the time of his death. In 1848, on the fortieth anniversary of Schwann's professoriate, deputations from all the important universities in the world went to Liége and presented addresses, while all distinguished biologists contributed their cartes to an album which was presented to the Professor.

— The report of P. W. Norris, superintendent of the Yellowstone National Park, describes the recent violent eruptions of a geyser which he calls the "Excelsior." During much of the summer of 1881 this geyser sent up to a height of from 100 to 300 feet, sufficient water to render the rapid Fire Hole river, nearly 100 yards wide, a foaming torrent of steaming hot water, and hurled rocks of from one to one hundred pounds' weight around the edges of the crater. When the geyser is not in motion the column of steam rising from the crater forms a conspicuous landmark in the park. A new map of the park accompanies the report.

— At the last meeting of the Quekett Microscopical Club, Mr. F. Enock explained a new method of protecting cells from damage by external pressure upon the cement, his device consisting of a small metallic ring of angular section, which at the same time fitted closely round the cell and overlapped the margin of the cover-glass. It was believed that when placed in position and properly cemented round it would effectually prevent the escape of glycerine.

— Professor DuBois Raymond, in a recent address before the surgeons of the French army, adopts the dynamic theory of heredity originally proposed by Cope in 1871, and subsequently elaborated by Haeckel under the name of perigenesis. He does not credit either of these naturalists.

— The milk of the elephant, according to Dr. Charles Doremus (America), is the richest that he has ever examined, containing less water and more butter and sugar than any other. It has a very agreeable taste and odor.

— Dr. William A. Hammond has recently read a paper on the mental constitution of Guiteau, in which he takes the ground advocated by the NATURALIST in its August, 1881, number.

— The Naturalist Brazilian Exploring Expedition, under Mr. Herbert Smith, left Rio for the interior, Jan. 1, 1882.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

CALIFORNIA ACADEMY OF SCIENCES. Dec. 5.—At this meeting Professor Davidson again presided after an absence of several months in the field in connection with the work of the U. S. Coast Survey. There was a large attendance. Among the donations to the museum was one from E. F. Gerald of a fine specimen of vanadinite, the first discovered in the Pacific States or Territories. It was found forty-five miles above Yuma. Dr. W. F. McAllister presented an aboriginal skull, taken many feet below the surface at Mount Goat, Tombstone District. Captain C. L. Hooper of the *Corwin* donated two specimens of Emperor geese and a moosehead, with horns attached, from the Yukon river, in Alaska. John G. Lemmon described a new species of gentian, which he discovered in September last on the summit of the Chiricahua mountains, in Southeastern Arizona, and which on account of its small flower-cups, he named *Gentiana microcalyx*. It was a valuable acquisition to the cultivated flora, besides having valuable medicinal properties as a tonic. Robert E. C. Stearns read a suggestive paper on the growth of certain California forest trees, and meterological data suggested thereby. The death of Henry Chapman, the taxidermist and curator of mammals and birds of the Academy, was announced, and resolutions of respect to his memory were adopted.

The San Diego Society of Natural History held its eighth annual meeting in the new building recently erected by the Society, on Sixth street, November 18, 1881, the President, Dr. G. W. Barnes, in the chair. There was a good attendance of members, and of visitors on invitation.

Mr. C. J. Fox exhibited an Indian relic, probably a medicine tube, from Temecula cañon. Mr. O. N. Sanford exhibited an enormous beetle from Africa.

The president gave the substance of a communication from Mr. Henry Hemphill, of Oakland (now of San Diego), addressed to Mr. Tryon, and by him submitted to the Philadelphia Academy of Sciences, describing a species of Acmæa collected by him, which was also presented to the Academy of Sciences. Mr. Hemphill had discovered that the *Acmæa pelta* and *Nacella instabilis* were identical, apparent differences depending on stages of growth and effect of station. It is regarded as an interesting addition to our limpets. Annual reports of the librarian, treasurer and president were made.

State Natural History Society of Illinois.—The annual meeting was held at Champaign, February 28 to March 2, 1882. About thirty members were present, with an unusually good local attendance. Twenty-two papers were presented, nineteen of which were read. Mr. Wm. McAdams gave an account of the religion of the mound builders, as indicated by idols and other relics of a religious character, and also described the "Great Cahokia Mound," opposite St. Louis, and other mounds of that vicinity, giving the results of a recent survey of the group. Mr. F. S. Earle described the mounds of a part of south-eastern Missouri, explored by him last autumn for the Smithsonian Institution. Mr. F. M. Webster gave an account of the appearance and movements of the Army Worm in north-eastern Illinois, in 1881. Mr. S. A. Forbes described the lateral organs of blind fishes and reported the results of a series of observations and experiments on the first food of the white fish. Mr. J. A. Armstrong described the life history of a jelly fish; and Mr. C. W. Butler contributed a number of notes on the habits of animals and described the effect of the poison of snakes upon red blood-corpuscles, as determined by his recent experiments. Mr. A. B. Seymour read a paper on methods of field work on parasitic fungi. Professor T. J. Burrill reported the normal occurrence of bacteria in the juices of plants, which act as ferment poisons on man, and also explained some recent improvements made in microscope objectives, and Mr. C. W. Rolfe gave the results of some experiments made by him on the directions taken by the roots of germinating seeds, and some observations on the number of rings exhibited by cross sections of the wood of trees of known age. The latter gentleman likewise read a paper on the improvement of methods of science teaching in the public schools. Dr. Edward Evans described the rock system of Northern Illinois, Wisconsin and Iowa, as indicated by records of deep borings, and gave a theory of the artesian water supply of this region; and Professor D. C. Taft delivered a lecture on the fossil tracks of the Connecticut valley. Mr. James Forsythe read an abstract of the proceedings of the last meeting of the Industrial University Natural History Society, and Professor N. C. Ricker described and illustrated the "blue process" of copying manuscript, drawings, plates, etc., by photography. The evening of Wednesday was devoted to a reception given to the society by the faculty and students of the university, an interesting feature of which was a fine microscope display, given jointly by the society and the university. The officers selected for the ensuing year were: President, Dr. J. W. Taylor, Kankakee; Secretary, S. A. Forbes, Normal; Treasurer, Tyler McWhorter, Aledo; Vice-Presidents, Professor T. J. Burrill, Champaign, and Hon. William McAdams, Otterville, and additional members of the Executive Committee, Dr. Edwin Evans, Streator, and Dr. E. R. Boardman, Elmira. The reports of the Secretary and Treasurer showed that the society was in a flourishing condition as to funds and membership.

Boston Society of Natural History, February 15.—Mr. S. Carr remarked on the Indians as mound-builders, and Mr. W. M. Davis concluded his paper on the origin of lake-basins—the "obstruction type."

March 1.—Dr. W. S. Bigelow spoke of some points in connection with the theory of spontaneous generation and the life-history of the lowest organism.

New York Academy of Sciences, March 6.—Mr. W. E. Hidden remarked on a phenomenal "pocket" of quartz crystals containing inclusions of water and carbon dioxide. Mr. N. H. Darton read some notes on the Weehawken tunnel.

Appalachian Mountain Club, Boston, March 9.—Professor G. L. Vose made a communication on the relation of mountains to the construction of railways. The president exhibited a new map of a portion of Japan, on porcelain.

AMERICAN GEOGRAPHICAL SOCIETY, February 24.—Mr. George Kennan lectured on Siberia.

MIDDLESEX INSTITUTE, January 11, 1882.—Mr. Herbert Gleason read a paper on Structural geology as illustrated by the formation of the American continent. E. H. Capen, president of Tufts College, Professor John P. Marshall and Dr. A. S. Packard, Jr., were elected honorary members.

February 8.—President Dame read a paper on Schools of forestry. A paper from Warren H. Manning, of Reading, on the cultivation of trees, was read by the secretary, and followed by a general discussion. The executive committee announced a course of instructive lectures in the different departments of botany for the remainder of the winter season.

February 15.—Professor Edward S. Morse delivered a lecture on the Ancient glaciers of North America.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE, March.—Gold-bearing rocks of the province of Minas Geraes, Brazil, by O. A. Derby. The flood of the Connecticut River valley from the melting of the Quaternary glacier, by J. D. Dana. Geographical distribution of certain fresh-water mollusks of North America, and the probable causes of their variation, by A. G. Wetherby. Description of a new genus of the order Eurypterida from the Utica slate, by C. D. Walcott. Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England, No. 4, by A. E. Verrill. Origin of jointed structure in undisturbed clay and marl deposits, by J. LeConte.

GEOLOGICAL MAGAZINE, February.—*Cyrena fluminalis* at Summertown, near Oxford, by J. Prestwich. On Spermophilus beneath the glacial till in Norfolk, by E. T. Newton. Supplement to a chapter in the history of meteorites, by W. Flight. Traces of a great post-glacial flood, by H. H. Howorth (concluded).

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THE ACORN-STORING HABIT OF THE CALIFORNIA WOODPECKER.

BY ROBERT E. C. STEARNS.

THE acorn-storing habit of the Californian woodpecker *(Melanerpes formicivorus)*, has long been known to the "country folk" and others who frequent the country and take notes by the way. Before the American occupation, the Spanish Californians had observed this curious habit, and gave the bird the appropriate and musical name "*el carpintero*." No doubt, still further back the aborigines had their name for the *carpintero*, and regarded the bird as invested with superior power, or possessed by some unseen or hidden influence, which placed it above its feathered congeners and proved it to be in some mysterious way a little closer to the heart of nature.

It is highly probable that if we knew the traditions of the former red men of California, we should find some quaint story or curious legend connected with this ingenious and interesting bird. I find no mention of this woodpecker in either Bancroft's[1] or Powers'[2] ethnological volumes, relating to the California tribes.

During a recent visit to Napa county, I noticed near the house where I stayed, on Howell mountain, a fallen pine of the species known to botanists as *Pinus ponderosa*, the yellow pine of the woodsmen, the bark of which was full of acorn holes.

The tree was a noble specimen, and its prostrate position gave me a chance to learn not only its dimensions, but also to ascertain very nearly the number of holes which the woodpeckers had made in its bark.

In falling, the tip of the tree had broken off, and was so hidden in the general débris of fragments of branches, cones and under-

[1] Native Races of the Pacific States.

[2] Contributions to Ethnology, U. S. Geog. and Geol. Survey, Powell, Vol. III, 4to.

brush, as to escape detection. The length was not less than 175 feet, the diameter of the butt just above the ground, five feet ten inches. At ninety feet the diameter was three feet eight inches. Above the ninety foot line the holes continued, but were so scattering that they are not included in the reckoning. Neither are those in the first ten feet of the trunk, as between the ten foot line and the ground they were comparatively few.

Between the ten foot line and the ninety foot line the number of holes to the square foot, with a fair allowance for verification, was from *sixty* to *twelve.* A piece of the bark, sawed from the tree by my own hands, which measures exactly twelve inches by twelve inches, contains sixty holes; this is a much smaller number than could be counted in the same sized piece in a great part of the section of eighty feet, while twelve is a very low minimum.

The two diameters as above given, when added make eight feet and eighteen inches, the average diameter being one-half of this, or about four feet nine inches; this multiplied by three, to get the circumference, gives fourteen feet and three inches; and this again multiplied by the length of the section, eighty feet, produces 1140 square feet.

Now if we add the maximum and minimum of acorn holes to the square foot (sixty and twelve), we have seventy-two, which divided by two, gives an average of thirty-six to the square foot, and thirty-six times 1140 gives a product of forty-one thousand and forty (41,040) acorn holes.

The holes are of different sizes, varying with the size of the acorn, which each hole is made to receive, for these birds are good workmen, and each acorn is nicely fitted into its special cavity. Making a fair selection of acorns as to size, I find that it takes on an average seven to make an ounce (that is, picked when green); and taking that number for a divisor, it shows the total weight of acorns required to fill the holes in the tree, is three hundred and sixty-six pounds seven ounces, avoirdupois. Whether any particular species of acorn is preferred, I am unable to say. The acorns in the tree above described, so far as it was possible to determine them without the cups, which the woodpeckers reject, appeared to belong to the nearest adjacent oaks, *Quercus chrysolepis.* This oak is very abundant all around the mountain and is itself peculiar in having two forms of leaf on the same twig.

At the upper end of Pope valley, not far beyond Ætna springs, I noticed a standing pine of the same species as that described and of about the same dimensions as the foregoing, which was full of holes. In Knight's valley, in August, 1879, I observed woodpecker holes closely set in the bark of a large Douglass spruce *(Tsuga douglassii);* and I have been informed by various parties that these woodpeckers also bore and deposit acorns in the bark of various species of oaks.

Sometimes the acorn holes are made in the *wood,* as I have been informed by a friend, Mr. C. H. Dwinelle, of the University of California, who has seen such holes in a species of white oak in Alexander valley. He also related an instance of the "carpintero" sticking acorns in a crack between the boards in the porch of a house in Redwood city, San Mateo county.

Mr. J. W. Bice, of the University, has also observed acorns stored in the white oaks near Healdsburg, in Sonoma county, as well as in the cracks between the boards in and around the projecting eaves of barns and houses. Where the projecting rafters are boxed in, sometimes they will find a hole, and at other times make one, and store acorns in large quantities in such places.

In clearing land the trees are girdled, and in about two years the bark drops off, leaving the exposed wood of the trunk in a sappy state, particularly on the side which is usually in the shade, and this side is especially selected by the woodpeckers for their purposes. They not infrequently drop acorns down chimneys, where of course the result of their labor is without any advantage.

Upon turning to the volume on Ornithology in the Geological Survey (of California) publications, in reference to this species of woodpecker, it says: "They are fond of playing together around the branches, uttering their rattling calls, and often darting off to take a short sail in the air, returning to the same spot. They have a habit, peculiar to them, of drilling small holes in the bark of trees, and fitting acorns tightly into them, each one being carefully adapted and driven tight. The bark is often so full of these as to scarcely leave room to crowd in another without destroying the bark entirely. These are generally considered as laid up for a winter supply of food; but while in this climate no such provision is necessary, it is also very improbable that birds of this family would feed on hard nuts or seeds of any kind. The more probable explanation is, that they are preserved for the sake of the grubs they contain so frequently, which, being very small when the acorn falls, grow until they eat the whole interior, when they are a welcome delicacy for the bird. Whether they select only those containing grubs, or put away all they meet with, is uncertain; but as they leave great numbers in the tree untouched, it is probable that these are sound acorns, and often become a supply to the squirrels and the jays."

Without questioning the foregoing as to the preference of the woodpecker for animal food, and especially for the larvæ often contained in the acorns, it is undeniable that, in common with the jays, they are exceedingly fond of fruit, as many an orchardist can testify; and their predilection for almonds *before these nuts are quite ripe*, is well known to the cost of many almond growers; that they eat other nuts and also acorns to some extent, I have no doubt. The jays and squirrels are quite likely benefited by the acorn-storing habit of this species of woodpecker; and I have been told that the jay sometimes assists the woodpecker by bringing acorns for the carpintero to deposit in the bark; and further that sometimes the jays put pebbles in the acorn holes "to fool the woodpeckers;" but these latter statements, though perhaps true, need confirmation.

As several woodpeckers are engaged in the work at the same time on the same tree, their operations, as may be imagined, are carried on with a good deal of vivacity and noise, in which the jays become interested, and dart about, adding to the tumult in their own peculiar chattering way.

The latter have related singularities in the matter of food-storing, as will be seen below. The friend, Mr. Dwinelle, whom I have already quoted, states that the large thistle, which is abundant in certain places in Alameda county, owes its distribution in part to the jays who take the seeds, which are of good size, and plant them in the ground. He further states that a friend of his, who fed Indian corn to his chickens, had observed the jays fly down and pick up a kernel and then go off a short distance and plant it; in this way he discovered how it was that stalks of maize came up and were growing where he had never planted.

Mr. Dwinelle has himself seen a jay plant an acorn in the ground of his (Mr. D.'s) house-yard or garden in Oakland. The bird deliberately made a hole, thrust in the acorn, covered it and then put a chip on the spot, perhaps the latter as a mulch; then flew away, found another acorn, which it accidentally dropped in a growth of periwinkle (myrtle), and after searching for it without finding it, gave up and flew away.

As it is hardly presumable that the jays plant either the corn or the thistle for the purpose of perpetuating those species of plants with the object of obtaining food from future crops, it is likely that being full fed at the time, with appetites satisfied, they simply buried the seed for future need, as a dog buries a bone, and forgot all about it, or not needing the same, the seeds remained where the birds planted them, until they germinated and grew into plants.

The holes made by the woodpeckers in the bark of trees also serve as a lurking place for beetles, ants and other insects, so that both vegetable and animal food are brought together side by side to furnish a meal in time of need, in which perhaps the jays sometimes participate. Judging by the tree herein described, it would seem as if there were enough for all.

Mr. Bice is of the opinion that the acorns are stored simply for the larvæ, which the *carpintero* eats after the maggot has attained a good size. He also relates the following, which is worthy of note: "On cutting down a hollow oak on his father's place, a woodpecker's nest was discovered after the tree had fallen, and a young bird of the *carpintero* species was found and caught, being unable to fly. It was carefully reared, and became a great pet with the family. After it had reached maturity and was perfectly able to fly, though no restraint was placed upon it, it would come at once in answer to call, leaving its fellows in the trees. Upon one occasion, when the family went several miles from home to visit a friend, the bird followed them, though at the time they were not aware of it, and only learned the fact from the friend whom they had visited, and who caught and kept the bird until an opportunity offered for returning it. Probably if it had not been caught it would have followed the family back."

There is a larger species of woodpecker, with plumage much resembling that of *M. formicivorus*, which sometimes appears in flocks and helps itself, or tries to do so, to the stores laid up by *el carpintero*, who bravely fights the maurauder. I have been unable to learn to what species these depredators belong.

OBSERVATIONS ON SOME AMERICAN FORMS OF CHARA CORONATA.

BY T. F. ALLEN, M.D.

Chara coronata Ziz. (in ed. 1814), revised by A. Braun to include all known varieties, belongs to the second division of the genus Chara, namely *Haplostephanæ* (stipules composed of a simple series of cells); it has but one stipular cell at the base of each leaf, is not corticated, is monœcious and is described as follows in Braun's Characeæ Africanæ: "Plant annual, smooth and flexible. *Leaves* verticillate nine to eleven, with 4–6 articulations, 3–5 elongated segments and a short mucroniform ultimate segment. *Bracts* developed at every node; at the terminal node forming with the terminal segment a 3–5 divided crownlet (coronula); the posterior bracts shorter, depauperate or wholly wanting; the anterior about equaling the sporangium, rarely longer, often shorter. *Stipules* about the size of the leaves. *Antheridia* and *Sporangia* produced on the same node, rarely double or triple. *Nucleus* of the sporangium black, with a calcareous shell and with 7–12 conspicuous striæ on a side."

The European form of this species, known as var. *Braunii*, has been considered the normal form, occupying as it does an intermediate position in respect to size, development of bracts, size of nucleus and form of the coronula. The nucleus varies from 420 to 550 μ. (micro-millemeters, mille-millemeters) in length, is 9-striate; coronula of the sporangium is short and obtuse; the bracts anteriorly are equal to or shorter than the sporangium, posteriorly they are undeveloped. This form is found also in America, but the more distinctively American form has been known as var. *Schweinitzii* A. Br. This is usually characterized by a larger nucleus, 550 to 650 μ., and by the great development of the bracts, which are often several times longer than the sporangium and are completely developed around the leaf, verticillate, though the posterior are much shorter than the anterior. An African form, var. *Perrottetii* A. Br., has a large nucleus, 600–650 μ., with unilateral bracts equaling in length the sporangium; this form we find in America also. From India, var. *Coromandelina* A. Br., has been designated by a very large nucleus 600–750 μ., with verticillate bracts, nucleus with seven strong angles; some of our forms approach very closely to this, having verticillate bracts and an equally large nucleus. In the Sandwich islands is found a delicate form in which the cells of the coronula are much elongated, and approaching this form is one collected in New Mexico by Wright. Besides the more distinct forms are many intermediate forms, difficult to place, possessing characters belonging to two or more varieties; indeed the forms of this species from different places are quite numerous. We find the plant everywhere from Canada to Mexico and from Massachusetts to California.

One interesting fact is, that the plant in any given locality is constant in its peculiarities, and though thousands of plants be examined they will all be found to exhibit precisely the same character. This is true not only of this species but of most other species of Characeæ; thus in a pond filled with *Chara fœtida* A. Br., with long bracts and long terminal naked nodes (Macroptila, Macroteles) all the plants will have the same peculiarity and will keep it unchanged year after year, while a neighboring pond perhaps only a few rods distant, may be inhabited by another distinct but persistent form.

A. Braun relates that *Chara gymnopus* var. *Humboldtii* A. Br., collected by Gollmer in the same lake in which fifty-five years before Humboldt had gathered it, presented precisely the same characters. We have, however, noticed in one instance an apparent difference in a form of *C. coronata* collected in precisely the same locality in which it had been found twenty years before, but there might have been a difference in the maturity of the plants. This permanence of slight peculiarities may be owing to the disagreeable odor and taste of the plant, which has often a strong smell of sulphuretted hydrogen, rendering it offensive to animals who might otherwise feed upon it and carry the seeds to other localities; and as the plants grow wholly under water, the seeds are not liable to be carried by the wind. Hybridization seems, therefore, to be infrequent and exceptional. These very qualities, which serve to limit the spread of the Characeæ, may also have determined the persistence of very ancient forms and limited their multiplication.

The characters relied upon for distinctions betweeen varieties, have been the development of the bracts, the size and striation of the nucleus, and the character of the coronula of the sporangium. The general aspect of the plant, size and length of stem, density or laxity of growth, seems to vary greatly from differences in the character of the water, exposure, et cetera. The plant has been thought to be free from incrustation, but one form from Canada (Pacific Railway survey) is so completely incrusted that it is extremely brittle, and when dry has a gray color; while another form has a most peculiar zonular incrustation, giving the plant a variegated appearance.

The development of bracts seems to be most capricious; though the comparative length of bracts and sporangia seems to be pretty constant in any one locality, the *posterior* development varies in a single plant, and at times on a single leaf, one node exhibiting verticillate bracts while the next node has absolutely no bracts on its dorsal aspect: this we often find to be the case in the longest bracted forms (var. *Schweinitzii).*

In America we have every length of anterior bracts from two to three times the length of the sporangium, a little longer, of equal length, a little shorter, to very short bracts, one-half or even a third its length. Some of the shortest bracted forms are found with the largest sporangia and with verticillate bracts.

Size of nucleus.—The smallest, mature nucleus we have yet met with occurs in the form collected by Wright in New Mexico, and determined by A. Braun as var. *Braunii* forma *tenera;* it is 420 μ. long and has seven striæ; next in order is the Silver-city form, recently found, 500 μ. with only five striæ; one from California is 500 μ. long with seven striæ; from Saranac lake, Vermont, N. Carolina, etc., are forms 520 to 550 μ. long with longer or shorter bracts; then come the more common long-bracted forms (var. *Schweinitzii)* with nucleus 550 to 650 μ. long with 8 to 9 striæ; then some forms with larger nucleus and very short bracts, Penn. and Kansas, 660 to 780 (!) long with 9 to 10 striæ. Both the smallest and largest nuclei now known to us have been associated with short bracts.

The number of striæ on the nucleus, representing the whorls of enveloping cells, varies considerably; while in a general way they are more numerous on the longest nuclei, yet a smaller nucleus may have more than one somewhat larger; the delicate Saranac form has 9 striæ, while the larger Vermont form has only 7 (the same as the delicate *Braunii-tenera*) though the nucleus is larger. The Silver-city form with a nucleus 500 μ. long has 5 striæ, while *Braunii-tenera* nucleus 420 μ. has 7 striæ.

The cells of the coronula vary greatly from the closely-set short cells of the more common forms to the divergent and elongated cells of *Braunii-tenera*, which exhibits an approach to the Sandwich island form (var. *Oahuensis* A. Br.).

These varying characters with their numerous combinations seem to us to render a division of the species into definite varieties well nigh impossible. As it has now become unadvisable to bestow distinctive names upon the numerous forms of that truly polymorphic species *C. fœtida* A. Br., so in view of the now numerous and rapidly multiplying forms of *C. coronata*, it seems to us proper to describe them as *forms* peculiar in many cases to certain localities.

The variations of this plant may be tabulated as follows, giving prominence to the size of the nucleus and length of the bracts, allowing also for variations in the habit of growth, et cetera:

I. *Microcarpa*, nucleus less than 500 μ. in length.

- 1. *Macroptila*, bracts longer than the sporangia, verticillate or unilateral.
  - a. Condensata, verticils approximate, the leaves longer than the internodes.
  - b. Laxior, leaves loose, spreading.
  - c. Clausa, leaves compact, incurved.
  - A. Pachygyra, nucleus with thick prominent angles.
  - B. Leiopyrena, nucleus smooth, or with but slightly prominent angles.
- 2. *Microptila*, bracts shorter than the sporangium, verticillate or unilateral.
  - a. Condensata.
  - b. Laxior.
  - c. Clausa.
  - A. Pachygyra.
  - B. Leiopyrena.
- 3. *Meioptila*, bracts equaling the sporangium in length.

II. *Macrocarpa*, nucleus more than 600 μ. in length.

- 1. Macroptila, microptila or meioptila.
  - A. Pachygyra or Leiopyrena.
    - a. Condensata, laxior or clausa.

III. *Meiocarpa*, nucleus of medium size, between 500 and 600 μ. long, Variations as above.

The American forms may be arranged and designated as follows, beginning with those having the smallest nucleus:

1. Forma tenuior, microcarpa, microptila, unilateralia, laxior, oxygyra (var. *Braunii tenera* A. Br.). This form was collected

by Wright in New Mexico (No. 908). It is a slender diffuse plant, with rather long leaves of 5–6 articulations, including the terminal one. The stipules and bracts are very slender; the bracts are unilateral, shorter than the sporangium, the anterior rather longer than the lateral. The coronula of the sporangium consists of five cells *with elongated diverging tips*, intermediate in aspect between var. *Braunii* and var. *Oahuensis* A. Br. The sporangia and antheridia are usually duplicated on each of the two lower nodes. The terminal segment consists of three slender elongated cells forming a tuft. The nucleus is oval with about seven sharp angles, 420 to 460 μ. long and about 250 μ. broad. In the adjoining cut *1* represents the anterior aspect of a node with two sporangia but with the antheridia removed, as at 3. 2 is a terminal node—all magnified forty diameters.

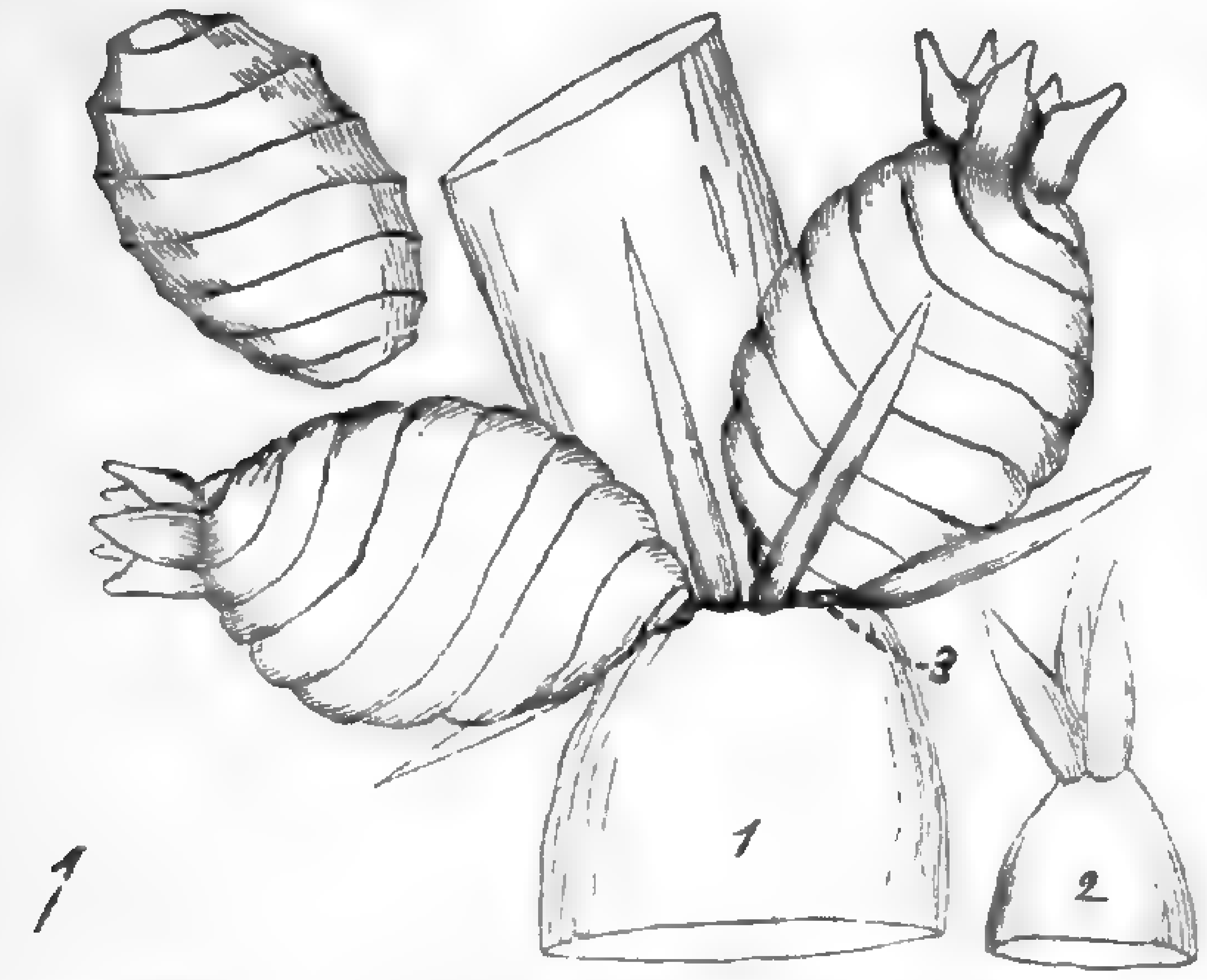

FIG. 1.—Variety *Braunii tenera.*

II. Forma microcarpa, microptila, unilateralia, laxior (var. *Braunii genuina*). This form has been collected near St. Louis by Dr. Engelmann (to whose kindness I am indebted for specimens). Plants diffuse, leaves longer than the internodes, 4–5 articulations, of which the lowest or the two lowest are fertile; stipules rather stout but short; bracts stout, unilateral, much shorter than the sporangium. Coronula of five connivent, blunt cells. Nucleus broadly oval, 475 to 500 μ. long, with about six ribs, which are blunt and not prominent. The accompanying figure, magnified forty times, represents the anterior aspect of a node of a leaf, with two sporangia, one antheridium, in situ (outlined) and one removed; only the anterior bracts are shown, the lateral are about the same length.

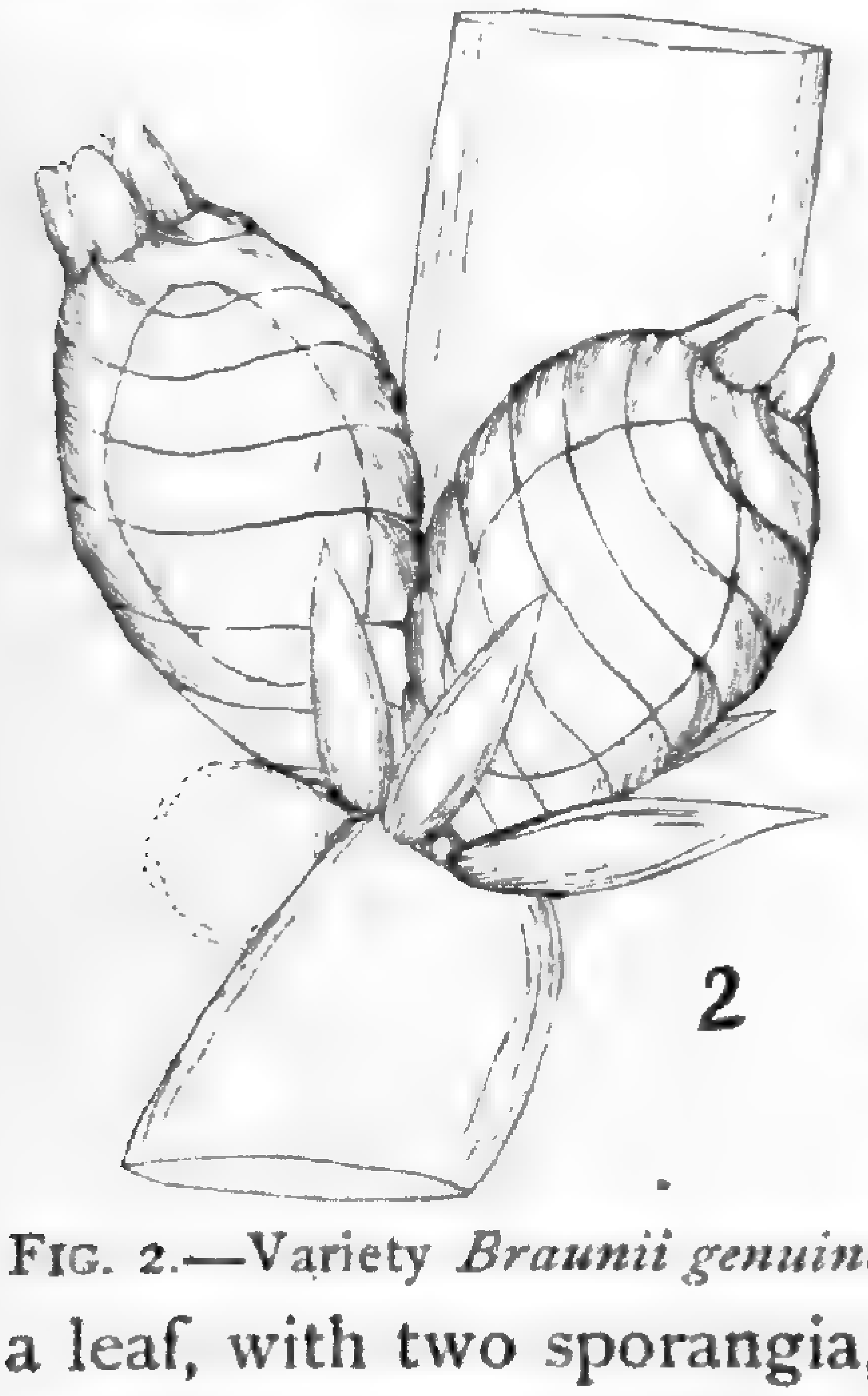

FIG. 2.—Variety *Braunii genuina.*

III. Forma meiocarpa, microptila, verticillata, elongata, clausa,

PLATE IV.

Chara Coronata, Ziz.
Var. gracilis, Allen.

pachygyra (var. *gracilis* Allen ined.). Plant slender, elongated, 15 to 20^{cm} in height. Verticils consisting of 9–10 leaves, distant. Leaves much shorter than the internodes, the lower spreading; the upper fruiting ones connivent; articulations few, usually three, the two lower nodes bearing fruit, the upper sterile, the fertile nodes usually connivent while the subterminal internode is elongated and divergent. Stipules very slender and rather short; bracts slender, usually verticillate, much shorter than the sporangium, the anterior longer than the lateral, the posterior very small, sometimes wanting, the terminal bracts form, with the short terminal segment of the leaf, a triple tuft. Sporangia and antheridia usually duplicated on the two lowest nodes of the leaf. Sporangia large in comparison with the size of the plant, with about eight whorls on one side; coronula of short pointed somewhat divergent cells; altitude of cells of coronula in mature sporangia about 100 μ. Nucleus broadly oval, 480 to 520 μ. long, with five or six thick ribs.

This form differs in habit of growth from all other known varieties. It was gathered near Silver City, New Mexico, by Mr. Rushy in 1880, being found in only one pool. It occupies an intermediate position between var. *Braunii tenera* (Forma I) and the large fruited forms from Pennsylvania and Kansas, which seem almost identical with the East Indian var. *Coromandelina* A. Br. Explanation of the plate; 1, a partial view of a verticil, showing the relative size and position of the stipules; 2, a front view of the first node of a leaf, showing at *a* the points of attachment of the antheridia which have been removed; 3, a lateral view of a second node, with a younger sporangium, showing the verticillate bracts; 4, another second node, with a very young sporangium; 5, the terminal segment of a leaf; 6, a ripe nucleus.

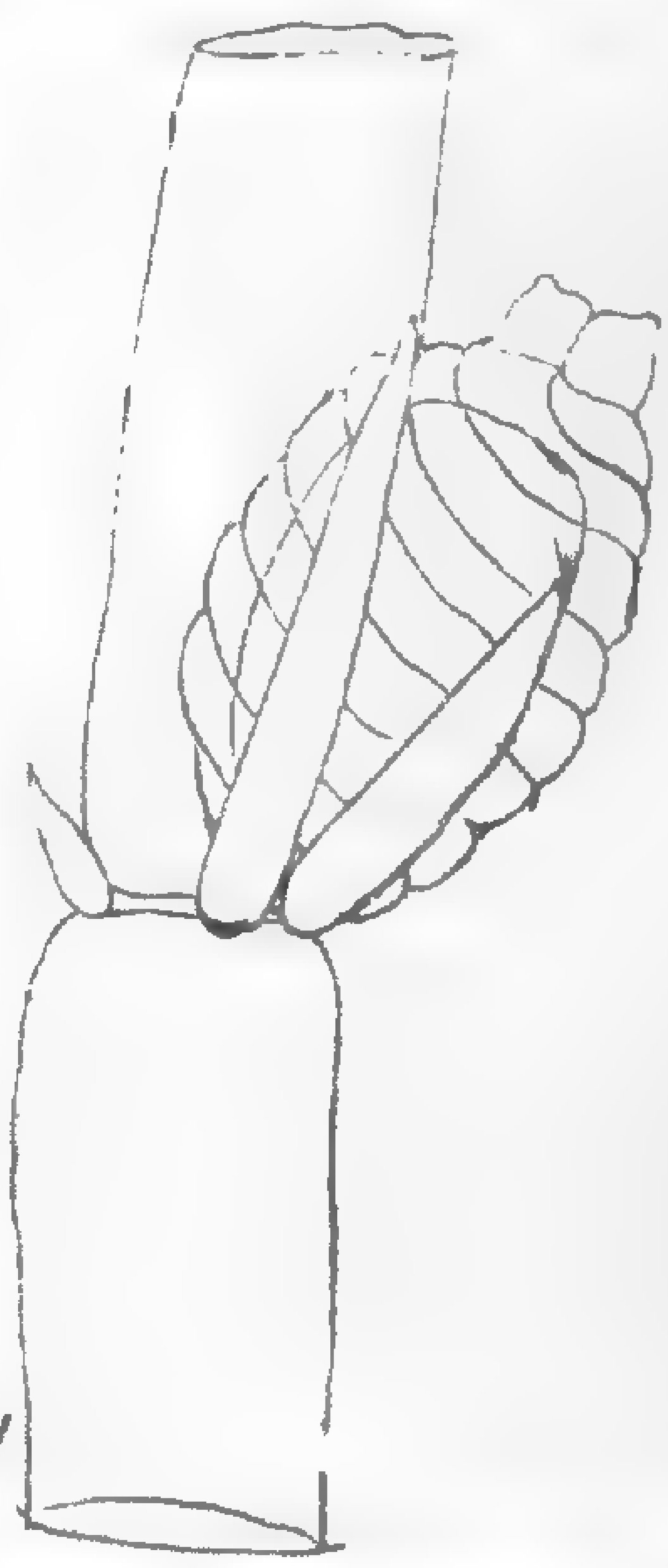
IV

FIG. 4.—*Chara coronata*, var. 4.

IV. Forma microcarpa, meioptila, verticillata, tenuior. This form was collected in California, at "King's river," by Berggren in 1875, and sent me by Professor Nordstedt. The plant is slender and diffuse, and is intermediate between the extreme small-fruited unilateral forms and the medium-fruited verticillate ones. The bracts are verticillate, *the anterior shorter than the lateral*, which about equal in length the sporangium; the coronula consists of short thick cells with a minute point, not at all developed as in *Braunii tenera*. Nucleus 425–500 μ. long, with 6–7 angles.

We now come to a group of forms representing in a general way the ordinary var. *Schweinitzii*, though the transition from the short bracted and small fruited forms to the large bracts and large fruit, is gradual. The bracts subtending the sporangium vary in relative length, sometimes the anterior, sometimes the lateral bracts are longer. The form with long lateral bracts has been known as *Chara foliolosa* Schw., the one with shorter bracts but long leaves, as in Form III. as *C. opaca* Schw.

V. Forma macrocarpa, meioptila, verticillata, tenuior, leiopy-

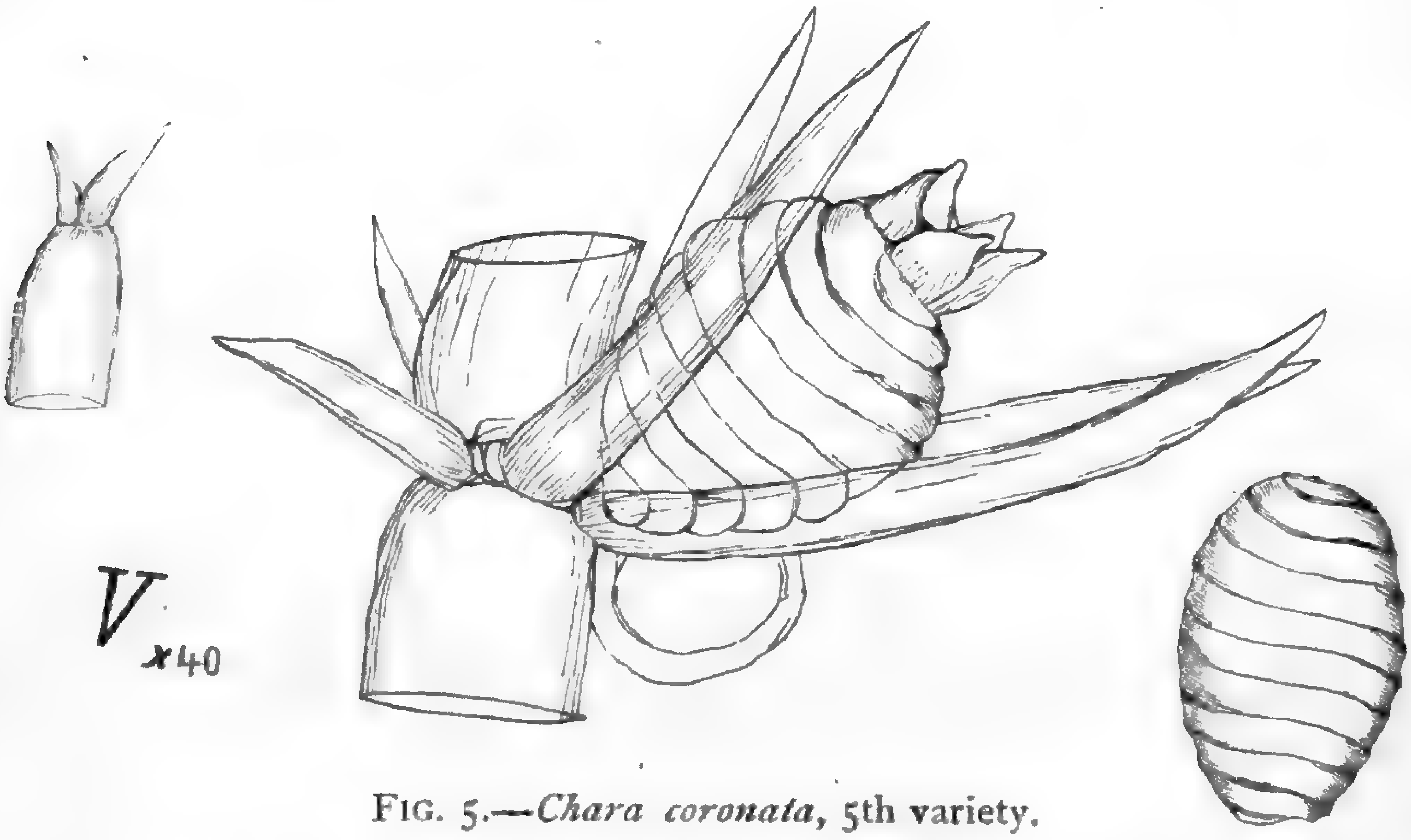

FIG. 5.—*Chara coronata*, 5th variety.

rena. Plant small, diffuse, with elongated leaves of 4–5 articulations; bracts usually verticillate, equal in length to or slightly longer than the sporangium, anterior bracts somewhat longer than the lateral, posterior often nearly as long as the lateral, rarely wanting. Sporangium with 9–11 whorls, coronula of divergent cells with rather long points, similar to *Braunii tenera* of New Mexico (Forma I). Nucleus 640 μ. long with 9–11 slightly prominent ribs. Saranac lake, N. Y., 1881.

In previous years Professor C. H. Peck, of Albany, collected specimens from precisely the same locality, and in 1860 I sent specimens to Professor A. Braun, who recognized it as a transition form between var. *Braunii* and var. *Schweinitzii*; the accompanying drawings are taken from Professor Peck's specimens.

The bracts are shorter and unilateral, the nuclei smaller, 550 μ., but the coronula seems less elongated; whether the plant still continues to vary, remains for farther investigation to establish.

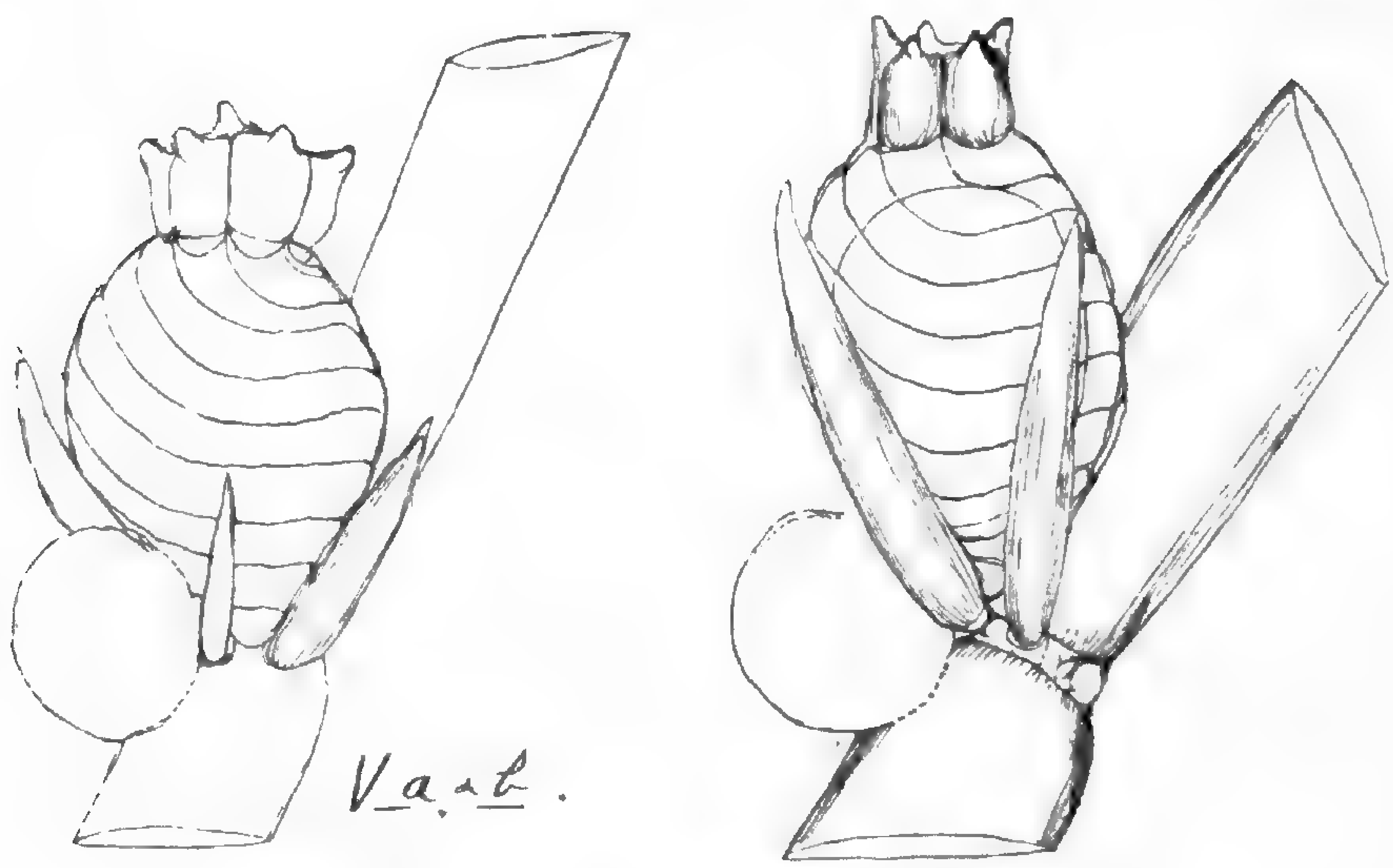

FIG. 6.—*Chara coronata*, 5th variety, *a* & *b*.

VI. Forma macrocarpa, macroptila, verticillata, laxior, leiopyrena. This very common northern form was collected in Canada by Professor Macoun; it is slender, diffuse, with long leaves of 4–5 articulations, verticillate bracts much longer than the sporangium, often two or three times its length, the anterior bracts longer than the lateral, the posterior large but much shorter. Nucleus precisely like the Saranac form (V), and about the same size, 620–650, ribs 9–10, scarcely prominent.

One collection of this form from the far west of Canada is completely incrusted with lime, and when dry is gray and very brittle; another from Eastern Canada has a peculiar zonular incrustation but usually the plant is perfectly smooth even in water containing considerable lime. The habit of growth varies exceedingly, some are delicate, diffuse and pellucid, others stout, thick, compact, and in deep water often attain a length of 4 to 5 feet (Litchfield lake, Ct.). This is our most common form, though the cells of the coronula are usually connivent, as in the next form, and the bracts may be unilateral on some nodes of the same plant.

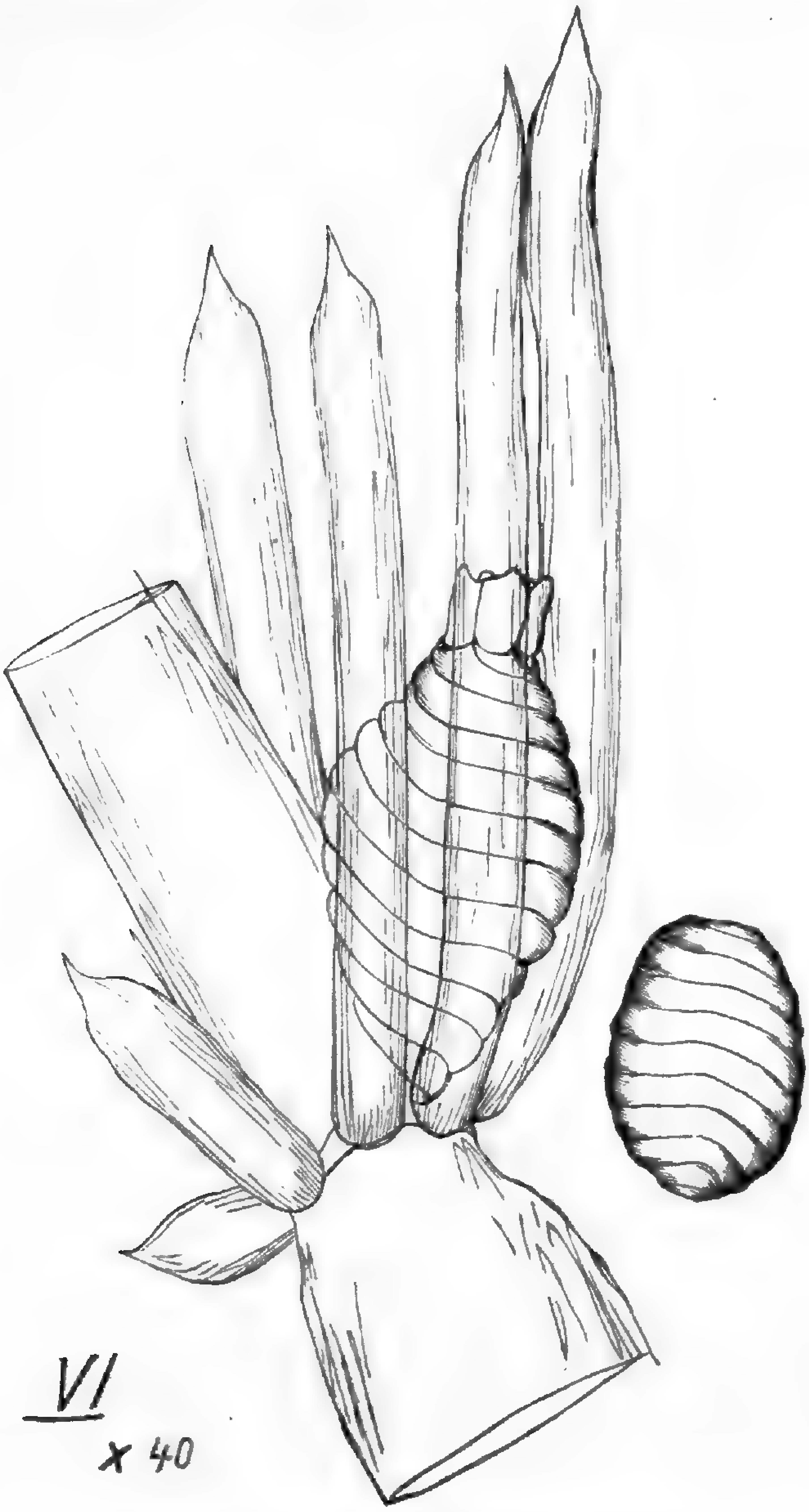

FIG. 7.—*Chara coronata*, 6th variety.

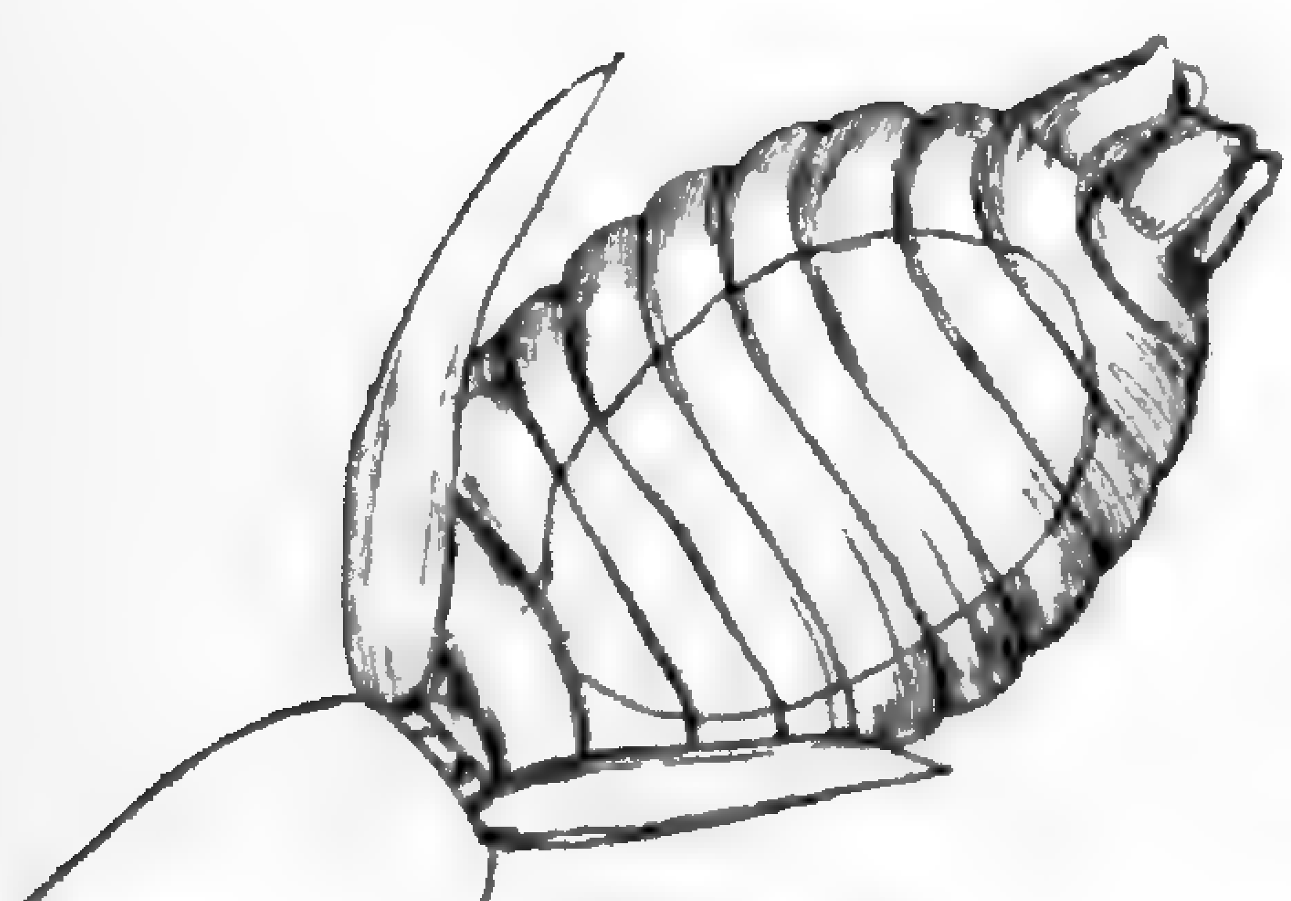

FIG. 8.—*C. coronata*, 7th variety.

VII. Forma meiocarpa, microptila, unilateralia, laxior. This form was collected at Brattleboro, Vt., by the late C. C. Frost, it presents no differences from the last except the short unilateral bracts, smaller nucleus, 550–600, with fewer ribs, 7–8.

VIII. Forma meiocarpa, meioptila, partim unilateralia, cellulis coronulæ sporangii conniventibus, condensata. Plants compact, rather stout, verticils approximate; stipules large, inflated, equaling the leaves in size. Bracts inflated, about equal in length to the sporangium or somewhat shorter, mostly unilateral, sometimes verticillate; leaves with 5–6 nodes, the three lower usually fertile; sporangium with about nine whorls on one side, *coronula connivent blunt;* nucleus nearly smooth with about seven angles, 550–575 μ. long. Collected in Vermont by Mr. Horsford.

From Hillsborough, N. C., have been collected specimens by Mr. Curtis (communicated by Dr. Engelmann) of

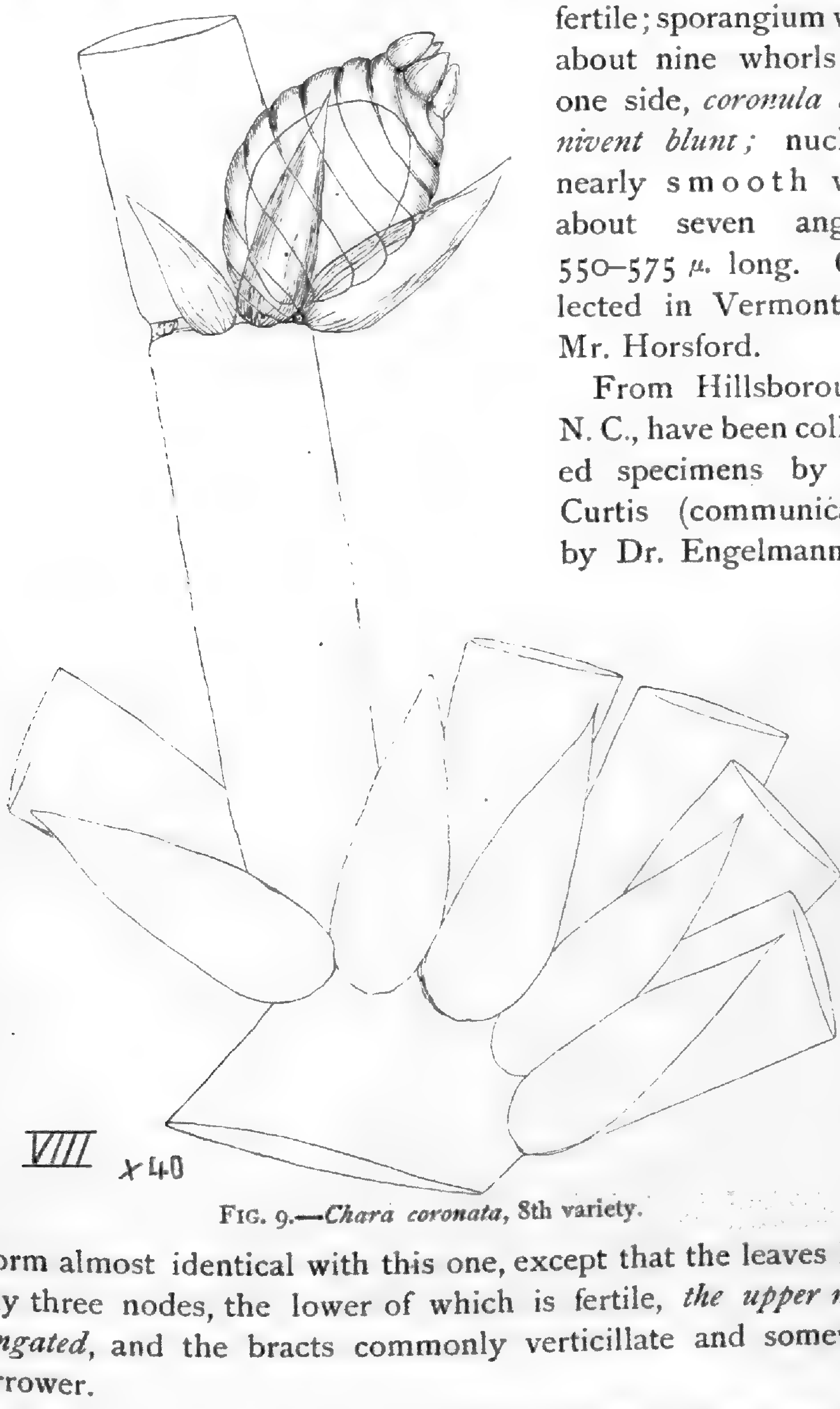

FIG. 9.—*Chara coronata*, 8th variety.

a form almost identical with this one, except that the leaves have only three nodes, the lower of which is fertile, *the upper much elongated*, and the bracts commonly verticillate and somewhat narrower.

IX. Forma macrocarpa, microptila, verticillata. The plants belonging to this form are remarkable for the large size of the fruit and the small verticillate bracts. The specimens from Pennsylvania

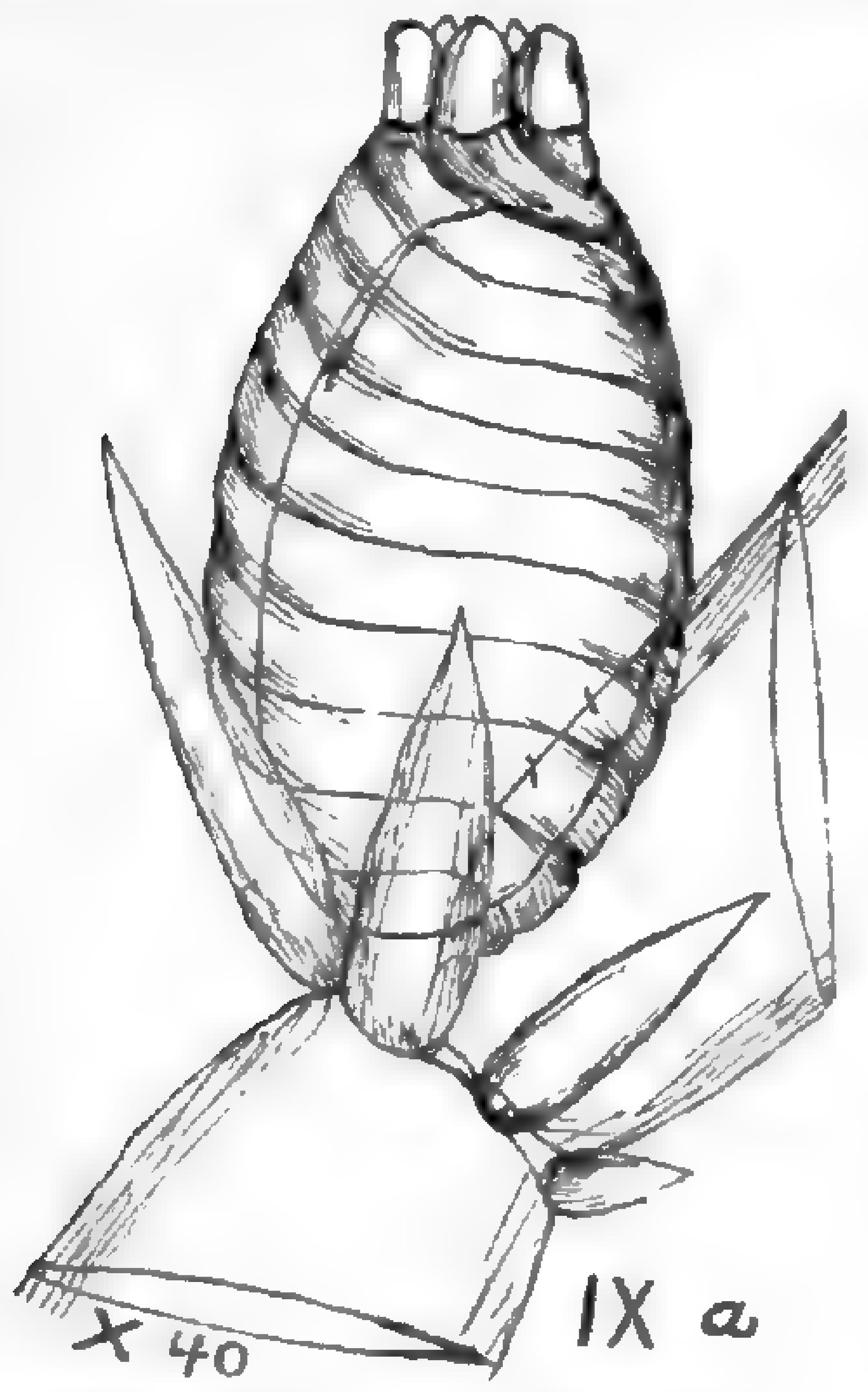

FIG. 10.—*C. coronata*, 9th var.; *a.*

were collected "in a flume" by Mr. E. A. Rau. The plants are diffuse, thin and transparent; stems long; verticils approximate at upper part; leaves long, spreading, with two fertile nodes and 2–3 sterile; the upper internodes much elongated. Bracts much shorter than the sporangium, verticillate, the anterior longer than the lateral; coronula of the sporangium consisting of connivent blunt cells; nucleus elliptical, about twice as long as broad, 650 μ. long, with nine faint striæ. Very similar to this, apparently, is a form from Kansas, collected by Fendler and communicated to me by Dr. Engelmann, of St. Louis. The leaves are long, consisting of four nodes, of which the lowest is fertile; the upper considerably elongated. The bracts are less than half the length of the sporangium, verticillate, *the anterior shorter than the lateral;*

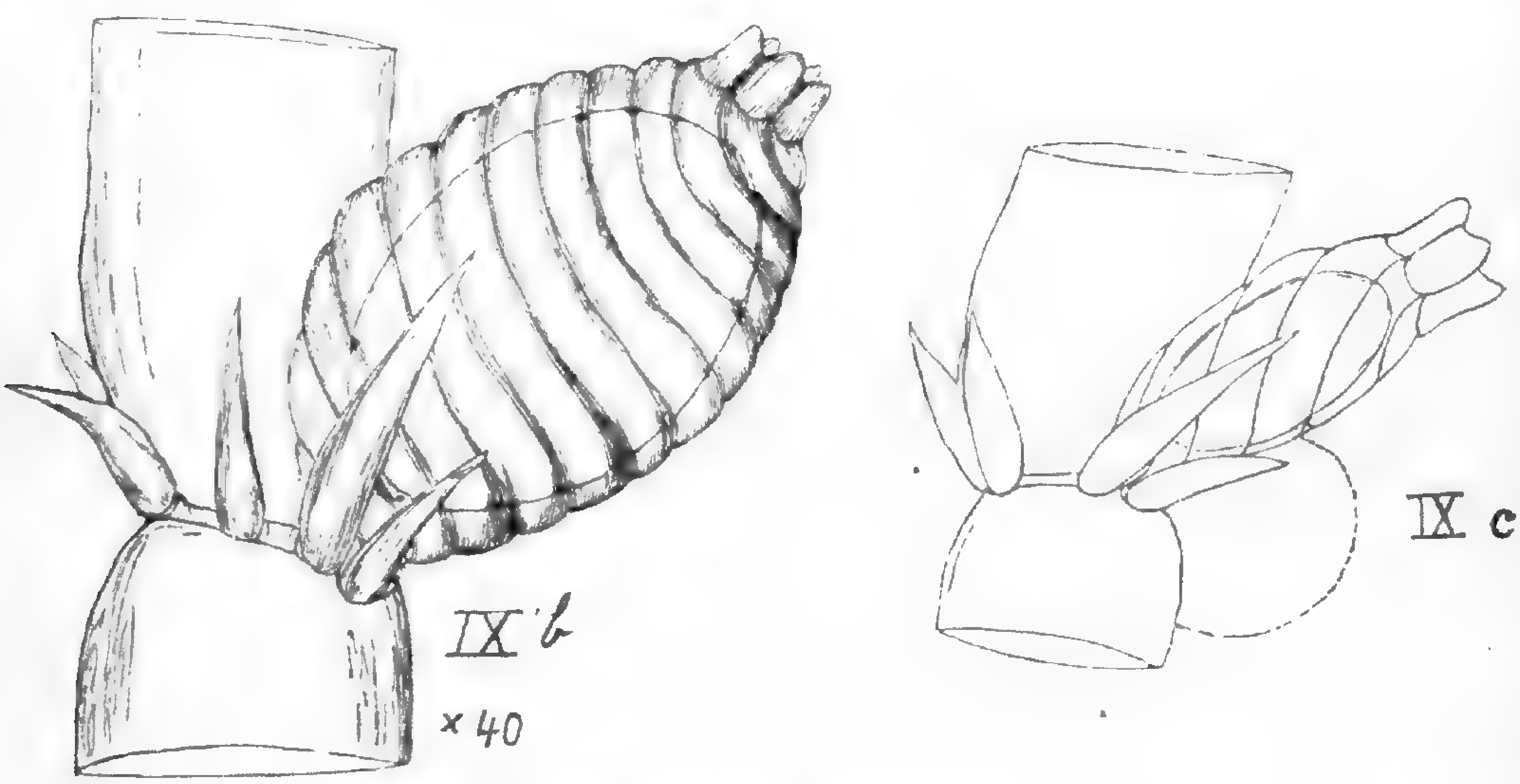

FIG.—*Chara coronata*, 9th variety; *b*, *c*.

coronula with blunt somewhat connivent cells, the sporangium large with about twelve whorls on one side. Nucleus gigantic in size, 760–780 μ. long with 9–10 faint striæ. This form is truly western in the enormous development of nucleus, but in no other respect does it seem to differ from eastern forms. *b*, a mature fruit; *c*, very young, showing a large antheridium. The figures have all been drawn with the camera lucida from actual specimens, and are perfectly true to nature.

To these forms we have been able to refer all the specimens which have thus far been collected in America; they seem to illustrate the futility of attempting to define satisfactorily varieties, and to warrant their abandonment and the substitution of "*forms*," varying with the locality, as has been suggested by Professor Nordstedt, of Sweden, and is the practice in the case of the polymorphous species, *C. fœtida* A. Br., *C. intermedia* A. Br., and many others.

A few of the more remarkable forms may still retain a specific name, as var. *Oahuensis* A. Br., perhaps var. *gracilis* Allen, and a few others; or it might even be admissible to bestow a specific name on each constant form as a convenient method of designating its peculiarities. For the present, however, while our knowledge of the American forms is yet so incomplete, we prefer to classify them as above.

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THE LOESS OF NORTH AMERICA.

BY R. ELLSWORTH CALL.

THE term loess is a purely provincial one, having been originally applied by the residents of the Rhine valley to a certain comparatively recent formation bordering that stream. It is the anglicized form of the German *löss*, itself a derivative of the verb *lösen*, to loose or to detach. It was evidently bestowed in allusion to the loose texture of that loam-like soil, and, in its present acceptation, is to be regarded as nearly the equivalent of the English *loam*.

Historical.—The earliest notice of the loess in America appears to have been in connection with various exploring expeditions sent out by the General Government. That of Lewis and Clark, made between the years 1803–1806, to the Rocky mountains, by way of the Missouri river, called attention to the remarkable character, both physical and lithological, of the bluffs along that stream, but for aught the report contains their true geological position and history were not recognized. Later, the celebrated artist, Catlin, in his letters to England from the Northwest,[1] gives a very accurate and graphic account of the Missouri river bluffs, in which he mentions certain of their remarkable physical peculiarities.

The real geological character of this formation in the United

[1] Catlin's N. A. Indians, Vol. I, p. 19, 1876. London, Chatto & Windus.

States seems to have been first surmised by Sir Charles Lyell, whose observations, however, were confined to the lower Mississippi, and notably to this deposit in the State of that name. He had traveled extensively in Europe, and in the progress of his journeyings had taken occasion to study somewhat carefully the Rhenish loess. In the first edition of his "Elements of Geology," published in 1838, he mentions at some length the loess deposits of the Rhine, and states that it is mineralogically and chemically similar to the famous deposits in the delta of the Nile. He also offers a few considerations touching its origin, to which it is not here necessary to make reference. Later, in 1846, while Lyell was in this country, Professor Wailes, of the Mississippi Geological Survey, drew his especial attention to the deposit as laid down in certain ravines in Adams county, in that State. In the subsequently published account of his travels, Mr. Lyell remarks that "the resemblance between this loam and the fluviatile silt of the valley of the Rhine, generally called loess, is most perfect."[1] Following him, most writers on the loess of the Mississippi valley consider it the counterpart of the Rhenish formation. About this period a large portion of the great hydrographic basin of the Mississippi was being for the first time geologically explored under the general and various State governments, so that discoveries of this deposit over large areas appearing *to border upon the principal streams only*, were both numerous and important. In Iowa, the first study of the loess was made by Dr. D. D. Owen, and reported upon to the General Government in his "Geological Survey of Wisconsin, Iowa, and Minnesota," published in 1852. He crossed the state from Des Moines, then a mere military post, to its western limit. Commenting on the rock structure as he advanced, he says:[2] "On approaching the Missouri, the hills bordering the extensive bottoms, known as Council Bluffs, attract particular attention, not only from their contour, but from their geological formation. Where vegetation has been removed from their slopes, they are seen to be composed chiefly of a fine ash-colored, silicious marl, or loam, effervescing with acids. In favorable situations many species of terrestrial and fluviatile shells were discovered, of the same species as are found in similar

[1] Quoted by Wailes in "Report on the Agriculture and Geology of Mississippi," 1854, p. 213.

[2] *Op. cit.*, p. 132.

deposits in the Wabash valley, which are considered contemporaneous with the loess of the Rhine." At about the same time loess was found by Whittlesy[1] on the south shore of Lake Erie, and from the presence of fresh-water shells he likewise inferred that the formation belonged to the age of the Rhenish lacustrine deposits. In writing on the superficial geology of the Lake Superior section, E. Desor concludes that "though the terraces of Mackinac differ widely in composition from the loam, or loess, of Lakes Erie and Huron, yet, the fact that both are posterior to the drift and occur at similar heights on the coast of the same lake, seems to warrant the conclusion that they may have been simultaneous." Whether those deposits are to be considered *true loess*, we are not prepared to state.

The field of discovery and study now again reverted to the south, for, in 1854, was published Wailes' account of this formation as existing in Mississippi. One year later appeared Swallow's "First and Second Reports on the Geology of Missouri," in which is given, for the first time, a full account of the loess, to which Professor Swallow applies the name of "bluff formation." This work was followed in the succeeding year, 1856, by Owen's "Report on the Geology of Kentucky," in which occur numerous references to the loess of that State. In the same year was published Volume III of the Pacific Railroad Reports, in which W. P. Blake, in giving an account of the geology of the thirty-fifth parallel, extends the geographical distribution of the loess to twenty-six miles above Fort Washita on the Red river, and quotes the observations of Shumard, made in the same section during the explorations under charge of Captain Marcy, in 1852.[2] In 1860, E. W. Hilgard, in his "Agriculture and Geology of Mississippi," gave the most complete account of the loess of the south yet published. In Nebraska, during the year 1867, it was studied by Dr. Hayden, and later by Prof. Aughey, who published an account of the surface geology of that State in Hayden's Annual Report for 1874. Meanwhile, Safford in Tennessee had published, in 1869, his account of the geology of that section; and White's "Geology of Iowa," which appeared in 1870,

[1] Report on the Geology of the Lake Superior Land District, 1851, Foster & Whitney. Pt. II, p. 248.

[2] "Exploration of the Red river of Louisiana," pp. 28–29. The common error is here made of referring the fossils found to European species. *Pupa muscorum*, *Succinea elongata*, and *Helix plebium*, are named.

contains the most finished treatment of the Iowa loess, and incidentally that of Missouri and Nebraska, which has come under notice. The last elaborate study, to which it is here necessary to make reference, is contained in the "Sketches of the Geology and Physical Geography of Nebraska," by Professor Samuel Aughey, which is, mainly, so far as the loess is concerned, an extension of his previously published paper in the report of the Hayden survey above mentioned.[1]

From these facts it will have been gathered that the loess is of wide distribution in the great central basin of the United States, to which it seems wholly confined. It is found in the States of Ohio, Indiana, Michigan, Iowa, Kansas, Nebraska, Illinois, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Missouri, Kentucky, and in the Indian Territory; but *in every instance* is apparently confined to the higher lands along the larger streams. Its superficial extent is greatest in Nebraska, where, according to Aughey,[2] its area is three-fourths that of the State, or 56,994 square miles.[3] In Iowa its superficial area is estimated by White[4] at about 5000 square miles, but his calculations included only those sections along the Missouri, inasmuch as he was evidently unacquainted with its existence in Central Iowa, and in the eastern portion of the State. Its area appears to be next greater in Missouri, which is, indeed, but the southern extension of the Iowa and Nebraska deposit. In most of the other States where it occurs its area is comparatively small.

Physical characters.—Observers agree, in the main, with reference to the physical features of this formation. Its material is exceedingly fine, very silicious as proven by numerous analyses, ashy color with slight yellowish tinge—normally; and often highly calcareous. In all these respects it agrees entirely with published descriptions of foreign loess. *In situ* it presents a remarkably homogeneous structure, usually appearing in massive walls without, or with but faint, lamellation, the latter feature be-

[1] It is not possible to note here all the minor papers, however important, that bear upon the different aspects of the loess. The reader is referred to the accompanying bibliography for all other details of publication.

[2] Sketches, &c., p. 265.

[3] "I should judge that the true loess covered about one-fourth to one-fifth of the State, not more. It is largely confined to the borders of streams and the eastern portion." Professor Hayden, *in litt.*

[4] Geology of Iowa, Vol. I, p. 127.

ing purely local. So perfect is the homogeneity that very careful examinations of specimens of soil from the Missouri valley, and the valleys of the Des Moines and Iowa rivers, failed to reveal even slightly marked physical differences. A peculiar feature of the loess—in all parts of the world—is the presence of numerous calcareous concretions—the *löessmännchen* of the Rhenish deposits —which occur in zones, at varying distances throughout the mass. They assume all possible shapes from the spherical (Plate v, Fig. 4) through the spheroidal to the oblong; in all cases they are more or less numerously studded with roughened projections. No one shape seems to obtain more than another, and not unfrequently several are found cemented together, forming an eccentric single mass. They are certainly characteristic of the loess, for that formation nowhere occurs without their presence. They are decidedly hydraulic as would be naturally inferred from their constitution. In no case have I ever observed fossils—either mollusks or vegetable matters—acting as a nucleus. On one occasion, 2803 of these bodies were crushed with that especial point in view. In nearly every instance, 2789, they were found to contain loose fragments broken by some means from their inner walls, but no foreign substance whatever could be detected.[1] In the remaining fourteen specimens, while the concretions were hollow, they yet contained loose particles of no substance whatever. Not a single specimen was solid throughout. That they were originally solid, or of a pasty consistency, is not to be doubted, as a study of the inner surface reveals. They all present a deeply fissured interior (Plate v, Fig. 1),[2] consequent on the evaporation of water and subsequent contraction. In the vast majority of cases the pyramidal masses of the interior showed distinct irregularly concentric lines of growth, or rather of accretion (Plate v, Fig. 2). The presence of these zones and the peculiarly granulated surfaces of the crushed masses, with entire absence of distinct crystallization when viewed under the microscope[3] complicates somewhat the problem of their

[1] On being shaken a rattling sound is produced, owing to these separated fragments violently striking against the inner walls of the concretions. This has earned for them among the boys of this city, the appellation of "rattle-boxes," for which reason they seem to be in great demand.

[2] View of a transverse section of spherical loess concretion, showing interior: *a*, peripheral layer, highly calcareous; *b*, pyramidal appearance of interior caused by the numerous deep fissures *c*; natural size.

[3] Professor A. F. Gray, *in litt.* So also my own examinations.

origin. Professor J. D. Whitney says of them[1] that they "have been formed in the loess by infiltration along the lines of cleavage and resultant chemical action on calcareous matter occurring in large quantity along certain planes."

It should be noted, in framing any theory on these peculiar bodies, that *without exception* the fissures of the interior surface end with the outer calcareous envelope, as shown in Plate v (Fig. 1 and 2, *c* and *a*). So also should be considered the numerous rugosities or protuberances more or less thickly studded over their surfaces (Plate v, Fig. 3).[2] Further, there often occur, in the pyramidal masses of the interior, numerous small black masses, apparently carbonaceous, the true nature of which has not yet been satisfactorily determined. I am, however, disposed to consider these concretions as a result of chemical changes in the composition of the loess itself through the action of carbonic and various of the humus acids. These exert, as is well known, a marked action upon certain mineral substances contained in soils, as notably upon carbonate of lime.[3] Whether there may have been an original foreign nucleus about which accretion began I am unable to say, but the *fact* is, that in none of the above mentioned 2803 specimens could any such nucleus be found.

On one other point the writer's observations lead to negative results. In *every case*, even when from considerable depths, the concretions are of a stony hardness. One observer[4] states that "when first exposed, most of these concretions are soft enough to be rubbed fine between the fingers, but they gradually harden by being exposed to the atmosphere." Furthermore, the portion interior to the outer calcareous envelope is largely, more than one-half, carbonate of lime. A little more than one-third is silica, with a small per centage of alumina. We have here, then, the conditions which produce their hydraulic properties, a fact in itself sufficient, almost, to lead to a belief in their universal hardness.

Another feature of the loess remains to be noticed, which is in some particulars its most remarkable characteristic. Reference is

[1] AMERICAN NATURALIST, Vol XI, p. 709.

[2] This figure represents a form of twin concretion fairly common in the loess deposits of this city, Des Moines, Iowa.

[3] *Vide* Darwin's "Vegetable Mould and Earth Worms," p. 140, *Ibid.* p. 240. In this wonderful volume the reader will find numerous facts bearing on this point.

[4] Aughey, Sketches, &c., p. 266.

here made to the almost or quite vertical planes of cleavage. Wherever streams, both great and small, have eroded channels through the deposit, or when they undermine the resulting cliffs, the masses that become detached break off in planes parallel to the original cleavage planes. This is especially remarkable since the material of the loess is not cohesive, and not at all plastic, unless thoroughly saturated with water. The use to which this feature has been put is well illustrated by the great work of Richthofen on China. In our country it is most common to meet with bluffs that are more or less rounded, a condition due to the action of rains and frosts.

Microscopical and Chemical Features.—The soil of the loess presents an unusually beautiful field when viewed with a good working microscope. A number of such examinations were made (1) of soil as taken *in situ*, in which were presented minute granules of pure silica of an average diameter of $\frac{1}{500}$ to $\frac{1}{1000}$ of an inch ; (2) of soil after treatment with strong nitric acid, when the same features were prominent, the silica granules merely appearing somewhat brighter. None of the olive-green crystalline particles, found by Pumpelly in the Chinese loess, were to be found, while in our examinations, as in his, there were no remains of minute organisms, such as diatoms.[1] In most cases the granules were devoid of the sharp angles which recently detached particles of silicious rocks give. This may, in part at least, be due to the action of the acids mentioned above, and in part to attrition against one another. They were all irregularly ovoid and somewhat translucent bodies, but occasionally discolored by some one or another of the iron oxides.

Numerous analyses made by several observers, rate the approximate quantity of silica in the loess soil at from seventy-five to eighty per cent. Blow-pipe analysis, conducted solely with a view to qualitative ends, gave, as constituents of the soil from the Missouri river and Des Moines valley deposits, water, phosphorus (trace), sodium (trace), iron (trace), calcium, magnesium, aluminum and silica. To present more clearly the nature of the soil, its value agriculturally, and as anticipatory of its mode of origin, the following table will be found useful and instructive. I give, also, in juxtaposition, the average of the results of Bischoff's ex-

[1] The examinations were conducted by the writer and Dr. A. G. Field, to whom the instrument used belonged. It was a Zentmayer's Centennial improved stand, with the A eye-piece and 8-10 objective.

amination of the Rhenish loess, to enable ready comparison:

TABLE SHOWING THE CHEMISTRY OF THE LOESS.

Composition of Missouri Loess.	Average of four Analyses by Litton.	Composition of Nebraska Loess.	Average of five Analyses by Aughey.	Composition of Iowa Loess.	Average of two Analyses by Emery.	Composition of Rhine Loess.	Average of five Analyses by Bischoff.
Silica	77.4275	Insoluble (silicious) matter	81.334	Insoluble (silicious) matter	84.85	Silicic acid	72.136
Alumina and peroxide of iron	12.83	Ferric oxide	3.854	Ferric oxide and Alumina	3.77	Alumina and peroxide of iron.	15.362
Lime	3.2425	Alumina	0.742			Lime[1]	0.02
Magnesia	1.4975	Lime carbonate	6.058	Calcium carbonate	8.33	Magnesia	0.298
Carbonic acid and water	2.765	Lime phosphate	3.584	Magnesium carbonate	1.70	Potash and soda	2.094
		Magnesia carbonate	1.294	Moisture	1.10	Carb. lime[2]	15.895
		Potassa	0.316	Organic matter, traces, and loss	1.25	Carb. magnesia	3.615
		Sodium	0.154			Loss	1.114
		Organic matter	1.06				
		Water	1.086				

[1] No lime appeared in analyses numbers 3, 4 and 5.

[2] No carbonate of lime nor carbonate of magnesia appeared in analyses numbers 2, 3 and 5. Hence in these cases the average of the *two* in which they appear is given.

PLATE V.

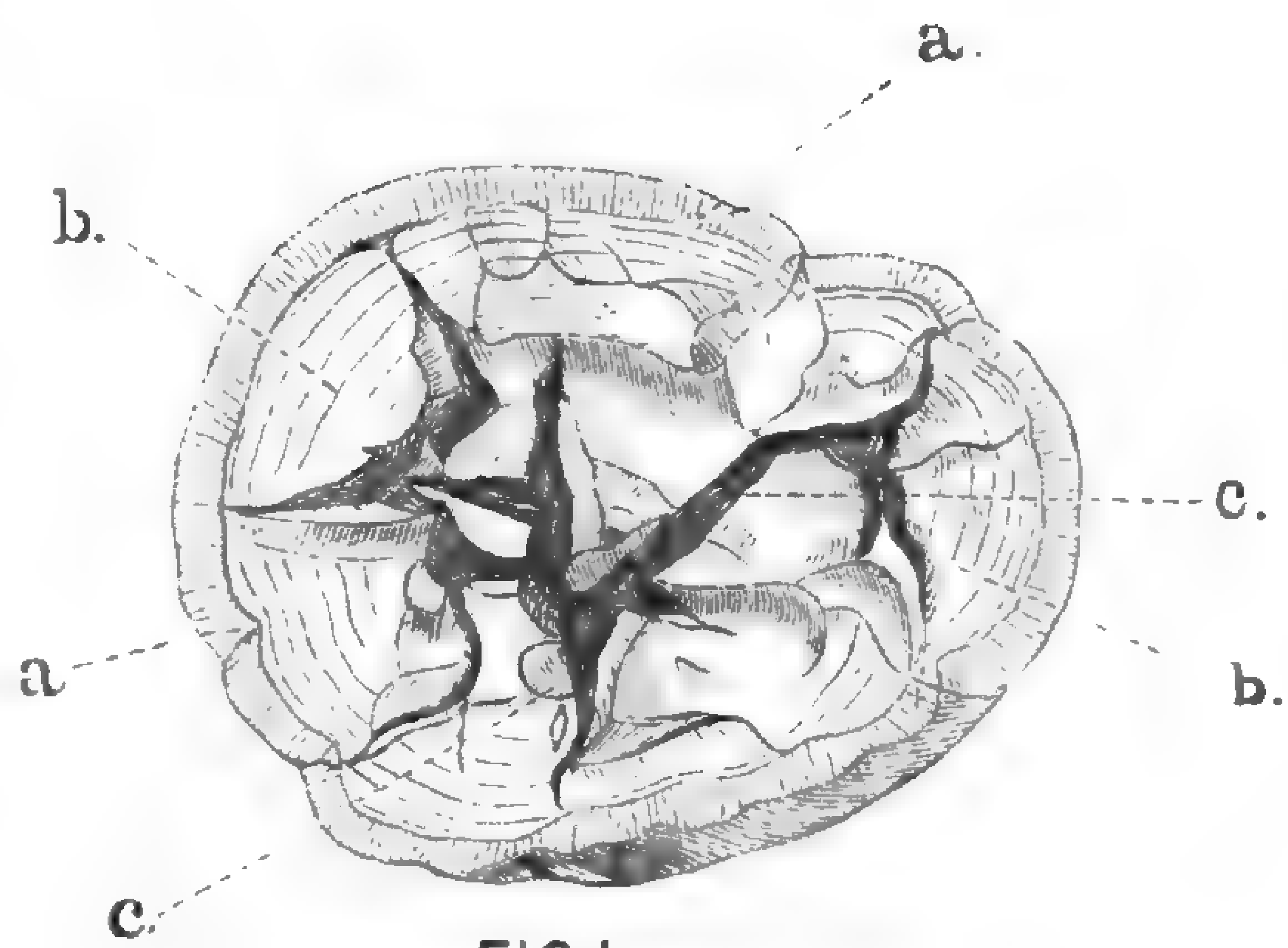

FIG. 1.

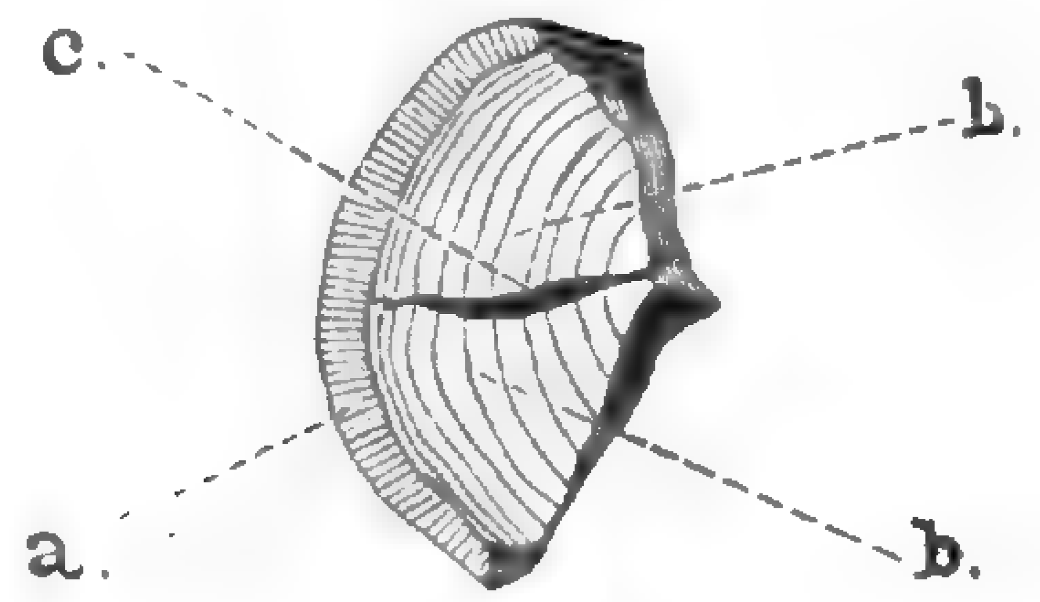

FIG. 2.

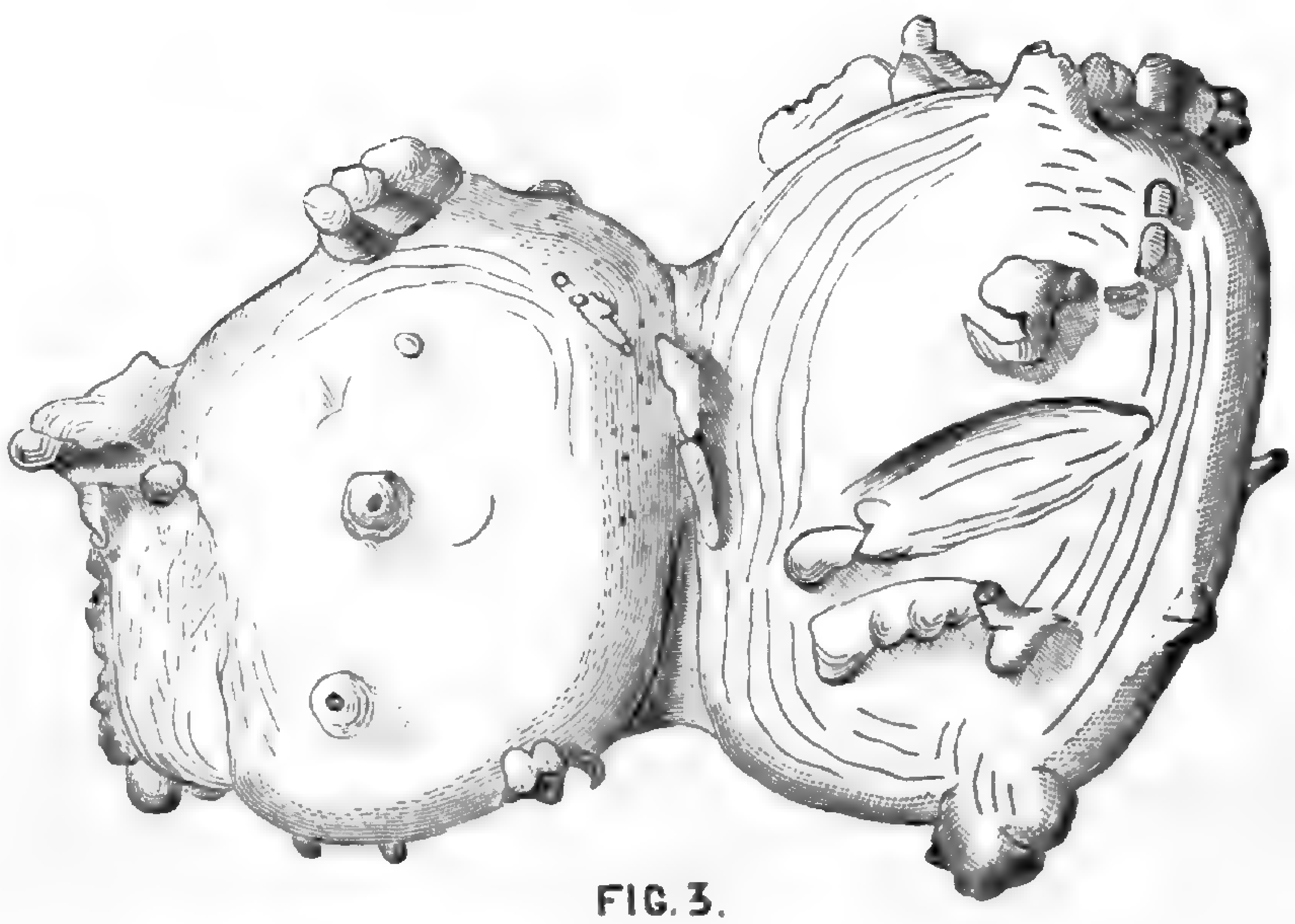

FIG. 3.

A F GRAY. DEL.

FIG. 4.

LOESS CONCRETIONS.

The composition of the concretions is essentially the same as that of the loess proper, though some of the elements do not appear therein. After treatment of 100 grains of the interior with strong muriatic acid, there remained, after thorough washing and drying, thirty-one grains of insoluble residue, or nearly one-third, which was plainly silica. Dr. Litton's analyses of concretions from the loess of Missouri, the only ones, I believe, on record in America, gave him :

Residue, insoluble in hydrochloric acid, principally silica	35.08
Alumina and peroxide of iron	5.29
Carbonate of lime	58.33
Carbonate of magnesia	0.77

The absence of a greater amount of carbonaceous material in the loess soil proper is matter of common remark. It may be accounted for, perhaps, by the fact that carbon in the soil tends generally to oxidize and disappear, save where there is an accumulation of water and a cool climate.[1] Its presence in the shape of "organic remains" seems to have been noticed, in chemical manipulations, only by Aughey and Emery, as noted in the table.

Method of Deposition.—The older geologists, without exception, seem to have agreed either upon the fluviatile or lacustrine origin of these famous deposits. Nor does this decision appear to have been questioned until the publication of Von Richthofen's *China*, in which that celebrated geologist elaborated his views, based upon extensive and painstaking study of the loess of that country. His views are radically distinct from those of his predecessors in the same field of investigation. They are based upon a study of the Chinese loess extending over a period of five or six years, while engaged in certain other investigations under the auspices of the Prussian Government. His observations were published at length in the work to which allusion has been made, in 1877, but not having access to the original containing them, I am obliged to formulate a *résumé* of his theory from reviews which have appeared in the several scientific journals. This is deemed necessary for the reason that though based upon the Chinese loess, Richthofen expressly states that in his judgment the theory of that deposit is applicable to the loess whereever on the globe it may be found.

[1] *Vide* Darwin's "Naturalist's Voyage around the World," ed. of 1876, pp. 286, 287. Contains some interesting facts relative to peat formation.

Richthofen holds[1] that the loess is a subaërial accumulation, due to the drifting action of the winds; to transportation by rivulets from the hills immediately adjacent to each loess basin; and to the mineral material left over the basin by the growing grasses and other plants. The material for wind transportation is gathered from the circumjacent or even from remote rocks which were decomposed or disintegrated by alternate changes in temperature or humidity. The plants that covered the great plains served to stop the wind-drifted particles, and thus kept the accumulation ever in progress. Observing certain local differences in the appearance of the deposits which he studied, he invented the distinctions of *land-loess* and *lake-loess.* The last named was designed to account for certain indications of stratification or lamellation not to be adequately explained by the wind theory.[2] The present system of drainage he accounts for much as do most other geologists, the main difference consisting in the assumption of great changes of climate causing heavy rains which led to floods. The usual indication of changes of level are also noticed by him, but they seem to have led to novel interpretation. Von Richthofen states that he found no evidence of a fresh-water *fauna* in the formations he studied, but land forms of molluscous and other animals abounded. In this he is directly opposed by the earlier and original observations of Pumpelly[3] who distinctly states that he found fresh-water

[1] This view was *first* advanced by him in 1870 in a memoir on the geology of the provinces of Honan and Shansi.

[2] *Vide* Am. Jour. of Sci. and Arts, Vol. XIV, p. 490, series third.

[3] *Vide* Smithsonian Contributions to Knowledge, No. 202, pp. 42–43. That this author at that writing was convinced of the fresh-water origin of the Chinese loess is attested by the following language. He says: "That this deposit was formed in fresh water, is shown by the presence of the shells found in the terrace of the Te Hai. The uniform character of the loam in the different basins, and in all parts of the same basin, its great extent, and the fineness of the material of which it consists, are conditions which prove that it is not of a local origin, or derived from the detritus of neighboring shores, but that it was brought into the lakes by one or more large rivers which must have drained an area of great extent. Now throughout the region in question, the only rivers are those of the Yang Ho and Sankang Ho basin, and independently of the fact that these streams drain a very small area, the valley systems of these were almost entirely occupied by the lakes." *Op. cit.*, p. 42.

On p. 43 he derives the following argument from physical geography: "Indeed, all the information we possess concerning this region, goes to show that it has been the basin of a great lake, which once extended from the northern bank of the Yellow river southward to the mountains crowned by the Great Wall." These words were penned eleven years before the work of Richthofen appeared.

forms in the loess regions on the borders of Mongolia. The points, however, which are mainly relied on by the Baron, appear to be (1) the presence of root-marks occurring throughout the formation; (2) absence of fresh-water or other aquatic life-forms; and (3) absence of stratification. Both the second and third of these propositions are met by the repeated statements of numerous careful observers, who have found aquatic and semi-aquatic forms in many localities. The presence of the semi-aquatic forms alone—such as *Succinea*—which are indicative of a moist station, effectually negatives the assumption of a "dry, elevated area swept by fierce winds." The first proposition has been met by the studies of Professor J. E. Todd,[1] who has shown that from the law which evidently obtains, that root-marks vary in frequency inversely as their distance below the present surface, "unusual care is necessary to interpret observations correctly." The conclusion reached by that observer is, that when correctly interpreted the distribution of root-marks opposes the sub-aërial hypothesis.

It will have been observed that the original statements and inferences of Pumpelly and those of Richthofen were distinct and opposed. The former recognized the agency of water alone as sufficient to explain the phenomena he studied, while the latter called to the aid of the winds a lake-basin, which in turn necessitated his artificial distinctions of lake-loess and land-loess. That such a distinction is wholly inapplicable to American deposits—unquestionably true loess—is patent, for the reasons that it presents a perfect homogeneity of structure, entire absence of any such modification as is seen in dunes—such as are true wind structures—and does present at several localities a faintly stratified appearance. Besides, the climatic conditions required by this theory of the Chinese loess, seem to have had no counterpart in climatic changes over the areas covered by our loess.

The argument for the lacustrine origin of the American deposits has been in part anticipated in the foregoing. But there should be added the facts that here the formation is confined to river

[1] Proc. A. A. A. S., 1878, Vol. XXVIII. "Richthofen's Theory of the Loess, in the light of the Deposits of the Missouri." Professor Todd here shows that the lower limit of root-marks—about forty-five feet—is approximately parallel with the present surface. A table accompanies giving the depth of penetration of roots in the loess. Those of the scouring rush (*Equisetum lævigatum* Braun) reached a point more than twenty-five feet beneath the surface.

valleys, and the high lands immediately adjacent; that of the fineness of its material, its composition, its rounded or triturated form, the fossils imbedded in it, and the unmistakable action of water in assorting; that of general continental depression synchronous with its formation; that of the vast quantity of the material and its deposition alike on hill and in valley. These severally and together are fatal to the hypothesis of Von Richthofen.[1] It is nevertheless beyond question that the loess, *after deposition*, has been somewhat modified by the action of strong winds, but the evidences of such action are purely local. The great dust-storms of Western Iowa, extending far beyond the central portions of the State, which occurred in the spring of 1880, will long be remembered in the annals of Iowa. For days the air was filled with fine dust, coming from the south-west, the locality of the greatest areas of loess and the prevailing quarter of the winds. That much of this fine material was carried miles further away I have no doubt. The main effect however, of such wind storms, would be the denudation of the windward, and the deeper covering of the leeward bases and sides of hills.

Fossils.—The mollusks of the loess belong, with perhaps a single exception, to genera which now flourish in regions adjacent to the formation. They are *Limnæa*, *Physa*, *Planorbis*, *Segmentina*, *Pomatiopsis*, *Valvata*, *Amnicola*, *Sphærium*, *Anodonta*, among fresh-water forms, and *Hyalina*, *Stenotrema*, *Helicodiscus*, *Conulus*, *Strobila*, *Helicina*, *Patula*, *Mesodon*, *Vallonia*, *Macrocyclis*, *Pupa*, *Succinea*, *Vertigo*, and *Cionella*, among the land forms. *Unio* is

[1]At the present day the Missouri flows past the western boundary of Iowa at an average rate of five miles per hour (Pacific R. R. Rept., Vol. I, p. 232). The fall per mile of this remarkable river, from the three forks of the Missouri to St. Joseph, varies from 31.59 to .88 feet, with an average for the whole distance of 1.55 + feet per mile. It annually discharges into the Mississippi about four trillions of cubic feet of water, and at the western boundary of Iowa it is not too great an estimate to assume an annual flow of two trillions of cubic feet of water, equaling one-tenth the whole discharge of the Mississippi. (See Humphrey's and Abbott's "Report on the Mississippi River," p. 49.) The amount of sediment *now* being contributed by the Missouri to the Gulf is remarkable. From specimens taken at Council Bluffs at both low and high water, Professor Emery determined the amount in one gallon of the former at fifty-two grains, and in an equal quantity of the latter at 404 grains. That, under the conditions prevailing at the time of the loess deposition, the amount of sediment was *very largely* in excess of these figures, is a fact beyond question, the material being, without doubt, furnished by the grinding of glaciers. These considerations should have their full weight in determining the dynamics of the loess of the Missouri region.

quoted by Drs. Hayden and Aughey from the loess of Nebraska. There are thus, of mollusks, eleven genera attributed to fresh-water, against thirteen genera to land forms. The single exception to varieties now living, as above noted, is *Helicina*, the species meant, *H. occulta* Say, being now extinct.[1] It may be properly considered the only species characteristic of the loess. From the loess of east Central Iowa, at Iowa City, the *chela* of a *Cambarus* is reported,[2] under circumstances which leave no doubt that it is from *true* loess.

Of higher animals there have been found, especially in the Southern States, remains of *Mastodon*, *Megatherium*, *Mylodon*, *Megalonyx*, *Castor*, and *Fiber*, among others. Their remains and the relation of the loess to the drift, which, when both are present, it always covers, places its epoch at the close of the glacial period.

(To be continued.)

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ICHTHYOLOGICAL PAPERS BY GEORGE POWERS DUNBAR, WITH A SKETCH OF HIS LIFE.

BY JACOB L. WORTMAN.

A STUDY of the fishes of the Southern States is one replete with many points of interest for the naturalist, and had it not been for a series of misfortunes, the credit for the earliest research into this field would probably be due to an American student now unknown. It is the object of the present article, to give some information relating to the life and labors of this meritorious naturalist, which are of especial interest, since he was one of the first native-born Americans who made an extended study of the ichthyology of this region. The absence during his time of any periodical devoted to the natural sciences in this country, contributed much to his disadvantage, and as a consequence the technical descriptions were withheld in anticipation of an opportunity to publish. This unfortunate circumstance is one of the causes of his obscurity, and is in part answerable for the loss of his many excellent observations in this branch.

George Powers Dunbar was born in Baltimore, February 11th, 1812. Nothing of unusual interest was noticeable in his early childhood, except an innate love for a study of natural history, on

[1] This statement now needs some modification. Since it was in type, a species of *Helicina* has been sent me in considerable abundance, taken in the vicinity of Iowa City. That they are *H. occulta* Say, is hardly to be doubted. The forms sent all approximate the variety described by Green as *Helicina rubella*.

[2] A. H. Pilsbury, *in litt.*

account of which his parents were doubtful of his future success in life. He entered St. Mary's College, Maryland, at an early age, and graduated from it with high honors in his eighteenth year. The unfavorable outlook that science then presented for a livelihood, induced him to look elsewhere for means of support. Civil engineering was the profession that he chose, and the one that he practiced until his death. Having completed his studies in this branch, he was engaged on a survey of the Baltimore and Ohio, and the Portsmouth and Roanoke railroads from 1829 to 1835, a station on the former line still bears his name. In the early part of 1835, he removed to New Orleans, where he was employed on the Nashville railroad under Major Ranney. He was appointed Engineer of Public Works of the State in 1837, which office he held until 1842, when he was elected surveyor of the second municipality. This last office he retained with the exception of a few months till the time of his death, which occurred on December 29, 1850, at the mouth of the Coatzacoalcos river, Mexico. Although in feeble health, Mr. Dunbar had accepted a position with a corps of engineers, to survey the route for the Tehauntepec railroad, where his health gave way entirely, and he died on shipboard while en route to his home in New Orleans.

At the early age of nine, he began collecting and arranging in systematic order entomological specimens. In the course of a few years his collections on this subject amounted to several thousand specimens, which he afterwards presented to Dr. Luzenburg, of New Orleans. The collection was afterward destroyed for want of proper care. He was likewise familiar with the Flora of the South, and contributed something on the "Flora of the Dismal Swamp." Shortly after leaving college, he began a careful study of the classification, structure and habits of the fishes of the Southern States, which he continued with great zeal up to the time of his death. All the time that could be spared from his professional duties was given to the pursuit of his favorite study, and he had prepared nearly all the plates and texts for an extensive volume which he was intending soon to publish. The volume was to contain descriptions of over one hundred fishes, and was to be profusely illustrated by drawings from life made by himself. His last observations on some of the fishes of the Mexican coast, made a short time previous to his decease, are still in existence and were probably the last that he intended to make before publishing his work. In connection with his sad and untimely death we are called upon to chronicle another most lamentable fact, the utter destruction of his manuscript by fire at Riesterstown, Maryland, a few years afterwards. His friends intended to publish his work, but deferred publication in the hope that his son would take up the subject and finish what his father had so nobly begun. The son, however, had no inclination for such study, and the publication was too long delayed. The notes above referred to, a small field book containing drawings and descriptions of twenty species of fishes, together with some popular descriptions that were published in various newspapers, are all that remain of his labors in this field. These are the property of his eldest daughter, wife of Dr. W. H. Corbusier, Asst. Surg. U. S. A. Although the subject has been carefully developed by subsequent students, yet our respectful esteem is due to the merits of this pioneer naturalist, whom misfortune has cast into the shadow of obscurity. It is unfortunate in the extreme that death should have cut short his career, and the result of his close and careful observations should have been swept away at a flash. That he possessed true merits is observable by a glance at his remaining notes, which likewise serve to indicate the excellence of his intended publication.

I give some extracts from his MSS. which will prove interesting and novel even to ichthyologists.

I. The Alligator Gar (Litholepis spatula Lac. *Jor.*)—But few of my readers except those who have resided in the South, have an idea of the alligator gar, and for their benefit I will describe this river robber. The body is cylindrical and elongated, and completely enveloped in a strong coat of mail, formed by strongly toothed quadrangular plates lapping over each other, and held by an exceedingly thick and tough skin. The head is elongated, with a flattened obtuse snout, something similar to that of a pike, and armed with several rows of strong pointed and trenchant teeth, the outer row being much larger than the inner ones. The bones of the head are naked, and form a series of stout plates. So hard is the armor with which this fish is enveloped, that no arm, however strong, can penetrate his back with an axe, and it is only by cutting him in his throat or by a blow on the back of the head that he can be killed. They grow to an immense size, being often seen in the waters of the Mississippi twelve or fourteen feet long, and sometimes reaching a weight of several hundred pounds. He is possessed of prodigious strength, and sets at defiance the efforts of the uninitiated angler, swallowing his hooks by the handful and parting his tackle as if it were pack thread.

This remarkable fish is familiar to almost every resident in the South, and yet but little is known generally of its habits and history. His terrific jaws, his flinty scales, and the extreme difficulty of hooking him, the ease with which he destroys the ordinary tackle used by the angler, added to his worthlessness for the table, render him an object of terror to the fisherman, which added to his fierce and repulsive appearance, is sure to obtain for him, should he by any means fall into his hands, such treatment as his namesake, the alligator, might expect from the huntsman whose dog had been devoured by the monster.

Possessed of an exceedingly ravenous appetite, he snaps at and devours every thing which comes in his reach, and yet there are times when the most dainty morsel will scarcely tempt him. Early in the morning the water is continually broken by him as he rises to seize the floating insects, or small fish swimming upon the surface; but, as the sun ascends, if on the feed, he takes to the deeper water, slowing moving along in search of his prey, and occasionally rising and rolling on the surface in sport. Tired of the chase, he may be seen basking his huge and motionless form in some sunny nook, the shoals of mullet frisking and frollicking around him unheeded. Rapid, current or pool, the clear running spring stream, the sluggish bayou, the pond, or the salt creek, all are familiar to him, but he particularly affects the deep still bayou, or the entrance of some sluggish stream into a bright, clear and dashing current. Stand on the little bar formed by the junction of the last mentioned, and you may see him pass and repass, plunging into the current after a small fish, diving under the rooty bank, and rolling in fun on the top of the dark bayou, and snapping his jaws together, as if the livelong day were only created for him to rollick in. The ringing steel launched from the sturdy arm of the fisherman glances harmlessly from his more than steel-clad body, the river robber rolls his huge form through the deep river, now rising like a porpoise, and now with noiseless movement of a cat swimming slowly to the shallows, stealing along through the bright green leaves of the beautiful nelumbium to surprise the sunny perch or sleeping pike, or suddenly attracted by a passing shoal of sardine or mullet, he dashes like light to their center, his capacious and horrid jaws wide open and his sinewy tail dealing death on every side. The wary bass retires to his shady nook, and the little patasa dive deeper into their rooty recesses at his approach, and woe betide the uulucky wight who trails his well filled string of bass at the stern of his pirogue; the river robber is sure to attempt a rescue, and well will it be for the angler, as seizure once made, if he have a single fish left, of his morning's sport.

During the months of December and January the fish seek the heads of the still and almost stagnant bayous or the deep caves of the sluggish rivers to deposit their spawn. The eggs are held suspended in a thick gelatinous transparent substance, forming long ropes several inches in diameter, which are hung on old snags, roots or branches of trees that have fallen into the water. The spawn has much the appearance of that of the frog, with the exception of the circular form it assumes, and the size of the eggs, which are about as large as No. 4 shot, and of a dark purple color. The young come forth during the spring, and tiny little rascals they are, but they grow with astonishing rapidity, and by the latter part of August are some fourteen inches in length and weigh several ounces; in one year they reach a weight of from nine to twelve pounds, and go on increasing to several hundreds. Large numbers of these fry are destroyed by other fish, and well that it is so, otherwise no fish could live in any of the rivers for them, the ovaries of a large fish containing several hundred thousand eggs.

Well skilled are ye, my piscatory brethren of the North, in the art of killing trout and salmon, rock and pickerel, and truly you have beautiful customers to deal with, but I would put you with your Conroy's and your plaited silk, at a sixty pound Poipon D'Armèe, and in an hour you would be hookless, lineless and rodless, and only have for satisfaction that you had seen the lazy hulk roll his huge form in sport over the surface. Few of you would come off victorious in your first day, but when you became acquainted with your customer, and learned the necessary rigging, then would the armed monster repent of his appetite for mullet or sardine.

Although I have taken many small gar, from twenty to thirty pounds, with a light fly rod and a single gut, yet I never fish for them with such tackle, for where you succeed in striking one in a tender place and beyond the reach of his tremendous jaws, you will break your gut a hundred times. No! I go upon the safe, the sure principle of saving my fish, and I use tackle accordingly. My ash and hickory (I cannot yet boast a Conroy, but I will soon) are laid aside, and a three-joint cane, with a stout tip substituted in their place; instead of rings my line passes through small beckets *on top of* the rod and over a roller at the tip. My line is generally manilla or sea grass of fine size. I prefer it as such a large quantity can be placed upon the reel. But the main point is the arrangement of the hooks, which is as follows: A brass or copper wire about four inches long with an eye at one end holds the bait hook. The line is made fast to a double wire passing through this eye and bent outwards, with two stout sharp hooks to each end with their points inwards, so that the fish when he takes the bait must have his throat directly above them. When the bait is taken, a strong strike is made and the consequence is that the gentleman has the hooks driven deep into either side of his throat.

The bait is overboard and every one waiting anxiously to see the "gar killer" strike his fish. The blue float slowly moves off and gradually sinks; he's there. Quietly the line is paid from the reel until he has gone some thirty feet. The hooks are driven home, the cane bends to the pressure but the line does not move. "You're fast to a log," cries one who never saw a gar. The line is slacked—another strike; another—he feels the steel and off he goes. Now for it! Full well does the gar killer know the exact pressure which his tackle will bear, and as well does he know that he can conquer only by making his prey fight and struggle for every inch of line. He whips him to his work, and now the robber has thrown off all his lethargy and tries every art, lays out all his strength to rid himself of the toils—beware his rush, for salmon or rock never came near it. Whiz goes the reel; twenty yards are gone, and you have him. Now comes the struggle and the angler is victorious, his head is turned, and rapidly comes the line to the reel. Half an hour is gone and yet his form has not been seen. Do you see the line slowly ascending? Watch him well, 'tis his last attempt—defeat him and he is safe. Slowly the white line leaves the water. Now faster the spray is thrown far and wide, and high in the air leaps the victim, hoping by his huge weight to break the tackle. Down goes the tip, the line is slack as he leaves the water, and his last attempt is abortive. Weaker and weaker are his struggles; he rolls and tumbles in the water as he is slowly drawn up; the gaff is in his gills; one haul, and he's beached.

II. The Grande Ecaillé (Megalops thrissoides Bl).—In shape the head of the grand ecaillé is similar to the shad, but his mouth is much larger in proportion to the size of the fish, and his body is covered with large splendid silver scales, fitting like plated armor; those of a fish five feet long being about two inches in diameter, and showing at each intersection about a quarter moon. His tail is large, broad and stout, and he sometimes grows to a length of eight and a-half or nine feet, but generally runs from three to seven. I record the killing a grand ecaillé with a rod and reel as the greatest piscatorial feat I ever performed, which is saying a good deal after successfully playing and killing two fish, each over twenty-five pounds, with two rods and reels at the same time. I could never have killed the grand ecaillé, however, with the tackle I used, had I not been in a pirogue with a sure and steady arm at the paddle, which gave me the advantage of running on him.

In point of beauty, activity and strength, the grand ecaillé is excelled by none of the finny tribe which have come under my observation. He belongs to the same family with the shad, herring, etc., and is the king of his tribe. He scorns the seine, and generally puts at defiance the efforts of the angler. Calmly he swims around the netted prison, seeking quietly to escape from the toils, but finds no outlet, with a quiet turn of the tail he goes slowly back to the center of the net—swiftly flies the foam from his vigorous tail; with one long sweeping, graceful bound, high above the floating corks he passes, and plunges with the grace and ease of an accomplished diver, head foremost into the green wave beyond; or if by chance he becomes entangled in the bag, he gathers his immense strength together, and like the tiger springing on his prey, he rushes at the end of the bag, the corks quiver for a second, and the next instant sees the silvery meteor passing like a ray of light through the atmosphere, he quivers his broad forked tail in triumph, and laughing at the weak net, goes on his way rejoicing. See him struck by the hand line of the sturdy coastman; every inch of line is given to him and the fisherman braces himself for the pull; well for him that his hands are hard; the moment he finds himself checked in his rush, he leaves the water and springs some ten feet into the air, shaking himself violently with the hope of casting off the hook, which he will do unless it is firmly fixed deep in his mouth, or tear off his jaw in the attempt. Another leap, another and another, with all the frenzy of the wild horse when he first feels the lasso, he springs through the air and dashes through the water; for a time there appears to be no diminution of his immense strength, but you may notice that after a while the long curve he at first described in the air becomes broken, shorter grow the graceful leaps, and finally change into a violent jerking summersault—then all is calm. The fisherman pulls on the line; one last glorious effort of those splendid powers is made—right in a line with and towards the fisherman; the grande ecaillé takes his last leap, and falls helpless into the sea. Now a child can take him without resistance—no struggling, a dead weight upon the line, he is hauled upon the beach. He flounces not, his fins are laid to his body, his gill covers do not move, he is dead! And not until death came upon him did the mighty and beautiful creature surrender himself to the superior robber.

I have often seen a school of red fish knocking the mullet into the air. I have seen troops of flying fish retreating from the lovely dolphin, I have heard for miles the roar of an immense company of mullet flying in short, regular leaps before a herd of porpoises, or a family of sharks, by whose giant forms I have seen the sea beaten into bubbles, as they lashed and struck among the frightened mullet, from my boyhood up. I have seen man prey upon his fellow-man, but never has it fallen to my lot to witness so magnificent a sight of the strong preying upon the weak as that presented by the grand ecailles. The yellow rays of the setting sun would glance upon the silver armor of a thousand forms leaping in every possible direction, crossing and recrossing, yet never striking, the air was filled with the small sardine thrown from their native element to be devoured as they touched the water, the green gulf was lashed into a sea of foam, and the bright rainbows were everywhere visible in the scene. We passed through them many times, hoping that one might leap into the boat, caught them by the tails as they swam slowly by, and cursed our lot that we had brought no harpoon. It was a brilliant sight—one which in all probability had not been seen on so grand a scale before, as they rarely run more than three or four together, and one which it may be my lot never to witness again.

PROBLEMS FOR ZOOLOGISTS.

BY J. S. KINGSLEY.

MR. S. H. Scudder in his address before the Entomological Section at the Boston meeting of the American Association for the Advancement of Science, presented some of the problems which the entomologist has yet to solve, and acting upon the hint which his article affords, I would here state some of the questions in other departments of zoölogy which are as yet unanswered. Throughout our land there are several hundred people who are greatly interested in zoölogy, but the greater portion of them through lack of guidance and through misdirected efforts, add nothing to the stock of scientific knowledge which the world possesses. On the shoulders of a few falls all of the original investigation done in America to-day. It is to that larger class who are willing to work, but who do not know how to work, or what to work upon, that this article is addressed. Some of the problems are simple, needing only a slight amount of experience, and a moderate amount of skill, while others require for their elucidation the trained investigator. To state all the problems requiring solution, would take more space than is contained in a volume of this magazine; a few only, therefore, are presented.

Hermann Fol has recently described the effects produced upon the eggs of star-fishes when two or more spermatozoa enter it at the same time. An abnormal segmentation ensues, proceeding from two or more centers, and resulting in a compound gastrula. This would suggest a possible explanation of the cause of double monsters, and assign an answer for a much vexed question in teratology. A single fact is but a slender foundation for generalizations of this character, and hence observations are needed to ascertain whether in other groups a multiple impregnation produces a compound gastrula, and if so, what the gastrula in turn produces.

The eggs of a few animals have been studied while becoming mature, and when the impregnation was taking place, and with wonderful results. Yet but a very few forms have thus been studied, and detailed accounts of the phenomena of the maturation and impregnation of eggs are needed in almost every group. The eggs of the larger proportion of the animal kingdom in becoming mature form what are known as polar globules. With the possible exception noted by Grobben, these polar globules have not been found in the eggs of insects and crustacea, but our information on this point is still of a negative character, and new and careful investigation may conclusively show that the Arthropoda in this respect do not form an exception to the rule that the extrusion of polar globules is one of the features of the maturation of the eggs of all animals.

Grobben when studying the development of a small fresh-water crustacean *(Moina)*, found that certain cells, which eventually formed the genital organs, were differentiated at nearly the same time as the epiblast and hypoblast. Metchnikow has also found in an insect that the reproductive organs were very early developed. When we consider that the chief end and purpose of every animal is the reproduction of its kind, this early appearance of the genital organs is what should be expected, but as yet, so far as I am aware, these two observations stand alone. Here is possibly a fruitful field for some ardent student.

In the waters of the whole eastern United States (with the exception of New England), and the Mississippi basin, are to be found representatives of a family of Mollusca peculiar to the American continent, the Strepomatidæ (Melanians). Of this family numerous genera and many hundred nominal species have been described, but as yet we know nothing of their embryology and but little of their anatomy. With the exception of a paper on the structure of two genera by the late Dr. Stimpson, a few short notes is the sum total of our knowledge of true "soft parts." We cordially commend the investigation of the "Melanians" to the naturalists of the Mississippi basin.

The fauna of the United States is exceedingly rich in Urodelous Batrachia, and a fine field is open for a *comparative* study of their visceral anatomy and their myology. Their osteology, however, has been pretty carefully studied, though the results are not yet published in full. European embryologists have confined their studies of the development of the Batrachia to the tailless forms, while Dr. Clark is the only American who has contributed anything of any extent to our knowledge of the life history of the salamander,[1] and his observations are principally on the external changes.

The calf fish *(Amia)* of the Western rivers is a representative of

[1] The observations of Scott and Osborn should not be overlooked, though published in England.

a group of fishes of whose development almost nothing is known, and a detailed account of its embryology would have an interest and importance only excelled among the vertebrates by that of *Ceratodus.* The gar pike's development has only been studied by Mr. Agassiz, and his observations are very incomplete, though very important. A study of the development of any of the *Amiuridæ* (cat fish and horned pouts) would be very interesting and instructive, and would amply repay the person who will undertake it, while the man who investigates the method of growth of *Myxine*, so common at Eastport, will have an entirely unexplored field to himself.

The problems which we have stated are almost entirely embryological, and it is in this line of development that the most important results are to be reached. A future article will present more of the anatomical side.

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RECENT LITERATURE.

The Zoological Record for 1880.[1]—This volume, the seventeenth of the series, has appeared with commendable promptness, and Mr. Rye, the editor, assures us that this rate of issue will henceforth be maintained. The recorders of the different departments are nearly the same as in the preceding volume.

It appears that the number of new genera and sub-genera contained in the present volume is 1008, as against 976 of Vol. xvi (which contained sixty new genera of *Arachnida*, properly belonging to Vol. xv, from which that group had been omitted). These are divided as follows: Mammalia, 34; Aves, 16; Reptilia, 216; Pisces, 31; Mollusca and Molluscoida, 79; Crustacea, 80; Arachnida, 78; Myriopoda, 2; Insecta, 438; Vermes, 28; Echinodermata, 24; Cœlenterata, 70; Spongida, 51; and Protozoa, 56.

The number of pages is about the same as in the preceding volume. On p. 3, Myriopoda, we notice an important error. Mr. Ryder's order *Symphyla* is spelled *Symphula*, the name not being repeated in the note under the heading thus misspelled.

This record is of the greatest service to the systematic zoölogist, and to none more than those who are unfortunate enough not to be within reach of large libraries. Hence the American zoölogist needs the "Record," if he has no other works.

The Fish Fauna of Borneo.[2]—In Vol. xvi of the Annals of the Genoa Museum of Natural History, D. Vinciguerra com-

[1] *The Record of Zoological Literature.* London. Van Voorst. 1881. 8vo.

[2] *Annali del Museo Civico di Storia Naturale di Genova.* Vol. xvi. D. Vinciguerra. Appunti ittiologici sulle collezioni de Museo Civico di Genova iv. Prima contribuzione alla Fauna Ittiologica di Borneo, pp. 161–182.

mences the publication of the results of the examination of a rich collection of fishes made by the Marquis Giacomo Doria and Dr. Odoardo Beccari during their residence at Sarawak.

Eighteen species of Siluroids, two of them new to science, and two others not before known to occur in Borneo are described; raising, with six species enumerated by E. Von Martens in the Zoölogy of the Prussian Expedition to Eastern Asia, the total number of known Bornean siluroids to fifty-eight.

The writer remarks that he finds many new species in this collection, and that this may be expected from the fact that, except Bleeker, few naturalists have collected the fishes of the island.

H. Schlegel, S. Müller, and J. Richardson had noted only ten Bornean species before the time of Bleeker, who, examining the collections made by Dutch government officials, raised the number to three hundred and forty, all of which were from few localities.

Since that date the only additions to our ichthyological knowledge of Borneo have been the description by Dr. A. Günther of two species of Gobiidæ, which formed part of the Doria collection, and the chapter by Martens on ninety-four species of fresh-water fishes from the rivers Kapuas and Sambas.

MARK'S MATURATION, FECUNDATION AND SEGMENTATION OF LIMAX.[1]—This work is very timely, and is valuable, both from the original facts it contains regarding the intricate subject of the preparation of the egg of the slug for fertilization, as well as the latter process, and the mode of segmentation, which is of great value from the detailed exposition for the English-reading student of a department of embryology which has been mapped out mainly by German embryologists.

The author first gives us his own original observations, illustrated by five excellent double plates, and then presents us with a lengthy discussion and review of all the papers and works which have been published on the earliest phases of embryonic development above enumerated.

In the third part, Dr. Mark presents theoretical considerations and general conclusions regarding the promorphology of the ovum, polar phenomena, asters, spiral asters, the nuclear spindle, origin of nuclei, the germinative vesicle and polar globules. The appearance of such a profound, critical summary of what is known on these points, should give a stimulus to those studies in this country. The treatment of the subject by the author is clear, candid, and the matter well digested and elaborated.

GENTRY'S NESTS AND EGGS.[2]—It is hard to say whether we look upon these beautiful colored lithographs, representing the nests

[1] *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, Vol. VI, No. 12. Maturation, Fecundation and Segmentation of *Limax campestris* Binney. By E. L. MARK, Cambridge, Oct., 1881. 8vo, pp. 173–625. 5 plates.

[2] *Illustrations of the Nests and Eggs of Birds of the United States.* J. A. Wagenseller, 23 N. Sixth street, Philadelphia.

and eggs of birds, or upon similar representations of the birds in other works of the kind, with the most pleasure. Illustrations of the nests and eggs, however, are more rare and proportionally more interesting.

We have now in the twenty-one parts already issued, representations of the nests and eggs of the cedar bird, the wood pewee, the cat bird, the orchard oriole, the kingbird, the red-wing blackbird, the humming-bird and towhee bunting, or chewink, also of the screech owl, the wild turkey, the tit, the auk, the killdeer plover, the chimney bird, the crow blackbird and many others. In the plate containing the humming-bird's nest and eggs, the male and female birds are also represented, forming a very beautiful picture. The nest is made "of vegetable wool from the poplar and oak, and is lined with a few small white feathers. Externally there is a dense covering of bluish crustaceous lichens and brownish oak tassels, which are held in position by saliva and strands of spider's silk. It was placed upon a branch of the beech tree, at an elevation of twenty feet from the ground. In height it measures one and three-fourth inches, in external diameter one and a half. The width of the cavity is three-fourths of an inch, and the depth about one-half."

The nest of the towhee bunting, or chewink, is described by Mr. Gentry as always placed upon the ground, usually half covered and concealed by long grasses that surround it. The author says, "When placed within a thicket, or on the borders of it, the nest is either built in a depression of the ground, usually beneath a bunch of grass, in a pile of old brush or faggots, or on a slight prominence surrounded by tall, graceful ferns."

The figures of the crow blackbird, Maryland yellow-throat, the killdeer and the red-throated loon, are especially good. This excellence is partly due to the skill of the able zoölogical artist Edwin Sheppard.

We take this opportunity to recommend this elegant work for every library.

Recent Books and Pamphlets.—Statistics of the Iron and Steel production of the United States. Compiled by James M. Swank. 4to, pp. 180, maps, cuts, Department of the Interior. Tenth Census of the United States. Government Printing Office, Washington, 1881. From the department.

Palæontological Bulletin, No. 34. Contributions to the history of the Vertebrata of the Lower Eocene of Wyoming and New Mexico, made during 1881. By E. D. Cope. 8vo, pp. 60, map. (Ext. Am. Phil. Soc.) Philadelphia, 1882. From the author.

The Distribution of Plant Life, and the agencies contributing to it. An address delivered before the Maryland Horticultural Society at its April meeting, 1881. By Dr. Bolling W. Barton. Roy. 8vo, pp. 8. Baltimore, 1881. From the author.

Eels (Anguilla acutirostis). By William Hosea Ballou. 4to, pp. 2, cuts. Jan. Am. Field. Chicago, 1882. From the author.

On the variability of the Acorns of Quercus macrocarpa Michx. By Joseph F. James. 8vo, pp. 4, 1 plate. Ext. from the Journal of the Cincinnati Society of Natural History. Cincinnati, 1882. From the author.

The Domain of Physiology, or Nature in thought and language. By T. Sterry Hunt, LL.D. 8vo, pp. 27. Boston, 1882. From the author.

A Revision of the Cis-Mississippi Tertiary Pectens of the United States, pp. 16. Remarks on the Molluscan genera Hippagus, Verticordia and Pecchiolia, pp. 12. Note on the approximate position of the Eocene deposits of Maryland. By Angelo Heilprin. pp. 6. Proceedings of the Academy of Natural Sciences of Philadelphia. Philadelphia, 1882. From the author.

Proceedings of the United States National Museum. Washington, 1882.

The tailed Amphibians, including the Cæcilians. A thesis, presented to the Faculty of the Michigan University. By W. H. Smith. 12mo, pp. 158, bound. Detroit, 1877.

A case of Polymely in Batrachia. By J. S. Kingsley. 8vo, pp. 8, plate. Ext. from the Proceeding of the Boston Society of Natural History. Boston, 1881. From the author.

The Winter Birds of Minnesota. By T. S. Roberts. 8vo, pp. 10. Extract from the Ninth Report of the Geological and Natural History Survey of Minnesota, for the year 1880. Minneapolis, 1880. From the author.

Transactions of the American Institute of Mining Engineers.

Geological Relations of the Limestone belt of Westchester county, New York. By James D. Dana. 8vo, pp. 80, plate, maps, cuts. Extract from the American Journal of Science. New Haven, 1881. From the author.

Beiträge zur Paläontologie Oesterreich-ungarns und des Orients. Herausgegeben von E. v. Mojsisovics und M. Neumayr. Vol. I, Part I and II, 4to, pp. 70, 13 plates. Wien, Jan., 1882. From the publishers.

Die Stegocephalen aus den Rothliegenden des Plauerschen Grundes bei Dresden. Von Hermann Credner in Leipzig. Vol. II, 8vo, pp. 32, 2 plates. Berlin, 1881. From the author.

Die fossilen Saurier in dem Kalke dés Rothliegenden von Niederhässlich im Plauerschen Grunde bei Dresden. Dr. H. B. Geinitz und Dr. J. Deichüller. 8vo, pp. 2. (Extract from) Mineralogisch-geologisches und prähistorisches Museum in Dresden, 1882. Dresden, 1882. From the authors.

Anatomische Notizen uber Heloderma horridum Wiegm. Von Dr. J. G. Fischer in Hamburg. 8vo, pp, 16, plate. Hamburg, 1882. From the author.

Une Page de L'Historie D'une Beleie ou La Catologie il y Cinquante ans. Discours prononcé a la Seance publique de la Classe des Sciences. Par M.P.-J. Van-Beneden. 8vo, pp. 34, plate. Brussels, 1882. From the author.

Liste des Membres de la Société Géologique de France, au 1re Fevrier, 1882. 8vo, pp. 32. Paris, 1882. From the society.

Ottawa Field-Naturalists' Club, 1879–80. Transactions No. 1, 8vo, pp. 64. plate, 1880–81. Transactions No. 2. 8vo, pp. 44, plate, with the address of President Fletcher. Ottowa, Canada. From the president.

The Scientific Roll and Magazine of Systematized Notes, conducted by Alexander Ramsey, F.S.S. Climate, Vol. I, 8vo, pp. 40. London, Feb., 1882. From the conductor.

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GENERAL NOTES.

BOTANY.[1]

The Study of Lichens in North America.—The interesting plants which botanists term lichens, but which the non-botanical are wont to call "mosses" or "tree mosses," those greenish-gray or grayish-green, sometimes blackish or brownish, growths on bark, boards, rails and rocks are likely to acquire a new interest, and to be much more studied than they have been heretofore.

[1]Edited by Prof. C. E. Bessey, Ames, Iowa.

As microscopes become cheaper and less cumbersome, and as information as to the general structure of lichens becomes more available, many students will turn their attention to these curious products of the vegetable kingdom. Indeed, few of the thallophytes recommend themselves in as many ways to the laboratory worker as do the lichens. Their curious dual structure, their colorless filaments (hyphæ), contrasting strongly with the roundish green cells (gonidia), will alone furnish material for much close observation, and if the student permits himself to inquire as to the theories of Schwendener, and Minks, he need have no fears of speedily exhausting the study. Then, too, the various forms of fruiting, the differences in the spores and spore-sacs (asci) with the development of the latter may well claim the prolonged attention of the student.

As a most important aid to the study of the lichens we have now the first part of the long promised "Synopsis of the North American Lichens,"[1] from the hand of Professor Edward Tuckerman, than whom no one is better able to write upon this subject. Long ago (in 1848), Professor Tuckerman gave us a little book, now rare, "A Synopsis of the Lichenes of New England, the other Northern States, and British America," and in 1872 his "Genera Lichenum; an Arrangement of the North American Lichens." We now have Part I of what will doubtless be for many years the standard manual of our lichens. The work being the result of the author's life-long studies, we may reasonably look for much of stability in the arrangement, and in the limits he has assigned to species, genera, and other groupings. Indeed, we notice but few changes in comparing this work with "Genera Lichenum," and these are all of minor importance.

The method of the book leaves nothing to be desired, the specific descriptions being full, and very carefully written. The separation of the species into tribes or sub-genera is equally well done, and the student must be dull indeed who cannot readily follow the author. The key to the arrangement, which precedes the descriptive portion, includes all the genera of North American lichens, seventy-two in number, while this part of the work treats of but forty-three of these.

It may be interesting to note what the author has to say upon several questions which have been under discussion in botany. As to their relationship we find (p. v), "The lowest divisions of vegetable life may still be recognized as Algæ, Lichenes, and Fungi; and conveniently associated together under the designation of Thallophytes; * * * * and there is no doubt, notwithstanding the numerous and now startling discrepancies of these vast groups, that they stand in close natural relations to

[1]A Synopsis of the North American Lichens. Part I, comprising the Parmeliacei, Cladoniei, and Cœnogoniei; by Edward Tuckerman, M. A., author of Genera Lichenum. Boston: S. E. Cassino, Publisher. 1882.

each other. Lichenes are reckoned as intermediate between the other two classes of Thallophytes; but all the limits are uncertain." As to the now famous question regarding the autonomy of lichens, after describing hyphæ and gonidia, we find (p. vi.) "But we are not quite at liberty to stop here. The marked contrast of hypha and gonidium was open to a hypothetical explanation, based on the apparent relations of these organs to what seemed the same in other classes of Thallophytes, which suggested and had its exemplification in the memorable labor of Schwendener. This was met, however, by lichenologists in a manner and tone often ill enough corresponding with the simply objective position of the other side; and there was room for further investigation. Ideally, from the point of view of those who look at lichens as autonomous, the primordial cell should be referable either to hypha or gonidium; but, in fact, as well emphasized by Minks, it is its dualism which, from the beginning of our knowledge, and through all its extent, characterizes the lichen structure, and determines its history. Yet this is not all. The penetrating glance of the cited vegetable anatomist has demonstrated the existence of a third element. Behind and before the manifestation of the hyphæ, which are to play so great a part in the lichen world, is a dimly seen, primordial tissue, a web or net-work of exceedingly delicate filaments (*Hyphema* Minks), which gradually pass into the hyphæ proper, as these accomplish their highest result in generating the gonimous cells."

On the terms Annual and Biennial.—There is certainly much ambiguity in the terms annual and biennial. Those plants which germinate in the spring and die in the autumn are not very different from those which vegetate in the summer or autumn, and flower and die in the succeeding spring or summer; nor indeed can I see much between them and plants like Agave, which live in a barren state for many years, and then flower once and die. It seems to be only a question of the time required to concentrate the requisite energy to produce flowers and fruit. True annual plants may be divided into winter annuals and summer annuals. The former usually store up nutritive matter in the autumn to supply the flowering state in the spring; differing in this from summer annuals. But this is not constantly the case. The Agave is many years doing this. Although this plant flowers only once, we of course ought to have a term to distinguish it from the annuals. There are also the plants which produce stoles rooting at the end, such as the sympodes of Fragaria; in that case the plants are truly perennial. But see such plants as Epilobium, where the buds at the end of stoles alone remain alive during the winter, and produce the plants of the succeeding year: what are we to call these? We usually denominate them perennial. Then how separate them from those which are not aërial, but go through the same course? Then come such plants as Orchis, where a new tuber is formed by the side of the old one each year, usually at a very short distance from it, but sometimes at some considerable distance, as in Herminium; and the tuber which has flowered dies. The tuber is therefore a winter annual. Of course all these ought not to be confounded with the true perennials, where the same root lives and flowers at least several years in succession. DeCandolle's terms *mono-* and *poly-carpic* will not do, for they convey another idea. *Mono-* and *poly-tocous*, as suggested by A. Gray, are better, but here we do not distinguish between Agave and Brassica. And he has not attempted to distinguish these from Orchis (except by calling the latter perennial, as we all do), or Orchis from Fragaria.—*C. C. Babbington in Jour. of Botany.*

A Botanist's Trip to "The Aroostook." No. 2.—On June 6th, '81, my Western friend and I left Orono (Penobscot county) for Northern Maine, by way of the railroad as far as Mattawamkeag, where we passed a day pleasantly in following the banks of the river for flowers. On the stream of the same name I saw for the first time *Alnus viridis*, which afterwards became a daily occurrence; also *Cratægus coccinea*, with three of its forms; *pyrifolia* and *mollis* being quite abundant, as I found in September, when the fruit had matured. We traveled by stage to Patten (still Penobscot county), a distance of 38 miles through a most delightful country, but saw no new weeds by the roadside. At this place I procured seven of the plants, which were gathered on the Aroostook river the previous year in fruit. Perhaps this locality may be called the boundary line of some of these plants, as they do not grow either at Orono or Mattawamkeag (in writing this article I shall only speak of what I saw), but at Patten they were abundant. One morning we came across a large number of Cypripediums, among which was a purple *acaule* with two perfect flowers growing back to back. The greater part of them were pure white with yellow-green sepals and petals. After a week spent there, taking with us 16 new sketches and a large package of pressed plants, we staged it to Ashland, a ride of 48 miles. The beauty of the country beggars description. For a distance of 12 miles we were in full view of Mounts Ktaadn, Double and Round Top. A good-natured driver told us the names of all the hills, streams and ponds. It may seem strange to the reader that we discovered no new plants in this long ride, but the only novelty spied was a rose-pink *Viburnum lantanoides*. *Amelanchier Canadensis* vars. *rotundifolia* and *oligocarpa* were abundant but not new, neither were any of the shrubs. *Taxus baccata* var. *Canadensis* is quite common, but straggling and partially dead. *Acer Pennsylvanicum* and *spicatum* is the prevailing underbrush in many of the forests. But for our own voices the stillness would have been oppressive; for a distance of many miles that day we did not find an opening. The mail agent said that between us and Canada on one side there was probably no house to be found. In one plantation through which we passed there were but two families living. There were but few houses along the road, yet one might almost believe that a village would spring up some time in this untrodden wilderness, whose tangled undergrowth makes it almost impenetrable. The forests often look black with the *Abies nigra* (" Black growth ") and the dead trees are oftentimes covered with long green moss. We passed several cabins which are occupied by the lumbermen during the winter months. Ashland is a small, " finished " village, situated on the Aroostook river. The people whom we met there are hospitable and refined. I added *Arabis perfoliata, Rosa nitida,* and *Prunus pumila* to my list; also learned through Mrs. G. D. that *Trillium album* grows on their farm, but I was too late to procure it. This immediate region is said to be rich in minerals. After another week profitably spent, we took passage for Fort Kent, 48 miles due north, by a corduroy road. The first day we passed at Portage Lake, a famous resort of fishermen. We gathered some Potamogetons of great size, but they were not in flower, and the day was productive of pleasure alone. For miles the forests were burned and still smouldering, the work of careless gunners, it is supposed. A dismal swamp, indeed! The two fire-weeds, *Erechthites hieracifolia* and *Epilobium angustifolium*, are found here as elsewhere on burnt ground, although I have been told that the first named had never been found in the county; but it is quite abundant on the line of the railroad. The country is decidedly mountainous; the one, two and three mile hills would have been decidedly monotonous but for the lovely foliage and the frolicking brooks. In many places the road was " repaired," and the ditches at the sides were frightful for hypersensitive nerves to contemplate. Eagle lake was the great feature of the ride, it lays along the route for a distance of 5½ miles. No part of the journey furnished excitement until the driver took his pistol out to load it, saying that he should have done so before starting; that he had been fired upon twice in two years, and might need to use it before reaching Fort Kent. He also stated that a peddler who had left this place by that road was never heard from and that his bones were probably bleaching in the woods somewhere. Although we were on the *qui vive* all the afternoon, we only saw the enemy, for whom he had prepared, quietly standing in their doorways looking as demure as possible. At 9.30 Saturday night we found ourselves in Major D.'s hospitable home, 200 miles due north of Bangor. Fort Kent may be called properly a French town. It is situated on the Fish river (its original name), which empties into the St. John river at this place. Nature has done much for this section of the State. The scenery is fine, the air is cool, and the people seem as happy twenty-two miles removed from a railroad (Edmundston, on the Canada side, being the nearest point), telegraph, doctor or drug store as those do who have all the advantages of hourly intercourse with the world. It is a healthy place also, and the people welcome strangers to their midst with the characteristic hospitality of the county. Space will not admit of the list of plants made here, but the more rare ones were *Pyrola rotundifolia* and *secunda*, with their lovely varieties; also *P. minor*, *Vaccinium cæspitosum*, *V. uliginosum*, *Clematis verticillaris* (Mr. Niles), and *Pyrus sambucifolia*. The swamps at this place afford several orchids; these dark, damp places are favorable to this family of plants. *Habenaria orbiculata* often grows two feet high, with leaves seven by nine inches; *H. viridis* also very large. *H. obtusata* and *Listera convallarioides* abound here. It is hard work to procure them, requiring many a tumble and scratch, and the thought must often come to the mind of the most practical, Does it pay? Why all this toil for "weeds" which have little beauty save to the eye of the botanist? Yes, it does pay; our natures evermore grow young among the primitive pines. The scenery is wild and the silence oppressive. Some of the swamps seem like ponds filled with trees; the fallen ones often form pens, and how to get along, though armed to the teeth with waterproof and rubber boots, one does not know always. Suffice it to say that people who care to visit such places find their way out of them feeling well paid for the trouble. It is interesting to trace the outlines of large trees in the primitive woods. Some have a little bark left, while in other cases there is merely an outline of green or brownish dust. "How old are you?" I asked, half frightened at the sound of my own voice. I did not see a snake either year, and the squirrels and birds did not seem startled, as they do elsewhere. There are but few flowers in the pathless woods; many a hard day's work was lost in search of plants in the primitive forests, but in the "clearings" they are more abundant. The banks of the rivers and ponds furnish more still. St. Francis, 18 miles further up the St. John river, afforded me a white form of *Prunus Pennsylvanica*, *Rhinanthus Crista-galli*, *Euphorbia helioscopia*, *Potentilla frigida*, *Gentiana Andrewsii*, *Juncus Vaseyi*, *Graphephorum melicoidis*, and *Triticum repens*. The small islands in this neighborhood are rich in interesting work. On the way "out" in September I gathered *Goodyera Menziesii* and *Botrychium lanceolatum*; at another place *B. simplex* was abundant, and at Houlton *Lappa officinalis* vars. *major* and *tomentosa*. The former grows five feet high and the lowest leaves often measure more than 18 inches across. These are but few of the many interesting plants which grow in this fascinating county. Go and see.—*Kate Furbish.*

Botanical Notes.—J. C. Arthur in Vol. III of the Proceedings of the Davenport Academy of Sciences, publishes "Contributions to the Flora of Iowa, No. IV," in which he adds forty-three native and six introduced species to his previous lists. Descriptions are given of such as are not found in Gray's

Manual, viz: *Artemisia serrata* Nutt., *Senecio lugens*, Rich., var. *Hookeri* Eaton, *Plantago Rugelii* Decaisne, *Gerardia tenuifolia* Vahl., var. *macrophylla* Benth., *Cuscuta Gronovii* Wild., var. *latifolia* Engelm., *Polygonum Muhlenbergii* Watson, *Aristida purpurea* Nutt.——F. A. Mansfield has compiled a list of plants (137 species and varieties) "discovered in Maine, chiefly since the publication in 1868 of the 'Portland Catalogue of Maine Plants.'"——N. L. Britton has issued a circular of "Notes" for the guidance of those who have the "Preliminary Catalogue of the Flora of New Jersey." Attention is directed to many doubtful natives, and difficult species, and also to the common names of plants.——"The Index to the genus Carex of Gray's Manual," by Jos. F. James, issued as an extra in the *Botanical Gazette*, will prove very useful to all students of that large genus.——The list of New Mexico and Arizona plants collected by H. H. Rusby, contains many interesting species. Sets of these are offered for sale by the collector at Franklin, N. J. ——The February numbers of our botanical journals are full of interest. N. L. Britton in the *Torrey Bulletin* describes and figures (three fine colored plates) a new hybrid oak, between *Quercus Phellos* and *Q. nigra*, and which he names *Q. Rudkini*. E. L. Greene describes six new Compositæ, mostly Californian; J. B. Ellis describes sixteen new species of fungi mostly from New Jersey; and G. E. Davenport contributes interesting "Fern Notes," in which he gives reasons for suspecting *Asplenium ebenoides* to be a hybrid between *Camptosorus rhizophyllus* and *Asplenium ebeneum*.——Dr. Engleman's "Notes on Yucca," in the *Botanical Gazette* include the description of a new species, *Y. elata*, from the deserts of Arizona. L. M. Underwood brings together in an alphabetically arranged catalogue the genera and species of North American Hepaticæ. It includes forty-nine genera, 219 species and seventeen varieties.——In Jos. F. James's paper on "The Variability of the Acorns of *Quercus macrocarpa*, in the Jour. Cinn. Soc. Nat. Hist., the author brings out to a remarkable degree the variable character of the acorn of our common bur-oak. "There are all gradations from no fringe at all on the cup, to one which has a fringe half an inch long. The cups are shallow to deep, thick to thin, extending half way up the acorn, reaching to its apex, or almost entirely concealing it." Eight figures accompany the paper.

ZOÖLOGY.

Note on the Geographical Distribution of certain Mollusks.—The occasion for this note arises from a brief review of Professor A. G. Wetherby's paper "On the Geographical Distribution of certain Fresh-water Mollusks of North America, and the probable causes of their variation," in this journal, March, 1882, page 231. The entire paragraph reads, "The Strepomatidæ first appear in New York, and are almost confined to the district occupied by the Unionidæ just mentioned. They do not cross the Mississippi, and are chiefly found in mountain streams." Now, this last statement, "they do not cross the Mississippi," does injustice to what Professor Wetherby really states in the paper reviewed, and does violence to the facts in the case. The statement made by the author reviewed is "This fauna [Fauna C] has a very limited distribution of genera and species west of the Mississippi * * ." (See Am. Jour. of Sciences, March, 1882, page 207.) Mr. Tryon, in his generally excellent monograph of the Strepomatidæ published as No. 253 of the Smithsonian Miscellaneous Collections (1873), made the same statement the writer in the NATURALIST made, but with reference solely to the Trypanostomoid division of that family; he recognizes the occurrence of *Goniobasis* in various streams west of the Mississippi and tributary to it, and also the few forms of doubtful generic relationship from California and Oregon (*Op. Cit.*, pp. xxxviii, xl, xli, xlvii, and xlviii). Of the genus *Goniobasis* there are seven forms from west of the Mississippi exclusive of those found on the Pacific slope. They are *Gon. cubicoides Gon. potosiensis, Gon. sordida, Gon. lirescens, Gon. ovoidea, Gon. haleiana*, and *Gon. alexandrensis*. I am not aware that *Gon. cubicoides* Anth. has been hitherto reported from any other habitat than Indiana; but the specimens to which reference is here made can be referred only to that species, with any degree of certainty. I obtained them from the Middle Raccoon river, Dallas county, Iowa, and have distributed them among some of my correspondents with labels as above. Of *Trypanostoma*, one species at least occurs west of the Mississippi—the *Try. subulara* Lea—which I desire to place on record here. Several hundred specimens were taken from the Des Moines river, at Fort Dodge, Webster county, Iowa, by the writer, many of which have likewise been distributed. They occur further to the westward, since five species of this family are accredited to Nebraska by Professor Aughey (Sketches of the Physical Geography and Geology of Nebraska, page 144), but specific names are not given; these latter, however, may be found in Bulletin U. S. Geological Survey, Vol. III, No. 3, to which I have not access at this writing. The streams of the western slope of the great basin of the Mississippi have not yet been examined with sufficient care to justify any statement as to their wealth in *Strepomatidæ*, but such evidence as is now accessible points to the conclusions reached by Professor Wetherby.

In the paper by Professor Wetherby (Am. Jour of Science, March, 1882, p. 208), occurs a most singular error in a matter of fact, which would seem to have an important bearing on the particular theme in connection with which the statement is made. Referring to the somewhat anomalous distribution of *Margaritana margaritifera* Linnè, he states that the species is found "in Maine and Oregon, but not between these stations so far as now known." This statement gives that remarkable species too narrow a limit *by many thousands of square miles.* In 1843 appeared Vol. V of Part I (Zoölogy of New York), by James E. DeKay, in which, p. 197 (Plate XIV, Fig. 214), is given a description of this shell with the name *Alasmodon arcuata ;* De Kay quotes it as "one of the largest and most commonest of our Unios," and states his specimens were from Rockland county, Champlain, Oneida and many other localities. Dr. Lewis (Bull. Buf. Soc. Nat. Sci., August, 1874, page 141) lists it among the shells of New York, as "reported orally, localities not known." I have five examples from a brook at Haydensville, Mass., and over 100 from a branch of the Connecticut river, near Hartland, Vermont, where it abounds. Beyond Maine the species is reported from various points in New Brunswick, and even from Newfoundland. Of its distribution in the western portions of America the following facts are known: "It is the most abundant of the fresh-water bivalves, and the only one I have been able to find in the Chehalis, the streams emptying into Puget sound, and most branches of the Columbia" (Cooper, Pacific R. R. Reports, Vol. XII, Pt. II, page 311). It is also quoted from the Shasta river, Oregon, having been collected in that stream by Dr. Trask, and from the Klamath and Yuba. It is known to the eastward among the Rocky mountains, specimens having been taken from the Missouri river above the Falls; also from the Spokan river, below Lake Cœur d'Alene (Carpenter, Mollusks of west coast of North America, page 116). Concerning the conclusions drawn from this species, I am not prepared at this time to say anything. But to fix as a fact the important deduction that this form and the others mentioned in connection therewith are "remnants" of another fauna which has suffered such remarkable changes as incidental to glaciation is a matter which will yet require a vast amount of labor and research. The exact distribution of this species, since so much is made to depend on it, should be determined. It is believed that in this note all the known points of its occurrence in America have been, for the first time, brought together.—*R. Ellsworth Call.*

THE EUROPEAN HOUSE SPARROW.—*Passer domesticus* has its place in nature, possibly monarchical Europe, and monarchical individuals in other places can overestimate their worth, but in America they are out of place, and their introduction was a grievous mistake. Its disposition is very far from being republican, and its treatment of some of our native birds, which are of much more value than themselves, is tyrannical and despotic. Quarrelsome with and pugnacious towards the swallows, martins, wrens and bluebirds they take by force the houses put up especially for their use. Thanks for the love of liberty, right and justice, the swallow, martin, wren or bluebird having possession of the house can, and usually does succeed in keeping it against the attack of a single pair of sparrows, but often, this pair, unsuccessful in their house-breaking attempt, go off and solicit the aid of their fellows, and return with a dozen or twenty of their kind, lay siege to the place, and by united effort *take it*, after the rightful occupants have made a desperate defence against enormous odds.

It may be only a coincidence—it is a fact, however, that as the sparrows have increased in numbers, the purple martins, *Progne purpurea*, have decreased in this locality.

The sparrows are essentially gramnivorous and frugivorous, and are not insectivorous in the legitimate use of the term. They are very destructive to garden and flower seeds, the small grains, and no species of fruit is free from their depredations. They are more dirty around the house than any of our native, social birds, dropping *en masse* their excrements about the door. I presume they have their good qualities. I cannot agree with Mr. Minot when he says of the purple grackles that he "would not hesitate to sign the death warrant of the whole race," but I would not hesitate to sign a warrant to banish the house sparrow from the United States to the place from which they came, and furnish a liberal supply of good food and clean water for the voyage.—*Elisha Slade, Somerset, Mass.*

The Opossum at Elmira, N. Y.—Some five years since Mr. H. C. Hill, of Norristown, Pa., where opossums are plenty, sent a female with eleven young, to Dr. Wilder at Ithaca.

Not altogether liking the Doctor's methods, and perhaps having doubts as to his intentions, they all made their escape and disappeared.

This may perhaps account for the one captured near Elmira, mentioned in the Naturalist.—*Franklin C. Hill.*

A Large Octopus on the Florida Coast.—I have in my possession an Octopus, caught in the Halifax river one mile inland from the sea, which weighed when caught two and a half pounds, measured from tip to tip of extended arms diagonally across the head twenty eight inches, longest arm sixteen inches with one hundred and ninety-eight suckers, shortest arm eight inches with eighty-seven suckers, other arms ten, thirteen, thirteen and a half and fifteen inches in length; one arm was broken in its capture. —*Mrs. N. Hasty, New Smyrna, Florida.*

Japanese Aquatic Animals Living on Land.—Among the conditions favorable to the transition from aquatic to terrestrial life, says Professor C. O. Whitman in his "Zoölogy in the University of Tokio," is a saturated atmosphere. This condition is found in Japan, and it is here that we find some very interesting cases of true aquatic animals living on land. Every one knows that the medicinal leech is a fresh-water animal. This leech has the habit of crawling partly or wholly out of water, when the air is so saturated with moisture that it can do so without exposing its skin to dessication. The question naturally arises, could such a creature ever become habituated to living on land? When we remember that the skin of the leech performs the function of lungs, and that, provided it is kept wet, it is capable of drawing its supply of oxygen from moist air, there is no difficulty in understanding how such a change might be induced. Experiment has already shown that some water-breathing animals can without difficulty become air-breathers. The Mexican axolotl is a well known instance, and the Lymnæidæ which belong to the deep water fauna of the Lake of Geneva form another. Nature herself supplies us with numerous examples in which such a change is a normal occurrence in the animal's cycle of life. No one has undertaken to test the matter in the case of the leech; but there is every reason to believe that nature has made this experiment, and that the land-leech found on the mountains of this island, and in some other parts of the world, is a living demonstration of her success. In this country the land-leech is found near the tops of mountains, in dense thickets, where the ground is carpeted with moss and other low plants. During the dryest months of summer, these localities are kept moist by mists and showers. The structure of the leech has been modified to some extent in accommodation to its present mode of life, but this modification is in every particular one of adaptation. Not an organ has been lost or acquired, certain organs have been compelled to do more work in the land-leech than they do in the common leech, and the natural result has been multiplication and enlargement. The skin-glands have become larger and more numerous, and the urinary vesicles have expanded into bladder-like reservoirs. The liquid secretions of these organs supply any deficiency of water in the air, enabling the leech to keep its dermal respiratory organ constantly moist.

The land planarian forms also are interesting examples of the kind here considered. This worm, which creeps about in damp weather, somewhat like a slug, is abundant in this island, and in many of the islands to the south. It has a wider distribution than the land-leech, being found in nearly all temperate and tropical zones, not only on islands, but also on the continents, where the moisture of island atmosphere prevails.

There is another very remarkable case, allied in some respects to those just mentioned. What could seem more out of place than a fish on land! It would seem that fishes are especially adapted to live exclusively in water. In providing the fish with fins, and with a respiratory organ in the form of gills, nature seems to have decreed that one class of animals should have a place and keep it. But all her devices to keep certain members of the finny tribe within the prescribed medium have failed. Among those remarkable fishes which have succeeded in overcoming every obstacle to living out of water, at least one very interesting species occurs on the coasts of Japan. This is the jumping-fish (*Periophthalmus modestus* Siebold), or the "Tobi-haze" as the Japanese call it. This fish is more truly amphibious than the frog, for it is able to change the mode of its respiration at pleasure, breathing water and air alternately. It is accustomed to spend a great part of the time out of water, and actually appears to prefer the air to water. If one attempts to capture it, it rarely, if ever, plunges into the water, but skips along the surface. It can climb up the steep sides of rocks or plants, and jumps along the shore in quest of insects and other small animals, with the agility of a frog. When out of water, it puffs up the cheeks with air, which is held for a short time and then renewed.

ZONES OF LIFE IN THE OCEAN.—Mr. A. Agassiz, in the third volume of the report of the scientific results of the voyage of the *Challenger*, recognizes three belts or zones of life from shore to the greatest ocean depths. The following extract is taken from the Harvard University Bulletin No. 21. "The discovery by Count Pourtales, in his first dredgings off the Florida reefs, of ancient forms closely resembling types and genera characteristic of the chalk, first suggested the probability of the theories which looked upon the oceanic basins as of very ancient origin, and of their having retained practically unchanged the limits they now occupy from the time of the later Jurassic period. This ancient facies of many of the deep-sea Echini has also been traced in other groups of the animal kingdom. Professor Alph. Milne Edwards, in some of his preliminary reports on the Crustacea of the *Blake* calls special attention to the resemblance of some of the deep-sea types to the Jurassic and Cretaceous forms.

"In making a comparison of the bathymetrical belts, Mr. Agassiz has found it convenient to recognize three such belts which are mainly dependent for their characteristics on their temperature; pressure, representing great depth, apparently being a very unimportant element in the distribution of the species.

"The first belt, the littoral, extending from low-water mark to a depth of about 100–150 fms., represents what is usually known as the continental line (the 100 fm. line). It is the plateau which is found to represent the extension of the coast line to a depth at which the influence of the direct action of the sun's heat is limited. The next or "continental belt," extends from this continental line to a depth of 450–500 fms., and represents the steep slope which has been subject to greater or less disturbance during the formation of the shore deposits and of the continental plateaus while they were assuming little by little their present outlines; it represents also the bathymetrical belt, in which the diminution of temperature is very rapid, the third belt, the abyssal region, extends from the continental limit to the greatest depths which have thus far been obtained. This region embraces the great oceanic floors where life is somewhat less abundant than along the continental belt, where the detritus carried to its slope supplies abundant food to the animals living within its limits. It is also a region in which the temperature is very low, where it varies but little from the freezing point, and where the conditions under which the animals now living there have probably remained undisturbed for a considerable period of time, geologically speaking. It is in this abyssal region that we find the greatest number of forms having an ancient facies. In the continental belt they are less numerous, and their resemblance is more with the types of the later geological periods."

STELLER'S MANATEE.—In his "Voyage of the *Vega*," Baron Nordenskjöld has collected all information attainable on Steller's sea-cow *(Rhytina Stelleri)*, which on Steller's visit to Bering island in 1741, was found pasturing in large herds on the abundant sea-weeds on the shores of the island. Twenty-seven years after, not a specimen was to be found, and it was believed to be then extinct. But Baron Nordenskjöld adduces evidence to prove that a specimen was seen twenty-seven years ago, though there can be little doubt that it has really gone the way of the mammoth. The Baron does not believe that its extinction is due to the destruction by hunters, but that it was a survival from a past age doomed to extinction, which overtook it when driven from its pastures on the shores of Bering island.

Steller's sea-cow *(Rhytina Stelleri* Cuvier) in a way took the place of the cloven-footed animals among the marine mammalia. The sea-cow was of a dark-brown color, sometime varied with white spots or streaks. The thick leathery skin was covered with hair which grew together so as to form an exterior skin, which was full of vermin and resembled the bark of an old oak. The full-grown animal was from twenty-five to thirty-eight English feet in length and weighed about sixty-seven cwt. The head was small in proportion to the large thick body, the neck short, the body diminishing rapidly behind. The short foreleg terminated abruptly without fingers or nails, but was overgrown with a number of short thickly placed brush-hairs; the hind-leg was replaced by a tail-fin resembling a whale's. The animals wanted teeth, but was instead provided with two masticating plates, one in the gum, the other in the under jaw. The udders of the female, which abounded in milk, were placed between the fore-limbs. The flesh and milk resembled those of horned cattle, indeed in Steller's opinion surpassed them. The sea-cows were almost constantly employed in pasturing on the sea-weed which grew luxuriantly on the coast, moving the head and neck while so doing much in the same way as an ox. While they pastured they showed great voracity, and did not allow themselves to be disturbed in the least by the presence of man. One might even touch them without their being frightened or disturbed. They entertained great attachment to each other, and when one was harpooned the others made incredible attempts to rescue it.

Zoological Notes.—Professor Felix Plateau gives directions for the rapid preparation of large myological preparations, of which we copy his abstract: 1. Maceration in alum during dissection; 2. Wash with pure water; 3. Tint with carmine; 4. Fix the carmine with alum; 5. Maceration in phenicized glycerine; 6. Suppression of the excess of glycerine by compression between absorbent paper. The article is published in full in the Proceedings of the French Association for the Advancement of Science, 1880.——Professor B. G. Wilder has published in the Proceedings of the American Philosophical Society the anatomy of the brain of the cat, accompanied by numerous figures.——Professor Owen lately read a paper before the Linnean Society on the homology of the conario-hypophysial tract, or the so-called pineal and pituitary glands. He propounds the view that it is the modified homologue of the mouth and gullet of invertebrates; that the subœsophageal ganglia and succeeding nervous cord constitute the centers whence are derived and caudally continued the homologues of the vertebrate myelon.——Mr. W. A. Forbes exhibited at a late meeting of the London Zoölogical Society horns of the prong-horned antelope (*Antilocapra americana*) lately shed by the specimen living in the society's garden. This was, it is believed, the first instance on record of the same individual having shed its horns in captivity in two consecutive years. He also read a paper on the existence of a gall bladder in barbets and toucans. From the peculiar form of the gall bladder in these birds, as well as other features of their myology which he describes, the relationship of these birds to the woodpeckers becomes still more evident than previously stated by Nitzsch, Kessler, Garrod and others.——The last number of the *Memoirs* of the Boston Society of Natural History contains descriptions, with excellent figures on three plates, of new Hydroids from Chesapeake bay, by Professor S. F. Clarke. A new genus (*Calyptospadix cerulea*, n. sp.), is described. The most interesting of the six forms is *Stylactis arge*, "which has the remarkable habit of dividing its hydranths by a transverse partition, leaving the distal half free, which latter, with its two or three hydrorhizal processes that are developed before the division takes place, floats away free, being carried about by currents; finally it settles down, becomes attached, and by growth and budding gives rise to a new colony. It is another method in which the Hydroids are already so rich, by virtue of which they increase their numbers and their geographical distribution."—— The Peabody Academy of Sciences has resumed the issue of its *Memoirs*. Vol. 1. No. 5, is devoted to Contributions to the Anatomy of Holothurians, by Mr. J. S. Kingsley; and No. 6 to Mr. J. W. Fewkes' development of the pluteus of Arbacia, which differs in certain details from that of Echinocidaris as worked out by J. Müller.——At a recent meeting of the Linnean Society of London, Professor Cobbold exhibited a large Guinea worm taken from a pony, in Madras. Only one previous instance of the occurrence of this parasite in the horse has been mentioned, and its authenticity has been doubted. ——Kossman in *Zoologischer Anzeiger* states that the Entoniscus, a parasite Isopod, is an endoparasite; these Isopods are usually external parasites.——C. P. Sluiter in the same journal describes the segmental organs in certain Sipunculidæ from Malaysia.——Farther additions to our knowledge of the fishes of Lower California and the Gulf of California are recorded in the Proceedings of the U. S. National Museum by Messrs. Jordan and Gilbert.——Another paper of value in the same serial is that of Mr. Dall on the genera of Chitons, especially the fossil forms.——An elaborate account of the structure and development of the gar pike by Messrs. Balfour and Parker, read before the Royal Society, is reported in *Nature*. As regards the skull the authors say that its morphology cannot be understood "unless it be seen in the light derived from that of the Elasmobranchs, the sturgeon, and the anurous larva on one hand, and that of *Amia calva* and the Teleostei on the other.——P. Geddes gives in *Nature* an abstract of an important paper on animals containing chlorophyll, such as Spongilla, Hydra, and certain Planarians, while others as Actinia, &c., contain chlorophyll originating from minute algæ which he calls *Philozoön*, which inhabit these animals. The same discovery was recently published by Dr. Brandt, so that both observers independently arrive at nearly the same conclusions, M. Geddes, however, differing in some important particulars.

ENTOMOLOGY.[1]

CARNIVOROUS HABITS OF MICROCENTRUS RETINERVIS.—I noted a circumstance on Sunday, October 23, which to me was very interesting. On what is called Mill island, in the Mississippi, two miles above Burlington, there are a number of burr oaks clustered on the extreme point of the island. The trunks were covered with thousands of *Megilla maculata* Deg. A large number of Locustidæ, I think *Microcentrus retinervis* (as near as I can determine them), were apparently feeding upon the beetles. It was so much aside from the habits of the Locustidæ, as I thought them to be strictly herbivorous, that I watched them very closely. They seized the beetles with their front legs, holding them in the same manner as a squirrel its food, and kept biting until the wing covers were broken through, then masticated the abdomen. I took a number of fragments of the beetles as they were cast off, so I could not be deceived.—*H. G. Griffith, Burlington, Iowa.*

NOTE ON THE FIRST INSECT FROM WRANGELL ISLAND.—Dr. I. C. Rosse, of the *Corwin*, has given me a small spider and a dried

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

larva, which he picked up during a short visit of the *Corwin* to Wrangell island. As the officers of the *Corwin* were the first persons ever known to have landed upon this island, it is probable that these are the first insects from that locality, and it may therefore be interesting to note that the spider has been identified by Mr. Geo. Marx, of the Department of Agriculture, as "an undescribed species of *Erigone*," the larva being probably lepidopterous, but in too poor condition for determination.—*J. H. Kidder, Washington, February 6th, 1882.*

Lichtenstein's Theory as to Dimorphic, asexual Females.—The translation into French by our friend, M. Jules Lichtenstein, of Dr. Adler's renowned paper on Dimorphism in Cynipidæ will be very welcome to all those who do not understand the German language, especially as the original and admirable plates are reproduced. We have already noticed Adler's discoveries. In the preface to the translation which Lichtenstein gives, is a very amusing illustration of the insufficient and misleading nature of his theory regarding the evolution of the Aphididæ, where he insists on calling the winged females *larvæ*, and their eggs *pupæ*, since he carries the analogy into the Cynipidæ, and would call the asexual females larvæ. He draws what he conceives to be proof of the correctness of his theory from the hypermetamorphoses of the Meloidæ, designating the coarctate larva as a pupa and implying that it shows the eyes, legs and jaws of the perfect insect, and yet produces instead of a perfect insect a larva like that from which it was formed. The error in this comparison lies in calling the fourth larval stage the pupa, when it has nothing to do with the pupa, but is simply a quiescent larva indicating none of the members of the perfect insect. It is in fact, as we have called it, a *coarctate larva*, and the eyes, legs and jaws represent those of the larva and have simply become rigid, whereas those of the perfect insect, as subsequently foreshadowed in the true pupa, have a quiet different aspect, and we fail to see how this coarctate larva form can be compared with an asexual female Cynips any more than with a female of the bisexual generation. The translator's work is admirably done and he adds an instructive catalogue of the known species of Cynipidæ at the end.—*C. V. Riley.*

Naphthaline Cones for the protection of Insect Collections.—Mr. C. A. Blake, of Philadelphia, has been preparing cones of naphthaline run around a pin so that they may be stuck into a box with insects and that the naphthaline may permeate the box and last for a considerable time. They are made after a formula recommended by Drs. LeConte and Horn, and are very convenient to handle. They gave such promise of usefulness that we obtained quite a lot of them and went to the trouble of supplying all our insect boxes with the same. We have speedily rejected them, however, and give this note of warning, especially to lepidopterists to whom they will prove particularly objectionable, as our experience of a few weeks suffices to show that they very quickly encourage greasing, and soon produce a relaxed sordid or greasy appearance of the insects. Another objection is, that by deliquescence the pale chocolate color of the cones communicates to, and discolors the lining of the boxes wherever it comes in contact therewith. They may not be so objectionable for Coleoptera and Hemiptera, though in many families they would certainly prove injurious. We much prefer the old method of protection, viz: the pouring in the box of a little pure benzine, or what is better, according to LeConte's formula, a mixture of 1 oz. nitro-benzole, 1 pint alcohol, ½ oz. carbolic acid and 1 pint pure benzole.

Injurious Insects in California.—Our California friends are very active in their warfare with the increasing number of their insect pests, and Mr. Matthew Cooke, chief executive horticultural and health officer, has recently sent us a neatly bound little treatise on the insects injurious to fruits and fruit trees of California, giving a good deal of valuable practical information which must be productive of great good. Mr. Cooke lays no special claim to entomological knowledge, and several determinations are erroneous. It is doubtful, *e. g.*, whether *Clisiocampa americana* or *Orgyia leucostigma* occur on the Pacific coast, and other species of these genera must be intended; while the determination, as *Nematus similaris*, of a saw-fly larva injuring pear trees is made without any warrant, so far as we can find, the insect which we have bred from cocoons sent us by Mr. Cooke, proving to be something quite different. These technical shortcomings do not, however, impair the practical value of the manual.

Sarcophaga lineata destructive to Locusts in the Dardanelles.—From communications by Mr. Frank Calvert to members of the London Entomological Society, and a report of a committee appointed by said society to inquire into the matter, it appears that *Œdipoda cruciata* Charp., which is the destructive species there, is preyed upon by parasites closely related to those which attack our *Caloptenus spretus*, and very much in the same way. Two Dipterous species are worthy of note, viz., a flesh-fly, (*Sarcophaga lineata* Fall.) and a bee-fly (*Callostoma fascipennis* Macq.). Of the *Sarcophaga*, Mr. Calvert remarks:

"I beg leave to call your particular attention to the larva that is found in the body of the locust, no longer a matter of doubt. Each locust has from one to three of these larvæ, which are seen on tearing open the neck and thorax. When the locust dies the larva, which is very active, leaves the body and buries itself in the ground with haste—proved by experiments I have made. The head is provided with a couple of black hooks which can be drawn in; these hooks are used when the larva is in motion, and to bury itself.

After a few hours the larva loses its liveliness in the ground. I have no pods at present to try if the larva feeds on the eggs of the locust.

A remarkable coincidence with the appearance of the parasite is the melting away of the immense swarms of locusts that were hatched; it is true some were devoured, but the great masses have died before the deposit of the egg; the country so freed round us is about twenty miles by forty. It is difficult to find locusts for specimens! * * * The body parasite has destroyed the locusts that escaped the Callostoma over 800 square miles.

PARASITIC DIPTERA.—To the parasitic Diptera that are already well known, Dilophus, a genus of Bibionidæ, should, it appears now be added as, according to Mr. R. H. Meade of England, it has recently been bred from larvæ of *Chætoptria hypericana.* The Bibionidæ have hitherto been known only as vegetable feeders in the larva state.

DORSAL LOCOMOTION OF ALLORHINA NITIDA.—In the October, 1879, number of the *Canadian Entomologist*, I published a note on the larvæ of *Lachnosterna fusca*, remarking on the numbers in which they occurred in the lawn in front of the Capitol at Washington, and describing the peculiar manner in which the larvæ moved when placed upon a smooth surface—immediately turning upon their backs and moving forward with considerable rapidity by the alternate contraction and expansion of the segments. The specimens were determined for me as Lachnosterna by an experienced coleopterist; but the next year, by the rearing of the adult, they were proved to have been *Allorhina nitida.* Professor Riley had meanwhile called my attention to the fact that in Le Baron's fourth report, he had figured the larvæ of the latter species upon its back and in the act of progression. The statement is also made in this report that this larva "when out of the ground crawls with ease on its back."

This interesting habit is not confined to this species, as Rev. Samuel Lockwood, in the AMERICAN NATURALIST, 1868, mentions the same fact of the full-grown larva of *Cotalpa lanigera*, stating, however, that the young larvæ walked normally upon their legs. Other Scarabæid larvæ will doubtless be found to share in the same habit.—*L. O. Howard.*[1]

MODES BY WHICH SCALE-INSECTS SPREAD FROM TREE TO TREE.—I watched to-day a colony of *Hyperaspidius coccidivorus* Ashmead which has for two months or more been increasing on the trunk of a tall seedling orange tree. The main trunk of the tree is covered densely with Chaff scale,[2] and upon it the larvæ and imagos of the beetle are feeding. The greater number are now in imago. I found but one pupa although larvæ are still abundant. The

[1] Mr. W. Kite of Germantown, Philadelphia, sent to NATURALIST, some months ago, a description of the same habit.

[2] *Parlatoria Pergandii* Comstock.—ED.

beetles, both larva and imago, feed upon the Coccids in all their stages. They never bite through or tear off the scale, but seem to push their heads under, between the bark and the scale. Larvæ of the scale-insect are quite abundant on the trunk, and these are sucked by the Coccinellid. Although this is not properly a breeding time of the scale, there are considerable numbers of scale larvæ wandering about, and I noticed again and again that they frequently mount upon the bodies of the Coccinellids while the latter are feeding and without attracting the attention of the beetle. It even seems to me that they are attracted by the smooth and shining surface of the Hyperaspidius' elytra, as I sometimes saw three or four of the scale larvæ together upon the back of a single individual of this extremely small beetle. As several large Coccinellids, *Chilocorus bivulnerus, et al.*, are extremely common in all our groves, and all feed more or less upon Coccids, it does not seem surprising that the scale should spread from tree to tree. Another method of transportation has recently occurred to me. The shrike or butcher bird is very fond of selecting orange thorns as places to store insects. The bird is extremely common, and of course preferably selects orange trees that have long straggling branches, in fact, precisely those that are most thickly infested with Long scale. I know of one grove, much infested with scale and where at any time may be collected a double handful of dead or living insects (Orthoptera and common beetles like Phanæus) from the orange thorns upon which they have been impaled. The thorns on infected branches are always thickly coated with long scale, and in impaling a hard shelled insect like Phanæus many scales are torn off, and both scales and their eggs adhere to the insect. The shrike sometimes transfers the insects it has impaled upon one tree to a thorn upon another tree, or after making a meal of its prey which it takes off of a thorn, the bird flies off and wipes its bill on the next tree. In this way as well as upon its feet, the bird must spread scales from tree to tree.—*H. G. Hubbard, Crescent City, Fla., Dec. 12, 1881.*

ANTHROPOLOGY.[1]

Charney on the Age of Palanque.—I am strongly inclined to agree in the main, though not entirely with Charney's opinion in reference to the age of Palanque as expressed in the October number, 1881, of the *North American Review*. But the inscription on the tablet presents a serious difficulty to his supposition that it was of Toltec origin, unless Toltec and Maya be the same.

This is undoubtedly Maya, as it is not difficult to show that at least fifty of the characters are the symbols or hieroglyphs of Maya days and months with accompanying numerals. The large initial at the upper left-hand corner is probably the hieroglyph of the word *Pacumchac*, the name of a great religious festival held in

[1] Edited by Professor Otis T. Mason, 1305 Q. street, N. W., Washington, D. C.

the month *Pax*, which accounts for the repeated introduction of the character for this month in the inscription.

The four characters by the side of the upright of the cross are the symbols of four days, each with the numeral *five* attached, and correspond to the day columns of the Manuscript Troano.

The whole inscription is doubtless a religious calendar relating chiefly to the festival mentioned. I call attention here to the fact that a reduced and imperfect copy of this cross is found on the back of one of the Copan statues; see middle plate between pages 156 and 157, Stephen's Travels in Central America, Harper's edition, 1877.—*C. Thomas.*

MAJOR POWELL'S FIRST ANNUAL REPORT.—Within a few days a handsome volume has been placed in our hands, entitled; First annual report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1879–'80, by J. W. Powell, Director. Washington, Government Printing Office, 1881, XXXVI, 603 pp., gr. in 8vo, with 1 map, 346 figures.

The report of Major Powell, which occupies 86 pages consists of an account of the work done and in progress by the Bureau of Ethnology, and the following papers by Major Powell:

On the Evolution of Language, pp. 3–8.
The Mythology of the North American Indians, with several new myths, pp. 19–52.
The Wyandot Government, pp. 59–68.
On limitations to the use of some anthropologic data, pp. 73–86.

The succeeding pages of the volume are occupied with the following monographs:

A further contribution to the study of the Mortuary Customs of the North American Indians, by H. C. Yarrow, pp. 89–203, figures 1–47.

Studies in Central American Picture Writing, by E. S. Holden, pp. 205–545, figures 48–60.

Cession of land by Indian tribes to the United States, by C. C. Royce, pp. 247–262.

Sign language among North American Indians compared with that among other peoples and deaf-mutes, by Garrick Mallery, pp, 263–552, figures 61–346.

Catalogue of linguistic manuscripts in the library of the Bureau of Ethnology, by J. C. Pilling, pp. 555–562.

Illustrations of the method of recording Indian languages. From the manuscripts of Messrs. J. O. Dorsey, A. S. Gatschet and S. R. Riggs.

No more important contribution to the science of anthropology has ever been made than the volume before us. Every contributor, Powell, Yarrow, Royce, Mallery, Pilling, Dorsey, Gatschet and Riggs, excepting Professor Holden, is *facile princeps* in the subject of which he treats, and no one who is at all familiar with the vague methods in vogue respecting the decipherment of Central American hieroglyphics, will withhold from the astronomer the credit which he deserves for applying rigid scientific methods in a new horizon.

In its form and preparation, the volume is faultless. It is royal octavo in size, printed upon cream calendered paper. The illustrations have no parallel in modern anthropological works, except perhaps in the English editions of Evans' Stone Implements, indeed we do not know which to admire the more, the gorgeous lithographs in Dr. Yarrow's paper or the life-like wood-cuts in that of Colonel Mallery.

The works of Major Powell, Dr. Yarrow and Colonel Mallery are so well known that, did our space allow, there would be no need of an extended review. It is sufficient to say that each author has embodied in his sketch his best and latest thoughts. The articles by Professor Holden and Mr. Royce are not so well known, each author having traversed an untrodden field, or at least having followed unbeaten tracks.

Professor Holden attempts to apply the methods employed in the interpretation of the ordinary cipher writing to the deciphering of the inscriptions of Yucatan. The slabs in Stephen's and other works are indicated by Roman numerals and letters, and each hieroglyph has a number. A copy of the plates was then cut up and each glyph pasted on a separate card, which also bore the plate and glyph number, and the other numbers with which the glyph corresponded. Thus each form is known and the exact location where it appears. These cards may be arranged in any way the student sees fit, and indeed the case of 1500 cards has been deposited in the Bureau of Ethnology for the use of investigators. The rest of Professor Holden's paper is occupied with the comparison of Palenque and Copan with Mexican hieroglyphics and bas-reliefs.

Mr. Royce, formerly connected with the land division of the Indian office, years ago conceived the idea of illustrating, by means of colored maps and descriptive texts, the time and the manner in which the aborigines of the United States have surrendered their territory to the whites. Nothing in the way of ethnologic work now going on has interested us more. Indeed, one has no trouble to imagine, as the author proceeds, that he can see the savage title vanishing as breath from a pane of glass. The State of Indiana is given in the present volume, but Mr. Royce's work, when finished, will include the treaty cessions of the whole Union.

In closing it is only justice to Mr. Pilling, the editor, to say that much of the attractiveness of the volume is due to his good taste. The catalogue of manuscripts, pages 555–577, is a foretaste of what his great bibliography will be.

Lubbock's Origin of Civilization. — Those who are now active in ethnologic work should never forget the debt of gratitude they owe to those masters at whose feet they learned the rudiments of their science. The Appletons, foremost of American publishers to foster science, have just issued the fourth edition of Sir John Lubbock's Origin of Civilization, which was, at its first appearance, an epoch-making work. The opinions set forth by Archbishop Whately and others, that all savages are the degenerate descendants of far superior ancestors, that no community ever did or ever can emerge from utter barbarism to civilization was first successfully met by Sir John Lubbock, who was able, from a wide generalization, to demonstrate the contrary. Arts, ornaments, marriage, relationship, religion, ethics, language and law are each treated as organisms, and followed up from very humble beginnings to their very highest development. The reader is not called upon to follow the author through the dim mazes of speculation, but each argument is enforced by a concrete example taken now from one part of the world, now from another. Mr. Lubbock is a most charming writer, never losing his sense of courtesy to his opponents, and moving on by a settled plan to his conclusion.

Pre-Indian Aborigines.—From the Boston *Evening Transcript* of Feb. 4th, we clip the report of a paper by Professor Henry W. Haynes upon the existence in New England, in very early times, of a race of men different from and far less advanced than the Indians. The evidence is the occurrence of rude, coarse, stone implements in numerous localities where none of the ordinary evidences of Indian occupation could be found. Professor Putnam exhibited at the same meeting a collection of rude surface implements from Marshfield, in order to emphasize the fact that conclusions relating to the antiquity of relics could not be drawn simply from the character of the specimens themselves.

Will not all our kind friends whose papers or discussions are reported in the daily press send a copy to the editor of this department?

Were Copper Axes Swedged or Cast?—The Kansas City *Review* of February has an article by Professor H. A. Reid on the above subject, in which he gracefully makes his adieu to a former opinion, and frankly shakes the hand of Dr. Hoy on the swedge theory. It takes a brave man to say, "I was wrong."

Anthropology in France.—The *Revue d'Anthropologie* is the most prompt and readable of all our anthropological journals; Vol. v, No. 1, for January, 1882, comes in good time and is not behind in value. Three original papers are given, two by the editor.

Le poids du cerveau, d'après les registres de Paul Broca, by Paul Topinard.

De l'Acclimatement dans le race noire africaine, by Dr. A. Corre. [Especially valuable to American students.]

De l'Indice cephalique sur le crane et sur le vivant, d'après Broca, by Paul Topinard.

The rest of the number is filled with reviews by specialists, among them the following American works are considered: Powell's Introduction, Yarrow's Mortuary Customs, Smithsonian Report, and the Fossil man of Brazil, by Quatrefages.

GEOLOGY AND PALÆONTOLOGY.

A SECOND GENUS OF EOCENE PLAGIAULACIDÆ.—Although many of the Mammalia of the Lower Eocene formation resemble the *Marsupialia*, characters which are unquestionably those of that order, have not yet been observed. They appear in many instances to possess characteristics of the insectivorous and carnivorous orders as well, so that it has been thought best to refer them to a single order in combination with the *Insectivora*, the *Bunotheria*. Some new species, however, present the marsupial facies so decidedly as to leave no alternative but to refer them to that order, until further evidence shall confirm or set aside such a conclusion.

The new genus now to be treated of is not very nearly related to any existing form of marsupials The nearest ally, *Plagiaulax*, is a genus of the Jurassic age, which has been referred by Professor Marsh to a distinct order, under the name of the *Allotheria*. As Professor Marsh does not offer any characters by which this group can be distinguished as an order from either the *Marsupialia* or the *Bunotheria*, I have not been able to adopt it. As Falconer has suggested, the nearest ally is perhaps *Hypsiprymnus* among the existing Marsupials, and *Thylacoleo* has, perhaps, an equal affinity. As the only part of the structure of these genera which is well known is the dentition, I define them as follows:

The family of the *Plagiaulacidæ* differs from that of the *Macropodidæ* in the possession of but two inferior true molars. Most of the genera have the fourth premolar trenchant, and generally those anterior to it also, while there is but one, if any—the third—in the *Macropidæ*. There may, however, be but one in *Catopsalis*. The genera differ as follows:

a. One large premolar, which presents anteriorly.

Fourth premolar with a cutting edge anteriorly, and a free posterior cusp; molars with numerous cusps .... *Catopsalis*.

aa. Several large premolars which present upwards.

Premolars four, not ridged.......................... *Ctenacodon*.

Premolars with lateral ridges extending to the posterior edge of the crown.......................... *Plagiaulax*.

Premolars with lateral ridges not extending to the posterior edge of the crown.......................... *Ptilodus*.

Of the above genera, *Plagiaulax* is represented by two species in the English Jurassic; *Ctenacodon* by two species in the North American Jurassic; *Ptilodus* probably by two species from the Lower Eocene, one from France according to Lemoine, and one from North America; and *Catopsalis* by one species from the Lower Eocene of North America, which I now describe.

Catopsalis foliatus, gen. et sp. nov.

Char. Specif.—The mandibular ramus which represents this animal, is robust and deep. The alveolar line rises from behind forwards, as in *Elephantidæ* and various rodents, and then suddenly descends. The inner side of the ramus is concave, while the external side, anterior to the masseteric fossa is convex. The incisive alveolus is thus thrown inside the line of the molars in front. There is a large fossa exposed by weathering, below and behind the last molar, which is identical with that seen in *Hypsiprymnus* and *Macropus*, and indicates a large dental foramen. Below the middle of the fourth premolar tooth, the incisor tooth is quite large, suggesting whether it had not a persistent growth, as in the rodentia.

The posterior cusp of the fourth premolar is triangular in profile, the anterior edge descending steeply. It is uncertain whether the edge of the crown rises again, forming another lobe. The apex of the cusp is conic. The first true molar is of large size and remarkable form. The crown viewed from above is a long oval. It has a deep median longitudinal groove, which sends out branch grooves alternately, and at right angles to the edge. The spaces between the grooves form block-shaped tubercles, four on the inner and five on the outer sides, whose transverse diameter generally exceeds their anteroposterior. The median groove is open at its anterior extremity; the posterior is closed by an elevated convex margin. The apices of the lobes are obtuse where not distinctly worn. The last (second) true molar is much shorter, and a little wider than the first, and has the same character of surface. There are two large tubercles on the inner side, and four smaller on the external side. The posterior end of the crown is narrower than the anterior. The anterior base of the coronoid process is opposite the posterior extremity of the first true molar tooth. The jaw with its dentition, in its present condition, has a curious resemblance to that of a tubercular-toothed *Mastodon*, with the order of size of the molars reversed. Length of base of fourth premolar .0108. Vertical diameter of root of incisor .0070. Diameters M. I; anteroposterior .0107, transverse .0050; diameters M. II; anteroposterior, .0060, transverse .0060; depth of ramus at front of P-m. IV, .0120; depth of ramus at front of M. I, .0190; depth of ramus at posterior edge of M. II, .0150.

Found by D. Baldwin in the Puerco bed of Northwestern New Mexico.—*E. D. Cope.*

TWO NEW GENERA OF THE PUERCO EOCENE.—*Haploconus lineatus*, gen. et sp. nov.—*Char. gen.* The same as *Anisonchus*, excepting that the crown of the third superior premolar is a simple cone, wanting the large crescentic crest of the inner side seen in that genus and *Catathlæus*. It is more nearly allied to the two genera named than to *Phenacodus*. *Char. specif.* These are derived from a number of specimens, the species having been abundant in New Mexico in the earliest epoch of the Tertiary. It is about the size of the *Anisonchus sectorius*, and differs from it in several details besides in the generic characters. In the *H. lineatus* the base of the posterior inner tubercle of the superior molars is more distinct, and projects further inwards. The fourth premolar is relatively larger, and the enamel is delicately plicate, remotely approaching the condition of the surface seen in *Catathlæus rhabdodon.* In the inferior molars, the anterior marginal tubercle is wanting. The first premolar has but one root; the second and third have a posterior but no anterior basal lobe. The canines of both jaws are rather large, are acute, and flat on the inner side, and vertical in direction. Length of superior molar series M. .032; of premolars, .021; diameters P-m. IV; anteroposterior, .005; transverse, .006; of last true molar, anteroposterior, .004; transverse, .0065. Depth of ramus mandibuli at M. I, .0127.

A second species of this genus is probably the *H. angustus*, from the same horizon, which I described as a *Mioclænus.*

Pantolambda bathmodon, gen. et sp. nov. Founded on a mandibular ramus which supports the first true molar and the last two premolars. The characters of these teeth remarkably resemble those of *Coryphodon. Char. gen.* Crowns of molars supporting two Vs, of which the posterior wears lower than the anterior. Premolars III and IV, crowns consisting of one V and a short median longitudinal crest, as in *Coryphodon*; II and I, unknown. The character which indicates that the genus is distinct from *Coryphodon* is the elevation of the anterior branch of the anterior V of the true molar, which is more elevated than the posterior branch. In Coryphodon it is much less elevated. The type species is smaller than any known Coryphodontid. *Char. specif.* The bases of the P-m. III and IV are subquadrate, the inner side rounded, that of the IV relatively the wider. On the III the median keel constitutes the heel; on the IV, the keel is in the center of a wide heel. No cingula. The first true molar has an anterior cingulum, but no external one. The enamel is wrinkled where not worn. Diameters of P-m. III, anteroposterior, .009; transverse, .007; of P-m. IV; anteroposterior, .009; transverse, .0085. Width of first true molar in front, .0083. Apparently about the size of a sheep.

It will be for additional material to demonstrate whether this genus belongs to the *Amblypoda* or *Perissodactyla.* It was discovered with the preceding species by Mr. D. Baldwin in the Puerco formation of N. W. New Mexico.—*E. D. Cope.*

"MUD LUMPS" AND MOUNDS NEAR NEW ORLEANS.—While attached to a Coast Survey party working on the Mississippi river, I was informed that there were three "Indian mounds" back in the edge of the swamp; on examination they proved to be "mud lumps," but of a shape and material different from those at the mouth of the river. I have looked over various works on geology, but can find no notice of any of these elevations so far above the river mouth, and no very satisfactory explanation of the manner in which they are formed or of the forces forming them. The mounds above spoken of are on the left bank of the river, on the place of Mr. Louis Le Bourgeois, fifty-five miles above New Orleans, they are about one and a-half miles back from the river and just in the edge of the swamp. The largest one is 40 feet in height and 144 feet in diameter, conical in shape with no signs of a crater. 300 yards N. × E. from it is a smaller one, 15 feet in height and 80 feet in diameter. 250 yards E. N. E. is another, not more than 5 feet in height and 20 feet in diameter. Formerly the large mound was entirely surrounded by a circle of these small elevations, but they have been leveled during the process of cultivation. The surface soil around the mounds is the usual black alluvium of the valley.

Mr. Ogden, U. S. Navy, and myself cut into the large mound from the top to a depth of 18.5 feet, and found as follows: There were less than two inches of vegetable mold, and the remainder of the excavation was cut through a hard orange sand; it was so hard that the pick had to be used continuously; single valves of shells, apparently Corbula, were abundant as far down as we went; to a depth of ten feet the shells were mostly soft and calcareous, below that they were all silicified; limestone concretions were very abundant, though generally small; six feet below the surface there was a layer or bed of these shells, with the valves separate; this bed was three feet wide and long, and about three inches thick, and immediately underneath it the sand was black; in some case rough concretions were attached to the shells. There were numerous black spots about the size of buck-shot thickly scattered throughout the whole extent of the excavation; under the microscope these black spots proved to be aggregations of sand; we considered them probably the result of the destruction of minute shells. Eight feet below the surface there was a handful of blue clay and sand mixed, and a little below that a handful of fine gray sand. Half way down the side of the mound I found the same material and appearances, and at the beginning of the slope, the orange sand lay thirty inches from the surface; thirteen feet out from the bottom of the mound, it was necessary to cut through forty-seven inches of alluvium to reach the orange sand, and nineteen feet out it could not be found at all.

About 100 yards from the mound there was a deep ditch, in the bottom of which there was indication, in one place, of the orange sand, eight feet below the surface, but I think that it had been brought from a greater depth by crayfish. The large mound is thickly covered with a growth of magnolia, ironwood, cane and a species of wild climbing vine. During the summer season, as we were informed, flowers peculiar to the mound are found. From the regular shape of the large mound, broken only by holes dug by treasure-hunting negroes, it seems probable that the mound-builders may have shaped it to suit their ideas of symmetry. On the right bank of the river, some three miles back, and in the swamp, I was told by the negroes there were two other large mounds similar in appearance to the one described above. I did not have time to see and examine them. Below New Orleans I noticed two small irregular lumps, bearing evidence of a crater on one side, in one, and in the center in the other.

At Southwest Pass there is a mound, or elevated area, called a "salt mound," from the well of salt water in the center. The pilots told me that when these lumps, or areas, are thrown up, there are, at first, salt wells on them; the wells are very deep and boil up, apparently from escaping gas; ultimately the wells fill up and disappear. There are frequent vibrations, and horizontal and vertical movements of the land in the passes. On one of the lumps in Southwest Pass there is a well discharging an inflammable gas.

Professor Thomassy examined the Le Bourgeois mound and pronounced it the result of the damming of a subterranean stream. Professor Lyell thinks that they may be caused either by the binding of the stratum of earth deposited in the bottom of the river by its own weight and motion, down the grade of the stream, or by the vertical pressure of accumulations of gas, or by both.

In one or two works on the antiquities of the mound-builders, there are notices of numerous anomalous mounds, generally of small size, scattered throughout the Mississippi valley. These may be mud lumps similar to the small ones surrounding the Le Bourgeois mound.—*M. H. Simons, P. A. Surgeon, U. S. Navy.*

Geological News.—The *Geological Magazine* for February contains articles upon the occurrence of Spermophilus in Norfolk, England, beneath the boulder-clay or till, by E. T. Newton; and a Supplement to a chapter in the history of Meteorites, by W. Flight. Mr. Flight notices the principal meteorites found between 1875 and 1881.——In the same magazine Mr. H. H. Howorth concludes his argument for the occurrence of a great post-glacial flood. After reviewing the theories of Pére David, Mr. Kingsmill, Baron Richthofen, etc., and pointing out that they fail to explain the occurrence of the loess at considerable elevations, the character of the loess material and the nature and preservation of its fossils, he proceeds to argue that the loess had its origin in vast outbursts of volcanic mud, a great portion of which was swept away and carried to a lower level by a deluge on an immense scale.——At a recent meeting of the Royal Institution of Great Britain, Dr. W. B. Carpenter spoke upon land and sea in relation to geological time. The conclusion supported was that the deep ocean basins date from the most remote antiquity, and that the subsidences and depressions of existing continents have been of comparatively small vertical extent, the elevation of mountain-chains being formed by lateral thrust.——The March number of the *American Journal of Science* contains the second of a series of articles upon the flood of the Connecticut River valley from the melting of the Quaternary glacier, by J. D. Dana. The average depth of this flood, taken from the level of the wide terrace out of which the present river-bed is hollowed, was 140 feet north of the Massachusetts line, and about 125 feet in Massachusetts and Connecticut.——In the same magazine C. D. Walcott describes a new genus of the order Eurypterida, from the Utica slate. As far as known no example of the Eurypterida has previously been described from a lower horizon than the Medina sandstone.——At a recent meeting of the Paris Academy of Sciences, M. Emile Blanchard stated that the condition of the fauna and flora of New Zealand showed it to be a remnant of a southern continent submerged during the modern epoch of the earth's history.

MINERALOGY.[1]

PSEUDO-SYMMETRY.—Much interest has been excited among crystallographers in those curious crystalline forms, which, while appearing to be simple forms belonging to one system of crystallization are now regarded as composed of a number of twinned crystals of another system. These are the crystals which exhibit the "optical anomalies" for which so many explanations have been offered.

Some recent investigations in this direction appear to be overturning our most elementary mineralogical conceptions. Thus, the garnet, for example, so constant in crystalline form, notwithstanding the great variations in composition, has always been considered a type of the isometric system. Yet, by means of delicate optical investigation, the conclusion has been reached that several of the varieties of garnet are not simple dodecahedrons, as indicated externally, but are composed of twelve orthorhombic crystals symmetrically arranged around a central point. It has moreover been stated that in the case of the varieties topazolite and ouvarovite, each of these twelve orthorhombic crystals are themselves composed of four more elementary crystals, making a group of 48 crystals in all to produce each apparently simple form.

Pseudo-symmetrical crystals formed by a less number of twins arranged around a line or plane have long been known. The three crystals often twinned in aragonite, the four in harmotome, the six in witherite and the eight in rutile are familiar examples of twins symmetrically placed around a line. The repeated twinnings in the plagioclase felspars offer an example of numerous twins on a single plane.

[1] Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

But the arrangement of twins around a *point* has not been known until recently. A simple example of this new kind of twinning and of the method of detecting it may be given in the case of Romeite. This mineral crystallizes in simple octahedrons, and had therefore been supposed to be isometric. Bertrand has endeavored to show that the octahedron of Romeite is in reality a twinned arrangement of eight rhombic crystals grouped symmetrically around a point. He found that if a section be cut between the summit of the octahedron and the center of the crystal, parallel to the cubic face, and this be examined in polarized light, it will show, if parallel rays be used, four similar right-angled triangles each having its hypothenuse either parallel or perpendicular to the plane of polarization; if, however, converging rays be used, each triangle will show a cross and a series of rings, indicating an optic axis for each, which is oblique to the section, but which bisects the right-angle of each triangle. If now a section is cut parallel to any octahedral face, and is examined in converging rays, a central cross and series of rings appear, just as in a uniaxial crystal, and indicate an optic axis normal to the octahedral face. He holds, therefore, that the whole octahedron of Romeite is composed of eight uniaxial (rhombic) crystals arranged around a point.

The investigations of Descloiseaux, Vom Rath, Bertrand, and more especially Mallard, tend to the belief that quite a number of apparently simple crystals of one system are in reality groups of crystals of a higher system.

Among the *pseudo-isometric* crystals, are, as Mallard has shown, topazolite, formed of 48 triclinic crystals, having for their bases the faces of a hexoctahedron, and arranged in 12 different positions; ouvarovite, formed of 12 orthorhombic crystals, corresponding to each face of the dodecahedron and arranged in 6 different positions; boracite, formed of 12 orthorhombic crystals whose summits are at the center of the crystal, as in ouvarovite; leucite, an assemblage of monoclinic crystals; senarmontite, whose octahedrons are composed of 48 orthorhombic crystals as in topazolite (this being an interesting result when taken in connection with the orthorhombic form of valentinite, hitherto supposed to be a dimorphic form of oxide of antimony); analcite, whose anomalous optical characters have long been known, now shown to be formed of 24 orthorhombic crystals, corresponding to the faces of a tetrahexahedron; fluorite, probably composed of interlacing rhombic crystals. To these, Bertrand has added Ralstonite, and, very recently, Rhodizite, both of which are composed of twinned biaxial crystals. Among *pseudo-tetragonal* crystals may be mentioned apophyllite, idocrase and zircon, now shown to be assemblages of monoclinic crystals; while as regards rutile, octahedrite and brookite, generally supposed to prove the trimorphic character of titanic acid, the interesting conclusion has been reached by Mallard that the elementary form of titanic acid is monoclinic with tetragonal habit, and that each of those minerals represent merely different twinning arrangements of the same elementary form. Apatite, tourmaline, emerald and corundum are examples of *pseudo-hexagonal* minerals, formed by the twinning of orthorhombic crystals, while other examples might be given in the remaining systems.

Interesting as are the conclusions here reviewed, it is to be remembered that other and more simple explanations of these "optical anomalies" have been offered, which do less violence to our crystallographic ideas and are perhaps nearer the truth. Most of the mineralogists of Germany are opposed to this twinning hypothesis, and hold that all the optical phenomena in question can be explained by irregularities of internal tension in the crystal. The fact, recently discovered, that when amorphous gelatine is cast in the form of a crystal, it frequently shows, after drying, optical phenomena identical with those under discussion (*e. g.*, analcite), lends great weight to this latter and more simple hypothesis.

Hieratite, a New Mineral.—At the February meeting of the Mineralogical Society of France, M. Cossa described a new mineral which occurs in microscopic crystals in volcanic tufa around the fumaroles of the crater of the Island of Vulcano (one of the Lipari islands). The minute crystals dissolve in boiling water to form an acid solution, from which there soon separates a gelatinous substance which, after desiccation, becomes a mass of transparent isometric crystals, of which the predominant form is the cube modified by the octahedron. The composition of the crystals was found to be that of a fluosilicate of potassium $2KFl, SiFl_4$ The name, Hieratite, is suggested by the Greek name of the island, Ἱερά.

Hieratite occurs abundantly in the stalactitic concretions which cement the tufa and decomposed lava, and is associated with selensulphur, realgar, mirabilite, glauberite, sassolite; the alums of potassium, cæsium and rubidium; and the soluble salts of arsenic, iron, thallium, zinc, tin, bismuth, lead and copper.

Attention is called to the abundant occurrence of a compound of tin soluble in water, possibly an alkaline fluostannate, and to a soluble bismuth salt, both of which may be new.

Monazite from Virginia.—Prof. G. A. König[1] has identified monazite from the mica mine in Amelia Co., Va., thus adding still another rare mineral to the list already reported from that locality. It occurs in masses, some of which are from fifteen to twenty pounds in weight. Two varieties were noticed, one having an amber or brown color, a straw-colored powder and a spe-

[1] Proc. A. N. S., Phila., Jan. 24, 1882.

cific gravity of 5.4; the other being gray, yellow in thin splinters, and greenish-gray in powder, and with a specific gravity of 5.1.

The mineral is decomposed by concentrated sulphuric acid and has the following composition:

$(Ce\ La\ Di\ Y)_2O_3$	$(Y\ Fe\ Ca)_2O_3$	P_2O_5	ignition
73.82	1.	26.05	.45

SOME SUPPOSED NEW SCOTTISH MINERALS.—Pilolite, Rubislite, Xantholite, Balvraidite, Abriachanite, Haughtonite, Walkerite, Bhreckite, Tyreeite and Torbermorite are names given by M. F. Heddle[1] to some supposed new minerals from Scotland. Some of these are certainly mixtures and products of decomposition; others are provisional names given to substances "which may prove to be new," and most of them require further examination before being entitled to be classed as new species. Names so given are of little advantage to the science of mineralogy. The numerous analyses given by Dr. Heddle are his most valuable contributions to science.

Pilolite is the name given to "mountain leather," usually regarded as a fibrous amphibole. *Rubislite* greatly resembles the doubtful mineral Hullite, and is found in red granite. *Xantholite* occurs in impure yellow nodules, somewhat resembling chondrodite, and appears to be an alteration product. It resembles "grenatite." *Balvraidite* is an altered felspar, resembling Bytownite. *Abriachanite* is a bluish mineral which may be either fibrous, slaty, powdery or clayey. It is a silicate of iron and magnesia and undoubtedly a decomposition product. *Haughtonite* is a black mica resembling biotite, but containing more iron and less magnesia. It is found in granite at numerous localities. It appears to be identical with the mica from Pike's Peak, Colorado, previously named, by the present writer, *Siderophyllite*. *Walkerite* is a variety of pectolite containing magnesia. *Bhreckite* is a soft, granular, pale green substance not unlike glauconite, but of uncertain affinities. It occurs in veins in granite. *Tyreeite* is the name provisionally given to a *red mud* left after dissolving a large amount of marble in hydrochloric acid. It is undoubtedly a mixture. *Torbermorite* is a massive, uncleavable zeolite whose main constituents are SiO_2 47, Al_2O_3 3, CaO 33.7 H_2O 12.4. It is said to possess no reactions distinguishing it from other zeolites.

MENACCANITE, LEUCOXITE AND TITANOMORPHITE.—A. Cathrein,[2] after a careful investigation of the titaniferous minerals of the Northern Tyrol announces the following conclusions:—

(1.) That apparently homogeneous menaccanite exhibits microscopical inclusions of rutile, and that the excess of titanic acid and the alteration of the normal ratio of Ti : Fe = 1 : 1 can be demonstrated by analysis.

[1] Proc. Min. Soc. Gt. Britain.

[2] Zeits. f. Kryst, 1882, VI, 244.

(2.) That the so-called Leucoxite is no new mineral, but is titanite with or without admixture of rutile microliths.

(3.) That the so-called titanomorphite is not a new lime titanate, but is also titanite.

(4.) That the red brown decomposition products surrounding menaccanite are rutile, not hematite, and were originally enclosed in the menaccanite, since dissolved.

New Minerals.—*Heldburgite* is the name given by O. Luedecke to some minute yellow columnar crystals found in the phonolite of Heldburg, in Coburg, and supposed to be new. The mineral is associated with zircon, and somewhat resembles that species. It is infusible, transparent, with white streak and adamantine lustre, and of unknown composition.

Krugite.—This is a new sulphate of calcium, magnesium and potassium found in the Stassfurt rock-salt deposits. It is crystalline, with a hardness of 3.5, and specific gravity of 2.8. In hot water potassium and magnesium sulphates are dissolved, gypsum remaining; but in cold water the potassium sulphate alone is dissolved, the double salt $K_2SO_4.\ CaSO_4 + H_2O$ remaining insoluble. It has the following composition: K_2SO_4 18.2, $MgSO_4$ 13.5, $CaSO_4$ 63 4, H_2O 4.1, NaCl .5—as though a mixture of anhydrite and polyhalite.

Mineralogical Notes.—The white *tourmaline* crystals of De Kalb, St. Lawrence county, New York, have been carefully measured by G. Seligman, and are the subject of an exhaustive paper in the last number of *Zeitschrift für Krystallographie und Mineralogie.*

The *boracite* crystals which occur in the kainite beds at Stassfurt are soft and pliant and under water fall to pieces to form a slimy mass. They have the same composition as the ordinary hard boracite of the carnallite beds.

By submitting crystals of *nephelite* to the action of weak hydrofluoric acid, certain etch-figures are produced which, according to a recent paper by Baumhauer, prove that nephelite crystals are always twins. The twins are regarded as the result of trapezohedral hemiedry in combination with hemimorphism according to the principal axis.

The discovery by Mr. W. E. Hidden, of remarkably fine *emeralds* in North Carolina, is of much interest. A well known Philadelphia mineralogist is the fortunate possessor of one of these emeralds, which is a perfect hexagonal prism of deep green color, having a length of over ten inches—a size probably unsurpassed by any emerald in existence.

The *prehnite* of Farmington, Conn., has, according to Descloiseaux, remarkable optical properties, probably due to the superposition of numerous lamellæ in different positions as regards their crystallographic axes.

Simple dodecahedrons of *fluorite* are very rare. They have recently been found in the department of Puy de Dome, France.

The proof of the identity of two species is as important as the discovery of a new one. Descloiseaux and Koksharow have recently shown by crystallographic measurements that *vauquelinite* and *laxmanite* are identical. Laxmanite had been distinguished from the vauquelinite of Siberia by Nordenskiöld in 1867, under the impression that the more lustrous crystals, of somewhat different form and brighter green color belonged to a distinct species.

Kieserite, a sulphate of magnesia found in the Stassfurt salt mines, when placed in water is broken up into a crystalline meal, which, on exposure to the air, sets to a hard, cement-like mass. It has been used as a cement. It has been shown that the formation of the cement is due merely to the compression of the mineral upon drying.

GEOGRAPHY AND TRAVELS.[1]

THE CAROLINE ARCHIPELAGO.—The Caroline Islands have recently been visited by the British war steamer *Emerald*. Her commander, Captain Maxwell, reports his arrival at Strong Island on June 25, 1881. He describes it as mountainous with lofty peaks, some 2000 feet above sea-level, clothed with verdure to the summits; bread-fruit, bananas, etc., grow in abundance, but cocoa-nuts are far less plentiful than in the low coral islands, and, owing to the bountiful supply of water, they are not much needed. The ancient walls and fortifications on the small island of Lélé. where the king lives, are very extraordinary. The walls are some twenty feet high, having been in former times probably as high everywhere, and twelve feet thick, and are built of enormous basaltic rocks which must have been brought from a distance, and have cost much labor and ingenuity to raise them to their present position. The natives of Strong Island are described as a most gentle, amiable and intelligent race; they are lighter in complexion than the Marshall islanders. Captain Maxwell afterwards visited Ponafi, or Ascension Island, in the Simavina group, the population of which is stated to be 5000. This island is divided into several districts each of which has its own chief. The natives are particularly pleasant and good-looking; Captain Maxwell thinks they have more refined features than any he has seen, but they are not so well dressed or advanced as the inhabitants of Strong Island—the grass petticoat, indeed, seemed to be the principal article of clothing. The island is about fourteen miles square and very beautiful, with lofty peaks from 2000 feet

[1] Edited by ELLIS H. YARNALL, Philadelphia.

to nearly 3000 feet high, which are wooded to their summits, and is surrounded by coral reefs with pretty detached islets; all sorts of fruits and vegetables grow there in abundance. The ruins of residences of former chiefs are numerous and consist of enclosures within enclosures, with walls in some places thirty feet high and upwards of twelve feet thick, built of great basaltic prisms (many of them twelve feet by two feet six inches), laid regularly tier upon tier; each tier being at right angles to the one below, and the interstices filled in with coral and rubble.[1]

THE PAMIR.—The Russian traveler, M. Severtsof, gives the following results of his last journey in the Pamir: The Pamir is not a table-land and has no steppe region up to the height of about 12,000 feet. Up to an elevation of some 14,000 feet, the rivers flow in valleys which never exceed about thirteen miles in width. This peculiarity occurs also in the Tien Shan and Tibet where narrow valleys are found at a considerable elevation. There are, however, no lofty plateaux in the Pamir, where the mountains rise in lofty ridges 6000 or 7000 feet above the level of the valleys. In the Pamir mountain system, M. Severtsof states that 19,000 feet above the level of the sea is often reached, while three mountain groups attain an absolute elevation of 25,000 feet. He says, however, that these elevations do not alter the generally symmetrical character of the Inner Pamir. The mountain lines stretch in the direction of the meridian, and seldom strike out at right angles, in which respect they resemble those in the Tibetan system, while in the Tien Shan there is a tendency to parallel ranges. M. Severtsof is of the opinion from the evidence he obtained, that in the Inner Pamir the groundwork of the system, the elevation, which in 12,000 years has risen 600 feet, is still going on.

ALASKA.—Mr. E. W. Nelson has recently returned to Washington after four years spent in Alaska, chiefly at the U. S. Signal Station at St. Michaels, on Norton Sound, where he was sent by the Smithsonian Institution to study the meteorology and natural history of the region. The New York *Herald* states that he has made exhaustive researches in the mammalogy, ornithology and ichthyology, as well as in the ethnology and physical geography of the surrounding country. He made extensive sledge journeys and obtained a very valuable collection of Eskimo implements and utensils, and has brought back with him many water-color sketches of birds and fish, photographs, and also much information concerning the language and life of the Western Eskimo.

POLAR STATIONS.—The Austrians are making active preparations to establish their polar station at Jan Mayen.

The Germans have appointed a commission to make the neces-

[1] Royal Geographical Society *Proceedings*, February, 1882.

sary arrangements for the erection of their station, while the Russians, having already, as previously mentioned, dispatched their expedition to the mouth of the Lena, are fitting out another to go to Novaya Zemlya.

The Dutch also expect to continue their explorations in the Arctic seas.

Dr. Crevaux in South America.—Dr. Crevaux, the French explorer in the Guianas and the basin of the Amazon, has been dispatched by his government on another journey. He is accompanied by an astronomer and other assistants. He proposed to ascend the Paraguay River to the headwaters of the Amazon, and to make a thorough exploration of the Tapajos tributary.

The Emperor of Brazil having placed a steamer at his disposal, he has decided to proceed up the River Pilcomayo to ascertain the practicability of a trade route between the Bolivian interior and the Argentine Confederation.

African Exploration.—The Marquis Antinori, the leader of the Italian expedition in Shoa, has heard of the existence of a race of pigmies to the south-east of Kaffa. It is thought probable they belong to the same race as the Akkas. The Marquis expects to return to Europe soon. He has made, during his five years residence in Africa, a large ornithological and entomological collection. He says that the natives distinguish clearly between the true leopard, the gepard *(Cynailurus guttata)* and *Pardus varius*, but that there is a fourth species, called by them "abasambo," and apparently intermediate between the lion and the leopard.

Mr. Schuver writes to the *Mittheilungen* stating that he never intended to cross Africa from north to south, as has been reported. Fadasi, according to him, lies in N. lat. 9° 48′, or forty-three miles north of the position given by Marno.

The *Academy* states that Captain Cecchi has returned from Northeast Africa, and it is expected that he will shortly give an account of his travels in the Galla country, where he visited the Gurangué tribe, previously unknown to Europeans. He describes them as the most handsome and intelligent of the races in Eastern Africa. They are surrounded by the Gallas, against whom they defend themselves vigorously. A tradition respecting Christianity exists among them, and further research may perhaps discover ancient Ethiopian MSS.

The Russian African Expedition, of which mention was made in our last number, intends to explore the Liba rivers of West Africa, forming a station at the island of Fernando Po. After this region has been explored, the party proposes to continue their journey across the continent to the Uganda and Galla countries.

Geographical Notes.—The French Scientific Expedition on board the *Travailleur*, and of which M. Milne-Edwards was the head, has been recently exploring the western portion of the Mediterranean. The seas off the coasts of Provence and Corsica were carefully explored to a depth of over 8700 feet, and after dredging between Spain and the Balearic Islands, the *Travailleur* put into Tangier, which was the point of departure for the second part of the voyage in the Atlantic Ocean. The numerous soundings and dredgings off the coast of Portugal produced some remarkable results, as they revealed the presence, at a depth of from 4900 to 5900 feet, of large fishes of the shark family which exist there in large numbers without ever coming to the surface. In returning to Rochefort, the greatest depth which has ever been found in the seas of Europe, was obtained by the dredge in 44° 48′ 30″ N. lat., 4° 40′ 15″ W., viz., 16,733 feet. A great number of foraminifera and radiolaria, several crustacea and an annelid were found in the mud here brought up by the dredge. As regards the Mediterranean, the *Travailleur* expedition has proved that this sea has no fauna of its own, this want being supplied by immigration from the Atlantic Ocean.

The Russian scientific expedition to the mouth of the Obi, has determined a number of positions astronomically. The eastern coast line of the gulf has been found to be placed from twenty to twenty-five kilometers too far to the east on the maps. If a similar correction is to be applied to the west coast, it will make the Yamal peninsula very narrow.

It is estimated that a third of Asia and a thirtieth part of Europe still remains to be explored.

Colonel Prejevalsky is actively engaged on his great work on Tibet and China, the first volume of which will be published in May with a map.

Nature notices the Journal of the Geographical Society of Tokio. It is printed wholly in the Japanese characters. It contains a paper on Saghalin and the Kurile Islands, and one on the historical geography of Japan.

MICROSCOPY.[1]

The New Trichinoscope.—So long as the detection of trichinæ in the flesh of animals used for food was solely a scientific curiosity and sanitary precaution, it naturally devolved upon scientific students to whose instruments and skill it presented no difficulties whatever; but when by depreciating, to a great extent falsely, the market value of a staple article of food, and inter-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

fering with the distribution of one of the great articles of export from this country, it became a question of national and commercial importance, there arose a need for some means by which unscientific persons, acting merely in the interest of trade, could determine with facility the presence or absence of these parasites. A thorough examination of the pork offered for sale must not only prevent the use of that which is dangerous, but also show the gross exaggeration of the prejudice recently excited against

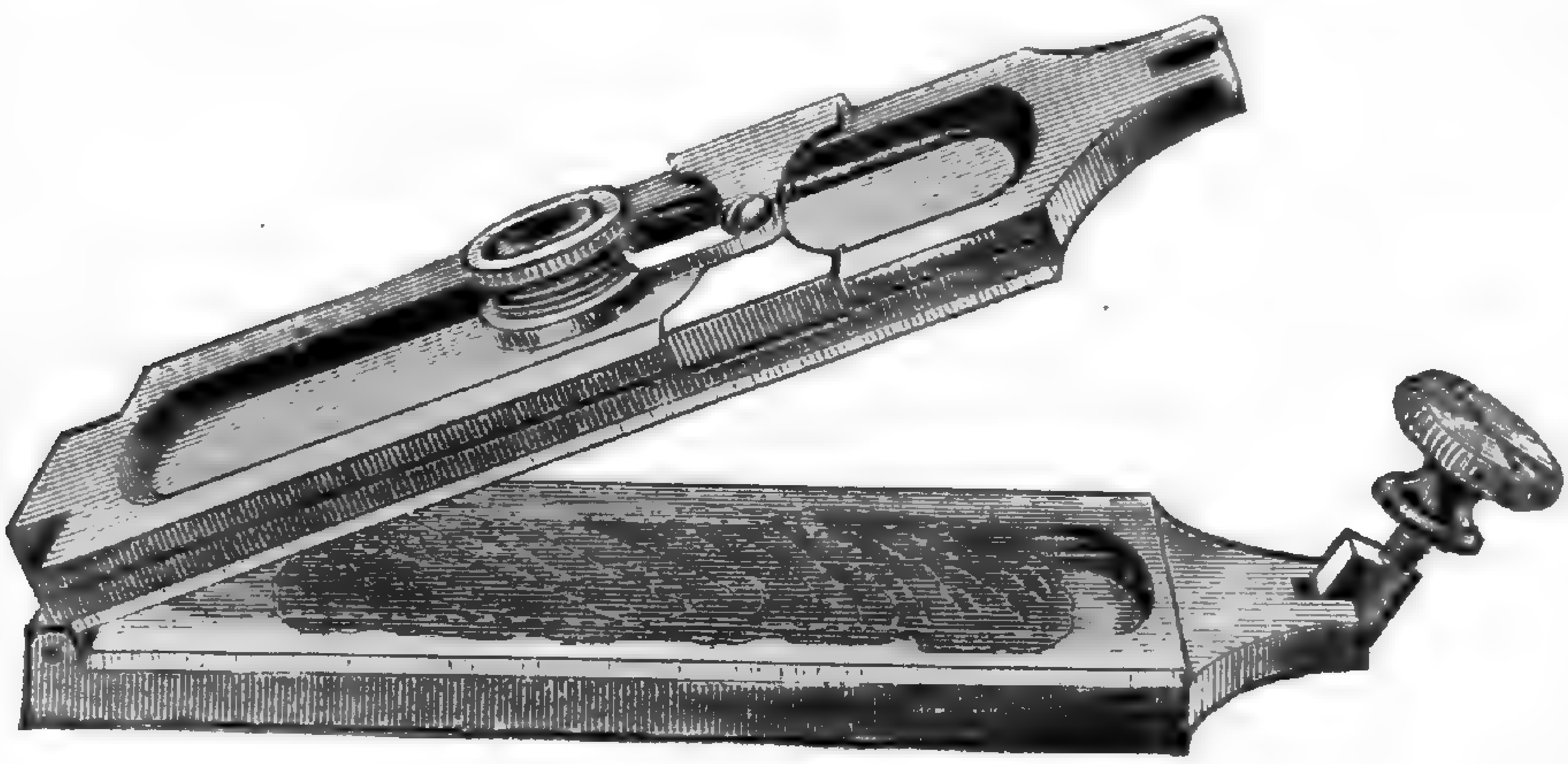

FIG. 1.

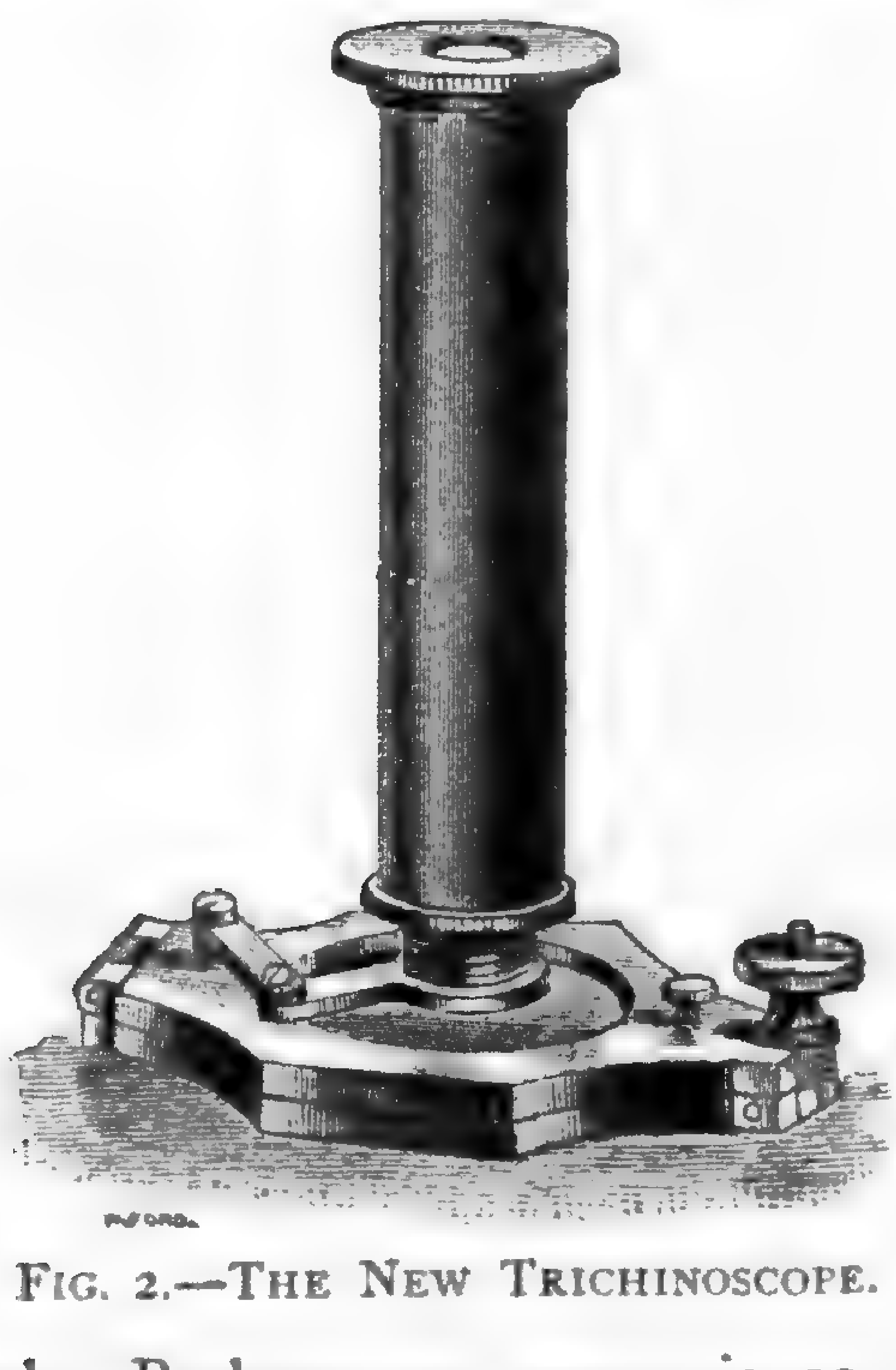

FIG. 2.—THE NEW TRICHINOSCOPE.

this article of food. Perhaps no means is so available for this purpose as the trichinoscope produced by the Bausch & Lomb Optical Co., of Rochester. This instrument consists of a compressorium with a magnifying arrangement so mounted that it can be easily slid over the whole surface of the fragment of flesh which has been flattened between the glasses. In the form shown in

Fig. 1, the compressorium is long and narrow and fitted with a pair of 3 x 1 glass slips, such as are commonly used by microscopists, and it is supplied with a magnifying doublet of sufficient power for the easy recognition of trichinæ. Instead of the doublet, or compound microscope tube may be used, in which case it is best combined with a short compressorium having round disks of thin glass as shown in Fig. 2. On the whole, the simplest form, as drawn in Fig. 1, is considered preferable, and it is furnished at the remarkably low price of $3. Aside from its intended use, this instrument is an excellent pocket microscope for field use when making collections of algæ and infusoria among the ponds and ditches.

STRUCTURE OF THE COTTON FIBER.—Foremost among the instances of the present day, of the application of scientific methods and instruments to the development of economical interests, is the microscopical study of fibers and fabrics. The three lectures on the structure of the cotton fiber, delivered by Dr. F. H. Bowman before the Bradford Technical School in 1880, have been published in Manchester, and they constitute a volume of remarkable interest and value.[1]

Dr. Bowman combines, in a rare degree, the love of truth and the analytical methods of a scientist with the practical sense of a business man, and his book, though intended primarily for the instruction of cotton spinners and others concerned in that industry, is a still greater acquisition to the library of the botanist and the microscopist. The development, size, structure, and varieties of the different kinds of cotton fibers known to trade, their varieties of place and season, their qualities and faults, and their behavior under the processes of preparation, dyeing and spinning, are discussed with great thoroughness, and are illustrated with good drawings. A companion book on the structure of wool is promised by the same author. Thus is opened by science a field, whose importance has scarcely been realized before, for the practical improvement of those engaged in the manufacture of fabrics. The author's incidental directions for the microscopical examinations upon which the whole work is founded, are in the main judicious and excellent, and we fully concur in his assumption that the best attainable objectives are desirable for the work; though the experience of the present day is rather in favor of the employment, for such work, of smaller and simpler stands instead of those as large and elaborate as the one figured by him. The author does not specify the powers most available; but we have found a 1 inch or 1½ convenient for preliminary survey of the material, or $\frac{4}{10}$ for the study of its general character, and a $\frac{1}{10}$ or $\frac{1}{8}$ immersion for study of sections, local details, effects of dye

[1] The Structure of the cotton fiber in its relation to Technical Applications. By F. H. Bowman, D. Sc. 8vo, pp. 211, plates 11. John Wiley & Sons, 15 Astor Place, New York. $4.

stuffs, etc. These lenses should all be of very high angle, unless the expense be a positive objection. An instrument costing $50 to $75, would be sufficient for every-day use in a mill for examining the stock as received and worked up; but one worth $300 is none too good for a person designing to give advice and decisions as an expert in obscure cases.

The editor of the Boston *Journal of Commerce* has introduced the microscope into this field in this country, and has already in important cases detected the cause of the imperfect working of cotton apparently of good quality. He strongly endorses the practical value of the use of the microscope by the cotton mill agent or superintendent, specifying, among other things, that "it tells him the effect of different mordants at a glance, the effect of various chemicals which are used, also the real value of different dye stuffs or drugs, and wherever the mixing of fibers is followed or the actual fabric of goods is to be investigated, there is no other possible way to do it than by the microscope."

The prominence which the microscope is assuming in this country in this technical application, may be judged from the fact that in the catalogue of instruments, apparatus, etc., for designers and others engaged in the manufacture of textile fabrics, by A. & A. F. Spitzli of West Troy, N. Y., of the 118 pages of the catalogue, the first 48 are devoted to microscopical apparatus. Messrs. Spitzli also publish a "Manual for managers, designers and weavers," an octavo book of 250 pages, which is of interest to all, whether of scientific or of practical intent, who are desirous of studying thoroughly the structure of fabrics.

Practical Microscopy.—Under this title Mr. George E. Davis, editor of the *Northern Microscopist*, has issued a general text-book of the microscope and its manipulation. It is a work of over 300 octavo pages, illustrated with wood cuts, and published by David Bogue of London. The author announces his intention, with a cheaper and more modern book, to occupy much the same field as did Queckett's now obsolete treatise on the "Use of the Microscope." He practically makes good the claim to be a successor of Queckett by ignoring American and continental apparatus almost entirely, and confining himself to descriptions of English work. Moderate credit is given, in the preface and elsewhere, for American precedence in the introduction of high angled objectives; but these objectives (or any of American make for that matter) are omitted from the practical part of the work. Only one American stand is described, and the accessories mentioned are almost exclusively English. While this peculiarity may make the book more convenient for practical use among its largest constituency, nearer home, it will render it somewhat less attractive and satisfactory to American students.

A similar deficiency occurs in the bibliography of algæ, infusoria, etc., of minerals, and mosses, where no mention is made of even such elegant works as Wood's Fresh-Water Algæ, Leidy's Fresh-Water Rhizopods, Zirkel's Microscopical Petrography, and Sullivant's Icones Muscorum. On the other hand, the American style of naming oculars by their degree of amplification, as 2-inch, 1-inch, etc., is noted with approval; as is also the adoption of the metric system in micrometry, and especially the selection of the one-thousandth of a millimeter, under the name of micro-millimeter or micra, as the unit to be employed. The question of angular aperture, and of testing objectives, is discussed with candor and freshness. The later chapters of the book treat of collecting objects, dissections, section-cutting, drawing and measurements, polariscope, micro-spectroscope, staining and injecting, and preparing and mounting objects. While giving recipes for various reagents and mounting media and cements, the author offers the very sensible advice that parties who require only small quantities should purchase them from a dealer instead of attempting their manufacture. He also advises against the use of "secret nostrums." Natural history subjects, which form so large a part of some of the manuals, are only touched upon incidentally. The work is freely illustrated, though only one of the plates is accompanied by a scale showing the magnifying power employed.

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SCIENTIFIC NEWS.

— In the Kansas City *Review*, Mr. L. F. Ward gives the following sensible views as to the reasons why the Western plains are destitute of forests. He considers that the prairies are without forests, because of fire set by Indians: Since the elevation of the Rocky Mountain range at the close of the Tertiary age, the atmosphere, in the general easterly movement which it possesses at all latitudes within the United States, has at all times lost the greater part of its moisture by condensation upon the cold summits of these and the more western ranges, so that by the time it reaches the great plains it is too dry for precipitation except under unusual conditions. As it moves still further eastward across a level country, having river valleys and lake basins, it comes in contact with currents from the north, the south and the east, brought there by the constant disturbances of barometric pressure with which all are acquainted, and in this manner it gradually becomes at length again sufficiently laden with moisture to yield portions of it to the soil when condensed by currents of unlike temperature. This characteristic becomes more and more marked with the eastern movement until the Mississippi valley is reached, in which and at all points eastward the rain-fall, varying from thirty-two to sixty inches is sufficient to be depended upon for agricultural purposes.

Where the annual precipitation is below twenty, or perhaps twenty-four inches, there can be no growth of forests, and this is the true cause of the absence of trees on the great plains. But this does not prevent the existence in arid regions of certain specialized types of arborescent vegetation. The sage brush that covers the dreary wastes of the Rocky Mountain region, the Laramie plains, the Bitter creek valley, and such vast areas of the West, while in its botanical characters it is little more than an over-grown weed, is to all intents and purposes a tree, and often attains a great age. The region it occupies is even more arid than the great plains, yet no fires occur and no forests grow. In the nearly rainless areas of Arizona, Southern Utah and New Mexico, and stretching eastward into Texas, there occur a number of arborescent forms, the creosote bush *(Larrea mexicana)*, the mesquit *(Prosopis juliflora)*, various acacias and mimosas, and one yucca *(Y. brevifolia)*, together with the tree cactus *(Cereus giganteus)*. These grow scattered at great distances from each other and rarely form thickets or groves. Why no such characteristic species are found occupying the great plains is not known, and it is probably a mere accident that none happens to exist, adapted both to their temperatures and their arid condition. Did any such exist, there seems no reason why it might not thrive as well as the sage brush farther west or the mesquit of the South.

The absence of forests or extensive tracts of timber land on those areas of our Western country where the rain-fall annually exceeds twenty-four inches, must, as already remarked, be attributed to human agency in repeatedly burning over these areas, whereby all forms of vegetation requiring more than one season to mature their fruit are prevented from perpetuating their kind.

— The Board of Control of the Iowa Agricultural College at their last annual meeting passed a resolution that the College Board would provide a competent entomologist for the State, paying his salary out of the college fund, *provided that* the legislature would defray the other expenses. A bill has accordingly been introduced into the legislature now in session, with a good prospect of becoming a law. It provides that the teacher of entomology in the Iowa Agricultural College shall be *ex officio* the State Entomologist. It is made his duty to visit different parts of the State upon direction of the governor, to study the injurious insects. He is also to make an annual report, and this report shall be in two parts, "the first of which shall be written in plain non-technical English for popular perusal, while the second part shall include the necessary technical descriptions."

Provision is made for the printing and distribution of five thousand copies of the report. Provision is also made for paying the expenses of making visits to different parts of the State, and for supplying the necessary cuts and illustrations. The direct appropriation from the State treasury (not counting the printing of the report) will be only six hundred dollars annually, but no part of this is to be used for payment of the salary of the entomologist. One valuable feature of this plan is *its permanence* when once under way.

Mr. Herbert Osborn (now studying with Dr. Hagen) well known in Iowa for his scientific and popular writings on insects, a young man, and warm friend of the lamented Putnam, is the teacher of entomology in Iowa Agricultural College, and it is to be presumed that if this bill becomes a law, he will be the State Entomologist of Iowa.

— Professor C. V. Riley has deposited in the U. S. National Museum his extensive private collection of insects. The collection comprises some 30,000 species and upward of 150,000 specimens of all orders, and is contained in some 300 double folding boxes in large book form and in two cabinets of eighty glass-covered drawers. The specimens are all in admirable condition, and the determined species duly labeled and classified. The collection is chiefly valuable, however, for the large amount of material illustrating the life-histories, habits, and economy of species, 3000 of which are represented in one or all of the preparatory states, either in liquid in separate boxes, or blown and mounted dry with the imagines. Fifteen blank books are filled with notes and descriptions of these species, most of them yet unpublished. Though several special collections surpass it in a single order, few, if any, general collections of North American insects equal it, and perhaps none from the biological point of view.

The Museum is now prepared to properly care for such collections, under direction of Professor Riley, who has been appointed honorary curator of insects, and it is hoped that in time, with so good a beginning, a truly national exposition of the insect fauna of the country will be brought together. The Museum building is entirely fire-proof, and there is every facility for the safe preservation of specimens or collections that may be donated. He requests that correspondents send the adolescent states in connection with mature forms whenever possible, together with all material exemplifying the transformations, architecture and economy of species.

— Sir Charles Wyville-Thompson, who was well known as the director of the *Challenger* Expedition, and author of the "Depths of the Sea," died at Edinburgh early in March, at the age of 51. Professor E. Desor, of Neuchatel, Switzerland, well known as a student of glaciers, of zoölogy and anthropology, died last March. He lived when a young man for several years in this country, and paid a good deal of attention to American marine zoölogy, and to glacial geology. Among botanists we have to record the death of T. P. James, of Cambridge, Mass., who, at the time of his death

(Feb. 22), was preparing a descriptive work on the mosses of the United States. The most eminent of French botanists, Joseph Decaisne, died Feb. 8, aged 74. He was the director of the Jardin des Plantes at Paris.

—A Correction.—In the April NATURALST, p. 292, in our article "Is Limulus an Arachnid?", I quote the published statements of the late Willemoes-Suhm, that the East Indian *Limulus rotundicauda* passed through a free-swimming nauplius stage. It now appears, as we learn from Prof. Faxon, from a letter from Mr. Murray, who was on the *Challenger*, "that the whole thing was a blunder of Willemoes-Suhm's, and that he had the larva of a Cirriped instead of a Limulus. A blunder which Suhm himself rectified." It was evidently overlooked by the editors of his "letters," and we have failed to find any rectification of the blunder in the *Zeitschrift für wissens. Zoölogie* or elsewhere.—*A. S. Packard, Jr.*

—Professor R. E. Call of DesMoines, Iowa, is preparing for a second collecting trip to the South in the interests of conchology. The collections of the present season will be confined to the State of Georgia, the greater portion of which has never been explored. It is notorious that most of the Georgia *Uniones* are rare in collections, and many of them rare even in Georgia.

The number of full shares will be again limited to *twenty-five*. The expenses of a trip of this nature are very great, and, with so limited a number of shares, it is necessary to place the price of each *full* share at $20, and *half* shares at $15. Subscriptions are due when the shares are delivered.

— The Census Bureau has issued statistics of the production of precious metals in the U. S., by Clarence King, with useful, graphic presentations of the results. The bullion product of the United States, for 1880, was $74,490,620. The United States produce 33.13 per cent. of the gold yield of the whole world, 80.54 per cent. of the silver, and 40.91 per cent. of the total.

— A fellowship in mining has been established at Princeton, which is to be opened to the senior class and to post-graduate students. The income of the fellowship is $600, and the fellow will be required to spend one year in the continuous study of the mines and mining interests of Colorado. The first award will be made on examination next June.

— The younger naturalists of Boston, Mass., have formed an association called the "Boston Zoölogical Society," which publishes a quarterly journal, of which two numbers have been issued.

— The methods and results of a study, by Capt. W. H. Dall, of the currents and temperatures of Bering sea is a timely and useful publication, issued by the U. S. Coast and Geodetic Survey.

— A third edition of Quenstedt's Handbuch der Petrefaktenkunde is now being issued in numbers. The first lieferung begins with the fossil mammals.

— The Transactions of the American Fish Cultural Association, tenth annual meeting, comes to us, containing some excellent matter.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF SCIENCES. Oct. 11, 1881.—Dr. H. C. Wood, in the course of a lecture on diphtheria detailed various experiments and observations made by himself and Dr. H. Formad with a view to ascertain the cause of that disease. Inoculation under the skin of some of the lower animals with diphtheritic poison failed to produce the disease, but inoculation by the windpipe caused death with diphtheritic symptoms. Other irritants similarly introduced produced false membrane.

Samples of diphtheritic poison were then obtained from Luddington, on Lake Michigan, where diphtheria of the most virulent type raged, chiefly in the third ward, which was built upon a swamp filled up with sawdust. Micrococci swarmed in the blood of the children suffering from the disease at this place, and this diphtheritic matter produced all the symptoms of malignant diphtheria, attended with swarms of micrococci in the blood, in animals inoculated with it. These micrococci existed in the white blood corpuscles to the number of forty or fifty in each, causing the disintegration of the corpuscle. They abounded also in the spleen and bone marrow. In suitable liquids infected with the diphtheritic matter from Luddington, it was found that generation after generation of micrococci could be produced indefinitely, whereas the matter from the milder type of the disease prevailing in Philadelphia, exhausted its productive power in three or four generations. Micrococci are present in healthy throats, but lack this power of continued development. Micrococci obtained on filter paper from the watery discharges of malignant cases proved more fatal when planted in animals than the membrane itself. Micrococci grown in liquids reproduced diphtheria when introduced into animals. The inference to be drawn was that the micrococci were the active agents in producing the disease, while their existence in healthy persons was explained by the supposition that, as is known to be the case with some fungi, the same organism which is innocuous under some conditions, may become harmful under others. It was also suggested that inoculation with the cultivated poison of exanthematous diseases might eventually be practiced as a protection against severer attacks.

Oct. 18.—Mr. Meehan called attention to two forms of willow leaves from the same tree, one form an inch in width, the other not more than a line, and argued that this tended to show the production of variations by sudden leaps.

He also spoke of an Arceuthobium (mistletoe) from the Pacific coast, the seeds of which were forcibly expelled to some distance.

Mr. Ryder described *Licnophora cohnii* Clap., a ciliated protozoan found on a hydroid at the mouth of Chesapeake bay. The hydroid was parasitic on the shell of a bivalve mollusk inhabited by a hermit crab.

Oct. 25.—Mr. Pike made a communication upon the celebrated insect-bearing deposits of Mazon creek, Illinois. These fossils are usually found in nodules of blue shale.

Nov. 1.—Mr. Ryder stated that efforts had been made during the last two summers to delay the development of fish eggs with a view to transportation. These experiments were only partially successful. At a temperatnre of 53° development proceeded normally, but more slowly than usual, up to a certain point, when a fungus formed upon the egg membrane. Temperature slightly lower than 53° caused abnormal development, and 45° proved fatal. Professor Brooks had found in the case of oyster eggs that the phenomena of segmentation and nuclear division were rythmical, and Mr. Ryder held that there was a direct relation between these phenomena and heat as a mode of motion.

Nov. 8.—Mr. Meehan said he had lately found *Robinia viscosa*, which he believed had never been collected by botanists since its description by Michaux, growing abundantly in gardens near the Delaware Water Gap. It was said to have been brought from the neighboring mountains. The plant produced a multitude of flowers, but very few seeds. The rose acacia of the nurseries has never been known to produce seeds.

Mr. Ryder described the development of Hippocampus. The quadrate, hyo-mandibular, and symplectic cartilages are largely developed, the intestine is provided with a curious valvular arrangement at its posterior end; and the plates, which are much fewer than in the adult, are developed as conical caps immediately under the epithelium.

Mr. Potts indicated a new species of sponge under the name of *Mayenia craberiformis.* Sponges occur only in flowing, drinkable water. He had found from four to six species in every stream he had examined.

Nov. 15.—The Rev. Dr. McCook spoke of the methods of escape practiced by orb-weaving spiders when thrown into the water. Some apparently formed a little raft of web for their hinder feet, and paddled ashore with their fore feet; while another further out allowed threads to float upwards from its spinnerets, and was wafted ashore by the wind. These two methods were both probably instinctive.

Nov. 22.—Mr. Ryder gave the results of his studies of the division of cell nuclei. Dr. Horn described the peculiar structure of the mandibles of a Balaninus which bores through hickory nuts. The mandibles are reversed, so as to move in a vertical direction.

Dec. 6.—Mr. Potts referred to three species of fresh-water sponges, the statoblasts of which are provided with long curled tendrils, homogeneous and continuous with the chitinous coat; these forms constituted the genus Carterella. Mr. Ryder stated that the silver gar and other allied fishes had eggs provided with long cylindrical filaments, which twist with those of other eggs so as to form masses of several hundreds.

Professor Rothrock stated that in *Ceanothus prostratus*, the chlorophyll of the leaves is confined to a layer around inward-growing sacs, in the interior of which are the stomata. These sacs are protected by downward-growing hairs.

The Biological Society, Washington, D. C., March 3.—The twenty-third regular meeting of the Biological Society was held at the above date in the lecture room of the National Museum, at which ninety members were present, Professor Gill in the chair. A discussion of the shape of the sea-cow's tail, continued over from the previous meeting, was carried on by Mr. H. W. Elliott, Dr. Elliott Coues, Mr. F. W. True, Dr. T. H. Bean, Mr. G. Brown Goode, and Professor Theodore Gill. The committee on lectures announced that in conjunction with a similar committee from the Anthropological Society they had arranged for a course of eight popular lectures on scientific topics. The programme is as follows: March 11, Professor Theodore Gill, "Scientific and Popular Views of Nature contrasted;" March 18, Major J. W. Powell, "Outlines of Sociology;" March 25, Professor C. V. Riley, "Little-Known Facts About Well-Known Animals;" April 1, Professor Otis T. Mason, "What is Anthropology;" April 8, Professor J. W. Chickering, Jr., "Contrasts of the Appalachian Mountains;" April 15, Dr. Robert Fletcher, "Paul Broca and the French School of Anthropology;" April 22, Professor William H. Dall, "Deep-Sea Exploration;" April 29, Dr. Swan M. Burnett, "How We See." These lectures will be delivered in the lecture room of the National Museum, beginning at half-past 3 P. M.

Boston Society of Natural History, Mar. 15.—Mr. William Trelease described the structures which favor cross-fertilization in several plants, and Mr. J. S. Kingsley remarked on the embryology of fishes.

April 5.—Professor G. F. Wright described the "Terminal moraine of the great ice period in Pennsylvania," and Mr. N. F. Merrill read a second paper on the lithological collection of the Fortieth Parallel Survey.

New York Academy of Sciences, Mar. 27.—Professor Thomas Egleston remarked on the proposed Government Commission for the testing of iron and steel.

April 3.—Dr. George E. Beard read a paper (with illustrations) on the psychological explanation of the Salem witchcraft excitement, and the practical lessons derived therefrom.

Middlesex Institute, Feb. 28.—L. L. Dame, president, delivered an instructive lecture—the first in a series of twelve weekly botanical lectures—on the "Growth of the plant from the seed," to a class of nearly fifty members.

Mar. 7.—Mrs. A. J. Dolbear gave the second in the series, her subject being "Morphology of roots, stems and branches."

Mar. 8.—President Dame briefly reviewed the first year's work of the Institute, and made some excellent suggestions in regard to the best manner of carrying on the work which the Institute had undertaken.

The various reports presented a most gratifying exhibit of the condition of the Institute, and its future as a permanent scientific educational force seems well assured.

Mr. Davenport announced the death of Professor Thomas P. James, an honorary member, and a committee consisting of the president, W. H. Manning and Mr. Davenport was appointed to draw up suitable resolutions of respect to the memory of the deceased.

American Geographical Society, March 21.—R. E. Colston delivered an illustrated lecture on modern Egypt and its people, the army of Egypt and the military revolution in progress there. the customs of marriage and divorce, and the condition of women in Mussulman countries.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science, April.—The wings of Pterodactyles, by O. C. Marsh. Sandstones having the grains in part quartz crystals, by A. A. Young. The timber line, by H. Gannett. Notice of Fisher's "Physics of the Earth's Crust," by C. E. Dutton. Great dyke of Foyaite or Elæolite-syenite in Northwestern New Jersey, by B. K. Emerson. Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England, by A. E. Verrill.

The Geological Magazine, March.—Supplement to a chapter in the history of meteorites, by W. Flight.

Journal of Conchology, Oct. 1881.—Life history of *Helix arbustorum*, by J. W. Taylor.

THE June number of the NATURALIST will be devoted almost exclusively to articles on Evolution. It will contain articles by Morris, Hyatt, Cope, Rockington and others, with reviews of Beale, Butschli, Loew, Pokorny, Wythe and others.

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TRANSFORMATIONS OF PLANORBIS AT STEINHEIM, WITH REMARKS ON THE EFFECTS OF GRAVITY UPON THE FORMS OF SHELLS AND ANIMALS.[1]

BY ALPHEUS HYATT.

IN continuation of our review in this journal for October last (p. 793) of Professor Hyatt's contribution to the evolution theory, we make the following extracts from his last condensed paper, and reproduce from the Proceedings of the American Association the plates illustrating the paper. The results of his studies on the Steinheim shells are roughly exhibited on Plate VI, and may be described briefly as follows. Figs. 1, 8, 12 and 16, are the ancestors, varieties of *Planorbis levis* from the older Tertiaries of another locality, identified, named, and kindly sent to me with eleven other specimens of this species by Professor G. Sandberger,[2] who opposes the evolutionary conclusions of both Hilgendorf and myself.

From these four varieties spring four distinct lines of descent. Fig. 1 begins the series from 2–7, in which of course numbers of the connecting forms are not figured. Fig. 8 begins the series from 9–11, much shorter and containing fewer forms than in series 2–7. Fig. 12 also gives rise to a short series with only few forms. Fig. 16, however, is the starting point for a compound series, or one composed of at least three sub-series, 19–20, 21–24, and 25–28.

The intermediate forms by which the gap between the four

[1] From the Proceedings of the American Association for the Advancement of Science, Vol. XXIX, Boston Meeting, August, 1880.

[2] The author of the most complete Memoir on Tertiary shells in existence, Conchylien d. Vorwelt.

ancestors and the four first forms of each series, viz: 2 and 9 and 17, which occur in the Steinheim basin, is very complete, but neccessarily left out in this plate.

Numbering the series from right to left we see that Series I has three sub-series. Two of these show a tendency to uncoil, to become distorted and smaller than the ancestor, Fig. 16, while the third decreases in size, but has a form, Fig. 20, which is turreted like Figs. 11 and 6.

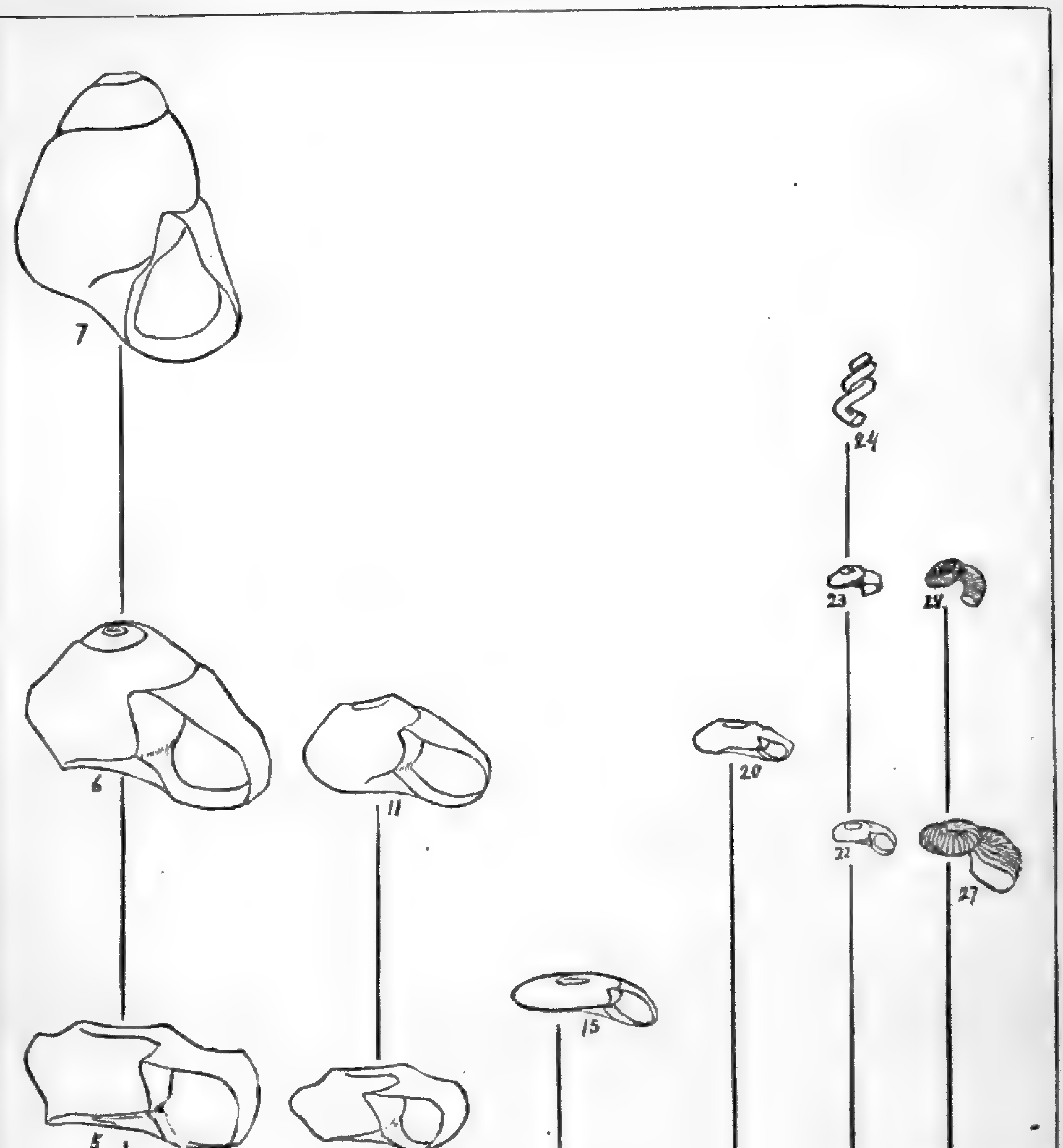
Series II maintains a size about the same throughout, but becomes flatter than the originating form, Fig. 12. Series III grows sensibly larger, and 10–11 are turreted-shells with a more rigid and sub-angular form of whorl than the primal form of Fig. 8.

Series IV exhibits not only greater increase in size, but vastly greater differences in form and in other characteristics of the shell from Fig, 1, with which it started.

We can, therefore, without fear of error call series IV a highly progressive series; Series II a persistent series; sub-series 3 of Series I a partly retrogressive series; sub-series 2 of Series I, a purely retrogressive, and sub-series 1 of Series I also partly retrogressive; since, though it decreases in size and becomes deformed and uncoiled, it also has a tendency to produce a new characteristic, the transverse ribs, and also increases in size its more closely coiled forms, as in Fig. 26.

There is also other testimony going to show that this classification is correct. Semper's researches on *Lymnæus stagnalis* show, that under the most favorable physical conditions, this species increases to a maximum of size and has larger whorls, while under less favorable conditions with relation to food and temperature, the size is very much decreased.

The immediate results of weakness, produced by wounds, are also important in this connection. Pl. VII, Figs. 21, 21*a* and 22, a diseased *Pl. oxystomus*, var. *revertens* Hilg, is a diseased specimen of the same species as Fig. 9, Pl. VI. Compare this diseased, partly uncoiled, shell with the species, Fig 23, Pl. VI, *Pl. denudatus* and *minutus*. The weakness consequent upon old age is equally significant and has a similar meaning. Pl. VII, Fig. 22, represents the effect of old age in distorting the growth of the outer whorl of *Pl. oxystomus*. Compare with Fig. 22, Pl. VI. These are true cases of disease of comparatively rare occurrence in *Pl. oxystomus*. I have in my collection many similar



TRANSFORMATIONS OF PLANORBIS AT STEINHEIM.

cases and have lately found some diseased shells of *Pl. trochiformis*, Fig. 7, Pl. VI. These are dwarfed, and show a tendency to unwind the spiral; so that they look remotely like the beginning of a series of transition forms from *Pl. trochiformis* to *Pl. denudatus*, Fig. 24, Pl. VI.

The following extracts contain the author's conclusions on the influence of the environment on mollusks:

Darwinists would say that want of bilateral symmetry or the unsymmetrical spire was of advantage to the animal, therefore it was selected and perpetuated.

Now this statement may be readily accepted, with the understanding that the "therefore" does not imply a relation of causation.

Most of the characteristics caused by the physical surroundings are of course advantageous, but the physical forces are the causes and not the advantageous or disadvantageous nature of the characteristic.

The form of the embryonal shell is straight, bag like or swollen, tubular; Figs. 29–30, Pl. VI.

The simplest form of all is a disk with which this embryonal bag begins, but this or the embryonal shell is not necessary for us to consider.

The coiled unsymmetrical shell (*ba*) is carried above the foot (*k*) as in the *Helix pomatia*, Fig. 8, Pl. VII, and Planorbis, Fig. 8 *a* Pl. VII. This is built by the mantle or internal soft covering of the body *d*, Fig. 9. The shell has been removed, and the fleshy cone of the mantle containing the stomach, intestines, etc., has been partly unrolled to show that it was originally coiled up inside the shell. The structure of the shell can be more easily understood in forms like Figs. 11, 12, Pl. VII, where the mantle is not so long and not coiled, but builds a broad, evenly balanced, conical roof above the foot as in the Patella or Limpet. If this shell be divided into halves and one half removed as in Fig. 12, the structure of the shell becomes visible and also the relations of the mantle *d*, and the mantle border *d'*, to each other and to the two layers of the shell, *e*, and *e'*.

This animal was once small enough to occupy only the upper part of this cone and then as it grew in size built the shell above itself. The outer layers, *e*, Fig. 12, the outer edges of which are seen also on the surface of the shell, *ba*, Fig. 11, were plastered up, one inside of the other, by the mantle border, *d+*, which exactly fits the last one formed, and the inner, longer layers *e'* which simply serve to strengthen and support these are laid on by the mantle itself, *d*, Fig. 12.

The mantle border in the gasteropod forms a sort of collar, *d*+ Figs. 8 and 12, Pl. VII, around the edge of the mantle, through which the creeping disk or foot projects when the animal is expanded. The mantle border among the lamellibranchs *d*+Fig. 18, Pl. VII,[1] forms a wider opening, or slit fore and aft, but it serves the same purpose of an aperture for the protrusion of the foot, when this is used as an external organ of motion, Fig. 18, Pl. VII.

Any force which, would confine or interfere with the excreting surfaces of the mantle border, would affect the form of the imbricated layers *e'* which determine the shape of the shell, and thus change or curve the form of the cone. The weight of the shell itself or gravitation is such a force. If we try to account for the regularity of the spirals, whether bilateral or unsymmetrical, we are struck by the fact of their great regularity of curvature, and that this regularity can only be accounted for as the result of some general and constantly acting physical force, which tends to make the bag-like, straight shell of the young bend first into a bilateral spiral and then into an unsymmetrical spiral.

The force of gravitation, unless counteracted by great muscular strength, or the equilibrium of a perfectly cone-shaped, erect shell, as in some mollusks, would make the growing shell hang back and weigh upon the hinder portion of the border of the mantle, thus compressing the excreting surface in that quarter and decreasing the breadth of the shell layers built by this part.

This would make the shell assume the form of a bent cone or the bilateral spiral as in Figs. 24–25, Pl. VII.

The unsymmetrical spiral would be occasioned by any additional inequality in the weight of one side over the other, which could be occasioned by the distribution of the heavier internal organs, particularly of the stomach, ovaries, etc. Any irregularities of weight on one side more than the other would, it is obvious, also compress that side as well as the back part of the mantle border, and tend to narrow the deposits.

This would occasion a deflection laterally, and we should have what is so commonly the case, a shell bilateral in the young or at the apex becoming by growth unsymmetrical or spiral.

[1] See also Fig. 3, a fresh water clam (Anodonta) thrown widely open.

This explanation is obviously applicable to the regular spirals, but the test cases are the irregular spirals.

These occur through weakness occasioned by wounds, disease, Fig. 21, Pl. VII, or old age, as in Fig. 22, Pl. VII.

All of the distortions thus produced tend to be irregular, that is the animal becomes too weak to counteract the effects of the weight of the shell by its inherited muscular power, and it falls over more or less to one side destroying the regular curve of the spiral. This falling over to the side of greatest weight occasions an irregularity in the deposition of the outer shell layers, and the shell becomes more and more irregular as the animal grows weaker in old age or through disease.

Another proof of the effects of gravity lies in the fact, that the irregularity of form of the shell is proportional to the extent to which it is supported and the excreting border of the mantle relieved from the effects of its weight.

Thus, a perfectly regular spire in the young, by being supported, is turned into an irregular meandering tube in the after growth of the same animal.

Magilus antiquus crawls freely when young among corals, and has, during this period, a regular turreted shell, Fig. 23 *ba*, Pl. VII. It becomes finally fixed in the growing coral, which completely invests and supports it, and thereafter its shell is a rough irregular tube growing upwards in the direction of least resistance. The border of the mantle being free from compression on all sides, deposits shell matter about equally all around in the specimen figured, and therefore grows upward in a straight line.

The Vermetidæ are supported in various degrees in the adults but free in the young. Their shells, therefore, though having a regular spiral in the young, are in proportion to the support received, transformed into tubes more or less meandering after they become attached as in Fig. 10 *a*, Pl. VII, or loose irregular spirals rising up like corkscrews and only supported on one side as in Fig. 10.

The Ammonoids and Nautiloids are notable for the complete bilateral symmetry of their spiral shells.

Diseased specimens, which are not infrequent, however, tend to become unsymmetrical, coiling like the Gasteropods, as is well known to all experienced palæontologists. These are commonly spoken of by Quenstedt and others as diseased or deformed or sick species.

Once at the Sorbonne in Paris, Professor Hèbert, a distinguished French palæontologist, showed me a magnificent series of uncoiled Cretaceous Ammonites, and by way of testing these conclusions, I asked this question:

"Where, M. Hèbert, is the closely coiled symmetrical form which ought to be found with these?" He turned to the other side of the room, and pointed out the required form, saying, "There it is, I found it last summer."

These and other facts of a similar kind indicate that when physical surroundings become unfavorable to any organization, it takes on a certain series of retrograde transformations.

When they occur in the individual in the decline of life, or prematurely in the course of growth, through disease, they are similar to the characteristics of whole species, and even groups of degenerate forms. As in the case described above, Fig. 22, Pl. VII, is taken from an aged specimen, but it is distorted in the same way as the diseased specimen, Fig. 21, Pl. VII, and the retrogressive or degraded species of Series I, Pl. VI.

All the facts corroborating this assertion have already been published and are too numerous to be described in the limits of a paper like this.

The direction of the spiral is backwards or away from the mouth in the Gasteropods and towards the mouth in the Lamellibranchs; in, both, however, it is in the direction in which gravitation acts with greatest effect.

The Lamellibranchs have a split shell, with two valves. Each valve is unsymmetrically spiral, but there is one on each side of the vertical axis or *axis of gravity*, so that they balance each other and together form a bilaterally symmetrical shell, Figs. 15, 18, seen from the side, and 16, 17, from behind; *a*, spiral of right valve, and *b*, spiral of left valve.

The spiral and the outlines of the valves are equal on either side except in those forms which change the vertical axis and lie habitually on one side.

These are deformed and unequal; the deformation is in accordance with the amount of support and the resistance of the surroundings.

Thus oysters may grow to the right or left or very irregularly, fitting the curvature of surface, Fig. 13, Pl. VII. In the young they are free moving, bilaterally symmetrical, and for a time attached by a byssus, and then lie over on one side.

Their symmetry is precisely accordant with these changes ending with having the lower valve permanently attached and larger and more concave than the upper.

Fig. 14, Pl. VII, shows the outlines of a clam shell above that of an oyster shell, and both in their real positions for comparison with each other, the beaks of the clam shell being upon the back and those of the oyster shell across the anterior or mouth end of the animal which has built the shell. The positions of the mouth in each animal are shown at *l*, *l*.

Fig. 18, Pl. VII, shows one side of a clam supposed to be buried in the mud with the siphons extended to the surface and the mantle border or shell-building organ *d* +, and the digging foot *k*, in their natural expanded condition.

What are the changes which can take place in a member of the oyster family by change of habit?[1] Can an animal of this family, which is always unsymmetrical when lying on one side, have a different position and thus return to the normal condition and have valves which are symmetrical and bilateral?

This question is answered by Lima, one of the same group as the oyster, a free swimmer but also burrowing into sponges as the clam does into the earth. This change of habit produces a corresponding change in symmetry, and it becomes like the clam, also perfectly bilateral, Fig. 16, Pl. VII.

On the other hand, can one of the fresh-water clams, Fig. 3, 17, Pl. VII, which are the reverse of the Ostreadæ, being almost invariably free moving or burrowing, and habitually bilateral, become attached, and if so does its shell become distorted like that of an oyster?

The answer to this is Mulleria and genus Ægeria. Mulleria, Fig. 19, becomes attached and is distorted so as to resemble the oyster and not only that, but the animal changes, since there is but one large muscle *g*, as in the oyster, Fig. 1, Pl. VII, in place of

[1] The effects of change of habit have lately been followed out by Dr. Anton Dohrn in an essay in which he shows the results of change of function induced by new conditions to be the transformations of the organs themselves. His hypothesis states that new habits bring about or induce the organs to exercise apparently new functions, which were latent or only partly developed under the original conditions of the surroundings. See Der Ursprung und d. Princip des Functionswechsel, by Dr. Anton Dohrn, Leipzig, 1875.

the two muscles used to close the shell in the clams, *g*, *g*, Fig. 18, Pl. VII, and the beaks of the shell have shifted from the middle of the back to the anterior end. Probably all attached animals show this tendency. Their attached and supported parts, the bases of the stems, etc., are irregular in form and growth, and their free upper parts more or less laterally symmetrical. The radiate symmetry of the soft bodies of corals and of the harder, plate-covered cups of the Crinoids, the attached parts of the Ascidians as compared with their freer bodies above; the perfect bilateral symmetry of the free moving parts of the Mollusca, as in the Helix, Fig. 8, Pl. VII, and Planorbis, Fig. 8 *a*, as compared with their supported spiral shells, the same perfection in the free Eolis, Fig. 2, Pl. VII, which has no shell in the adult, and in most of the Pteropods, Fig. 7, Pl. VII, free swimming animals, as well as in the Cephalopods, Fig. 5, Pl. VII.

One of the best proofs of this position lies where it is least to be expected. The Brachiopoda are attached by a peduncle, or fleshy stem, and the upper valve, and not the lower, is the larger, just the reverse of the oyster.

Upon examination, however, it is found that it is the upper valve which is held by the peduncle and the lower valve alone opens and closes. Then again Lingula, another type of Brachiopod, which is not fixed by its peduncle, but simply occupies a sand burrow, and can move its valves sidewise, one over the other, has equal valves. Professor E. S. Morse's investigations have shown that the symmetry in these animals changes from a worm-like upright form of three rings or segments, and becomes laterally symmetrical by subsequent changes in the form of the first and second segments, the third changing into the peduncle. Here then a round worm-like form exchanges its cylindrical shape for a flatter, shell-covered body in two of its segments, which become bent over into a horizontal position, while the third, which remains vertical, retains the original round tubular form.

The Anomia, Figs. 31, 32, Pl. VII, presents a series of changes very similar in their meaning, though this animal is closely allied to the oyster.

It has the lower valve flat, resting upon and taking the form of the surface upon which it grows. The upper valve, *b*, Figs. 30–31, is convex and larger than the lower concave valve, *a*, Fig. 30, and is supported by a plug, *h*″, passing through the lower valve.

PLATE VII.

Examples of effects of Physical Surroundings on Mollusks.

In this case in which also the upper valve is the larger, it is this which receives the direct support of the attached plug.

The young are at first free, then attached by a byssus. Figs. 26, 27, show the right and left valves at an age when the animal has fallen over on the right side, and the notch, Fig. 27, begins to be formed.

Fig. 28 shows how the lower valve continues to build out around the notch towards the anterior end, and in Figs. 29 and 30, it becomes complete. This greater demand upon functional activity of the lower side of the mantle, and the fact that this is the movable valve, explains why it is not larger than the upper valve as in the oyster.

As was pointed out to me by Mr. J. S. Kingsley, the growth of the upper and lower valves sidewise is really an effort on the part of the animal to recover, by lateral growth in a new direction, the symmetry lost when it fell over on its side. Any one comparing Figs. 28 and 31–30 will see that the long axis of the form in Fig. 31 is at right angles to what it is in Fig. 27.

I shall call this tendency, to equalize the form in the direction of a horizontal plane, *geomalic;* the downward tendency of the growth being designated by botanists, *geotropic.*

The Anomia, when it falls over, loses its bilateral symmetry, because the right and left sides become upper and lower, and being in the vertical position, they are unequally affected by gravity and by change of function. At the same time the dorsal and ventral sides, which were before vertical, have become horizontal; and the geomalic growth of the ventral side, in order to restore the lost equilibrium in a horizontal direction, at once begins. This does not attain perfect lateral symmetry. The form of the animal cannot be easily changed, and the dorsal and ventral sides are still distinguishable; therefore, it is necessary to call this tendency of the growth by a new name, so that we can speak of the dorsal and ventral as well as the right and left sides as having the same tendency to assume by geomalic growth the natural and inevitable condition of equilibrium. The experienced observer will at once think of many apparent violations of this law.

Many larval forms of Gasteropods begin to build the spiral, while they are still within the egg, or still free swimming animals.

Balfour[1] states, in his masterly summary of Comparative Embry-

[1] Comparative Embryology, vol. 1, p. 190.

ology that, during an early larval period, "in most Gasteropods, the shell and mantle extend much more to the left than towards the right side and that the commencement of the spiral shell is thus produced." This same explanation applies to the falling over on one side of the young Anomia and oyster, in so far as the side upon which they fall is heavier than the other or upper side.

These seem to be readily accounted for as the direct results of hereditary peculiarities which have arisen in their ancestors and become embryonic through the action of the law of quicker development or acceleration explained above, and into the same category comes also the straight anomalous bag-like shell or plate of the embryo, and the split bivalve shell of the young oyster, which according to Professor Brooks is never an embryonic plate as in other Lamellibranchs.

The problem has not been approached among animals as it has among the plants by Sachs, Darwin and others. and we do not know how to distinguish between the direct effects of gravitation upon the growth of any animal at any one stated period of its life, and the effects of the proximate causes arising from the inherent tendencies of heredity.

Notwithstanding these imperfections in the evidence, and the absence of experimental proof, it has appeared to me that the discussion of this question would not be without usefulness in calling attention to what seems to me one of the most fruitful lines for experimental research. This, though now attracting much interest among botanists, on account of Sachs' experiments and Darwin's last book, is neglected by zoölogists.

In conclusion, Hyatt summarizes what he has endeavored to condense in his brief communication.

I have tried to show the results of the study of the history of a single species, *Planorbis levis*, and its evolution into many distinguishable forms, of which 14–19 may with justice be called by different names and considered as distinct species. I have also striven to bring into comprehensible shape the following conceptions:

First, that the unsymmetrical spiral forms of the shells of these, and of all the mollusca, probably resulted from the modification of the action of the laws of heredity, produced by gravitation.

Second, that there are many characteristics in these and in other groups of shells which are due solely to the uniform action of the physical influence of the immediate surroundings, varying with every change of locality, but constant and uniform within each locality.

Third, that the Darwinian law of natural selection does not explain these relations, but applies only to the first stages in the establishment of the differences between forms or species in the same locality. That its office is to fix these in the organization and bring them within the reach of the laws of heredity.

Fourth, that after this is done, they are inherited according to the law of heredity with acceleration, which shows us in what manner these differences and all other inheritable characters, however originated, may with greater or less rapidity, become incorporated in the young of descendant forms and species.

Fifth,[1] that in these earlier stages they are more or less protected from change and may therefore remain comparatively invariable through long periods of time, or may be exposed to great changes in exceptional cases, and modified accordingly.

Sixth, that these phenomena show, that in growth, reproduction and heredity by acceleration, there is manifested a decided reaction of the organism, which succeeds in building up and maintaining the type structure and form, under all ordinary or normal terrestrial conditions, but in some cases fails in fully accomplishing this when exposed to exceptional surroundings, as in some cases of parasitism.

Seventh, that gravity appears to be one of the causes of the differences in effort, function and anatomy observed between the sides or ends of animal forms when in vertical relations to each other and to the earth, whether these be the anterior and posterior ends of the form, or the dorsal and ventral, or the left and right sides.

Eighth, that the bilateral or geomalic growth observed in the internal organs and the external parts of the organism when their sides are in their original and hereditary positions, and the geomalic growth of the dorsal and ventral sides, when these become horizontal through change of habit, appear to be directly or indirectly, responses to the demands of gravity.

Ninth, the origin of the limbs, etc., in pairs, while mere buds,

[1] The fifth and sixth propositions are not discussed in this communication for want of space, but were given in the Memoir on Steinheim Shells above quoted, and in the evening lecture of which this is an abstract.

is difficult to account for, if they are not considered as the results of the efforts of the tissues of animals to maintain the equipoise of all the parts by geomalic growth in obedience to the laws of gravity.

EXPLANATION OF LETTERS.

a, right valve; *b*, left valve; *ba*, shell; *c*, hinge area; *c'*, hinge ligament; *d*, mantle; *d+* mantle border; *d'*, inner limit of mantle border; *d''*, pallial line or trace made by *d'* on the inner side of the valves; *dx*, siphon of double funnel of clam; *e*, outer layers of shell built by the mantle border; *e'*, inner layers of shell built by the mantle itself; *f*, beaks of young valves, still remaining to form the beaks of the two valves; *fa*, right beak; *fb*, left beak; *f'*, beak, apex or young shell of Gasteropod still remaining at the center of the spire in Gasteropods; *g*, impression or mark made by the posterior adductor muscle on the interior of the valves; *g'*, position of anterior adductor muscle shown through the shell only by a dotted line; *h*, depression or hole made by the byssus or byssal plug in the lower valve of Anomia; *h'*, byssus of threads; *h''*, byssal plug; *k*, foot or crawling disk; *k'*, tentacles or feelers; *k''*, division between foot and head; *l*, position of the mouth; *m*, palpi, or flaps for conveying the food into the mouth; *m'*, right pair; *m''*, left pair; *n*, gills; *n'*, right pair; *n''*, left pair.

PLATE VI.

The specimens from Undorf all belong to an older Tertiary period than that at Steinheim. Plate VI is copied from Pl. 9 of memoir above quoted, except Figs. 29–30.

SERIES IV.

FIG. 1, Pl. levis, Undorf.
" 2, " Steinheimensis, Steinheim.
" 3, " tenuis, / Steinheimensis,[1] "
" 4, " tenuis, "
" 5, " discoideus "
" 6, " trochiformis, / discoideus, "
" 7, " trochiformis, "

SERIES III.

" 8, " levis, Undorf.
" 9, " oxystomus, Steinheim.
" 10, " supremus, "
" 11, " " var. turrita, "

SERIES II.

" 12, " levis, Undorf.
" 13, " crescens, / parvus, Steinheim.
" 14, " crescens, "
" 15, " " "

SERIES I.

Sub-series 3.

" 16, Pl. levis, Undorf.
" 17, " minutus, / levis, Steinheim.
" 18, " minutus, "
" 19, " triquetrus, "
" 20, " " "

Sub-series 2.

" 21, " minutus, Steinheim.
" 22, " denudatus, / minutus, "
" 23, " denudatus, / minutus, "
" 24, " denudatus, / var. distortus, "

[1] Names written in this way indicate the transition forms, as in this case the variety connecting Steinheimensis with *tenuis*.

Sub-series 1.

FIG. 25, " costatus. / minutus, } Steinheim.

" 26, " costatus, "

" 27, " costatus, var— "

" 28, " costatus, var— "

" 29, Doto coronata? young showing the oval shell and the swimming organ or velum from above. *V*, velum, *y*, eyes, *p*, operculum, the hinged disk used in closing the opening of the shell when the velum and foot, *k*, are drawn into it as the animal retracts. The mouth is indicated by the black spot near the center of the velum.

" 30, View of the same taken partly from the side.

PLATE VII.

FIG. 1, Left or lower valve of oyster (Fig. 13 *b*).

" 2, Eolis seen from above (after Adams).

" 3, Anodonta with shell open.

" 4, Young of oyster (after Brooks), abdominal view.

" 5, Loligo pallida (after Verrill), dorsal view.

" 6, Limax, side view.

" 7, Cavolina, dorsal view (after Brown).

" 8, Helix, seen partly from the under side.

" 9, The same with the shell dissolved by acid, showing the conical bag of the mantle partly unwound.

" 10, Vermetus tricarinatus, group of.

" 10*a*, " a broken specimen winding about on a shell of Lima.

" 11, Patella, diagram showing relation of shell to the crawling disk.

" 12, Same, edge of shell in section, and mantle exposed on one side.

" 13, Oyster in natural position attached firmly to a stone, but projecting without other support for about ¾ of its own length.

" 14, Clam shell (Mya) in outline above an oyster shell and both in the same position with reference to the structure of the two animals, if these were in their places inside of the shell.

" 15, Mytilus edulis (after Morse), common mussel attached to a stone by its byssus with the foot protruded.

" 16, Lima, view from the posterior end, showing bilateral symmetry.

" 17, Anodonta, same.

" 18, Mya arenaria. Common clam seen from the side with the siphon and mantle-rim or foot extended.

" 19, Mulleria, right or attached valve, with the solidified beak and the young shell showing at the end of the beak (after Adams).

" 20, Beak of the same showing the form of the young shells, from the dorsal side.

" 21, Pl. oxystomus, var. revertens, spiral showing the unwinding in an adult individual, due to disease.

" 21*a*. Top view of Fig. 21, and showing also the nucleus or young shell.

" 22, Pl. oxystomus, extremely old specimen showing similar unwinding of the spiral due to the weakness of senility.

" 23, Magilus antiquus, showing the regular spiral below and the irregular straight shell above built after the spiral shell has been buried in the coral (after Woodward).

" 24, Pl. steinheimensis, var. æquiumbilicatus, view of section showing how perfectly balanced the two sides of the spire are in some shells during their entire growth.

" 25, External view of the same shell, seen from the ventral side.

" 26, Anomia, young shell, left valve (after Morse).

" 27, Anomia, young shell, right valve (after Morse).

" 28, Anomia, young shell, right valve after the shell is turned so as to rest on this valve, which is now below and is making an effort to readjust the lateral symmetry by the geomalic growth of this valve around the byssal plug (aftor Morse).

" 29, The same, with the same valve after it has been built around the byssal plug (after Morse).

" 30, Anomia glabra, a full-grown shell, seen from the lower, right side, with upper left valve showing its projecting edges and beak beyond.

" 31, The same from the upper or left side, lower shell necessarily concealed.

" 32, The same from the anterior end to show distortion produced by the change in position. The lower or right valve is too concave to be visible.

[All figures not otherwise designated are original.]

ON ARCHÆSTHETISM.

BY E. D. COPE.

I. The Hypothesis of Use and Effort.

THE claims of the theory of Lamarck, that use modifies structure in the animal kingdom, are being more carefully considered than heretofore, and are being admitted in quarters where they have been hitherto neglected or ignored. Eleven years ago I restated the question as follows:[1]

"The influences and forces which have operated to produce the type structures of the animal kingdom have been plainly of two kinds: 1. *Originative*, 2. *Directive*. The prime importance of the former is obvious; that the latter is only secondary in the order of time or succession, is evident from the fact that it controls the preservation or destruction of the results or creations of the first.

"Wallace and Darwin have propounded as the cause of modification in descent their law of natural selection. This law has been epitomized by Spencer as the 'survival of the fittest.' This neat expression no doubt covers the case, but it leaves the origin of the fittest entirely untouched. Darwin assumes a 'tendency to variation' in nature, and it is plainly necessary to do this, in order that materials for the exercise of a selection should exist. Darwin and Wallace's law is, then, only restrictive, directive, conservative or destructive of something already created. I propose then to seek for the originative laws by which these subjects are furnished—in other words, for the causes of the origin of the fittest.

"It has seemed to the author so clear from the first as to require no demonstration, that natural selection includes no *actively* progressive principle whatever; that it must first wait for the development of variation, and then after securing the survival of the best, wait again for the best to project its own variations for selection. In the question as to whether the latter are any better or worse than the characters of the parent, natural selection in no wise concerns itself."

In seeking for the causes of the origin of variation, the following hypothesis was proposed:

"What are the influences locating growth force? The only efficient ones with which we are acquainted, are, first, physical and chemical causes; second, use; and I would add a third, viz: effort. I leave the first as not especially prominent in the economy of type growth among animals, and confine myself to the

[1] The Method of Creation, 1871, pp. 2 and 18. Walker Prize Essay. Proceeds. Amer. Philos. Soc., pp. 230–246.

two following. The effects of use are well known. We cannot use a muscle without increasing its bulk; we cannot long use the teeth in mastication without inducing a renewed deposit of dentine within the pulp-cavity to meet the encroachments of attrition. The hands of the laborer are always larger than those of men of other pursuits. Pathology furnishes us with a host of hypertrophies, exostoses, etc., produced by excessive use, or necessity for increased means of performing excessive work. The tendency, then, induced by use in the parent, is to add segments or cells to the organ used. Use thus determines the locality of new repetitions of parts already existing, and determines an increase of growth force at the same time, by the increase of food always accompanying increase of work done, in every animal.

"But supposing there be no part or organ to use. Such must have been the condition of every animal prior to the appearance of an additional digit or limb or other useful element. It appears to me that the cause of the determination of growth force is not merely the irritation of the part or organ used by contact with the objects of its use. This would seem to be the remote cause of the deposit of dentine in the used tooth; in the thickening epidermis of the hand of the laborer; in the wandering of the lymph-cells to the scarified cornea of the frog in Cohnheim's experiment. You cannot rub the sclerotica of the eye without producing an expansion of the capillary arteries and corresponding increase in the amount of nutritive fluid. But the case may be different in the muscles and other organs (as the pigment cells of reptiles and fishes) which are under the control of the volition of the animal. Here, and in many other instances which might be cited, it cannot be asserted that the nutrition of use is not under the direct control of the will through the mediation of nerve force. Therefore I am disposed to believe that growth force may be, through the motive force of the animal, as readily determined to a locality where an executive organ does not exist, as to the first segment or cell of such an organ already commenced, and that therefore effort is, in the order of time, the first factor in acceleration."

A difficulty in the way of this hypothesis, is the frequently unyielding character of the structures of adult animals, and the difficulty of bringing sufficient pressure to bear on them without destroying life. But in fact the modifications must, in most instances take place during the period of growth. It is well known that the mental characteristics of the father are transmitted through the spermatozoöid, and that therefore the molecular movements which produce the mechanism of such mental characters, must exist in the spermatozoöid. But the material of the spermatozoöid is combined with that of the ovum, and the embryo is composed of the united contents of both bodies. In a wonderful way the embryo develops into a being which resembles one or both parents in minute details. This result is evidently determined by the molecular and dynamic character of the original reproductive cells, which necessarily communicate their properties to the embryo, which is produced by their subdivision. Rud. Hering has identified this property of the original cells with the faculty of memory. This is a brilliant thought, and, under restriction, probably correct. The sensations of persons who have suffered amputation, shows that their sensorium retains a picture or map of the body so far as regards the location of all its sensitive regions. This simulacrum is invaded by consciousness whenever the proper stimulus is applied, and the locality of the stimulus fixed by it. This picture probably resides in many of the cells both sensory and motor, and it doubtless does so in the few cells of simple and low forms of life. The spermatozoöid is such a cell, and, how or why we know not, also contains such an arrangement of its contents, and contains and communicates such a type of force. It is probable that in the brain cell this is the condition of memory of locality. If now an intense and long-continued pressure of stimulus produces an unconscious picture of some organ of the body in the mind, there is reason to suppose that the energies communicated to the embryo by the spermatozoöid and ovum, will partake of the character of the memory thus created. The only reason why the oft-repeated stories of birth-marks are so often untrue, is because the effect of temporary impressions on the mother is not strong enough to counterbalance the molecular structure established by impressions oftener repeated throughout much longer periods of time.

The demonstration of the truth or falsity of this position so as to constitute it the true doctrine of evolution, could only be verified from the prosecution of the science of palæontology. It is only in this field that the consecutive series of structures can be obtained, which show the directions in which modification has taken place, and thus furnish evidence as to the causes of change. The most complete result of these investigations up to the present time, has been the obtaining of sufficiently full series of the Mammalia of the Tertiary period, to show their lines of descent. In this way the series of modifications of their teeth and feet has been discovered, and the homologies of their parts been ascertained.[1] Perhaps the most important result of these investigations is the following: The variations from which natural selection has derived the persistent types of life, have not been general or even very extensive. They have been in a limited number of directions,[2] and the most of these have been towards the increase in perfection of some machine. They bear the impress of the presence of an adequate originating cause, directed to a special end. Some of the lines struck out have been apparently inadequate to cope with their environment, and have been discontinued. Others have been more successful and have remained, and attained further modification.

The reader can estimate the chance of the production of an especially adaptive mechanism in the absence of any pressure of force directing growth to that end. It appears to me that the probability of such variation appearing under such circumstances is very slight indeed, and its continuance through many geologic ages directed to the perfecting of one and the same machine, still smaller. For this reason, attempts have been made to demonstrate a mechanical cause for the modifications of structure observed. For these I refer to papers by Messrs. Alpheus Hyatt, J. A. Ryder and myself; by Professor Hyatt * * "Upon the effects of gravity on the forms of shells and animals;"[3] Mr. Ryder "On the mechanical genesis of Tooth Forms;"[4] and "On the laws of digital reduction;"[5] by myself "On the origin of the specialized teeth of the Carnivora;"[6] "On the origin of the foot structures of the Ungulates;"[7] "On the effect of Impacts and Strains on the Feet of Mammalia."[8] Now demonstration of the mechanical effects of the application of force to matter can only be obtained by observation of the process, and this cannot be seen, of course, by the observation of fossils. The

[1] Homologies and Origin of the Molar teeth of the Mammalia educabilia. Journal Academy Nat. Sciences, Philadelphia, March, 1874. Proceedings Academy Nat. Sci., 1865, p. 22.

[2] See Hyatt on this point, Tertiary Planorbis of Steinheim. Anniv. Mem. Bost. Soc. Nat. Hist., 1880, p. 20.

[3] Proceeds. Amer. Assoc. Adv. Science, 1880, p. 527.

[4] Proceedings Academy Philadelphia, 1878, p. 45, 1879, 47.

[5] Loc. cit., 1877, October.

[6] American Naturalist, March, 1879, p. 171.

[7] Loc. cit., April, 1881, 269.

[8] Loc. cit., July, 1881, p. 542.

relation of the observed facts to the hypothesis is, however, shown by the above papers to be so precise that it only needs observation on the production of similar changes by similar causes in living types, to give us a demonstration by induction, which will satisfy most minds. That such facts have been observed among the lower animals is well known. The change of form of animals without hard parts, in adaptation to their environment, is an everyday occurrence.

That these views are now shared by many naturalists is becoming every day more evident. Professor E. Dubois Raymond[1] has recently delivered a lecture before the physicians of the German army, on exercise or use, in which he makes some important admissions. We give the following extract: "We should be, therefore, free to admit, with some appearance of reason, that the vigor of the muscles of wings and of digging feet; the thick epidermis of the palm of the hand and of the sole of the foot; the callosities of the tail and of the ischia of some monkeys; the processes of bones for the insertion of muscles; are the consequences of nutritive and formative excitation, transmitted by heredity." In this position Professor Raymond is in strict accord with the Lamarkian school of evolutionists. But Professor Raymond still clings to the obscurities of the Darwinians, though Darwin himself is not responsible for them, in the following sentences: "It is necessary to admit along with development by use, development by natural selection, and that for three reasons. First, there are innumerable adaptations—I cite only those known as mimetic coloration—which appear to be only explicable by natural selection, and not by use. Second, plants which are, in their way, as well adapted to their environment as animals, are of course incapable of activity. Thirdly, we need the doctrine of natural selection to explain the origin of the capacity for exercise itself. Unless we admit that which it is impossible to do from a scientific standpoint, that designed structures have a mechanical origin, it is necessary to conclude that in the struggle for existence the victory has been secured by those living beings who in exercising their natural functions have increased by chance ("par hasard") their capacity for these functions more than others, and that the beings thus favored have transmitted their fortunate gifts to be still further developed by their descendants."

[1] *Revue Scientifique*, Paris, Jan. 28, 1882.

To take up first the second and third of these propositions, Professor Raymond does not for the moment remember that movement (or use) is an attribute of all life in its simplest forms, and that the sessile types of life, both vegetable and animal, must, in view of the facts, be regarded as a condition of degeneration. It is scarcely to be doubted that the primordial types of vegetation were all free swimmers, and that their habit of building cellulose and starch, is responsible for their early-assumed stationary condition. Their protoplasm is still in motion in the limited confines of their walls of cellulose. The movements of primitive plants have doubtless modified their structure to the extent of their duration and scope, and probably laid slightly varied foundations on which automatic nutrition has built widely diverse results. We may attribute the *origin* of the forms of the vegetable kingdom to three kinds of motion which have acted in conjunction with the physical environment; first, their primordial free movements; second, the intracellular movements of protoplasm; third, the movements of insects, which have doubtless modified the structure of the floral organs. Of the forms thus produced, the fit have survived and the unfit have been lost, and that is what natural selection has had to do with it.

The *origin* of mimetic coloration, like many other things, is yet unknown. An orthodox Darwinian attributes it to "natural selection," which turns out, on analysis, to be "hasard." The *survival* of useful coloration is no doubt the result of natural selection. But this cannot be confounded with the question of origin. On this point the Darwinian is on the same footing as the old-time Creationist. The latter says God made the variations, and the Darwinian says that they came by chance. Between these positions science can perceive nothing to choose.

I have attempted to explain the relation which non-adaptive structures bear to the theory of use and effort, in the following language:[1]

"*The complementary diminution* of growth nutrition follows the excess of the same in a new locality or organ, of necessity, if the whole amount of which an animal is capable, be, as I believe [for the time being], fixed. In this way are explained the cases of retardation of character seen in most higher types. The discovery of truly complementary parts is a matter of nice observation and experiment. Perhaps the following cases may be correctly explained.

[1] Method of Creation, p. 23, 1871.

"A complementary loss of growth force may be seen in the absence of superior incisor teeth and digits in ruminating Mammalia, where excessive force is evidently expended in the development of horns, and complication of stomach and digestive organs. The excess devoted to the latter region may account for the lack of teeth at its anterior orifice, the mouth; otherwise, there appears to be no reason why the ruminating animals should not have the superior incisors as well developed as in the odd-toed (Perissodactyl) Ungulates, many of which graze and browse. The loss to the osseous system in the subtraction of digits may be made up in the development of horns and horn-cores, the horn sheath being perhaps the complement of the lost hoofs. It is not proposed to assert that similar parts or organs are necessarily and in all groups complementary to each other. The horse has the bones of the feet still further reduced than the ox, and is nevertheless without horns. The expenditure of the complementary growth force may be sought elsewhere in this animal. The lateral digits of the *Equidæ* are successively retarded in their growth, their reduction being marked in *Hippotherium*, the last of the three-toed horses; it is accompanied by an almost coincident acceleration in the growth nutrition of the middle toe, which thus appears to be complementary to them."

II. The Office of Consciousness.

If the law of modification of structure by use and effort be true, it is evident that consciousness or sensibility must play an important part in evolution. This is because movements of animals are plainly in part controlled by their conscious states. The question as to how many of the actions of animals are due to conscious states at once arises. It is well known that most of the more strictly vital functions are unconsciously performed. Not only these, but many acts which have to be learned, come to be performed in unconsciousness. Further, movements appropriate to needs which arise at the moment, and which are ordinarily termed voluntary, because they require the introduction of more or less of the rational faculty, are readily performed by vertebrated animals deprived of a brain, through the agency of the spinal cord alone.[1] The history of the origin of these movements must then be traced.

The movements of living beings generally possess the peculiarity of design, in which they differ from the movements of nonliving bodies. That is, their actions have some definite reference to their well being or pleasure, or their preservation from injury

[1] Such expressions as "unconscious sensibility" and "unconscious will" are not used here, as being self-contradictory in terms and without meaning.

or pain, and are varied with circumstances as they arise. This is not the case with non-living bodies, which move regardless of their integrity or that of objects near them. This characteristic at once suggests that some element enters into them which is wanting to the movements of non-living masses. It has been suggested that the attraction of animals for their food and their repulsion from pain are derivatives from the attractions and repulsions of inorganic bodies, supposed to be the exhibitions of the force called chemism. But this supposition does not explain the wide difference between the two classes of acts. The adaptation to the environment seen in organic acts is unknown to the inorganic world, while the invariable character of the motions of inorganic force is greatly modified in beings possessed of life. Whether consciously performed or not, the acts of organic beings resemble those of conscious beings actuated by instincts of hunger, reproduction and defense.

An explanation of these facts seems to be offered by a well known phenomenon. We know that it is true of ourselves and of many other animals, that while all new movements have to be learned by repeated attempts, with each succeeding movement the act becomes easier, and that finally it can be performed without requiring any attention whatever. If continued, the movement becomes automatic, so that it may be, or is performed in a state of unconsciousness. In the words of Spencer, nervous currents move most readily along accustomed channels. Thus the "habits" of animals may be looked on as movements acquired in consciousness, and become automatic through frequent repetition. Not only this, but the organization thus produced in the parent is transmitted to the succeeding generation, so that the movements of the latter are automatically and often unconsciously performed. This view may be even extended to the purely vital functions with every probability of its being the true explanation of their origin and development. On a former occasion[1] I wrote:

"In accordance with this view, the automatic 'involuntary' movements of the heart, intestines, reproductive systems, etc., were organized in successive states of consciousness, which conferred rhythmic movements whose results varied with the machinery already existing and the material at hand for use. It is not inconceivable that circulation may have been established by the suffering produced by an overloaded stomach demanding dis-

[1] Consciousness in Evolution. *Penn Monthly*, August, 1875, p. 565.

tribution of its contents. The structure of the Cœlenterata offers the structural conditions of such a process. A want of propulsive power in a stomach or body sac occupied with its own functions, would lead to a painful clogging of the flow of its products, and the 'voluntary' contractility of the body or tube wall being thus stimulated, would at some point originate the pulsation necessary to relieve the tension. Thus might have originated the 'contractile vesicle' of some protozoa, or contractile tube of some higher animals; its ultimate product being the mammalian heart. So with reproduction. Perhaps an excess of assimilation in well-fed individuals of the first animals, led to the discovery that self-division constituted a relief from the oppression of too great bulk. With the increasing specialization of form, this process would become necessarily localized in the body, and growth would repeat such resulting structure in descent, as readily as any of the other structural peculiarities. No function bears the mark of conscious origin more than this one, as consciousness is still one of the conditions of its performance. While less completely "voluntary" than muscular action, it is more dependent on stimulus for its initial movements, and does not in these display the unconscious automatism characteristic of the muscular acts of many other functions."

It was not proposed in the preceding paragraph that the contractility of living protoplasm should be regarded as due to consciousness, but that the location in a particular place of a contractility already existing, might be due to that cause.

The preceding hypotheses bring us to a general theory of the evolution of organic structures or species. It is that they are the result of movements long continued and inherited, and that the character of these movements was originally determined by consciousness or sensibility. It remains then to consider the nature of consciousness.

It may be mentioned that it is here left open whether there be any form of force which may be especially designated as "vital." Many of the animal functions are known to be physical and chemical, and if there be any one which appears to be less explicable by reference to these forces than the others, it is that of nutrition. Probably in this instance force has been so metamorphosed through the influence of the originative or conscious force in evolution, that it is a distinct species in the category of forces. Assuming it to be such, I have given it the name of Bathmism (Method of Creation, 1871, p. 26). Perhaps the contractility generally regarded as an attribute of living protoplasm may be a mechanical phenomenon dependent of course on nutrition; or it may be the exhibition of a force peculiar to living beings; and hence one of the "vital" group.

III. Archæsthetism.

The doctrine of evolution derives the organs of special sense from those of simple sensibility or touch. In other words, their history has been that of other organs; the complex have been derived from the general and simple. There are then generalized consciousness and specialized consciousness. A number of forms of consciousness multiplies its vividness, the one kind reinforcing the other by a slightly different appreciation of the same thing. In the case of persons deprived of the sense of touch, the sense of sight is not sufficient to convince them of their own existence, as a matter of intellectual reflection. When there is no nervous system we must suppose sensibility to be generally distributed throughout the protoplasmic substance of the animal. The localization of consciousness must depend on a localization of the kind and condition of protoplasm which sustains it; while in other parts of the body the protoplasm is modified in other directions and for other purposes. If this be true, the nervous tissue of the higher animals should retain the characters of the lowest simple organisms. In point of fact this is the case, the nucleated cell being the essentially active element in the functions of brain and nerve, and being more numerous in that tissue than in any other.

The remarkable evanescence of consciousness is one of its most marked characteristics. It is this peculiarity which has lead many thinkers to deny its existence in the lower animals, and to induce others to believe that it can have had but little place among the causes of evolution. Partly for the same reason many biologists attempt to derive it by metamorphosis from some form of force.

But the nature of consciousness is such that it cannot be derived from unconsciousness, any more than matter can be derived from no matter, or force from no force. The "unthinkable dogma of creation" (Haeckel) cannot be applied to consciousness more than to matter or force. It is a thing by itself, and with matter and force, forms a trio of primitive things which have to be accepted as ultimate facts. This is perfectly consistent with the position that consciousness is an attribute of matter, and neither more nor less difficult to comprehend than the fact that force is an attribute of matter. This view is maintained in a fashion of his own by G. H. Lewes. Professor Raymond[1] says in support of the same position:

"'More temperate heads betrayed the weakness of their dialectics in that they could not grasp the difference between the view which I opposed, that consciousness can be explained upon a mechanical basis, and the view which I did not question, but supported with new arguments, that consciousness is bound to material antecedents.' This position has been maintained by various writers, among them Professor Allman[2] and the writer. But Professor Raymond has not found it to be acceptable to his nearest cotemporaries. He says, 'The opposition which has been offered to my assertion of the incomprehensibility of consciousness on a mechanical theory, shows how mistaken is the idea of the later philosophy, that that incomprehensibility is self-evident. It appears rather, that all philosophizing upon the mind must begin with the statement of this point.' In stating this point some years ago, we used the following language:[3] 'It will doubtless become possible to exhibit a parallel scale of relations between stimuli on the one hand and the degrees of consciousness on the other. Yet for all this it will be impossible to express self-knowledge in terms of force.' And again,[4] 'An unprejudiced scrutiny of the nature of consciousness, no matter how limited that scrutiny necessarily is, shows that it is qualitatively comparable to nothing else. * * From this standpoint it is looked upon as a state of matter which is coëternal with it, but not coëxtensive.'"

It is probable then that consciousness is a condition of matter in some peculiar state, and that wherever that condition of matter exists, consciousness will be found, and that the absence of that state implies the absence of consciousness. What is that state?

It would be a monstrous assumption to suppose that consciousness and life are confined to the planet on which we dwell. I presume that no one would be willing to maintain such an hypothesis. Yet it is obvious that if there be beings possessed of these attributes in the planets Mercury and Saturn, they cannot be composed of protoplasm, nor of any identical substance in the two. In the one planet protoplasm would be utterly disorganized and represented by its component gases; in the other it would be

[1] Address on the celebration of the Birthday of Leibnitz, *Pop. Science Monthly*, Feb., 1882.

[2] Address delivered before the British Association for the Advancement of Science.

[3] Consciousness in Evolution *Penn Monthly*, July, 1875.

[4] The Origin of the Will, *Penn Monthly*, 1877, p. 439.

a solid, suitable for the manufacture of sharp-edged tools.[1] But as it is probable that protoplasm is adapted for the phenomena of consciousness by a certain peculiarity of its constitution, it seems evident that other substances having a similar peculiarity may also be able to sustain it. I have elsewhere attempted to discover what this is, in the following language:[2]

"Nowhere does 'the doctrine of the unspecialized' receive greater warrant than in the constitution of protoplasm. Modern chemistry refers compound substances to four classes, each of which is characterized by a special formula of combination. These are called the hydrochloric acid type, the water gas type, the ammonia type and the marsh gas type. These series are defined by the volumetric relations of their component simple substances: thus in the first, a single volume unites with an equal volume of hydrogen; in the second, two volumes of hydrogen unite with a single volume of another element; in the third, three, and in the fourth, four volumes of hydrogen unite with the single volume of other elements. Hence the composition of these compounds is expressed by the following formulas—chlorine, oxygen, nitrogen and carbon being selected as typical of their respective classes: HCl, H_2O, H_3N and H_4C. Now it is an interesting fact that protoplasm is composed of definite proportions of four simple substances, each one representing one of the classes above named, or in other words, the capacity for proportional molecular combination which characterizes them. The formula $C_{24}N_8O\,H_{17}$ expresses the constitution of this remarkable substance. Now although the significance of these combining numbers is unknown, there is a conceivable connection between the characteristic peculiarities of protoplasm and the nature of the substances which compose it. It is probable that these, when in combination with each other, exert a mutually antagonistic control over each other's especial and powerful tendencies to form stable, and hence dead, compounds. It is therefore reasonable that the terms 'unspecialized' or 'undecided' should be applicable to the molecular condition of protoplasm, and in so far it is a suitable nidus for higher molecular organization, and a capacity for higher forms of force conversion than any other known substance. If also in inorganic types, as in the organic the generalized have preceded the specialized in the order of evolution, we are directed to a primitive condition of matter which presented the essentially unspecialized condition of protoplasm, without some of its physical features. We are not necessarily bound to the hypothesis that protoplasm is the only substance capable of supporting consciousness, but to the opposite view, that the probabilities are in favor of other

[1] Fraser in AMERICAN NATURALIST, 1879, p. 420.

[2] Consciousness in Evolution, 1875, p. 573.

and unspecialized, but unknown forms of matter possessing this capacity."

The condition of living protoplasm was also referred to in the following language in a later publication:[1]

"The cause of the difference between conscious and unconscious force must be secondarily due to different conditions of matter as to its atomic constitution; consciousness being only possible, so far as we can ascertain, to matter which has not fallen into fixed and automatic relations of its atoms."

Protoplasm in the form of food is not conscious; and tissue formed of protoplasm is not conscious, excepting certain cells where the forming process is in action. Nor is consciousness present in all cells where nutrition is active. From the increased consumption of energy, and the increased expenditure of energy (heat, Lombard) which takes place during conscious processes, we may well believe that the decomposition of protoplasm is more considerable in such processes than in other forms of nervous activity. We can imagine simple nutrition to be a condition of the elements of this substance in which the chemical force is simultaneously combining and dissolving its combination, and that during the process there is a condition in which the chemism is for the time being unsatisfied, though present. The direction which this nutrition or metastasis takes, is due to the arrangement of the molecules already existing in the tissue, the new molecules taking the form of the old ones in replacement, so long as no extraneous force interferes. That they are rearranged under the influence of consciousness is apparent in the origin of variations of structure in accordance with the views of evolution already entertained. It is the arrangement of the molecules which constitutes the automatic machinery of nutrition as well as of other activities, so that consciousness necessarily only appears in that stage of nutrition while the matter is in a transition state, and unformed. Whether chemism must be regarded as suspended, or only unsatisfied, at this stage, can only be imagined. As non-satisfaction is probably the temporary condition in all nutrition it is not unlikely that suspension may be the condition of consciousness.

Perhaps the character of the components of protoplasm is such, that the movements of their atoms, *i. e.*, their chemism, mutually

[1] The Origin of the Will, *Penn Monthly*, June, 1877, p. 439.

interfere and destroy each other, as in the cases of the interference of the waves of light and sound.

The colloid form of protoplasm is especially favorable to internal movements which shall not destroy the integrity of the mass, perhaps more so than a gaseous state in a compound of similar constitution. It is, moreover, more favorable to the preservation of molarity than a gas could be, on account of the ease with which it adheres to solid substances, and transports and locates them as part of its external and internal supports. But it is not inconceivable that under other conditions of temperature, etc., the gaseous condition of matter might answer the same purpose. It must be borne in mind, however, that this is a subordinate question, and that the real characteristic of the "physical basis of life" is to be found rather in its generalized *dynamic* condition.

We must then believe that wherever this generalized condition exists, consciousness will be present. As soon as mechanical or chemical force appears in the molecules of the sustaining substance, consciousness disappears. The organism has taken the first step towards death, but is not dead, but is *anæsthetized.* Constant nutrition is essential to the performance of all life functions, including consciousness, and it is evident that this is necessary to the maintenance of the unspecialized condition in which the latter appears.

Is the appearance of sensibility on the development of its sustaining condition, evidence that the latter stands to the former in the relation of cause and effect? If the view of the preëxistence of consciousness be true, there is no more relation of cause and effect than in the case of the opening of a door which admits a wind. The force expended in opening the door is not converted into the energy exerted by the wind as it enters the room. It simply releases it, or admits it to a new field. It is, however, true, that consciousness having once entered, a larger conversion of force is necessary to its persistence than is expended during its absence. Like combustion, which is only communicable under suitable conditions, consciousness having once been transmitted to a new *æsthetophore*,[1] lives on it, and requires constant supplies of material for its sustenance.

The hypothesis of the primitive and creative function of consciousness may be called *Archæsthetism.*

[1] Æsthetophore, a substance which sustains consciousness.

IV. Panæsthetism.

It has been the custom of men from the dawn of thought to attempt to construct for themselves cosmogonies and theologies. Science is yet far from supplying the facts necessary to the construction of a true system of the universe, and philosophy can only stretch out a little further into the unknown by the use of necessary inference. In spite, however, of the insufficiency of the data, men still suggest new views or cling to old ones, and an occasional flight into this region of thought, at least brings the thinker into sympathy with the thoughts of his fellow-men.

The admission of the possibility of the existence of consciousness in other forms of matter than protoplasm, and in other planets than the Earth, lends countenance to a rational belief in the so-called "supernatural" (better called the supersensuous) so prevalent among men in irrational forms. The question naturally arises, is there any generalized form of matter distributed through the universe which could sustain consciousness? The presumption is that such a form of matter may well exist. Evolution or specialization has only worked up part of its raw material in the organic world. Wherever primitive conditions remain, there primitive organisms abound. *Protozoa* are yet numerous on land, and the *Protobathybius* inhabits the depths of the sea. Highly specialized forms of life are in fact numerically a minority of living beings. May not this be true also of inorganic beings? It is thought that various celestial bodies represent unfinished worlds. Is it not probable that the grand source of matter not yet specialized into the sixty odd substances known to us, may still sustain the primitive force not yet modified into its species, and that this combination of states may be the condition of persistent consciousness from which all lesser lights derive their brilliancy? There is much to warrant such a view in the observed facts of life, taken in connection with the general course of evolution. Moreover that some form of matter connects the interstellar spaces, is thought to be proven by the transmission of light in some cases, and light and heat in others. That such a form of matter pervades all spaces whatever, is the theory of some physicists. If it be so generalized as to be capable of sustaining consciousness, it becomes the source from which other substances derive it, so soon as they, through the energy of nutrition, which resists death, maintain the same primitive and unformed constitution capable of exhibiting it.

Of course there is no evidence in our own memory of the existence of our personality prior to our human experience. No one on awaking from unconsciousness remembers having been anywhere in particular during the interval. These facts may be harmonized with the theory here presented, on the supposition that memory is lost on a transfer of consciousness from one physical basis to another. The arguments in favor of a transfer of consciousness do not sustain the idea of a transfer of memory. Memory requires an arrangement of molecules or atoms which when finished no longer exhibits consciousness. With proper stimulus, when the proper kind of force conversion is set up in them, consciousness extends into them, and taking their form, produces reminiscence or conscious memory. The molecular arrangement would be probably lost on a transfer of consciousness to a new material basis. It might then be supposed that with every such transfer a new personality is established. Though the correct definition of personality includes memory as well as consciousness, when viewed as an objective concept, it may be questioned whether memory is necessary to the subjective belief in one's own personality. Those insane persons who believe that they have lost their personality, and think that they are some one else, nevertheless recognize the fact that what they now are has a continuity of existence with what they once were. The material limitations of consciousness are the authors of the kind of personality it presents. A limitation or an expansion of its range would not destroy the idea of personality, but would simply restrict or extend it. The possible confluence of many personalities would not destroy them, but each one would regard the others as additions to himself, and himself, therefore, as so much the greater being.

As a summary of the preceding conclusions, the following analysis of metaphysical systems may be given. It defines the place of the doctrine of archæsthetism, above proposed, as distinguished from the opposing view of metæsthetism, which is held by many monists:

I. Consciousness ("spirit") is independent of matter .... DUALISM.

II. Consciousness is an attribute of matter .... MONISM.

 a. Consciousness is primitive and a cause of evolution .... *Archæsthetism.*

 β. Consciousness is a product of the evolution of matter and force *Metæsthetism.*

ORGANIC PHYSICS.

BY CHARLES MORRIS.

I. The Chemical Evolution of Life.

In regard to the question of the origin and character of organic energy the whole course of modern science leads steadily to one conclusion. This is, to express it plainly, that the formation of the organic body is a chemical problem, and the source of life force a question in physics. There has been a severe battle fought against this tendency to reduce life to a chemical equation. The adherents of the doctrine of vital energy have entrenched themselves behind many successive lines of defence, and are still fighting, with the bitterness of despair, behind their last barrier, that of protoplasm. Yet science has gone steadily on, breaking down, one by one, the dividing walls between organic and inorganic nature. Chemical experiment has shown that many of the organic compounds can be reproduced directly from their elements, by processes identical with or parellel to those which nature employs. Others, not yet reproduced, have been analyzed, and the character and mode of union of their constituents shown. The whole vast array of the lower organic compounds has been brought fairly within the field of chemistry, and laid out in definite formulæ. In this respect there no longer exists any organic chemistry. It is simply the chemistry of carbon compounds.

In like manner physical science has taken hold of the forces of living bodies, and has arrived at a similar conclusion. These forces seem to closely accord in degree with the energy that should arise from the quantity of oxidized products yielded. Oxidation must set free energy. This energy must manifest itself as some mode of motion. And if the energy really manifested in the body closely agrees with that which must arise from the oxidation performed, there is nothing left, in this direction, for vitality to do. Chemistry is visibly at work here, too, and vitality is pushed out of the field of view.

Only one point yet exists upon which any question can be raised, and that is the synthesis of protoplasm, or rather of the molecules of which it is made up. There is no question about its analysis. This is admissibly chemical. Oxygen is constantly at work reducing it to its elements. But this oxidation does not suddenly break it asunder into elementary particles. On the contrary it takes it apart, piece by piece, as men take down the timbers of a house. Protoplasm has evidently a definite chemical structure, and if it can be taken down piecemeal it can be built up piecemeal. If susceptible to chemical analysis it must be susceptible to chemical synthesis.

Moreover, animal bodies have nothing to do with the production of protoplasm. It is produced in plants alone. Animals simply add new protoplasm derived from plants to their existing protoplasmic tissues. Thus if vitality is confined in its action to the formation of protoplasm, then vitality exists in plants alone, and animals are destitute of it. Or if animals possess vital force its action is confined to assimilation, the causing of one fragment of protoplasm to cohere to another.

Evidently chemistry has driven vitality into a very close corner, and left it a very weak leg to stand upon. And if we give vitality its correct name this leg grows weaker still. It is not chemical or physical energy. It is none of the forces at work in inorganic nature. Therefore it is something supernatural. Its adherents do not claim this. They do not boldly declare what they necessarily imply, that the formation and assimilation of protoplasm are miraculous processes, and that organic existence is only sustained by a continual miracle. But their premises admit of no other conclusion. Yet the duty of miracle in this direction is a very limited one. Chemistry has free possession of the whole field, with the exception of a single obscure corner, in which alone the miracle of vitality tremblingly holds out.

There is a crucial test to which this final question may be put. There is one fixed condition under which alone the activity of protoplasm can display itself. Oxygen must always be present. There is no life without oxygen. When this element is abnormally abundant life proceeds with abnormal rapidity. When it is deficient in quantity life becomes sluggish. When it is prevented from entering the organism life ceases to exist. Hence vitality is incapable of displaying itself except in the presence of oxygen, and the problem becomes the following: so much oxygen so much vitality. The one is measured in terms of the other.

No one can imagine that the mere presence of oxygen sets the wheels of vitality in motion. Oxygen is too vigorous a chemical agent to rest at ease in contact with the weakly cohering molecules of protoplasm. It cannot but seize upon some of their constituents. That it constantly does so we are well aware, and its vigor in this respect is in close accordance with the vigor of vitality. So much life action is represented by so much chemical action. Chemical waste of the tissues accompanies every exercise of vitality. Yet if vitality be some super-physical process, some miraculous energy by which life is sustained and growth proceeds, why is oxygen so absolutely necessary to its performances? Why does chemical action necessarily accompany it? The more closely we look into the matter the more evident it becomes that there is no such energy in existence as a special vital force, and that chemical affinity is the only energy active in organic processes.

Oxygen is much more than the scavenger of the organic body. It is its quickener. It is the life-giver to which all vitality is due. Its mode of action is undoubtedly destructive. But in destroying old constructions it yields the energy through which alone reconstruction can be effected. It is eating into life with an insatiable appetite, yet in doing so it gives off energies which constantly create new life. In the vegetable world the energy of the solar rays supplies the force necessary to the first step in organic synthesis, but oxygen does all the rest. Two opposite energies are constantly at work—chemical analysis and chemical synthesis—and the former is absolutely necessary to every step of the latter. Oxygen is incessantly engaged in the plant, breaking down its molecules into simpler forms. But in doing so it yields energy which is exercised in the formation of new and more complex molecules. Every step of analysis is followed or accompanied by a step of synthesis. All the energy yielded by oxidation in the plant is thus employed, and step by step organic chemistry advances, until the proteid molecules of protoplasm are finally produced.

In animals the life process does not differ essentially from that of plants. Yet chemically animals begin where plants leave off. The highest chemical product of plants serves as the nutriment of animals. Their principle of action is the same. Every act of chemical synthesis in both is preceded, or accompanied, by an act of analysis. Every step of a portion of matter up stairs is based upon a step of some other portion of matter down stairs. But in animals the process begins near the top of the stairs. Only a few steps can be made upwards; many steps can be made downwards.

Hence the energy set free in analysis is only partly needed for new synthesis. Certain changes perhaps take place in the proteid molecules, but the essential work performed is the assimilation of new material, closely similar to the protoplasm of the tissues. For this labor only a tithe of the energy set free by oxidation is requisite, and the remainder is ready for any other employment to which the organism can devote it. If not otherwise employed it becomes temperature energy, but it is also used in two special methods, as nerve and as muscle energy, and organic development is little more than an increasing specialization of these two modes of energy.

If now we come to seek the method by which assimilation of protoplasm, and growth of structure, is achieved in the animal body, we shall find it not easy to discover. Albumen is such a highly complex substance, and its chemical composition and changes in constitution are so far beyond the present appliances of chemical science, that we can only proceed by the process of analogy, and seek the possible instead of being able to display the actual. We are apt to speak of protoplasm as if it were one undeviating substance. Yet we might as reasonably speak of the several varieties of starch, of sugar, of woody fiber, of gum, etc., as a single substance. They are only variations of one special form of chemical molecule, and that a comparatively simple one. The molecule of albumen is excessively more complex than that of starch, and is therefore capable of an immensely wider series of variations, without essential change of constitution. And the more complex a molecule becomes the less its internal variations affect its physical constitution. Two simple oxides may differ very widely in physical character. Two unlike sugars present very slight differences. Two diverse albumens may present no appreciable difference. For all we know to the contrary not only the proteid molecules of every special animal tissue may have special constitutions, but also those of every diverse species of animal, and, in a minor degree, of every separate individual.

When we speak of protoplasm it is far from certain that we are speaking of a homogeneous substance. A mass of protoplasm is made up of chemical molecules which, even if similar in general constitution, may differ in important particulars. If, indeed, we come down to the basic principle of chemical action, we find it to be a satisfaction of active affinities. This satisfaction may be completed in a single step and inactivity be immediately produced, or it may require several successive steps, and inactivity be only gradually produced. Molecules in which considerable activity yet exists we denominate as acids or bases, accordingly as they diverge to the negative or positive side in their electric relations. Molecules in which activity has ceased, or has become very slight, we know as salts. If all their affinities are satisfied they are neutral salts. If acid or basic affinities yet exist they are acid or basic salts.

But the inactivity of a neutral salt only refers to its further synthesis. It is still susceptible of analysis. Some of its elementary materials may be taken from it by the affinities of an active element. And this loss of material leaves the molecule again energetic. It has become once more an active radical, and is capable of regaining the materials it has lost, or of taking up new ones. Thus it may form a new molecule more complex than the original one.

These modes of action of inorganic chemism certainly apply to organic chemism, even in its highest stages. Every exercise of affinity satisfies some of the active chemical energy of the molecule, and thus reduces its energies. When these are all satisfied it becomes inactive. It is a neutral salt, incapable of further synthesis, yet still open to analysis. But if we look upon a molecule of protoplasm as an organic salt it is evident that it may have many more bonds of unsatisfied affinity than an inorganic salt. An acid or basic inorganic salt is neutralized after taking up one or two monad atoms. An analogous organic salt may perhaps be able to take up successively ten or twenty monad atoms, or compound radicals.

These considerations are not without their bearing upon the question of the growth of protoplasm. Did the proteid molecule act only by its own chemical energies, evidently its action could not long continue. Although it might begin with many unsatisfied bonds, every new exercise of affinity would decrease its possible action. When all its affinities were satisfied growth must cease, and the molecule become a neutral salt. But though synthesis could proceed no further, analysis might act to again energize the molecule, and the more complex its condition the more subject it must become to analytic action.

Such seems to be the mode of operation in protoplasmic growth.

In fact there could be no other if this growth be a chemical process, for synthesis is a self-checking method and cannot long continue unless its energy be restored by analysis. If a mass of protoplasm be made up of molecules of the same chemical constitution they may yet differ in degree of satisfaction of their affinities, and may be partly neutral, partly basic, and partly acid in their energies. Any exercise of these affinities tends to reduce them all to neutrality, and thus to restrict their chemical action. But they are constantly exposed to the assaults of oxygen, which, at every contact, robs them of some of their constituents, and thus restores their chemical activity. We must certainly deduce some such conclusion as this from the necessity of oxygen to all life energy, and the increase in oxidized waste with every increase in vital activity. Oxidation gives rise to this vital activity, which consists in the restoration of active chemical affinity to the oxidized molecules, and in the reproduction of protoplasmic tissues. Both results arise from one cause. Oxygen robs matter from the proteid molecules, and restores their lost chemical energy. They assimilate new material from the nutrient fluid; while animal motion and temperature arise from the excess of energy yielded by the oxidation.

This general survey of the process leads us to a more particular conception of its character. There is a peculiar polarity concerned in all chemical processes which is of essential importance here. A neutral salt is really a polar arrangement of the elements. Its molecule has its positive and negative poles, but the energy of each restrains and balances that of the other. If we call such a molecule an acid salt, this is equivalent to saying that its acid pole has an excess of energy over its basic. New basic material is drawn in, and the poles become equal in energy, so that all their affinities are exercised internally. But if the constituents of this molecule be separated, their opposite chemical polarities at once become active. The one becomes an energetic base, the other an energetic acid. If this separation proceeds further, a portion of the products of the second separation becomes still more powerfully basic or acid, while other portions may return towards neutrality. If, for illustration, we take a molecule of the powerful acid H_2SO_4 and cause it to combine with two molecules of the equally powerful base NaOH, we obtain the neutral salt Na_2SO_4, two molecules of water being ejected. A redivision of this salt into its constituents yields the acid and base above named. The chemical poles, from being passive, have become active. A secondary division of the base gives us Na and OH, a powerful positive element, and a weak negative molecule. If finally OH be separated into its constituents, we obtain an atom of the active negative element, oxygen, and one of the weakly positive element, hydrogen. Analysis of the sulphuric acid molecule yields like results, one of which will be the neutral substance H_2O, or water.

It may here be asked what has all this to do with the chemical activity of protoplasm? It may possibly have much to do with it. If this activity be a chemical one it is certainly governed by the ruling principles and processes of chemistry. There is another chemical mode of action which may also have a bearing upon this question—that concerned in the chemism of the galvanic circuit. In this circuit, as ordinarily constructed, there is but a single chemical energy in active operation, the affinity of the positive metal for the negative element of the fluid. For instance, in an ordinary form of battery, the oxygen of water combines with the metal zinc, the molecules of water intercharge their atoms throughout the line of the circuit, and free hydrogen is given off at the surface of the other metal employed. But if this second metal could be replaced by a substance having an affinity for hydrogen, a more vigorous chemical action might take place, with the production of new molecules at each pole. Perhaps such a double action does occasionally take place in the local circuits produced in ordinary chemical action. In the case of such a double action much weaker affinities than those usually employed might suffice.

Yet any such galvanic chemism is necessarily temporary in its action. Its activity diminishes as the analysis of the molecules of the liquid is followed by the formation of new and more stable compounds. There is only one possible method in which we can conceive a constant reinvigoration of its activities, and that is through a continual restoration of its original conditions by reverse chemical action. Could some active atmospheric element, for instance, constantly penetrate the liquid, break down its new formed molecules, and reproduce the original ones, while carrying away the neutralizing constituents, the chemical action of the battery might indefinitely retain its original activity. Its lost energies would be constantly replaced by energy derived from exterior nature.

Such a continual reinvigoration takes place in organic chemism. The exercise of the affinities of the molecules of protoplasm must constantly tend to reduce their energy, and produce a neutral inactivity. But oxygen comes in, bringing with it the chemical energy of the exterior world. The new-formed, inactive molecules are partly oxidized, and perhaps regain their original condition. The chemical vigor of the circuit is restored, and its activity may thus be ceaseless, since it is continually re-energized by the forces of exterior nature.

As a final deduction from the principles of inorganic chemistry, may be mentioned the fact that the activity of a galvanic circuit in which the affinities of both the positive and the negative constituents of the molecules of the liquid are engaged, must depend upon the vigor of the opposite polarities of the circuit. If either the positive or the negative energy be neutralized the chemical activity must be checked, while if one or both of these polar energies be decreased the activity of the circuit must be similarly reduced.

These principles of inorganic chemism might have been considered in more detail, since there is reason to believe that they are the agencies concerned in the higher organic chemistry. For the sake of brevity they have been given in a very condensed form with little attempt at illustration. It remains to apply them to the phenomena of what is called life action, or the assimilation and growth of protoplasm.

In considering this question we have to deal with the units of organic beings. Not the cell, but the nucleus of the cell, which is undoubtedly the active agent in protoplasmic growth. The nucleus is itself an organized body, and appears to contain other materials than the proteid molecules to whose chemical activity the phenomena of organic life are due. It is also evidently a polar organization, its polarity being markedly displayed at the time of its division. The two nuclei into which the original one divides represents each a polar half of the original nucleus. Thus the probable balanced polarity of the primary cell nucleus becomes an unbalanced polarity in the new cells resulting from its division. We hope to show that this is a fact of essential importance.

The protoplasmic mass which constitutes the nucleus is an aggregation of highly complex chemical molecules similar, perhaps, in constitution, but which may differ considerably in the degree of satisfaction of their affinities. Some may be neutral, some acid, and some basic salts of the same chemical compound. If such be the case we can comprehend the polarity of the nucleus. The arrangement of its molecules may be but an expansion of the principle of arrangement of the polar constituents of a neutral salt molecule. This has its acid and its basic pole; and we can imagine the molecules of the nuclear unit to be similarly arranged, not only with the acid and the basic poles of each turned in opposite directions, but with the molecules of acid affinity occupying one pole, and those of basic affinity the other pole, of the nucleus.

For this to be the case, however, some influencing agency is requisite, such as that of external chemical affinity. In short, the polarity of the nucleus may represent that of a galvanic circuit with active chemical affinity at each pole. The two poles of the nucleus may represent the acid and basic poles of such a circuit, and the nutrient material, the zinc and copper, or whatever other substances are employed. If such be indeed the character of the nuclear polarity we can comprehend various results which are now mysterious to us. The assimilation of nutriment by such a polar arrangement would be a strictly chemical process, the opposite poles taking up respectively basic and acid material. But the activity of this circuit, if dependant upon its own energies alone, must quickly come to an end through the satisfaction of the polar affinities and the chemical neutralization of the molecules.

At this point the agency of oxygen comes in. This energetic element attacks and partly breaks down the complex proteid molecules, and restores to them their lost affinities. Through its action the original activity of these molecules is regained, and they again vigorously attract the chemical radicals of the nutriment. Thus the probably small quantity of material carried off by every act of oxidation is perhaps replaced by the assimilation of larger and more complex molecules from the nutriment, and the protoplasmic mass grows in consequence.

This, of course, is all pure hypothesis. We are ignorant of, and perhaps may always remain ignorant of the facts that would prove or disprove it. Yet we have no reason to doubt that the assimilation of nutriment is a chemical process; we know that the nucleus is a polar organization, we know that oxidation is essential to its activity, and that the chemical relations here supposed are in accordance with those that exist, or might possibly exist, in the active liquid of the galvanic battery. Thus the basis of the hypothesis is not unreasonable; and it may be shown that certain of its necessary results are strikingly in accordance with some of the most abstruse phenomena of organic life. If the hypothesis here advanced should prove a key to unlock the mystery of these phenomena, and the organic unit have in its chemical organization the essential elements of the most specialized life conditions, our hypothesis will certainly become worthy of consideration.

For such a polar arrangement of acid and basic molecules to be fully effective, it seems necessary that each pole should be in full vigor. Their energies mutually support and aid each other. Any check to the action of the basic pole, for instance, would check that of the acid pole. The chemical activity of the one is rendered possible by the chemical activity of the other, and there may take place an interchange of the constituents of the molecules like that supposed to occur in the water molecules of the battery. Hence the chemical activity of the nucleus would be controlled by that of its least vigorous pole, and for its fullest activity the poles must be equal in energy, and this energy be raised to its highest level of vigor.

As for the aid of oxygen in the process, it is not probable that the oxidation is an immediate accompaniment of the chemical action. Oxygen is constantly making its way into the organic cells, and it is probable that a slow oxidation continually goes on, its quantity depending upon the vascularity of the organ concerned. Under special circumstances, as of irritation of the nervous and muscular tissues, oxidation seems to become suddenly invigorated, and a considerable breaking down of the organic molecules takes place, with a vigorous discharge of energy. But every act of oxidation puts the nuclear molecules in a condition for active chemical assimilation, so that if the requisite nutrient material is provided, the loss is quickly repaired, and new proteid molecules, specially sensitive to the affinity of oxygen are produced. And so the wheels of life roll on, and growth replaces waste.

It might seem as if in such a process we had a provision for an endless life activity. The chemical energy of protoplasm, constantly quickened as it is by oxidation, appears capable of yielding an indefinitely large mass of material, so that the bulk and length of life of organisms might have no limits. Yet we are well aware that no such results take place, and therefore must believe that they are impossible. There must be some principle that checks both an indefinite increase in bulk and a ceaseless continuance of life.

There is such a principle, and the first step of its action is a check to indefinite growth of the nuclear unit. For the activity of this growth free access both of nutriment and of oxygen is necessary. But the oxidation to which growth is due quickly interposes a check to its activity. Some of the waste materials yielded by oxidation appear to remain within the nucleus. Others collect around it and form a mass which is known as the organic cell, of which the nucleus occupies the center. Evidently this process must oppose that of nuclear growth. With every exercise of chemical activity the mass of "formed material" around the nucleus increases in bulk, the access of oxygen and of nutriment is more and more hindered, and the nuclear energy is checked.[1]

There is only one method by which it can be regained. The waste material continues to cling firmly around it, and only by division of the mass into smaller portions can its nuclear center regain its former relations with the nutriment. This division takes place, and always through the nucleus. It might be imagined, indeed, that a vigorous effort was made by the polar constituents of the nucleus to reach the attractive nutriment, since division is always preceded by a strongly declared polar arrangement of its material, and it separates at its equator, its two original poles becoming the nuclear centers of two new cells. Growth energy is regained in these new cells, but its vigor is decreased with every successive division, for a reason now to be given.

[1] Part of the waste material is carried away by the nutritive current, and we can readily conceive of a condition in which all the waste is carried away, and the protoplasm left fully free to act. But such a condition is inconsistent with any high degree of organic development. Active protoplasm is necessarily semi-fluid in consistency. The retention of waste material is necessary to give consistency to the organism, and permit its increase in size and its organic differentiation. Some Protozoans are nearly pure protoplasm, but evolution in this direction must be soon checked by lack of solidity. For any extended development the protoplasm of the cell must retain around it some of its devitalized waste.

The ideas here advanced as to the constitution of the organic unit are not mere baseless supposition. This unit must be composed of chemical molecules, either identical or diverse in character. Their chemical activity seems to render a diversity more probable than an identity; but the apparent homogeneity of each unit seems to indicate that its molecules are not diverse in their chemical constitution, but only in their degree of chemical satisfaction. They must be either acid, basic or neutral in character, and very probably divergences in this respect occur between the molecules of every unit mass. But in mixtures of acid, basic and neutral molecules there might be great variations; here the acid, there the basic energy might be in excess. In other cases there might be a balance between these energies. Probably all these variations exist in organic units. Yet for the reasons we have here given, it seems probable that the unit mass in which the energies of the acid and basic molecules were balanced, would be best constituted for vigorous chemical action; and particularly so if these acid and basic energies diverged considerably from the neutral line. Such we conceive to be the constitution of a fully active chemical unit. But the process of cell division tends to diminish this activity.

For the separation of a nucleus into two halves, through its neutral equatorial region, must leave one of these halves with an excess of acid over basic vigor, and the other with an excess of basic over acid. The full energy of the acid pole remains in the one, in combination with a basic pole of reduced energy; and the same rule applies to the basic pole of the other. Thus the chemical energy of each must be less than that of the original unit. A second division adds to this effect. Of the acid half, for instance, after re-division in one of the new cells, the energy of the acid pole would be retained, with a basic pole still further diminished in energy; while in the other the two poles would return towards equality, but with diminished energy. This division must constantly tend to reduce the chemical energy of the cells.

A formula may aid in the elucidation of this principle. Suppose A———B stands for a normal unit, A and B representing the most vigorous acid and basic molecules, while the connecting line represents a mass of molecules becoming successively less strongly acid and basic, until neutrality is attained at the equator of the mass. If now this unit be divided equatorially we obtain two new units, A ——— B and A ——— B. Their chemical energy is decreased, because each has a weakened pole. A division of the first of these new units will give us A——b and A——B. Here the first is thrown still more out of polar balance, while the second regains equality, but with diminished energy. And so on with continued division. We would obtain as the extreme terms of the process two cells, in one of which the full acid was accompanied by a greatly reduced basic vigor, and in the other a like advantage would be gained by the basic pole. Between these would be a succession of cells, less out of chemical balance, with one or more intermediate cells in which the balance of energy would be preserved. But in all these cells the vigor of one or both of the poles would be greatly reduced, so that the chemical activity must decline in vigor with every new act of division. Such a result is but an organic example of the principle we have already considered in inorganic nature, in the gradual separation of the constituents of sodium sulphate, Na_2SO_4. The molecules of the original cell would be represented by the mass of new cells into which it finally breaks up, some of these cells being specially acid, basic or neutral, as were the molecules of the normal cell.

In such a process we see the original strongly declared heterogeneity of the normal unit gradually diminishing, and chemical homogeneity approaching, while life vigor decreases in accordance. The process of division, which is necessary to keep up the activity of the cell, inevitably tends to diminish this activity from a secondary cause, that of loss of chemical heterogeneity. How shall this essential condition be restored, and the full activity of life action be reproduced? Evidently by a reversal of the process above considered. If cell division reduces the life energy, cell combination may restore it. If, for instance, the two extreme terms of such a continued division be reunited, all the lost chemical heterogeneity would be regained, and the normal condition reproduced. Let the two extreme units, A——b and a—B, join to form a new unit; we would have as result A———B, the intermediate polarities falling into place between these polar extremes. Thus by a single process of combination a cell would be gained possessing all the chemical heterogeneity, the polar balance and the vital activity of the original.

And such a result must very strongly tend to occur, from the vigorous attraction between acid and basic chemical radicals. Many other unions might take place, between the remaining cells of the continued division. Thus the final result of the division of a single normal cell, would be the reproduction, from the union of its many daughter cells, of numerous normal cells, differing perhaps considerably in their degree of homogeneity, and in the completeness of their polar balance, yet each capable of setting up a new life cycle.

If now we give this polarity another name, and call it sexual polarity, new light may be thrown upon the life problem. Life is continuous, but not in the individual. The individual tends towards chemical inertness and final death. The continuity of life exists only in the race; and such, under our hypothesis, must be the law governing the development of the organic life units. Division, which is their only available method of continued growth, brings them more and more towards chemical inertness and loss of vitality. Reunion of oppositely polarized germs, which have arisen from the original individual, restores the life activity by the production of a new vitalized individual. The life energy, failing in the individual, is restored in the race.

If we replace the words acid and basic polarity by male and female polarity, the cycle of life opens out before us. A normal unit or germ possesses balanced male and female energies. Continued division produces a multitude of new cells, some with an excess of male, some of female energy. As either energy weakens, the life energy of the new unit weakens. Each of these cells is a male or a female germ. The union of two of opposite sex produces a fertilized germ, in which the balance of male and female energies is restored, and which is, therefore, capable of setting up a new cycle of development. All that we know of the life development of Protozoan animals is in accordance with this hypothesis. And evidently, if the sexual polarities were balanced in the original Protozoan, they must be balanced in all its descendants taken as a whole; so that the degree of opposite polarities, and the numbers of each sex, must continue equal. And as in the reunion of germs, it is highly improbable that out of the vast numbers produced, two of exactly balanced sexual polarity should meet, therefore the new individuals are very likely to be specially male or female in condition, possessing some excess of acid or basic energy in their chemical organization.

[*To be continued.*]

THE ORDER OF THE UNIVERSE.

BY W. N. LOCKINGTON.

I. Monism *v.* Dualism.

ONLY two complete theories of the origin, nature and preservation of the universe have as yet been presented. The first of these, monism, assumes the essential unity of the universe. Everything within the universal bounds, from the tiniest particle to the hugest globe; from the earth on which we poor reasoners dwell to the farthest star in heaven's vast galaxy; from the heaviest metal to the most etherealized interstellar medium, is by this theory conceived of as consisting of but one substance, to which, in the poverty of our human speech, we have given the name of "matter," and to all whose manifestations, qualities or properties, by which we are cognizant of its existence, we give the name of "force."

The second or dualistic theory accepts matter as it finds it, and to a certain extent admits that matter is possessed of qualities or gives out manifestations which may be called force; but in order to explain the existence of matter, assumes, entirely outside of material existence, a second principle, which existed before matter, created that matter, endowed it with force, and is itself directly active in the highest manifestations of force exhibited by material organisms.

Monism asks it disciples to believe many things which, to the understanding of the highest outcome of this earth's activities, are as yet incomprehensible. The formation and preservation of suns and planets; the molecular motions and structure of inorganic materials; the origin, nature, continuance and variation of life, have all to be conceived as emanating from matter by the action of its own inherent force.

Dualism escapes these difficulties—strikes them out with a word by one vast assumption. An immaterial, or rather non-material agency accounts not only for all the manifestations of force, from that which forms a crystal to the highly developed consciousness of the wisest man, but for the very existence of matter itself. The difficulty left is to account for the origin, nature and continued existence of the assumed creative power, and for the manner in which it was able to form matter out of preëxistent nothing.

The majority of men in all ages, and most of the accepted religions of mankind, have adopted the dualistic theory. By it the mind of man was relieved from all speculations regarding the nature of the material universe, every ordinary occurrence was referred to the action of a creative and preservative force, and extraordinary phenomena were unhesitatingly ascribed to a more direct agency of that force.

But the spirit of inquiry is natural to the human mind, when it is not distorted by education or paralyzed by sloth. Certain results were observed to follow certain causes with unerring regularity, whether in the broad domains of astronomy or in the narrow limits of human activities, and confidence in these results became so unbounded that men in their daily life, while theoretically believing in an omnipotent and omnipresent power, based all their actions upon the known properties of material things. This dual code of life is that observed throughout Christendom at the present epoch, and causes strange eccentricities.

To explain this inconsistency, the idea of law arose. The omnipotent, all-knowing power which made matter and gave it its properties either cannot (a contradiction) or will not change those properties. Laws once made were conceived to continue either by the properties originally impressed upon matter by its creator, or by the continual preservative power of that creator, exercised invariably according to certain fixed rules which he has made for himself, and according to a prearranged design which he has proposed to himself to work out.

Under this phase of dualism, a belief in any departure from the known laws of matter becomes an improbability amounting almost to the impossibility of such departure which is the logical result of the monistic view. This elimination from the order of the universe of any present interference of a creative power, reduces that power to the position of a passive spectator, or, at most, of an executor of laws framed in the far past, and is, therefore, rightly regarded by rigid dualists as a great concession in favor of monism.

A dualist conceives consciousness, or the soul, to be a direct emanation from the deity, imprisoned for a certain time within material bonds, but prompt at its liberation to return either to the God who gave it or to the punishment provided for it in consequence of its misdeeds. To account for the existence of evil, the idea of deity has also been made dual, including a good and evil principle, at war with each other. The evil principle, though nominally the weaker, is, in the current belief, allowed to succeed in the ruin of the future of the great majority of individual souls. Thus a dualist has at least a definite philosophy, one which, however it may be doubted, can never be disproved; and one which, however it may be believed, can never be proved.

Leaving dualism for a while, let us consider how monism can explain consciousness; let us see if it has yet fixed upon a definite theory.

II. Matter, Force and Consciousness.

The exigencies of language compel us to give names to express ideas which are not things, and it is a tendency of the human mind to figuratively speak of these names as though they were objects, and too often to conceive of them as actual objects. The word "matter," in the strict monistic sense, must include all properties exhibited by matter just as surely as the name "man" must be held to include all the physical and moral properties of man. Just as justice is an abstraction of our language put instead of "the state of being just," so is force an abstract term meaning "the state of being forcible," and consciousness an abstract noun meaning "the state of being conscious." The latter word is in its very shape clearly a nominal form of the adjective conscious, but in the case of force it is less easy to define, since the adjective "forcible" is commonly held in a more limited sense than the noun force, which is usually adjectived by the words "potential" and "kinetic" (actual), dependent upon whether the matter having force is using that quality internally or externally. "Latent heat," "potential energy," and other similar phrases, must be held simply to mean that a certain quantity of matter, not at the moment exhibiting heat or energy to our senses, may, under changed conditions, be made to do so, whilst "sensible heat" and "kinetic energy" mean the exhibition of those properties to our senses by portions of the universal matter.

But there is a particular exhibition of force, residing only in certain complex and unstable compounds, which differs so widely from other forces that we are compelled to give it a distinct name —consciousness. Unable to explain how consciousness can be produced, yet forced to acknowledge that it has never been met with apart from matter, some monists conceive of it as an independent thing, which is, however, unable to manifest itself except through matter. Such a belief is simply a degradation of the supernatural half of a dualist's belief. According to it, that which to a dualist is the soul, the emanation from an omnipotent deity, is a slave of matter. Such conceptions arise from the gross ideas of matter that have so long prevailed. The true conception of matter is "everything that exists." Under the monistic idea, as under the dualistic, the belief in supreme and subordinate spirits may exist, but the spiritualist who is a monist must concede the materiality of his supposed spirits. Under the monistic idea a future life is as possible as under the dualistic, but future consciousness must be accompanied by the matter which exhibits it, and the future existence of an individual must be a mental continuation of his present mentality. The Buddhistic idea of Nirvana, or of a state of generalized blessedness, an absorbption into an ocean of conscious matter, may be logically held by a monist; whether he can find peace in believing in an eternity of existence, coupled with annihilation of individuality, is another question. To be consistent, every monist must, when he speaks of consciousness, use that term in an abstract sense, as a certain force-quality of highly organized matter.

To conclude, the shades of belief possible are almost endless, and the positive proof or disproof of most of them is impossible. It would be well, therefore, for all who have the slightest claim to the possession of a high degree of consciousness, who claim to be intelligent or civilized, to make a broad distinction between proved facts and theoretical doctrines, and to have too much charity to be prejudiced against, and still less to discriminate against, those whose honest doctrines differ from their own. At the same time the faith of the truly scientific mind will be in harmony with proved facts, and he will be at any time ready to surrender a belief in deference to such facts.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The mortal remains of Charles Darwin lie by the side of those of Sir Isaac Newton, in Westminster Abbey. A great nation in doing homage to the name and fame of the world-renowned naturalist, has thus expressed its judgment of the true place he should take among those philosophers and students who have done it greatest honor. The feeling thus expressed, that Darwin should rank with Newton, Faraday, and other scientific leaders, is shared by the best judges of the work he has done in remodelling scientific thought, and in originating and completing the revolution in biological methods, which has been effected within the last quarter of a century.

As a physical geographer, as a systematic zoölogist, and as an anatomist, as well as palæontologist, whatever Darwin accomplished was of a high order. But it was not in these departments of science, that he excelled. He was most eminent and original in observing the habits of plants and animals, their relations to each other and to their surroundings; he studied the variations of species under domestication and in a state of nature; he studied hybridity, and especially the effects of heredity and growth force. He did little work in comparative anatomy, and almost nothing in embryology, but the influence his ideas exerted upon these difficult fields of research, have stimulated the development of these sciences to a wonderful and unprecedented extent.

Darwin pursued the objective or inductive method. He approached the subject of evolution, rather from the biological point of view, from a study of the living organism, than from the embryological and palæontological side. He was cautious in observing, collating, and arranging his facts, which were proved by experiment and tested again and again. With a broad foundation of facts, he could afford to make brilliant deductions and bold speculations. Some phases of his theory of natural selections may be unproven hypotheses, and his own theory may be emended and greatly extended, but the world remembers Newton's theory of gravitation and forgets his crude theory of light. Darwin showed admirable caution, self-criticism, candor, and an absence of the controversial spirit. He gave credit to those to whom it was due, and the charge of appropriating the work of others has never been breathed in connection with his name.

Moreover, his clear, simple, lucid style, his powers of exposition and rapid generalization, caused his books to be read by the layman as well as by the scientist. His works and views never needed an expounder.

Under all these conditions, Darwin was his own intellectual executor. He gave his theory to the world, and lived to see it become the common intellectual wealth of his own age. Within twenty-two years after the appearance of the "Origin of Species" his opinions gained the mastery of the philosophic and scientific field of thought.

This was mainly the result of his methods, the Baconian or inductive. The *à priori*, purely metaphysical or philosophical methods of Herbert Spencer are not convincing to the most of naturalists. But the solid array of facts which Darwin marshaled in orderly lines, carried force and conviction to every unprejudiced mind. It was partly for this reason that the views of Goethe, and St. Hilaire as well as Lamarck, did not gain universal sway and that they were temporarily overthrown by Cuvier and his school with their exact analytical methods.

But Darwin appeared in the fullness of time. Biology and geology with their subordinate departments of palæontology, embryology, and histology had, after Lamarck's and Cuvier's death, either originated or immensely developed, and the time had arrived for synthetical methods and speculative views.

Enough was known of the 100,000 species of plants and the nearly half a million species of animals now living, and of their relations to each other and to former worlds, to warrant the naturalist in attempting a solution of the question as to how they all appeared.

The result of such inquiries has already been fruitful and happy. It has been given to the intellect of man to attempt a solution of their questions, and the mere attempt, as the result proves, has elevated and drawn out man's intellectual powers in a new direction. Many have aided in this work, but as the leader and successful originator of the new school of evolutionial thought, all will ascribe to Darwin the highest position. His was an epoch-making mind.

Darwinism, as such, *i. e.* the theory of natural selection, expresses the ultimate cause. We have yet to demonstrate the evolutionary laws which originate the tendency to variation from which natural selection takes the start, and naturalists in the future will ascribe more to the effects of the environment upon the organism. But the sterile methods and subjects of study pursued before the year 1860, have been for the most part abandoned. New light has been thrown on old facts, and Darwin has sowed the seed, from which a rich intellectual harvest will be reaped by coming generations.

Charles Robert Darwin, the grandson of Dr. Erasmus Darwin, was born Feb. 12, 1809. After taking his degree at the University of Cambridge in 1831, at the age of twenty-two, he sailed with Captain Fitzroy, of H. M. ship *Beagle*, as volunteer naturalist in the survey of the coast of South America. Returning from his voyage around the world in 1836, he published, in 1839, his "Journal of Researches into the Geology and Natural History of the countries visited during the Voyage of H. M. S. *Beagle* round the World." In 1840–42 appeared his "Zoölogy of the Voyage of the *Beagle*"; and rapidly succeeded his works on "Coral Reefs," (1842), on "Volcanic Islands" (1844), and "Geological Observations" (1846). His most finished systematic work was his "Monographs on Cirripedia" (1851–53). His anatomical, systematic and palæontological work was all equally thoroughly well-done.

He then matured his views as to the origin of species, suggested by his observations on the South American coast, particularly by "certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent." The "Origin of Species" was issued in November, 1859, and was designed as an abstract of a more extended work.

Then appeared in rapid succession his "Fertilization of the Orchids" (1862), "Habits and Movements of Climbing Plants" (1865), "The Variation of Animals and Plants under Domestication" (1867), "Descent of Man" (1871), "The expression of the Emotions in Man and Animals" (1872), "Insectivorous Plants (1875), "The Different Forms of Flowers and Plants of the same Species" (1877), "The Effects of Cross and Self-fertilization in the Vegetable Kingdom," and "The Power of Movements in Plants" (1880). His last book was "The formation of Vegetable Mould through the action of Worms, with observations on their habits," which appeared in 1881. He also contributed numerous papers to the scientific journals. His own works may be said to have created a new department of literature.

After his return from his travels, he lived at Down, Kent, where he died. For many years his health had been precarious, and only a strong will, great powers of application, and his rare genius, enabled him to accomplish so vast and varied an amount of work.

Darwin married in 1839, and left five worthy sons and two daughters. His life was a happy and peaceful one. His nature was genial and devoid of the controversial, self-seeking spirit. The great philosopher and naturalist died, though full of years and scientific honors, yet almost prematurely, mourned by the intellectual and scientific world.

—— If it be admitted that effort and use lie at the foundation of development, it is important that the stimuli to effort and use should be preserved intact. The first great stimulus, both in importance and in order of time, is hunger. The second great stimulus is the instinct of sex. These two impelling forces lie at the foundation of the activities of man, as well of the inferior animals. A modern school of evolutionists believes that not only the machinery of animals has been built by these forces, but the mind itself has been by them elaborated from these forms of simple consciousness in conjunction with memory.

The mental faculties are divided into the intellectual (including rational) and the affectional classes. It is thought that the rational faculty has been developed by all kinds of experience, into which their necessities have continually forced living beings.

The affectional or emotional qualities have been developed in the same way. The especially beneficial emotion is that of sympathy, or the love of other beings than self, and this it is thought has been evolved from the primitive sexual instinct. Darwin has pointed out how sexual selection has probably effected development of purely bodily perfections, as in the cases of the brilliant plumage and musical voices of birds. He very significantly calls his book on sexual selection, "The Descent of Man."

That the rational faculty cannot be too much developed, goes without saying. It is also evident that the affections or sympathies should be developed sufficiently to produce a desire for the happiness of others, through the pleasure the happiness of others gives us. A lack of sympathy is as great a defect of character as is the lack of rationality.

The question for society then is, what are the best methods of developing the two foundation elements of character, rationality and sympathy. These qualities check each other in practice, and form the two sources of happiness.

If custom imposes on either sex any disability by which its development in any respect is curtailed, the race of both sexes suffers injury. It suffers in two ways:

First, by defective inheritance by children.

Second, through inequality in the sexes themselves, and consequent lack of mutual sympathy and interest.

I. Of course children are more or less influenced in their mental constitution by that of the mother, and we shall never have an ideal race until mothers are developed as much as possible. We speak of mothers because custom does not supply to them the same stimuli to intellectual exercise as it does to men. Some professional men have even permitted themselves to express the idea that the education of girls interferes with their physical development. We are loth to believe that this is a necessary state of things; if it be so in some instances, it is to be hoped that it is a temporary condition of race or family, and one to be remedied by future experience. There is also no doubt a lingering fear in some minds that intellectual women may be less women than are ignorant and thoughtless ones. The supposition that education can make a woman anything but a woman, can only be entertained by persons unskilled in zoölogy. It has been pretty conclusively shown by Broca and others, that a greater divergence or specialization of the sexes is consequent on civilization, as in evolution generally; and it would seem to be entirely within the range of our power to determine whether this diversity shall or shall not include an atrophy of the rational faculty in women.

II. The effect of education of both sexes is to enhance their interest in each other, and the relation is ennobled in direct proportion to the amount of mental sympathy which exists between them. It is to be doubted whether this field for the increase of happiness is as much as suspected by very many persons. One of the first conditions of the stability and harmony of society is the correct working of the double-headed system on which it has been created. It cannot be denied that the greater the amount of interest invested in this system, the more secure it must become. The stimulus which intelligent people bring to bear on each other is very great, and where this comes from a person in whom the affections are deeply interested, the force is greatly multiplied. It is self-evident that the effects of this force must be seen in the race, and that it is one powerful agent in progressive evolution. It acts especially in times of prosperity, when the pressure of the struggle for physical existence is diminished. It assumes especial importance when the impetus derived from the latter source diminishes, and is the best guarantee of future progress at such a time. Any agency, therefore, which effects the development of one sex, is a blessing to the other.

Is the present constitution of Christian society the best for the maintenance and development of the highest qualities of the mind? It is evident that the monogamic system will be preferred in proportion as the mental constitution of the sexes adapts them best to each other's needs. The rational education of women is not in the interest of polygamy; and the development of the higher affections of men is equally in the direction of monogamy. Monogamy in a community is doubtless in direct proportion to the development of its members in rational and sympathetic qualities. But sexual selection has but imperfect opportunities where there is little to choose from in the poorer classes; and where there are conventional standards of excellence in the richer classes. The problem is, how to secure a just regard for the far-reaching law of sexual selection, consistently with a maintenance of the monogamic relation. General culture will do much towards placing the solution in the hands of every one, and toward producing any modification of existing customs which may be necessary.—*C.*

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RECENT LITERATURE.

Volcanoes.[1]—The recent activity in the study of volcanism, with the erection on Mt. Vesuvius and Mt. Etna of observatories for the observation of volcanic phenomena, and of eruptive rocks by new methods of research, has called for a popular work treating of this subject in a simple and yet comprehensive way. These conditions have been met by the author, who is a friend and disciple of the late Mr. Poulett Scrope. The volume pre-

[1] *The International Scientific Series. Volcanoes: What they are and what they teach.* By John W. Judd, F.R.S. With 96 illustrations. New York. D. Appleton & Co. 12mo, pp. 381.

sents little matter subject to criticism except from those who may oppose some of the writer's views on metamorphism, a matter regarding which there is naturally much difference of opinion. After describing the nature of volcanic action, well illustrated by the eruption of Vesuvius in 1872 (Fig. 1), which, with that of

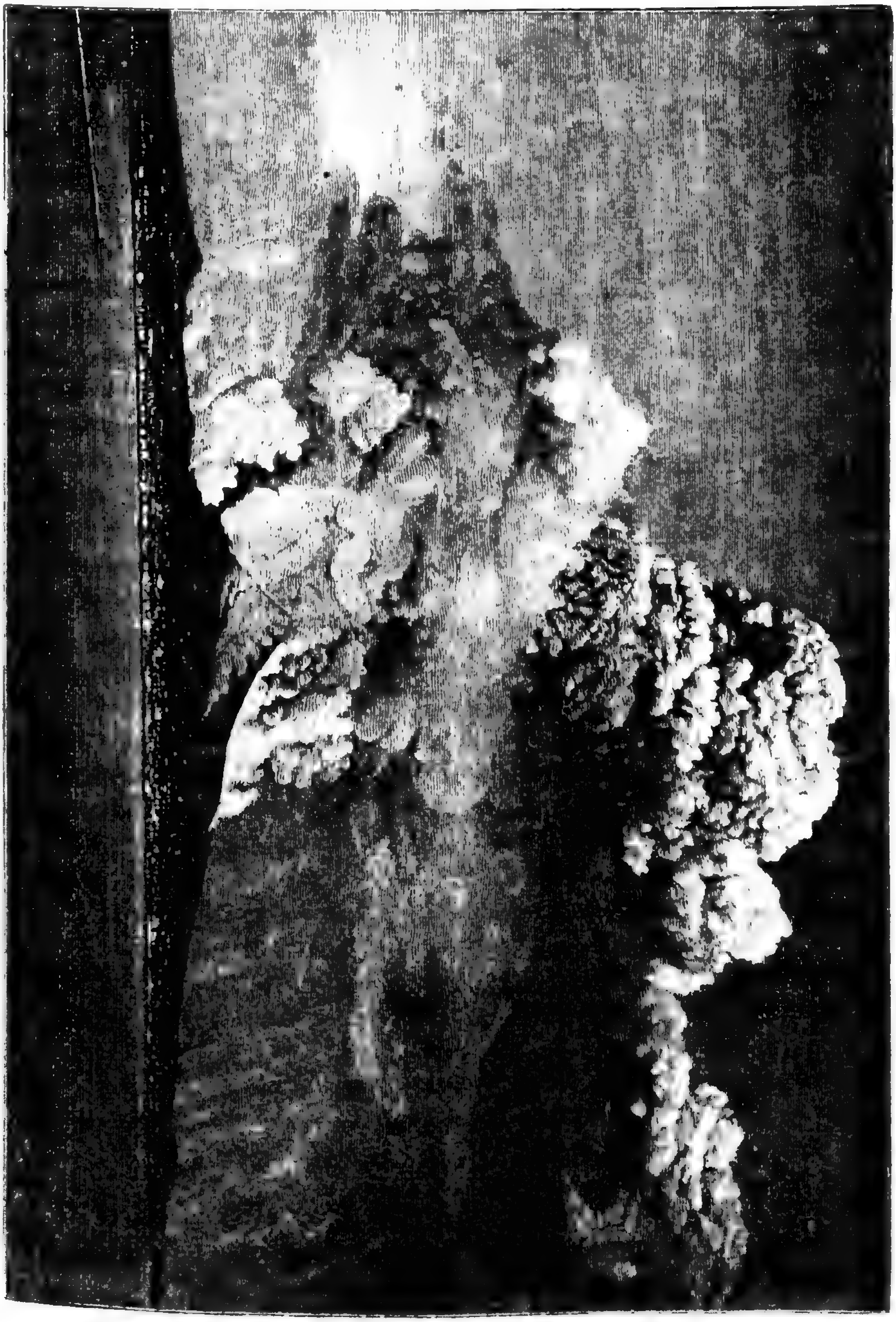

Fig. 1.—Vesuvius in eruption, as seen from Naples, April 26, 1872.

1858, was probably more carefully observed and photographed than any previous outburst, the work treats of the products of volcanic action, the distribution of the materials ejected from volcanic vents, with the various structures built up around them, as also the internal structure of volcanic mountains and their distribution over the earth.

The nature of lava overflows and the causes of the differences in their rate of motion are well discussed. The accompanying illustration (Fig. 2) of a lava stream which, from its imperfect fluidity in flowing over the edge of a precipice, forms heavy pendant masses like a "guttering" candle, is a fair example of the quality of the woodcuts.

The volcano from which all our pumice-stone comes is represented by Fig. 3. How this is formed is well told. By experiments with sawdust thrown up by an air-blast, the structure of volcanoes formed of scoriæ, pumice and other fragmental materials is illustrated.

"Many cones formed in the first instance of scoriæ, tuff and

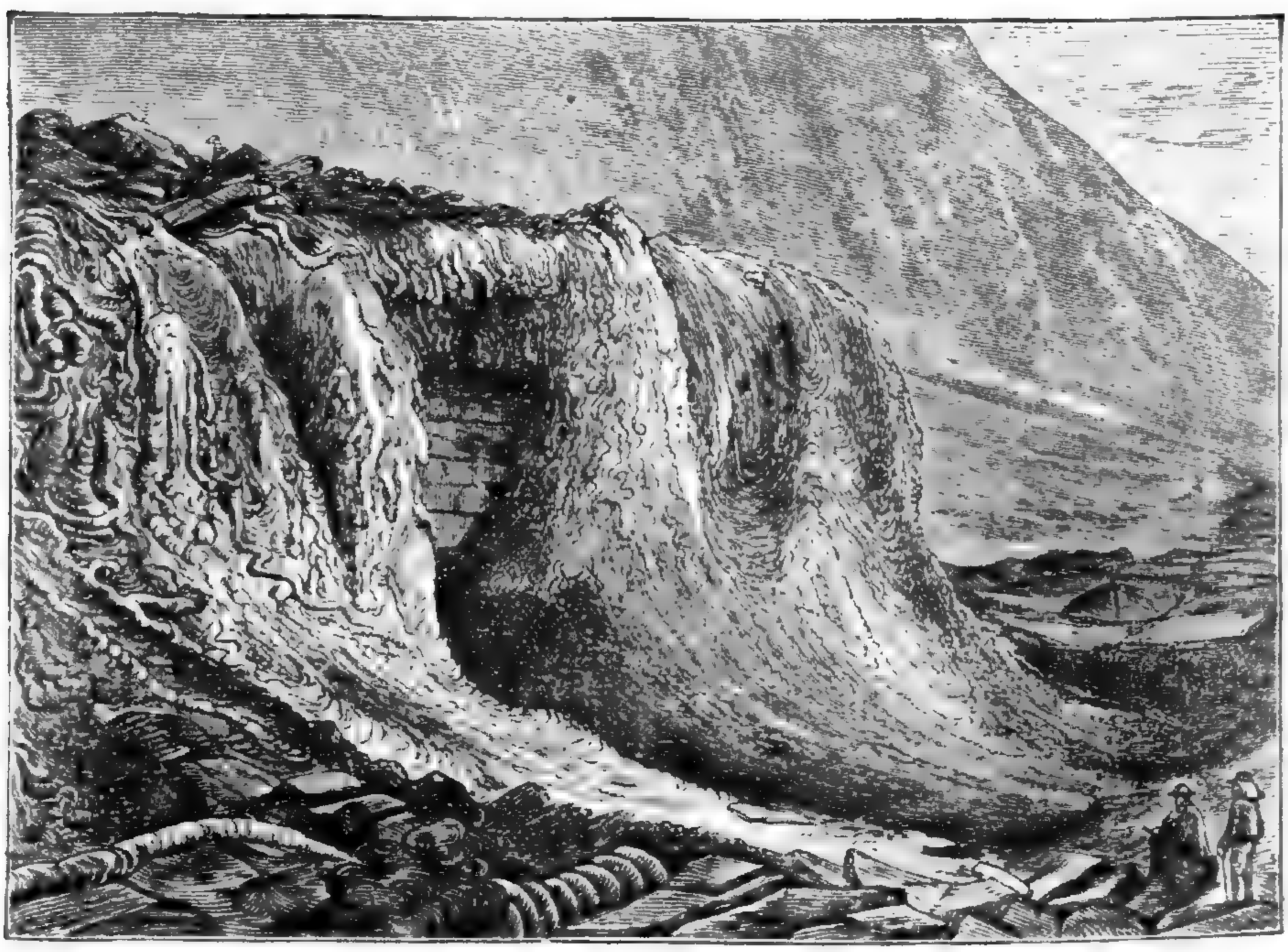

FIG. 2—Cascade of lava tumbling over a cliff in the Island of Bourbon.

pumice may give rise to streams of lava, before the vent which they surround sinks into a state of quiescence. In these cases, the liquid lava in the vent gives off such quantities of steam that masses of froth, or scoriæ, are formed, which are ejected, and accumulate around the orifice. When the force of the explosive action is exhausted, the lava rises bodily in the crater, which it more or less completely fills. But eventually the weaker side of the crater wall yields beneath the pressure of the liquid mass, and this part of the crater and cone is swept away before the advancing lava stream. Examples of such 'breached cones' abound in Auvergne and many other volcanic districts. A beautiful example of a cone formed of pumice, which has been breached by the outflow of a lava stream of obsidian, occurs in the Lipari islands, at the Rocche Rosse (Fig. 3). It is this locality which supplies the whole world with pumice."

FIG. 3.—Campo Bianco, Island of Lipari. A pumice-cone breached by the overflow of an obsidian lava-current.

To the general student the closing third of the book will commend itself. The writer successfully applies the doctrine of continuity to volcanism and volcanic rocks. He claims that the granites formed in Tertiary times present no essential points of difference from those which originated in the earlier periods, and that the same materials may, under different conditions "assume either the characters of granite on the one hand, or of pumice on the other." Professor Judd assumes that "the careful consideration of all the facts of the case leads to the conclusion that when pumice, obsidian and rhyolite are now being ejected at the surface, the materials which form their substances are, at various depths in the earth's interior, slowly consolidating in the form of quartz-felsite, granite-porphyry and granite," and after farther discussion, he concludes "that the manifestations of the subterranean forces in the past agree precisely in their *nature* and in their *products* with those taking place around us at the present time." We are then led to the subject of the formation of mountain chains, which are happily termed "cicatrised mounds in the earth's solid crust." He then epitomises the leading events in the formation of mountain chains.

"A line of weakness first betrays itself at a certain part of the earth's surface by fissures, from which volcanic outbursts take place, and thus the position of the future mountain chain is determined. Next subsidence during many millions of years permits of the accumulation of the raw materials out of which the mountain range is to be formed; subsequent earth-movements cause these raw materials to be elaborated into the hardest and most crystalline rock-masses, and place them in elevated and favorable positions; and lastly, denudation sculptures from these hardened rock-masses all the varied mountain forms. Thus the work of mountain making is not, as was formerly supposed by geologists, the result of a simple upheaving force, but is the outcome of a long and complicated series of operations."

What volcanoes teach us concerning the nature of the earth's interior is given in a clear, interesting way. The "crust of the earth" is, as geology now shows, only that part of a solid globe accessible to examination, and the interior may consist of materials similar to those found in meteorites, while the volcanic phenomena witnessed on our earth may be identical in nature with the great movements in other worlds than ours."

BRUNTON'S BIBLE AND SCIENCE.[1]—The author of this excellent book makes a very successful attempt to reason with those who regard the doctrine of evolution "with horror mingled with fear." He gives a brief, popular and very readable sketch of some of the data on which the doctrine is founded, and shows "that instead of

[1] *The Bible and Science.* By T. LAUDER BRUNTON, M.D., F.R.S., with illustrations. London, Macmillan & Co. 1881. 12mo, pp. 415. $2.50.

being atheistic it is the very reverse, and is no more opposed to the Biblical account of the creation than those geological doctrines regarding the structure and formation of the earth's crust, which were once regarded as heretical and dangerous, but are now to be found in every class book, and are taught in every school."

The three first chapters are excellent examples of a common-sense interpretation of some of the events recorded in Genesis and Exodus in the hyperbolical and oriental language of a childish age of mankind, and they are written in a most interesting, graphic style.

In lecture XVI on the Mosaic Record and Evolution, Dr. Brunton thus carries his readers in the following manner across the—to paraphrase a Latin expression—*pons simiarum:*

"But by far the most serious objection to the hypothesis is its necessary extension to man. If we accept it, we must give up the belief which we all learned in our childhood, that a single man was created out of lifeless mud, became a living soul, and was the progenitor of the whole human race. We must believe, instead, that men are descended, not from any of the species or genera of monkeys now living, but from creatures which were the common ancestors of man and monkeys, and much lower in the scale of existence than either. If such progenitors existed, they were probably somewhat like the lemurs of the present day, though still lower in the scale of existence than they. From these hypothetical common ancestors of man and monkeys, two different races started. Man developed onwards towards greater and greater intellectual powers; he learned to light fires, and gained all the power which this could give him; learned to communicate with his fellows, not merely by verbal signs, but by visible ones, either in the way of drawing or writing, and thus was enabled to pass on the accumulated knowledge of one generation to another. The monkeys on the other hand, developed rather physically than intellectually, they became admirably adapted for an arboreal life, but the satisfaction of their hunger, or the gratification of their other appetites, were the utmost ends to which their mental development enabled them to attain. Believers in evolution do not, however, fancy that a monkey can now become a man, or that monkeys of the present day can ever develop into men; for between men and monkeys there is a great gulf fixed. They may have started from a common point long ago, but the races have now diverged so far that it is perfectly hopeless for the one ever to pass into the other.

"The doctrine of a common descent of man and monkey from some lower animal, seems at first sight to cut at the root of all religious beliefs. But again we must ask the question, does it do so? Many people seem to believe that, according to the theory of evolution, men are monkeys, because men and monkeys are descended from a common ancestor. But this is not the case. A man is a man, and not a monkey, whether his first progenitors became men by special creation from a lump of clay, or whether they were developed from a man-like animal. We are not pagans, robbers, murderers, manstealers, living by rapine and dealing in bloodshed, and yet it is almost certain that we are descended from ancestors who were pagans, robbers, murderers, and manstealers, nor does it matter now whether these our ancestors were suddenly changed from heathen pirates to Christian herdsman and agriculturists, or whether a generation or two elapsed during the change. The change has taken place, and that is enough."

The author then argues that though we are reasonable beings, we were not always so, *i. e.* in early infancy, and hence he claims "the difficulties regarding the passage from an animal to a man, and the possession of a soul are the same in the case of the individual man as they are in the case of the race."

We would recommend this book to the general reader, while parents and teachers will find in the last chapter on the "Development of Individuals," some practical hints as to the care of children.

The author's views are expressed with so much earnestness, simplicity and attractiveness, that we feel sure the book will be widely read. It is, in spite of some points which might be criticised, the best of the sort which has yet been published, and deserves wide circulation.

CHAUTAUQUA TEXT-BOOKS, NO. 22, BIBLICAL BIOLOGY.[1]—Forty-one pages of false science mingled with true, the better to suit the babes who suck at the Chautauqua milk-bottle. The tract would not be worthy notice were it not for the contemptuous tone adopted by the clerical writer towards scientists who, since they are not clerical, have freed themselves from the slavery of clericalism. "Cobbler, stick to your last," is good advice to all clergymen, who, though interested in some branch of biology, go out of their way to depreciate those whose broader view enables them to discern the tendency of proven facts. Every non-evolutionist that works in biology is heaping up facts to his own condemnation.

After a tilt at monism, at Bichat, at Carpenter, and at Herbert Spencer, the author quotes the Rev. Jos. Cook. He then tries to squeeze help out of Huxley, notwithstanding that writer's known tendencies in an opposite direction.

In the teeth of all the facts that prove that living beings are constantly changing, changing even in a few years, while one man's eye can watch and record the changes; in the teeth of the shading of variety into species; of the production of generic characters by a slight acceleration or retardation under changes of environment; in the teeth of proofs as clear as those on which

[1] *Chautauqua Text-books.* No 22, Biblical Biology. By Rev. J. H. WYTHE, A.M., M.D.

the Copernican system is built, and in the teeth of the evolution of his own race during his own life, Dr. Wythe dare not only assert that "transmutation is impossible," but brands with the name of "Atheist," such men as Spencer, Wallace, Tyndall, Huxley, Darwin, Quatrefages, Cope and Draper, men whose reverence for all that is good, and honest hatred of all that is evil or hypocritical is evident in every line of their writings. Dr. Wythe does not know, or forgets, the fact that the teachers of a newer and better creed are always called atheists by the bigoted adherents of an older and worse one. His list of dualist naturalists consists in great part of the mighty of the past, and of men whose laurels have been won in non-biological fields, and whose claim to the title of biologist consists chiefly in their conservative opposition to the lessons biology teaches.

Then comes the old argument that, if transmutation be true, in the struggle for existence, all the lower should have been changed to higher forms. By the same reasoning, if civilization be true, all savages should have reached the highest civilization. But savages exist, and Dr. Wythe will not deny that they are of the same species with himself. Ergo, civilization is not true.

We refer, as a curiosity, to the paragraph on "spiral motion or fiber" *(sic)*, which the author declares to be a "wonderful thing." Even spiral motion without "fiber" is a "wonderful thing" according to the definition given, which is as follows: "For all circular movement two forces are needed, centripetal and centrifugal, but for a spiral, a progressive movement of the centrifugal point is also necessary." When we read the list of these movements we increase our wonder. They are "cyclosis and spiral fibers of plants, phyllotaxis, spiral forms in shells and radiates, the spiral movement of the moon and planets in space, and many spiral nebulæ."

The classification of our author is better than might be expected, indeed, in some points it is that of the "atheistic" Haeckel, but it is significant that the echinoderms are retained among the radiates, that the troublesome types of Vermes are ignored, and that *man is not included in the vertebrates.* Shades of Cuvier and Agassiz, what think ye of him who claims to be your follower?

Darwin's Formation of Vegetable Mold through the Action of Worms.[1]—This, the last of Mr. Darwin's works, is characterized by the same patient observation, ingenuity in methods of research, cautious spirit and powers of generalization, which may be seen in his more important works. The startling conclusions of this book are gradually approached, and each step is so

[1] *The International Scientific Series. The Formation of Vegetable Mould through the action of Worms, with observations on their habits.* By Charles Darwin LL.D., F.R.S. With illustrations. New York, D. Appleton & Co., 1882. 12mo, pp. 326. $1.50.

surely taken that the reader at the end is convinced that the results derived from so many facts must be well founded.

In 1837, in a short paper on the "Formation of Mould," the author showed "that small fragments of burnt marl, cinders, &c., which had been thickly strewed over the surface of several meadows, were found, after a few years, lying at the depth of some inches beneath the turf, but still forming a layer." This was due "to the large quantities of fine earth continually brought up to the surface by worms in the form of castings." This subject has been faithfully followed up through a period of over forty years.

After describing the structure and habits of the earth-worm, Darwin shows that they burrow both by pushing away the earth on all sides, the pharynx being, as Perrier had shown, pushed forwards into the end of the head, causing it to swell out, and thus push the earth away on all sides, while also the worm swallows the dirt, which passes through the body. In this way worms may penetrate to a depth of from three to eight feet. By their great numbers and continued activity earth-worms bury small, and often great stones left on the surface. In many parts of England it is estimated that a weight of more than ten tons of dry earth annually passes through their bodies and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mold passes through their bodies in the course of every few years. Moreover they triturate and thus disintegrate particles of rock, and thus aid in the denudation of land. By their action ancient earthworks and tumuli are lowered, and old ruins, pavements and stone walls are either buried or perceptibly lowered, and thus the humble earth-worm acts in the end as a not unimportant geological agent.

THE MICROSCOPE IN MEDICINE, BY LIONEL S. BEALE, M.B., F.R.S.[1]—This is the fourth edition of a well-known and valuable work, by one of the most practiced microscopists of the United Kingdom.

The introduction consists of an able plea for encouragement and assistance in the scientific investigation of disease, and is followed by nearly 200 pages devoted to a description of the apparatus necessary for the examination of objects of clinical importance, the practical operations required for their demonstration, and the methods of recording the appearances observed.

In this portion of the work full directions are given for hardening, boiling, freezing, rendering transparent or opaque, preserving, mounting, coloring, cutting sections, injecting, and other processes necessary for the examination of the various kinds of

[1] *The Microscope in Medicine*, by LIONEL S. BEALE, M.B., F.R.S., Fellow of the Royal College of Physicians, etc., Fourth Edition, pp. 528. Illustrations more than 500, most of which have been drawn on wood by the author. London, J. and A. Churchill; Philadelphia, Lindsay and Blakiston.

healthy and morbid tissues, both hard and soft, and the letter-press is aided by twenty-four plates.

The second and larger part treats of the microscopical characters of the simplest particles of tissues and of their demonstration; of structural elements and elementary parts in health and disease; of deposits from fluids, and of animal and vegetable parasites. After a chapter devoted to the living matter and cell-structure of organizms the author treats of lymph, chyle, blood and serous fluids, of medico-legal investigations, saliva, sputum, vomited matters, fæces, discharges of various kinds, and milk. Pus, animal poison or virus, contagium, and tubercle, are next considered, and the author's views of their nature fully stated; the urine, and urinary deposits and calculi, are next examined into, and the remaining portion of the work, except a short chapter devoted to human parasites, is taken up by methods of investigation of the various tissues and organs of the body in health and disease, and statements of the author's opinions of the nature of diseases affecting them.

In a field so broad as that covered by this book there is of course much room for difference of opinion. Dr. Beale devotes much of his space to theories of his own, more or less ably supported by argument; and to the disproof of rival theories.

His opinion upon the value of the microscopic examination of blood-stains in cases of supposed murder, based as it is upon the great resemblance of the red blood corpuscles of the carnivora, some ungulates, rodents, quadrumana and certain other mammals to that of man, and upon his own extensive practice, is entitled to great weight. He says, "I can hardly think that in any given case the scientific evidence in favor of a particular blood-stain being caused by human blood, will be of a kind that ought to be considered sufficiently conclusive to be adduced, for example, against a prisoner upon his trial." He, however, considers such evidence as of value in strengthening or weakening other circumstantial evidence.

Against all theories of disease that refer the contagion to germs of fungi or bacteria, Dr. Beale decides unhesitatingly and argues, in our opinion, almost convincingly. He does not by any means stand alone. Dr. Benjamin Richardson has long advocated very similar views, and although the adherents of the "germ" theory have of late years made a far greater show in print than their opponents, it has been through the remissness of the latter rather than on account of the powerful arguments of the former.

That bacteria, vibrios, etc., are found in abundance in all those diseases called zymotic, is undeniable, but it is also true, as Dr. Beale asserts, that "many things we eat contain them in countless multitudes. In the alimentary canal of infants suffering from a little stomach derangement, bacteria are often present in vast numbers * * * * many of the secretions may contain them without perceptible injury to the health, while hosts of them are invariably present in the fluids, and in and about the superficial cells of the mucous membrane of the mouth of all persons, even in the most vigorous health." All fungi and schizomycetes feed upon decaying organic matter, and therefore their presence does not prove that they are the cause of the disease. The assumption of a different species of bacterium to each disease is not warranted by our present knowledge of these low existences, and if, as our author asserts "the virulence of the virus decreases as the bacteria in it increase in number," the bacterium theory seems scarcely tenable. Dr. Beale asserts that he has never been able to discover a bacterium in pure vaccine lymph, and that those who regard the solid particles found in vaccine as bacteria commit the grave error of confounding the actual contagious "bioplasts," derived from the living matter of the cow, with bacterium cells, from which they differ visibly in the want of regular form and the absence of a cell-wall. Dr. Beale believes the contagium or virus of every contagious disease to consist of extremely minute particles of the *living* matter of the species infected by the disease. This contagium is "bioplasm" become poisonous, and "each kind of contagious bioplasm manifests its own specific actions, and only these." He admits, however, that such particles cannot, in the present state of our knowledge, be distinguished from healthy particles of the same size; and he also admits that it is remarkable that one form of disease has always been found accompanied by a specific organism that has not been found in any other.

May not the truth lie between the two opposing schools, and, although the great majority of diseases are caused by organic changes in the protoplasm or in the secretions (Dr. Richardson's theory) of the infected species, may not a few, especially those which are localized in their manifestation, be caused by microscopic organisms? We know that the entozoa sometimes produce positive disease, and that certain skin diseases are caused by acari—why then may not certain lower existences be poisonous, and cause some of the less common forms of disease?

Dr. Beale asserts that the pus corpuscle or globule has no cell-wall, and that "the bioplasm of tissue, being supplied with an increased quantity of pabulum, may give rise to pus." A too rapid multiplication, resulting in the formation of particles that have lost the power of forming tissue, is, in Dr. Beale's opinion, the origin of pus. Tubercle, he asserts, can be microscopically shown to consist of small protoplasmic masses of about the size of a red blood corpuscle, these particles are living, and grow, but more slowly than pus corpuscles, from which they differ also in their firmer consistence. Thus there is a tendency to heredity, yet tubercle may be developed by bad hygienic conditions in persons free from hereditary taint.

Morbid growths of a malignant, cancerous nature are by our author believed to originate "in the embryonic bioplasm found in connection with complex structures," yet he also thinks that "the cause of the cancer development operates at a period of time separated by many, many years from the period of the actual production of the cancer-cells, * * * * * even during embryonic life." Is the last belief, which is warranted by the often observed cancerous diathesis, consistent with the former?

It is greatly to be regretted that Dr. Beale continues to use the word "bioplasm" for the living formative substance of organisms, called by all naturalists and known to a large portion of the public as protoplasm. It matters not if the word has been, as Dr. Beale states, used improperly, the fact remains that those who use the word protoplasm, use it in exactly the same sense in which Dr. Beale uses "bioplasm," and nothing but confusion can result from the introduction of a new term.

"Protoplasm" was first introduced to the English public in Von Mohl's work "On the Vegetable Cell," translated in 1851, and was known in Germany several years earlier. The existence of detached particles of living matter, destitute of a cell-wall, and usually smaller than cells, does not, whatever Dr. Beale may assert to the contrary, disprove the cell theory, which receives such continued confirmation from the work of microscopists in all parts of the civilized world, that it ought not to be called a theory, but a fact.

Cells are the bricks of which the Metazoan edifice is constructed, but that edifice is also the manufactory for their construction, and the laboratory for their destruction and the working up again of a great portion of their material.

What wonder is it, therefore, that in the fluids, and on and in the tissues should be found protoplasm, which has not yet been formed into cells, or which has previously existed in that state?

The formative powers of protoplasm, and the distinction varying greatly in its width, between the formative and the formed material, are recognized by all biologists, and it is difficult to see what addition Dr. Beale brings to our previous knowledge.

Dr. Beale, in common with all other biologists, finds that a certain complex physical substance, occurring only in the organic world, possesses properties and performs movements not possessed or performed by other kinds of matter. In common with all other biologists, he is in the most absolute ignorance of the cause of these movements, but, instead of confessing that ignorance, he asserts that they can only be accounted for by assuming the existence of "some sort of supra-physical or vital power." The latter term is admissible as a title for what we cannot explain, but the former term involves an assumption unwarranted by anything within the range of our knowledge. The belief that every unexplained fact is "supra-physical" belongs to the mediæval stage of thought, and it is high time that it were banished from the beliefs and writings, as it is from the life and practice of the civilized portion of humanity.

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GENERAL NOTES.

BOTANY.[1]

THE QUILLWORTS OF NORTH AMERICA.—Probably few of the readers of the NATURALIST have given much time to the study of the grass-like or rush-like plants commonly designated as the quillworts, and included in the genus Isoëtes. They are Pteridophytes, that is, they belong to the great group of plants lying next below the Phanerogams, and distinguishable from the still lower plants by the possession of fibro-vascular bundles in their stems and leaves. The equisetums, ferns, adder-tongues, and ground-pines are among their relatives, and of these, the last named have by far the closest relationship. Although the plant-body of quillworts is much simpler than that of ground-pines and ferns, their reproductive organs are of a higher order, and for this reason they are to be regarded as among the highest of the Pteridophytes. In fact, in some respects, as for example in the germination of the microspores, there is an evident relationship to the Gymnosperms. The one, two or three small cells observable in the pollen grains of conifers are but little different from and are clearly homologous with the rudimentary prothallium of the quillworts.

The natural interest these plants possess, on account of their position so near the boundary line separating Pteridophytes from the lower Phanerogams, will be greatly enhanced by the excellent work recently done by Dr. Engelmann, the results of which have just been published in the Transactions of the St. Louis Academy of Sciences under the caption of "The Genus Isoëtes in North America," and also separately issued as a pamphlet of thirty-four pages. With his usual thoroughness the author has left little more to be desired in this admirable monograph. The history of the species, both as to discovery and publication is given with great fullness. From this we learn that "the first notice which we have of an Isoëtes in North America is given in Pursh's Flora" (A. D. 1806). During the succeeding quarter of a century but few specimens were collected. From 1831, when Robbins gathered *Isoëtes riparia* near Uxbridge, Mass., to the present time there has been a steadily increasing attention given to the species by collectors.

The morphological and biological characters are well worked out

[1]Edited by PROF. C. E. BESSEY, Ames, Iowa.

in sections 2 and 3 of the paper. In this part one regrets the absence of plates, which we hope the author may yet be enabled to add.

The whole number of species in the world is stated to be "perhaps forty to sixty," of which fourteen, besides a dozen well-marked varieties, occur in North America. It may be of interest to enumerate those occuring in this country, giving the geographical range, as indicated by specimens.

1. *I. lacustris* Linn.; Northern N. Y. to Lake Superior.
   var. *paupercula* Engelm.; Ry. Mts and California.
2. *I. pygmaea* Engelm; Californian Mts.
3. *I. Tuckermani* A. Braun; New England.
4. *I. echinospora* Durieu, *var. Braunii* Engelm.; Penn. northward and north-westward and to Utah.
   vars. *robusta* Engelm., *Bootii* Engelm., and *muricata* Engelm.; New England.
5. *I. Bolanderi* Engelm.; Cal., Oregon and Ry. Mts.
6. *I. saccharata* Engelm.; Maryland.
7. *I. riparia* Engelm.; Penn. to New England.
8. *I. melanospora* Englem.; Georgia.
9. *I. Engelmanni* A. Braun; Del. to New England to Missouri.
   var. *gracilis* Engelm.; Penn. to New England.
   var. *valida* Engelm.; Penn.
   var. *georgiana* Engelm.; Georgia.
10. *I. Howellii* Engelm.; Oregon.
11. *I. flaccida* Shuttleworth; Florida.
    vars. *rigida* Engelm. and *Chapmani* Engelm.; Florida.
12. *I. melanapoda* J. Gay; Ill. and Iowa to Indian Territory.
    var. *pallida* Engelm.; Texas.
13. *I. Butleri* Engelm.; Indian Territory.
    var. *immaculata* Engelm.; Tennessee.
14. *I. Nuttallii* A. Braun; Western Idaho to Oregon.

Modern Botany and Mr. Darwin.—In no one thing is the botany of to-day more sharply in contrast with that of a quarter of a century ago than in the attention now given to the study of plants *as living things*. The plant as a body of a certain form, occupying a definite amount of space, does not now absorb the whole attention of the botanist. For the botanist of to-day, plants are living, moving, feeling beings, whose habits and movements, and the secrets of whose lives are deemed worthy of the closest scrutiny and observation. In this work, the proper work of modern botany, Mr. Darwin led, and where he did not enter himself, he pointed out the way. The titles of his books alone, almost outline the whole work of the student of plant life. The "Contrivances by which Orchids are fertilized by Insects;" the "Movements and Habits of Climbing Plants;" the "Variation of Animals and Plants under Domestication;" the "Insectivorous Plants;" the "Effects of Cross and Self-fertilization;" the "Different forms of Flowers on Plants of the same Species;" the "Power of Movements in Plants;" certainly the field was well mapped out. Every book as it appeared gave a new impetus to biological botany, and at once directed attention to what in many cases had been almost entirely neglected subjects. It is, however, not so much what Mr. Darwin saw that others had not seen, for his actual discoveries in botany are not many, as the rare power he possessed of making everything have a meaning. He added many fold to the pleasures of study by teaching us how to look in a new direction for the reasons for things. The colors, odors, forms, the irregularities of flowers are no longer but so many variations for tickling *our* sense organs. It may be a humiliating lesson to learn, but close observation compels us to acknowledge that the fine colors and forms, and the sweet odors have no necessary relation to us, and that had man never come into existence, they would still have been just as beautiful and just as fragrant as they are now.

In the domain of systematic botany, the great law of the modification of species is slowly (as was to be expected, Mr. Darwin not being a systematist) bringing about a complete revision of classification. Cohn's, Sachs', Caruel's, De Bary's and Gobi's recent systems are all attempts to bring out the genetic relationship of the various groups, which are considered to have descended from more primitive forms. The parasites and saprophytes need no longer be placed by themselves in a group of exceptional plants, but find their proper places as the degraded members of various groups of chlorophyll bearing plants. Once granted the origin of species by means of natural selection, and its full import understood and acknowledged, a mutual relation is seen to exist between one group and another, a relation which is much more than that of mere structural similarity. Under the influence of the Darwinian method, the vegetable kingdom is assuming a shape in our classifications, which shows a gradually increasing complexity, a gradual modification and differentiation as we pass from the slime molds to the flowering plants. The flower of the phanerogam is not wholly phanerogamic, it had its beginnings away down among the simple pond-scums, and is but the last link in a chain extending throughout almost the whole plant world.

Botanical Notes.—We see it announced that Williams & Norgate, of London, are to issue a work by Dr. M. C. Cooke, entitled "British Fresh Water Algæ, exclusive of Desmideæ and Diatomaceæ."——Parrish Brothers, of San Bernardino, California, offer sets of the plants of Southern California. The specimens are beautifully prepared, and are well worthy of finding place in any herbarium.——The first fascicle of "N. A. Gramineæ," under preparation by F. Lamson Scribner, of Girard College, Philadelphia, is to be issued soon. Collectors of the Gramineæ can aid the prosecution of this work by addressing the author as above. ——The manual of North American Lichens, recently published by S. E. Cassino, of Boston, has unfortunately not been stereotyped, which is much to be regretted, as the edition will, as a consequence, soon be out of print.——M. S. Bebb, in the March *Bo-*

tanical Gazette, concludes that the Californian willow, *Salix Coulteri* Anders. is "nearly allied to—if not identical with"—*S. sitchensis* Sanson, which, like *S. Coulteri*, he now finds to have but *one stamen under each scale!* *S. Coulteri* he regards as probably nothing more than "an extravagant autumnal growth of *S. sitchensis*."——In the same journal Dr. Farlow notices the injury to the vine in Europe and Algiers caused by the American grape mildew (*Peronospora viticola* B. & C.). In moist regions it appears to be very injurious, even approaching the *Phylloxera* in some cases. Lime, antiseptic fluids, and other applications, failed to check the parasitic growths. Burning the leaves to destroy the oöspores is recommended.——Dr. R. E. Kunzé's paper on "The Germination and Vitality of Seeds," read before the Torrey Botanical Club, contains a mass of valuable information collected from many sources. Copies may be obtained of N. L. Britton, School of Mines, New York city, for fifty cents each.——Among the valuable foreign botanical journals, which American students may profitably consult, the *Archives Botaniques du Nord de la France*, must be mentioned. Lotar's memoir on the comparative anatomy of the vegetative organs of the Cucurbitaceæ is well worth careful reading.——Dr. W. P. Wilson has published a paper on "The Cause of the Excretion of Water on the Surface of Nectaries," in which he shows it to be due not to internal pressure, as has generally been assumed, but to osmotic action. ——Dr. W. A. Kellerman's paper, *Entwickelungsgeschichte der Blüthe von Gunnera chilensis Lam.*, is a valuable contribution to our knowledge of these curious plants. Four plates accompany the paper.

ZOÖLOGY.

The Nature of Life.—This is a tempting problem; it has attracted the attention of the thoughtful of the past, and is attracting the attention of the thoughtful of the present, yet in spite of untiring efforts, in spite of ingenious arguments, it is still unsolved. Is it insolvable? This again is a question not to be answered hastily, either in the negative or the affirmative, since so much that was once thought insolvable has been solved; while so much that was supposed to be solved (by revelation or authority) has proved to be still unknown. As indices which *may* point towards a solution, we give a short abstract of three papers that have lately appeared.

D. Monnier and C. Vogt (*Comptes Rendus*, Jan. 12, 1882) state that by the joint action of two salts forming by double decomposition one or two insoluble salts, are produced cellules, tubes and other forms assumed by organic life. The liquid in which this takes place may be of organic or semi-organic nature, or absolutely inorganic, but one of the salts must be dissolved in the liquid, while the other is present in a solid form. Saccharate of lime and silicate of soda are among the liquids in which these pseudo-organic forms can be produced; certain viscid liquids yield no such results; the form of pseudo-organic product is constant with the same salts; and with some exceptions, the forms are only obtained from substances which are found in real organisms. Sulphates and phosphates produce tubes, carbonates give rise to cellules. Membraneous cell-wall, giving passage only to liquids; and heterogenous granular contents combine to render the resemblance to forms organically produced, most striking. M. Fournier obtained similar results as early as 1878.

Messrs. O. Loew and T. Bokorny, of Munich, have worked the idea advanced by Professor Pflüger, that there is a chemical distinction between living and dead protoplasm, up to a tangible hypothesis. Herr Loew found that albumen contained a number of aldehyde-groups closely bordering on amide-groups. Such groups, according to modern chemistry, must have intense atomic motion, and Herr Loew argued that this motion constitutes life. It was found that living protoplasm had the power of reducing silver from a very dilute alkaline solution, whilst dead protoplasm lacked this power. Their theory is that the aldehyde-groups of each molecule are brought into immediate proximity with the amide-groups of the next, thus causing intensification of molecular action; with increased complexity and mobility follows increased instability, and thus apparently trifling agencies displace the molecules, cause their action to cease, and liberate heat, producing fevers, etc. When lifeless albumen is converted into the protoplasm of a living cell, heat becomes latent. Vital force, in the opinion of these chemists, is due to the tension of the aldehyde-groups ultimately due to electric differences, and life is the total result yielded.

The reviewer in the *Journal of Science* points out that Loew and Bokorny appear to regard albumen and protoplasm as identical, whereas, according to the analyses of Reinke, protoplasm contains scarcely thirty per cent. of albuminous matter, and includes upwards of forty proximate principles. The third contribution to the subject is that of O. Bütschli, who in *Zoologischer Anzeiger* publishes some original thoughts of life and death. He first draws attention to the great difference between the nature of death in the Protozoa and Metazoa. In the former the parent never exists by the side of its offspring, its reproduction (by fission or spore-formation is the death of the individual. The higher animals, on the other hand, live after the birth of their offspring, but for a certain limited time, and their death throws a quantity of organic matter into inactivity. He then finds the hypothetical cause of the limited duration of individual life in the nature of the egg, which he supposes to endow the individual with a limited quantity of a "in a certain sense ferment-like working substance" *(in gewissem Sinne fermentartig wirkenden Stoffes).* This limited quantity diminishes perpetually in energy, and is finally exhausted, producing the death of the individual. Meanwhile, certain tracts are set aside as reproductive organs, and produce a fresh supply of this "life-ferment" for the continuance of the species. The rejuvenescence of the nucleus of the infusoria by conjugation is homologized with that of the egg by the spermatozoa, but while the nucleoli of the infusoria are principally concerned in the process of rejuvenescence, the cells which bring about development in the metazoa proceed chiefly from the nucleus of the male sexual cells.

This is at least an ingenious hypothesis, but lacks support from observation. We know of no "life-ferment," and protoplasm the only life-substance we know of is certainly produced in plants, while animals contain more than they derived from the egg.

Is Man the Highest Animal?[1]—The measure of zoölogical rank is the specialization exhibited by all the organs, taken collectively. Specialization may be exaggerated in one or several organs, without the animal therefore attaining as a whole a high rank. This is the case in man. The measure of specialization is afforded by embryology, which shows in earlier stages the simplicity and uniformity of structure, which in later stages is replaced by complexity. The human body preserves several important embryonic features. In man we find three series of high differentiations, namely: in the brain, in the changes induced by or accompanying the upright position, and third in the opposibility of the thumbs to the other digits. These are the principal, though of course not strictly the only characteristics of man, which show that he is more specialized than any other animal. In other respects he shows a still more striking inferiority. It is of course a familiar observation that his senses are less acute than those of many animals—he has neither the keen vision of the falcon, nor the delicate scent of the dog. He is equally inferior in many structural features. His teeth are of a low mammalian type, as is shown both by his dental formula, and by the presence of cusps upon the crowns of the teeth, a peculiarity of the lower mammalia, entirely lost in the horse, the elephant, and many other "brutes." His limbs show a similar inferiority since they are little modified, preserving even the full number of five digits, and in respect of these members man stands therefore very low, lower than the cow and the pig. He plants the whole sole of his foot upon the ground, yet none except the lower mammalia, together with man and his immediate congeners are plantigrade. So too with his stomach, which is so simple as compared with that of a ruminant, and indeed is of about the same grade as that of the carnivora. It makes, however, a still more forcible impression to

[1] Read before the American Association for the Advancement of Science, Cincinnati meeting, August, 1881.

learn that the human face, which we admire when withdrawn under a high intellectual forehead, is perhaps the most remarkable of all the indices that point out man's inferiority. In the mammalian embryo the face is formed under the fore brain or cerebral hemispheres. In our faces the fœtal disposition is permanently retained, with changes, which when greatest are still inconsiderable. In quadrupeds the facial region acquires a prominent development leading to the specialization of the jaws and surrounding parts, which brings the face to a condition much higher than that of the fœtus. Hence the projecting snout is a higher structure than the retreating human face. These facts have long been familiar to anatomists, but I am not aware that the inferiority of the human to the brute countenance has heretofore been considered a scientific conclusion by any one. Yet that inferiority is incontrovertible and almost self-evident.

The preceding statements render it clear to the reason, that man is not in all respects the highest animal—and that it is a prejudice of ignorance, that assumes that the specialization of the brain marks man as above all animals in the zoölogical system. It does give him a supremacy by his greater power of self-maintenance in the struggle of the world, but that has nothing whatsoever to do with his morphological rank. There is nothing in morphology that anywise justifies assigning, as is actually done, an almost infinitely greater systematic value to the specialization of the brain and a specialization of the limbs, stomach, teeth, face, etc., hence it is impossible to call man even the highest mammal. It is also doubtful whether mammals would be regarded as the highest class of the animal kingdom, were they not our nearest relatives. Let us beware of claiming to be the head of organic creation, since the Carnivora and Ungulata are in many respects higher than we. I believe that it is just as unscientific to call any one animal species the highest, as to pitch upon any one plant to stand at the head of the vegetable kingdom.—*C. S. Minot.*

Zoological Notes.—Mr. Chas. Linden, in a paper in the Bulletin of the Buffalo Society of Natural Sciences, states that the wood duck is easily domesticated, Mr. Irvin having raised successive broods of that species for many years, amounting frequently to thirty or more full-fledged young in one season. All the various ducks he experimented with migrated southward each autumn, and infallibly returned with a male mate, which remained until the young began to hatch. The observations recorded indicate that the majority of our wild ducks do not easily change their wild condition, but yet manifest no aversion to breeding freely when placed under artificial restraint.——Mr. Fewkes has described in the *American Journal of Science* for February, a Cercaria $\frac{1}{16}$ inch long, found swimming with a jerky motion by means of a long tail, which at intervals has bundles of long setæ arranged on opposite sides like those of an annelid. Mr. Fewkes in stating that in the possession of regular paired bundles of bristles, this Cercaria differs from all others known, has apparently overlooked the work of Valette St. George, wherein he figures *Cercaria setifera* Müll. and *C. elegans* Müll., both inhabiting the Mediterranean sea. The tails are provided with bundles of setæ in pairs, and are much as in Mr. Fewkes species.——In his tenth census report on the Oyster Fishery, Mr. E. Ingersoll describes the way in which the star-fish gains entrance to the oyster shell in order to feed upon it. Having met with an oyster, scallop, or other thin-shelled mollusk, and young ones are preferred because their armor is weak, the star-fish folds his five arms about it in a firm and deadly grasp. Then protruding the muscular ring at the entrance of his stomach through the circular opening in the centre of the under side of the disc, which he previously describes, he seizes the thin, newly-grown posterior edge of the shell, which oystermen call the "nib" or "bill," and little by little breaks it off. Then the star-fish protrudes into the shell the distensible mouth of the stomach, until it can seize upon the body of the mollusk. "The consumption of this begins at once, and as fast as the poor oyster's or scallop's body is drawn within its folds, the capacious stomach is pushed farther and farther in, until at last if the mollusk be a large one, the pouches that I have described as packed away in the cavities of the ray, are also drawn forth, and the starfish has substantially turned himself wrong side out. If he is dredged up at this stage as many examples constantly happen to be, and dragged away from his half-eaten prey, his stomach will be found hanging out of the centre of his body for a distance, perhaps, equal to half the length of one of the arms, and filled with the juices of the oyster he has devoured, and whose body, within the shell, will be found almost as squarely trimmed as could have been done by scissors." The wholesale manner in which the star-fish invades oyster beds, and the great increase in numbers of this creature since oyster beds have been planted are described. The injury done to oyster beds by the star-fish from Buzzard's bay to the western end of Long Island sound is estimated at $200,000 a year.

ENTOMOLOGY.[1]

NOTES FROM ILLINOIS; GRAIN-FEEDING HABITS OF FIELD CRICKET.—One morning after a rainy night, as I was passing along the highway, I noticed one of our common field crickets working at a kernel of corn that had dropped from some farmer's wagon while on the way to market. The rain had softened the grain; and after watching the insect some time, I found it was eating the germ of the softened kernel; I watched patiently until the cricket seemed to have satisfied its hunger, and found the germ had all

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

been eaten away. Early in the fall I found them in cornfields eating the crowns of kernels or ears that had blown to the ground, something I had always before attributed to mice.

The same insect has annoyed farmers considerably in another manner. Much of the harvesting is done with self-binding harvesting machines, using cord for binding. Judge of the surprise and chagrin of the farmer when on drawing in his stacks of grain, to find instead of compact bound sheaves only a mass of unbound grain, the bands of cord having been cut in many places by the crickets. Also I noticed numbers of our common black blister-beetle *(Epicauta pennsylvanica)* denuding the ears of corn of the silk before the kernel had been fecundated, thereby either partially or wholly destroying the ear. I have also found *Diabrotica fossata* Lec., which usually feeds upon the pollen of the flowers of the Compositæ, varying its bill of fare by eating the pollen of corn. Its near relative, *D. longicornis* Say, which I fear is to be the future pest of the cornfield, I found feeding upon both silk and kernel; one individual had excavated nearly the whole interior of a kernel, and was still at work, being so far advanced into the interior as to leave only the tip of its abdomen visible. I had supposed the insect relied upon the flowers of thistle and some of the Compositæ for its food, but now think were all of these taken away it would find abundant sustenance in the cornfield itself.—*F. M. Webster, Waterman, Ills.*

HABITS OF CYBOCEPHALUS.—There is nothing recorded, to our knowledge, concerning the habits of this little Nitidulid genus, distinguished by its peculiar appearance from the allied genera. In the summer of 1881 we received from Dr. J. H. Mellichamp of Bluffton, S. C., several twigs of *Pinus elliottii*, the leaves of which were covered with a Coccid, *Chionaspis pinifoliæ* Fitch. We kept these twigs in a jar in the hope of obtaining Chalcid parasites from the scales and were rewarded by the appearance of several specimens of *Cybocephalus nigritulus* Lec. We had then every reason to suspect that this little beetle, either as larva, or imago, or in both states, was feeding upon the scales. Our presumption has been lately corroborated by receiving numerous specimens of *C. californicus* Horn, sent by Mrs. A. E. Bush from San Jose, California, with the remark that they were found on an apple twig badly infested by a scale insect.

ONE EFFECT OF THE MISSISSIPPI FLOODS.—Few evils are without their compensating benefit. The planters of the Teche country will, in all probability, be free for a number of years from the attacks of a beetle *(Ligyrus rugiceps)* which has of late years proved very destructive to the sugar cane there. It will undoubtedly have been drowned out by the months of submersion which the fields of the infested region have suffered. Late reports indicate that even the stubble has become spoiled, and that little, if any, seed cane will be saved the present year. This will necessitate an importation of seed on a large scale, and we shall be agreeably surprised if the accompanying importation of some new insect foe to the sugar cane is not chronicled within a very few years.

DORYPHORA 10-LINEATA IN ENGLAND.—Mr. J. Jenner Weir, a member of the London Entomological Society, found early last spring a living specimen of *Doryphora 10-lineata* which had been taken to London from this country in a barrel of potatoes.

DR. DIMMOCK'S INAUGURAL DISSERTATION.—We sincerely congratulate Dr. Geo. Dimmock, of Cambridge, Mass., on the successful completion of his dissertation on "The anatomy of the mouth-parts and of the sucking apparatus of some Diptera," by which he lately obtained the degree of Ph.D. at Leipzig University. It is an important contribution to our knowledge of comparative anatomy, and fully justifies us in expecting most valuable work from its author in this direction in the future. Mr. Scudder's remarks at the Boston meeting of the American Association for the Advancement of Science, upon the field offered by insect anatomy and physiology cannot be too heartily endorsed, and we consider Dr. Dimmock's paper a forerunner of much excellent work by American students in the near future.

THE TRIUNGULIN OF MELOIDÆ.—"Nothing new under the sun!" From a recent letter received from our friend M. Jules Lichtenstein, of Montpellier, we learn that the old entomological writer Johann Leonhard Frisch in his remarkable work "Beschreibung von allerley Insecten in Teutschland, etc," tome VI., published in 1727, was well acquainted with and describes, p. 15, the triungulin of *Melöe proscarabæus;* while some sixty years later Réaumur, DeGeer, and other old entomological writers did not know what the triungulin was. Frisch was also familiar with the male of the Coccidæ.

FOSSIL TINEIDS.—Mr. V. T. Chambers communicates to *Nature* (Vol. 25, p. 529) as corroborative of the Tineid nature of certain serpentine, thread-like trails found by Lesquereux on leaves of magnolia from the Tertiary of Alaska, that he distinctly remembers seeing the figure by the same author of a fossil leaf of *Acer* on which there were several blotches, one of which bore a strong resemblance to the mine of *Lithocolletis aceriella*, now made in leaves of *Acer saccharinum.*

CLASSIFICATION OF NORTH AMERICAN COLEOPTERA.—We are glad to learn that the new edition of the classification of North American Coleoptera to be published by the Smithsonian Institution, is being rapidly pushed to completion by Messrs. LeConte and Horn. The first edition was never completed and is now out of print, but it did more to promote Coleopterology in the United

States than any other work published either before or since. It has become somewhat antiquated, however, and it is gratifying to know that we shall soon have a new edition brought up to date and written by the two men most competent to do the work.

EXCHANGES WITH SOUTH FRANCE.—M. Franz Richter, assistant to M. Lichtenstein, at Montpellier, offers all objects of natural history in the south of France, and more especially southern *Hymenoptera* well-named, Aphididæ and Coccidæ in microscopic preparations. He has also sets of *Phylloxera* in the various life-stages.

HIBERNATION OF THE ARMY WORM.—The experience of the past winter has very fully confirmed the revised conclusions we reached in 1880 respecting the hibernation of *Leucania unipuncta* in the larva state. We found the larvæ of all sizes throughout the milder winter weather in Washington, and the first moths issued from them early in March or about the time when in South Georgia what may safely be assumed to have been a second generation of worms for that latitude were found of all sizes. At the present writing, in Washington the second generation of moths are ovipositing, preferring, in the open field, as we rightly inferred in 1877, old hay and stubble and coarse grass or corn stalks to the green grass, whenever the former are at hand. From the widespread occurrence of this insect wherever we have sought it so far, we conclude that much damage will result from the second and third broods of worms in the more northern States.—*C. V. Riley, May 4, 1882.*

ANTHROPOLOGY.[1]

DR. RAU'S LATEST CONTRIBUTION TO ANTHROPOLOGY.—The Smithsonian Institution has done a very important service to archæology by collecting into a single volume all the papers of Dr. Rau published in the Smithsonian Annual Reports. The work includes the following monographs:

Baegert's account of the aboriginal inhabitants of the Californian peninsula (Reports 1863 and 1864).
Agricultural Implements of the North American stone period (1863).
Artificial shell deposits in New Jersey (1864).
Indian Pottery (1866).
Drilling in stone without metal (1868).
A deposit of flint implements in So. Illinois (1868).
Memoir of C. F. P. von Martius (1869).
Ancient aboriginal trade in North America (1872).
North American Stone Implements (1872).
The prehistoric antiquities of Hungary (1876).
The stock-in-trade of an aboriginal lapidary (1877).
Observations on a gold ornament from a mound in Florida (1877).

Inasmuch as these articles were reprinted from stereotype

[1] Edited by Professor OTIS T. MASON, 1305 Q. street, N. W., Washington, D. C.

plates, the author has called attention to additional information, or a modification of his views in a preface of six pages.

Every young archæologist should possess and study this work, and older investigators will receive no harm from reviewing with Doctor Rau the grounds of their faith.

The Books of Chilan Balam.—A pamphlet bearing the foregoing title is issued by Edward Stern & Co., of Philadelphia. It is the substance of an address by Dr. Daniel G. Brinton to the Numismatic and Antiquarian Society of Philadelphia, in January last, which appeared also in the *Penn Monthly* for March. The Mayas of Yucatan possessed a literature written in "letters and characters," preserved in volumes neatly bound, the paper manufactured from the bark of a tree and sized with a durable white varnish.

The old sacred rituals preserved in these volumes were ruthlessly destroyed, but some of the intelligent natives, instructed in Spanish, wrote out in a new alphabet, partly in that language and partly in their own, what they remembered of the contents of their ancient records.

In whatever village or by whatever hand written out, each of these books was and is called "The Book of Chilan Balam." In the pamphlet before us, Dr. Brinton gives a digest of this wonderful work, together with photolithographs of the signs of the months compared with those of Bishop Landa.

The Relation of History to Anthropology.—In no way is the influence of anthropologic methods better exhibited than in the changes which have taken place among historians as to their manner of treating their subject. The best illustration of this we have seen is the History of Ancient Egypt, by Canon George Rawlinson, published in two beautifully illustrated volumes by S. E. Cassino, of Boston. The Egyptians themselves, undesignedly, realized that in the coming centuries there would arrive a time when men would tire of reading about long lists of kings and of royal personages, and would ask how did such a people dress, eat, build, work, fight, amuse themselves? How did they organize their society? How did they treat each other, their women, children, friends, or rulers? What were their methods, customs, and ceremonies? What did they know, and how did they use their knowledge? They perpetuated the knowledge of all these things in hieroglyphics on papyrus and cut in stone. Their climate favored the permanence of their record. Canon Rawlinson has written history before. His works on the great monarchies of the east supersede the older histories. For a long time the work before us will be the student's guide book to the geography, climate, races, language, industries, art, science, and religion of the land bordering the river which, "issuing from the equatorial regions, has strength to penetrate the 'frightful desert of interminable scorching sand,' and to bring its waters safely through two thousand miles of arid, thirsty plain, in order to mingle them with the blue waves of the Mediterranean."

DARWIN AND ANTHROPOLOGY.—When weeping friends gather to pay their last respects over the grave of a great pilot, the reigning thought in the minds of those who had sailed with him in former years would be the recollection of pleasant days and nights, narrow escapes, and almost miraculous deliverances. So perfectly human would be this oneness with the dead that for a time the gallant ship, the faithful sailors, and the helpful passengers would be quite forgotten, or else all their good qualities would be merged and blended with the virtues of this one heroic soul.

In attempting to study the connections of Charles Darwin with the natural history of man, we are embarrassed by this same feeling. We realize that in twenty-three years we have come a great journey, we have passed by innumerable shoals and quicksands, we have made decided progress in the right direction. How much of this work was done by Mr. Darwin? How much did he immediately inspire? How much was accomplished by those who had drank of his inspiration? How much was the logical fruit of seed which he had sown? How much was the outcome of opposition to him? In the brief space allowed to this note of regret, discussion of these topics would be impossible. Suffice it to say, there is no one acquainted with the progress of anthropology who will not admit that a great part of our latest anthropological research has been carried on through one of the motives enumerated above.

No doubt, in archæology, in anthropo-biology, in the elaboration of industries or comparative technology, it was known before Mr. Darwin's day that there had been evolution, selection, survival of the fittest. The great merit of Mr. Darwin's work and influence in anthropology had been the application of the same rule to anthropogeny, archæology, biology of man, evolution of races, of mentality, of language, of arts, of society, of philosophy, of creed, of cult, and of the amelioration of the race through better knowledge of and better adaptation to the environment, taking the word in its widest acceptation.

Although the greater part of Mr. Darwin's influence upon anthropology has been indirectly exerted, his own personal contributions were of no mean order. Long before he had publicly made the application of the doctrine of descent to include the human race, his disciples had boldly affirmed that man, so far as his body is concerned, is no exception to the great law of the consanguinity of all living creatures. The publication of the Descent of Man and the work on the expression of emotions convinced all readers, however, that the man with a thousand eyes had been gathering materials for another great induction. Not content with the guesswork of his pupils, he determined to submit his own theories to the most rigid scrutiny.

ANTHROPOLOGY IN GERMANY.—The *Archiv für Anthropologie*, issues a supplement to its thirteeth volume, which contains the following contributions:—

Hölder, H. v.—The skeletons in the Roman cemetery in Regensburg. pp. 1–52.

Schmidt, Emil—The import of cranial capacity. pp. 53–80.

Reviews:—Scandinavian Literature, by Miss J. Mestorf, including Engelhard, Sophus Müller, Steenstrup, Nicolaysen, Rygh, Udset Ingvald, Hildebrandt vonWaldheim, Montelius Söderwall;—by Dr. Fligier, including Diffenbach, Oppert, Spamer, Peschel;—by Schaathausen, of the ninth International Congress for Prehistoric Anthropology and Archæology in Lisbon from 20–29 September, 1880.

One hundred and twenty pages of the supplement are devoted to a Catalogue of Anthropological Literature, published mainly in 1880, containing.—

I. Archæology and priscan history, by J. H. Müller.
II. Anatomy, by A. Ecker.
III. Ethnography and Travels, by Dr. Fredrich Ratzel.
IV. Zoology in its relation to Anthropology, by Dr. W. Branco.

ANTHROPOLOGY IN GREAT BRITAIN.—Vol. XI., No. 3, of the Journal of the Anthropological Institute, is an exceptionally valuable contribution to knowledge, having very little of speculation and a great deal of important information. The following is a list of the papers:—

Woodthorpe, Lt.-Col. R. G.—Notes on Wild Tribes inhabiting the so-called Naga Hills, on the North-East Frontier of India.

Thane, George D.—On some Naga skulls.

Howorth, H. H.—The spread of the Slavs. Part IV.

Man, E. H.—On the Andamese and Nicobarese.

Thomson, Dr. Allen—Description of Andamanese Bone Necklaces.

Frere, The Right Hon. Sir. H. Bartle—On the laws affecting the Relations between Civilized and Savage Life, as bearing on the dealings of Colonists with Aborigines.

Mr. Woodthorpe's paper is part II. of his studies, respecting the unkilted Nagas. The author minutely describes their physique, customs, clothing, habitations, burial, skull trophies, and ceremonies. Professor Thane describes the crania of the Nagas procured by Colonel Woodthorpe and others.

Mr. Howorth, as is well-known, has given years of his life to the Slavic races and in the communication just cited devotes his pen to the Bulgarians. "There is a political Bulgaria and an ethnographic Bulgaria." The two are different in boundaries and otherwise. The former includes all the country subject to the Bulgarian crown in the days of its greatest prosperity, the latter includes the area peopled by Bulgarians properly so-called.

Mr. Man was not only an eye-witness of what he has recorded, but he is a keen observer, and a piquant writer. He has a charming way of knocking over old conceptions of how things must have been. For instance, the bamboo gridiron becomes a drying-grate; boiling meat in a bamboo pot over the fire is changed to roasting the whole affair, pot and all; holes in the ground to sleep in, are nothing but children playing burial, etc. For comparative technology, the article is invaluable. The necklaces described by Dr. Thomson are made from human bones.

Sir. Bartle Frere's paper, however, is the one of greatest moment. The editor of these notes read a paper on the same topic at the American Association last summer. Sir. Bartle Frere's observations were made in India, where the Aryan peoples have been in contact with uncivilized and more aboriginal races from the earliest times, and in South Africa among the Hottentots, Bushmen, and the Banta Tribes.

GEOLOGY AND PALÆONTOLOGY.

THE ANCESTRY AND HABITS OF THYLACOLEO.—The recent reception of nearly complete specimens of the mandibles of the *Ptilodus mediævus* (NATURALIST, November, 1881), enables me to correct the table of genera of *Plagiaulacidæ*, given in the May, 1882, NATURALIST. The remarkable mammal in question turns out to have but one huge cutting premolar tooth, and to present considerable resemblance to the supposed "pouched lion" *(Thylacoleo carnifex)* of the Australian Pliocene formation, which excited so much discussion a few years ago in England. Considerable light is thrown on the history of this group, which disappeared so early in Europe and America, to survive in Australia almost up to the present geological age.

The genera of the family differ as follows:

a. Several large cutting premolars.

Premolars four, sides not ridged.................................*Ctenacodon.*

Premolars typically three, with oblique lateral ridges.................*Plagiaulax.*

aa. One large cutting premolar.

β. Inferior molars with several tubercles.

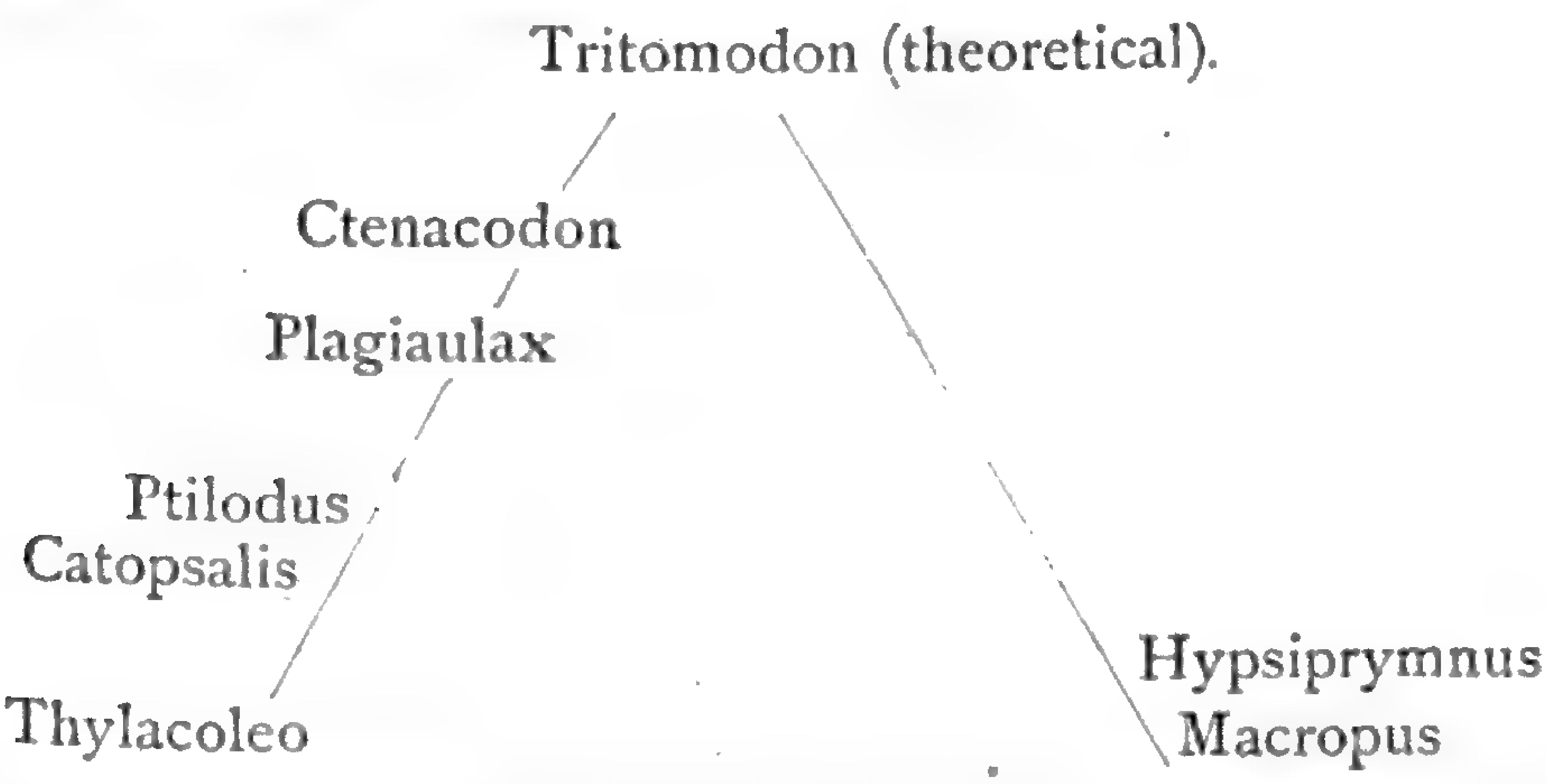
Large premolar without posterior cusp; edge directed upwards; sides ridged *Ptilodus.*

Large premolar with posterior cusp; edge directed forwards; sides (?) not ridged *Catopsalis.*

ββ. Inferior molars small with few lobes; the last rudimental.

Large premolar without posterior cusp; edge directed upwards; sides not ridged *Thylacoleo.*

The phylogeny of these forms, in connection with that of the kangaroos, may be expressed as follows: It is evident that such forms as *Thylacoleo*, *Ptilodus*, and *Catopsalis* are more specialized than *Plagiaulax* and *Ctenacodon*, inasmuch as the number of teeth is reduced, and the cutting function of the premolars is concentrated in a single large tooth. This is quite the same kind of specialization as that which has taken place in the history of the descent of the Carnivora. *Ctenacodon*, as having the largest number of premolars, which have the least amount of sculpture, is the least specialized of all the genera. *Thylacoleo*, with the rudimental character of the true molar teeth, is the most specialized, as it is the latest in time. The *Macropodidæ* retain the full series of true molar teeth of the primitive Mammalia, and present only a cutting third premolar in the lower jaw, the fourth resembling the true molars. Thus the cutting tooth of *Thylacoleo* is not the homologue of the cutting tooth of *Hypsiprymnus* as supposed by Professor Flower;[1] since the latter corresponds with the cutting tooth of *Ptilodus*, which is the fourth premolar of *Plagiaulax*. We must therefore regard *Hypsiprymnus* as the descendent of a type from which the *Plagiaulacidæ* were also derived, in which some of the premolars, as far as the third only, were trenchant, and in which the fourth premolar possessed the tubercular character of the true molars. Such a type would belong to Jurassic and perhaps even to Triassic times, and might well have continued to the Eocene. I call it provisionally by the name *Tritomodon*. The lines of the descent will appear as follows:



The discussion between Professor Owen, on the one hand, and Messrs. Falconer, Krefft, and Flower, on the other, as to the nature of the food of *Thylacoleo*, is known to palæontologists. From the form of the teeth alone Professor Owen inferred the carnivorous nature of the food of this genus, while his opponents inferred a herbivorous diet from the resemblance between the dentition and that of the herbivorous *Hypsiprymnus*. As the result of the discussion affects, in some degree, the genera *Catopsalis* and *Ptilodus*, I recall it here. The comparison of *Thylacoleo* with *Hypsiprymnus* is weakened by two considerations: First, the fact that the cutting tooth of the former is not homologous with the cutting tooth of the latter; and second, that the grinding series of molars of the former is rudimental, while in the latter it is complete. It evidently does not follow that because *Hypsiprym-*

[1] Quarterly Journal Geological Society, 1868, Vol. XXIV, p. 307.

nus is herbivorous, *Thylacoleo* is so also. Professor Flower refers to the reduction of the molars in *Thylacoleo* as slightly complicating the problem, and concludes that the food of that animal may have been fruit or juicy roots, or even meat. It is difficult to imagine what kind of vegetable food could have been appropriated by such a dentition as that of *Ptilodus* and *Thylacoleo.* The sharp thin, serrate, or smooth edges, are adapted for making cuts and dividing food into pieces. That these pieces were swallowed whole, is indicated by the small size and weak structure of the molar teeth, which are not adapted for crushing or grinding. It is not necessary to suppose that the dentition was used on the same kind of food in the large and the small species. In *Ptilodus mediævus* the diet may have consisted of small eggs, which were picked up by the incisors and cut by the fourth premolar. In *Thylacoleo* it might have been larger eggs, as those of the crocodiles, or perhaps carrion, or even the weaker living animals. The objection to the supposition that the food consisted of vegetables, is found in the necessity of swallowing the pieces without mastication. In case it could have been of a vegetable character the peculiar premolar teeth would cut off pieces of fruits and other soft parts as suggested by Professor Flower, but that these genera could have been herbivorous in the manner of the existing kangaroos with their full series of molars in both jaws, is clearly inadmissable.—*E. D. Cope.*

Notes on Eocene Mammalia.—The creodont, *Lipodectres penetrans*, turns out to be identical with the *Deltatherium fundaminis. Deltatherium absarokæ* must be referred to a new genus with the dental formula I. $\frac{2}{3}$; C. $\frac{1}{1}$; P–M. $\frac{3}{4}$; M. $\frac{3}{3}$. The premolars in *Deltatherium* are $\frac{3}{3}$, and in *Proviverra* $\frac{4}{4}$. The fourth superior premolar has an internal lobe, and a single trenchant external lobe, and the fourth inferior premolar is different from the first true molar. The genus may be called *Didelphodus*.

The *Oligotomus osbornianus* must be referred to a new genus. If it is not condylarthrous, it must be placed in the Chalicotheriidæ, as the most primitive form. The superior true molars have eight cusps, two internal, two intermediate, two principal external, and two external rising from the cingulum. The posterior of the latter is opposite the interval between the principal external, and if confluent with them would complete the two external V's of the other genera of the family. Inferior molars and last premolar, consisting of two V's. I call it *Ectocion.*—*E. D. Cope.*

On the Taxeopoda, a New Order of Mammalia.—A further examination of the carpus of *Phenacodus* shows that it is different from that of the order *Perissodactyla*, and agrees with that of the *Amblypoda*, *Proboscidea* and *Hyracoidea.* In the three groups last mentioned, the os magnum supports the lunare, and does not articulate with the scaphoid, while in the *Perissodactyla* it sustains the scaphoid, while the lunar rests extensively on the unciform. As compared with the three groups named, *Phenacodus* stands intermediate between the *Amblypoda* and the *Proboscidea*, and agrees with the *Hyracoidea* in the slight posterior articulation of the unciform with the lunar bone. The peculiar carpus characteristic of the *Perissodactyla* is seen in the genera *Triplopus* and *Hyrachyus*, and in the older *Hyracotherium*, which is the cotemporary of *Phenacodus*. There seems to be no sufficient ground for separating the latter from the *Proboscidea* as a full order, so I combine the two groups in one, under the name of *Taxeopoda*.

The *Taxeopoda* is the primitive type of Ungulata in having the carpal and tarsal bones arranged in linear series. In the more specialized orders of *Perissodactyla* and *Artiodactyla*, the second series of these bones has been rotated inwards one place. The *Amblypoda* has the fore foot of the primitive type, and the hind foot of the more specialized type.

The group of *Ungulata*, whatever rank it may have, will then be divided into the following orders or sub-orders:

I. Os magnum supporting os lunare, and not articulating with os scaphoideum.
a. Astragalus articulating only with navicular.
Fibula with interlocking articulation with astragalus.................*Hyracoidea*.
Fibula with lateral contact only with astragalus......................*Taxeopoda*.
aa. Astragalus uniting with both navicular and cuboid.
Lunar uniting with unciform; fibula only in contact with astragalus....*Amblypoda*.
II. Os magnum supporting os scaphoideum; lunar supported in part by unciform. Astragalus uniting with both cuboid and navicular.
Astragalus truncate distally; median digit longest.................*Perissodactyla*.
Astragalus ginglymoid distally; two median digits equal............*Artiodactyla*.

The *Taxeopoda* are naturally divided into two sub-orders, the Proboscidea and Condylarthra, as follows.

No postglenoid process, nor third trochanter of femur. Fibula articulating with a facet of the calcaneum...*Proboscidea*.
A postglenoid process, and a third trochanter of the femur; no calcaneal facet for fibula...*Condylarthra*.

It is probable that the *Toxodontia* form a third division of the *Taxeopoda*. It is also probable that the *Hyracoïdea* should be reduced to the position of a subdivision of the *Taxeopoda*—*E. D. Cope*.

Geological News.—In the *Geological Magazine* for March, Mr. A. S. Lucas discusses the age of the Headen Beds of the Isle of Wight, and M. J. E. Lee notes a peculiarity in the structure of a Pteraspidean plate found in the Eifel. This plate shows a repetition of the usually supposed outer corrugated layer, one of which is placed between two honey-comb layers, and an absence of the nacreous layer, thus throwing some doubt upon the received order of the occurrence of these layers. Mr. E. T. Newton gives a list of seventeen species of fishes, the remains of which have been found in the Forest-bed series of the east of England.——At a recent meeting of the Geological Society of London, Professor Owen described *Notochelys costata*, an extinct Chelonian from Blinder's river, Queensland. It is the first known Australian fossil turtle, and is of a generalized type between the Chelydrians and marine turtles. At the next meeting of the same society (Feb. 8, 1882), Mr. J. W. Hulke described *Iguanodon Seelyi* from a bed between the clays and gravel of the cliff in Brook bay, Isle of Wight.——Various and prolific seams of anthracite and bituminous coal, some of them 10 ft. or 12 ft. in thickness, have been found in Natal.——Professor Marsh contributes to the *American Journal of Science*, an article upon the wings of Pterodactyles, with a full size plate of *Rhamphorhynchus phyllurus* Marsh. The specimen described was found in the lithographic states of Bavaria, and shows very perfect impressions of the volant membranes of both wings, as well as of a separate vertical rudder at the end of the long tail. The membrane was similar to that of bats.——In the Journal of the Cincinnati Society of Nat. History, Mr. S. A. Miller describes some new species and genera of Palæozoic fossils. He also gives a well-merited criticism of Professor Nicholson's book on *Monticulipora*, showing the extensive ignorance of its author of American writings on the subject. We performed the same duty for the same writer's manual of Palæontology a year or two ago.

MINERALOGY.[1]

TWO NEW GUANO MINERALS.—Professor C. U. Shepard[2] has described two new minerals which have originated in the guano formation covering the islands of Moneta and Mona, near Porto Rico, W. I., and to which he gives the names *Monetite* and *Monite*. They were found lining the walls of cavities in the rock guano, and, though undoubtedly formed through the action of percolating waters, contain no organic matter.

Monetite occurs in crystals having the form of rather thin rhomboids, often interpenetrating each other to form complex groups. Mr. E. S. Dana refers them to the triclinic system. Their greatest length is between $\frac{1}{12}$th and $\frac{1}{20}$th of an inch.

The mineral has an uneven fracture, a vitreous lustre, a pale, yellowish-white color, and is semi-transparent; hardness 3.5; specific gravity about 2.75. Heated before the blow-pipe in the forceps, it turns white and melts into a globule with crystalline facets.

It has the following composition (mean of two analyses by C. U. Shepard, Jr.):

Lime	Phosphoric acid	Sulphuric acid	Water.
40.255	47.100	4.550	8.175 = 100.080

[1]Edited by Professor HENRY CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] American Journal Sciences and Arts, May, 1882, p. 400.

On subtracting the gypsum and hygroscopic water, and raising the percentage to 100, there was obtained:—

P_2O_5	CaO	H_2O
52.28	41.14	6.58 = 100

giving the formula $2CaO, H_2O, P_2O_5$. It is associated with crystallized gypsum and calcite, and with the following species.

Monite is massive, slightly coherent, and wholly uncrystalline. It is snow-white, earthy and dull, with hardness below 2, and specific gravity about 2.1. In the closed tube it emits much moisture, and in the blow-pipe flame melts with difficulty to an opaque white enamel.

A mean of analyses, after deducting an admixture of gypsum, gave

P_2O_5	CaO	H_2O
41.92	51.15	6.93

corresponding to $Ca_3P_2O_8+H_2O$.

It resembles kaolinite, and is a hydrated tricalcic phosphate.

URANOTHALLITE.—Schrauf[1] has named the variety of Liebigite from Joachimsthal, analyzed long ago by Vogl and Lindacker, *Uranothallite*. It contains more lime than Liebigite, and its composition may be represented by the formula $Ca_2UC_4O_{12} + 10\,aq$. It occurs in minute aggregated crystals and grains, often scaly, and has a green color and streak. It is translucent, has a vitreous lustre except on the cleavage face, where it is pearly, and is soluble in acids. The crystals are too imperfect to give satisfactory measurements.

CHIOLITE AND CHODNEFFITE.—Professor P. Groth, of Strassburg, has undertaken the revision of the natural compounds of fluoric acid, the analysis being performed by Mr. Brantl, of Munich, and, as one of the first results, announces the identification of Chodneffite with Chiolite. Three analyses of perfectly pure Chiolite gave:

	I.	II.	III.
Al	17.66	(2.) 17.65	17.64
Na	25.00	24 97	25.00
F	58.00	57.30	
	100.66	99.92	

yielding the formula $5NaF+3AlF_3$.

The former analyses of Rammelsberg were made upon massive uncrystallized fragments, some of which had a composition like that given above, but from which the formula $3NaF+2AlF_3$ was deduced; other portions, however, being richer in sodium and poorer in aluminium, and for these the formula $2NaF+AlF_3$ was constructed and the name Chodneffite given.

Professor Groth now shows that these latter analyses of Ram-

[1] Zeits. f. Kryst, 1882, VI. 4, 410.

melsberg were made upon material containing cryolite as an impurity, it being impossible to separate cryolite from chiolite in the massive state. Professor Von Jeremejew has examined the crystals of chiolite and finds them to be tetragonal.

Chodneffite is merely an impure chiolite, and must be stricken from the list of minerals.

Rhodizite.—Rhodizite, an extremely rare mineral, occurring in minute crystals upon some red tourmalines in the Ural mountains, and supposed to be a borate of lime, has been the subject of two recent communications by Bertrand to the Mineralogical Society of France. The crystals present the form of a dodecahedron, modified generally by tetrahedral faces. Bertrand concludes, from an examination of their optical properties, that the crystals are to be considered *pseudo-isometric*, and are composed of twelve elementary monoclinic crystals twinned symmetrically around a point. He has been able, moreover, actually to separate these elementary crystals by cleavage. The elementary crystal of Rhodizite consists, he holds, of an oblique monoclinic prism of 120°, of which the height is equal to the width, and of which the obliquity is 54° 44′.

Crosby's Common Minerals and Rocks.—The twelfth number of the "Guides for Science Teaching," issued by the Boston Society of Natural History for the use of teachers, has been prepared by Mr. W. O. Crosby, whose contributions to the geology and lithology of Massachusetts have been of great value. It is entitled "Common Minerals and Rocks," and is an elementary sketch treated in a familiar way, admirably serving the purpose intended. About twenty-five of the rock-forming minerals are described, special stress being laid upon their acidic or basic relations and their associations. The triclinic felspars, for example, are stated to occur with basic minerals, while orthoclase is acidic in its associations. The silicates are divided into the two groups of basic and acidic; all species containing sixty per cent. or less of silica being classed as basic, while those containing more than sixty per cent. of silica are acidic. The basic silicates are *dark* colored and *heavy*, the acidic being light in color and weight, and the two classes of silicates belong to distinct rocks.

The little treatise is written from the lithologist's standpoint, and the larger portion of it treats of the origin and physical differences of rocks. The author classifies rocks according to their geological origin.

Martite.—O. A. Derby[1] has examined a large number of octahedral crystals of *Martite* from Brazil, and concludes that while a portion of them have resulted from the decomposition of

[1] Am. Journ. Sc. and Arts, May, 1882, 373.

pyrite, a large proportion should be considered as produced by the alteration of magnetite. Nearly half the crystals examined were attractable by the magnet, and all possible gradation between typical magnetite and hematite, both in magnetism and composition, were observed.

SMALTITE FROM COLORADO.—*Smaltite*[1] has been discovered in Gunnison Co., Colorado, in sufficient quantities to lead to the belief that it will be a commercial source for cobalt. It is associated with calcite, erythrite, and occasionally pyrite and spongy leaflets of native silver. A sample from the surface gave M. W. Iles the following result:—

Co	Fe	As	SiO_2	Pb	S	Bi	Cu	Ni	Ag
11.59	11.99	63.82	2.60	2.05	1.55	1.13	0.16	trace	trace = 98.89

NEW MINERAL RESINS.—*Muckite.* This is a resin found in cretaceous lignite in Moravia, and named by Schröckinger. It has the formula $C_{21}H_{28}O_2$. *Neudorfite.* This is a resin associated with the above, and probably a mixture.

THE SAND OF THE DESERT OF SAHARA.—A mineralogical study of the sand of the desert of Sahara has brought out some particulars of interest. The sand is of a yellow color. The quartz grains, which constitute ninety per cent. of the sand are remarkably rounded and not so angular as those of sea sand; a fact evidently due to attrition by the action of the wind. It is found that more than nine per cent. of the sand is composed of grains of felspar. Other minerals which exist in small proportions are chalk, clay, halite, sylvite, magnetite, chromite, garnet, olivine, amphibole and pyroxene.

MINERALOGICAL NOTES.—*Beauxite*, a substance recently shown by Fischer to be a mixture, frequently contains considerable quantities of *titanium* and *vanadium*. It has been concluded by Dieulafait that beauxite originates from the decay of primitive granitic rocks, and that if so, these rocks should contain titanium and vanadium. In a recent paper in the *Comptes Rendus*, he demonstrates that this is the case, and that these elements are widely diffused throughout the older formations.——Certain zoned crystals of *blende* possess, in addition to the six characteristic cleavages of ordinary blende, three other planes of equally ready cleavage, which have recently been studied by Hautefeuille.——*Conarite*, or more properly, *Comarite*, has been shown by Bertrand to be probably hexagonal.——M. W. Iles has detected a vanadium mineral, probably *Dechenite*, forming red and yellow incrustations at some mines in Leadville, Col. An analysis of the incrustation was as follows: SiO_2 36.86, PbO 38.51, ZnO 9.07, V_2O_5

[1] l. c., 380.

9.14, Fe_2O_3 2.59, H_2O 2.41, CO_2 .48 = 99.06.——Professor B. K. Emerson has examined microscopically the rock forming a dyke which penetrates the bed of zinc ore at Franklin, N. J., and finds that it is a micaceous diabase, composed principally of labradorite, augite, biotite, and apatite, and containing, as foreign constituents, franklinite, zincite, willemite, and calcite.——The green nickle ore from New Caledonia, exhibited in quantity at the Centennial Exhibition, and known by the name of *Noumeite* or *Garnierite*, is an amorphous hydrous silicate of magnesia, containing more or less admixture of oxide of nickle. It has been considered as allied to Genthite, though probably a mixture. Bertrand considers that its optical character is that of a uniaxial substance.——Professor Shepard withdraws the species *Glaubapatite*, a name which he had given to a supposed soda-bearing guano. The soda was due to the damaged state of the cargo of the vessel in which the guano was shipped.

GEOGRAPHY AND TRAVELS.[1]

THE CONGO.—The treaty made by M. Savorgnan de Brazza with the native chiefs at Stanley Pool, is published in the *Proceedings* of the Royal Geographical Society for April. It is dated October 3, 1880, and cedes the territory between the rivers Jué and Impila to France for the establishment of a station. Mr. Stanley on arriving at Stanley Pool was not allowed to establish a depot or proceed any further in consequence of this agreement, which is considered by the native chief Makoko, as binding him not to receive any Europeans but Frenchmen.

Mr. Stanley on his way up the Congo to the Pool, passed from Isangila to Manyanga entirely by river, but after that, he was obliged to make a road seven miles long, past the Ntombo Mataka Falls where he was again able to take to the river.

The French missionary Père Augouard has also visited Stanley Pool, and on his way discovered a river over eighty feet broad, named the Eluala, which is not marked on Stanley's map.

The natives have also ceded a tract of land on the Congo at Manyanga, to the Belgian expedition for a depot.

Just below the boundary of this tract, the Baptist mission has chosen a site and are building a house. On each side of the river there are many native towns within a short distance of this spot.

LAKE NYASSA.—The headquarters of the missionaries on this lake, has been removed from Livingstonia at Cape Maclear to Bandawé at Misangi Point, S. lat. 11° 56′ E. long. 34° 6′, a more healthy and central port. The new road from Nyassa to Tanganyika is to be begun soon. A new steamer is to be sent out by the London Missionary Society to Quillimane and thence to the north end of Nyassa and over the new road when finished, to

[1] Edited by ELLIS H. YARNALL, Philadelphia.

Lake Tanganyika. The water however, continues to fall in the Nyassa, and also in the river Shire, and the navigation of the latter is increasingly difficult. The careful observations on the changes in the water-level made during the past four or five years, will prove of much practical as well as scientific importance.

O'Neill's Journey in Makua Land.—In the Naturalist for April last, we gave a short account of recent journeys in the Makua country lying west from Mozambique. An interesting paper by one of these travelers, Mr. O'Neill, British Consul at Mozambique, was read at a recent meeting of the Royal Geographical Society.[1] As was stated by Lord Aberdare, the President of the Society, "a remarkable fact in connection with the subject, is that the vast territory of Mozambique for the last 200 years had been in the possession of the Portuguese, and yet, so far as could be ascertained, no Portuguese of unmixed blood had ever been more than twenty miles inland."

One of the most interesting features of this journey, is the intelligence thus obtained of the existence of a lofty snow-clad peak in this part of the African continent. It is doubtless the same mountain Mr. Maples heard of when at Meto. Mr. O'Neill writes:—"Whilst at Namùrola, I also ascended a hill 500 or 600 feet high, and had a fair view of the mountain range which rises up west of the valley of the Malema, culminating in the Inagu Hills and Namuli Peak, and forming, if native accounts be correct, the water-shed of the rivers of the Mozambique coast, and those that on its western side help to feed the Lake Kilwa[2] and its outlet, the Lujende or Liendi. I wish, however, distinctly to say, that although the position of Namuli Peak was pointed out to me, I could not clearly distinguish it. A magnificent range of hills was visible, running apparently north-east and south-west, but the summits of its peaks and many of the hills themselves were totally lost in the mass of cloud and mist which the southerly winds had been drifting up during the past week, and which were, even now, descending as the first of the rains. I have concluded that this peak is snow-clad from the repeated accounts I have received, not only from coast men who have traded in the Malema valley, but also from chiefs and others who live comparatively near the spot. The usual description of it is, "Its top is always white,' and 'Mnwisho zake huwezi kuma,' or 'Its summit is invisible.'"

In an address made by Mr. Joseph Thomson after the reading of this paper, he said, "It was a very interesting and suggestive fact, that three Englishmen should have been traveling in the same country at the same time without any knowledge of each other's movements, and yet, not infringing on each other's districts.

[1] Royal Geographical Society *Proceedings*, April, 1882.

[2] Lake Kilwa is probably identical with the Lake Shirwa of Livingstone and Kirk. [Ed.

Thus, Mr. O'Neill kept to the south of the Upper Makua country, the Rev. Chauncy Maples to the middle part, and he (Mr. Thomson) along the northern boundary up the river Rovuma and the Lujende. From the reports of those travelers, together with the accounts given by Bishop Steere and Von der Decken further north, it was very evident that the same natural features extended from the Rufigi to the Zambesi, viz: a slightly undulating and irregular country, at one time spreading out in a great plain, at another forming a narrow valley; while small ridges of hills and isolated picturesque peaks diversified the scenery.

Geologically, the country consisted of metamorphic schists, gneiss, and granite. The schists had been worn away and washed down, forming the plains in the valleys; while the bosses of hard, compact rock had remained as the ridges of hills and isolated peaks. Of course, the most interesting part of Mr. O'Neill's journey, was the neighborhood of the mountain range in Makua, and the strange peak Namuli. That range evidently marked the commencement of the central plateau; and as to the peak Namuli, there could be little doubt that it was snow-clad, because Mr. Maples obtained his information about it from sources quite independent of Mr. O'Neill, and the reports of the two travelers were exactly identical. Considering its position, it must be over 16,000 feet high to be snow-clad. He had no doubt that it would prove to be volcanic; and if so, it would form another link in the chain from the Red Sea to the Cape, which had given rise to the volcanic deposits in Abyssina at Kilimanjaro, and the enormous series of tufas and lavas which he (Mr. Thomson) discovered round the north end of Nyassa. That line of volcanoes coincided with the line of weakness and dislocation, along which the eastern side of the continent had been upheaved. The areas of depression, Nyassa and Tanganyika, were also approximately parallel to the line of dislocation."

Mr. O'Neill also mentioned an error in the map, by Dr. Petermann[1] in which two lakes appear situated on a tributary of the Lurio, one of which is placed in the heart of Makuani. "I made careful and constant inquiries with respect to these lakes, and was every where assured that no such existed in the Makua country or upon any tributary of the Lurio. The only lake that I can hear of, is that of Kilwa, in the Ajawa country, which, as I have before said, is reported to be the scource of the Liendi. It seems not improbable, that there has been some confusion between these lakes. This probability is strengthened by the native statement that the Lake Kilwa is situated in a district called Muongoje, which name I find upon the shore of the easternmost lake in Petermann's map."

Abyssinia.—M. Raffray, French Vice-Consul at Massowah, in a recent journey to the camp of the King of Abyssinia, passed

[1] See Map No. 71. Sud Afrika und Madagaskar Stieler's Atlas.

through a portion of that country which is very little known and very different in character from other parts of it—the inner basin of Lake Aussa. The region is thickly wooded, and trees unknown elsewhere are found there. He visited Lake Ashangi (8254 feet) which has no apparent outlet. The level of the lake remains the same throughout the year, and its waters run off through subterranean channels. After traversing the plains inhabited by the Raya Gallas, he ascended the Zebul mountains, an isolated chain, from which the whole Ethiopian mountain system could be seen to the westward, for over seventy miles, while to the eastward immense plains stretched down to the shores of the Red Sea and enclosed the great depression of Lake Aussa—the basin which receives the waters of the Abyssinian plateaux. He afterwards ascended the lofty plateaux of Monts Abboi-Miéda and Abuna-Yusef, the passes of which are respectively 11,400 and 13,200 feet above the sea-level. M. Raffray describes these lofty summits on which grows a plant, reaching a height of twenty-six feet, the *Rhynchopetalum montanum*, and on which are found insects similar to those of temperate Europe. In speaking of the zoölogy of Abyssinia, and especially of the lower classes of animals found there, he defines four distinct regions of different altitudes. The first or coast region belongs to the fauna of the Sahara; the second or valley region, has a fauna similar to that of the Senegal; the region of the lofty plateaux is more peculiarly Abyssinian, with a strikingly similar fauna to that of the Mediterranean; and lastly, the region of mountain tops, varying in altitude from 11,483 feet to 13,124, belongs to the fauna of the mountainous parts of temperate Europe.

SCHUVER.—Mr. Schuver is continuing his explorations in the region south-west of Abyssinia. He finds that there are two Jaboos rivers—the word meaning simply a running stream. The Jaboos of the Blue Nile has its most southern and principal source at the foot of the lofty Mount Wallel, in lat. 8° 50′ N. The most easterly and chief sources of the River Yal (affluent of the White Nile) is in the western valleys of the Shugru Mountains, the eastern base of which is bathed by the Blue Nile Jaboos. As far as the Yal flows through the territory of the Aman negroes, it bears the name of Valasat, but after it has passed the Banghe defile in a series of cataracts falling 2000 feet in twelve miles, and reaches the Berta country, it takes the name of Jaboos, the name by which the other permanent river of that country is known. In ascertaining these interesting facts, Mr. Schuver followed the western Jaboos down to the junction of the Owé, the principal river of the valleys south of Gomashe; thenceforward it passes into the Burus plains, where it takes its final name of the Yal.

The New Polar Stations.—The Danish station has been changed from Upernavik, as first proposed, to a more southerly position at Godshaab, on the west coast of Greenland, so as to be at a greater distance from the American station at Lady Franklin Bay and the Austrian at Jan Mayen. The expedition, which is well fitted out at government expense, will sail from Copenhagen about May 20th, and is expected to reach Godshaab at the end of June. It is to remain there until September, 1883.

The Dutch propose to establish their station at Dicksonshavn, at the mouth of the river Yenisei, unless the ice prevents their reaching it, in which case they will go to the north-east point of Novaya Zemlya. Funds have been supplied for this purpose partly by the government and partly by public subscriptions. The party will be about twelve in number and will take with them all the instruments and apparatus specified by the International Polar Conference besides other instruments and a wooden house. It is hoped that an ascent of the Yenisei can be made in a steam launch.

The British Government has granted the sum of £2500 and the Canadian Government $4000 for a circumpolar station.

The Italian Antarctic Expedition started from Buenos Ayres on November 8, 1881, under command of Lieutenant Bove. The government of the Argentine Republic has sent out a commission with the expedition for the purpose of carefully revising the survey of the coast of their country; thus the expedition now consists of four ships, viz: *Santa Cruz*, *Uruguay*, *Cape Horn* and a steam bark. The *Cape Horn* is the largest vessel and will proceed to the Antarctic regions, while the *Uruguay* will remain at Cape Horn. Lieutenant Bove hoped to leave Cape Horn by the end of December, in order to sail across to South Shetland and Grahamsland. He hoped to be back at Tierra del Fuego by the end of March, to stay there until May, and then to leave for Buenos Ayres.

MICROSCOPY.[1]

Measurement of Microscopic Aperture.—Hon. J. D. Cox, in a very interesting article in the *Am. Month. Mic. Journ.*, discusses the present method of measuring angular aperture of the microscope by taking the angle of which the apex is the center of the microscopic field of view, and whose sides bound the telescopic field of view when the microscope is turned into a telescope, either by removing the ocular and looking down the tube with the naked eye, or by substituting a terrestrial eye-piece by restoring the ocular and adding an objective as an erector in the draw-tube. By experiments, confirmed and explained by geometric principles, he concludes that the telescopic aperture, however correctly measured, is not the microscopic aperture; and that the difference, which is practically immaterial in objec-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

tives of high power and short working distance, may become, with low powers, large enough to destroy the usefulness of the common methods of measurement of the lenses measured, a ¾-inch varied from 36° to 38° telescopic aperture to 39½° microscopic, while a 3-inch ranged from 13½° to 19°. Change of draw-tube caused a variation of several degrees.

A New Journal.—The (English) Postal Microscopical Society has undertaken the publication of a quarterly journal, the first number of which appeared in March. It is edited by the very able Hon. Sec'y of the Society, Mr. A. Allen, of Bath, and published by W. P. Collins, of London. Its primary object is the preservation of the most important notes and drawings from the note-books of the Society; but it will also contain original papers, notes, extracts, and correspondence upon microscopical subjects. It will be freely illustrated, and will doubtless prove an entertaining and instructive visitor.

Summer School of Biology.—Microscopists can enjoy rare opportunities for sea-shore collecting and laboratory work, at the Summer School of Biology of the Peabody Academy of Science, which opens at Salem, Mass., on July 11, and continues four weeks. Among the special advantages for microscopical students, will be a course of lectures on physiological botany, by Professor C. E Bessey, of Iowa, and a course on anatomy and physiology of vertebrates, by Professor A. H. Tuttle, of Ohio.

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SCIENTIFIC NEWS.

— It appears that the hunting of alligators in Florida is carried on to such an extent as to threaten the extirpation of the species there. Nothing is used except the skins on the belly and legs. The rough scaly plates on the back are rejected. The heads are cut off and buried for a few days, till the tusks can be detached. It was announced lately that one person had collected alligators' teeth to the amount of three hundred and fifty pounds. This will give some idea of the destruction going on. On the St. John's river a new method of hunting has been devised. A dark lantern, with a powerful reflector, is used on suitable nights; and no difficulty is experienced in approaching the quarry. The animals seem bewildered with the strong glare, and make no effort to escape. The gun is held within a few feet of the head—a touch to the trigger, and there is one "gator" less in Florida. This process is very effective, and the hunters are enabled, not only to kill, but to secure their prey. Large numbers of these animals are slain annually by tourists for amusement only, besides those slaughtered for profit. Further, many young alligators are stuffed as specimens, or sent off alive as curiosities, while myriads of eggs are blown or disposed of by dealers.—*English Mechanic.*

— The views of Dr. Hahn, as to the presence of organic structures in meteorites, have been refuted by Professor Carl Vogt, who, in a memoir presented to the French Academy of Sciences, affirms that Dr. Hahn has no foundation for his conclusions, and that in no single case do the pretended organic structures present the microscopic appearance of the organisms for which they have been mistaken.—*English Mechanic.*

— G. T. Wetterman, Director of the Museum Koninklijk Zoölogisch Genootschap, Amsterdam, Holland, writes that within a short time the new aquarium buildings, recently erected in the gardens, will be opened, not only for the recreation of the members of the society but to audiences for the academical course of zoölogy, as well as for laboratories for anatomical research. Director Wetterman states that naturally all sorts of sea animals will be needed for the work, and requests the addresses of aquaria in America that will enter into a mutual exchange of marine animals or will dispose of them by sale. He expresses a wish to have as much as possible of the American submarine fauna represented in their tanks.

— James Geikie, LL. D., author of the "Great Ice Age," and for twenty-one years a member of the Geological Survey of Great Britain and Ireland, has recently received the appointment to the Murchison Professorship of Mineralogy and Geology in the University of Edinburgh, made vacant by the appointment of his brother, Professor Archibald Geikie, to the director-generalship of the Geological Survey. He has resigned his position in the survey and enters upon his duties in the University in May.

— But two summer schools of science will apparently be opened to students this coming season, one at Annisquam, Cape Ann, Mass., under the charge of Professor A. Hyatt, curator of the Boston Society of Natural History; the other is the summer school of biology of the Peabody Academy of Science, Salem, Mass. Both offer good facilities for study.

— We are asked by Professor E. S. Morse to correct a mistake on page 326 of the NATURALIST in reference to the Japanese students. Mr. Ijima and Mr. Iwakawa have never been abroad, what they have acquired has been learned in Japan. Mr. Mitsukwri was a fellow at Johns Hopkins University and was a student of Professor W. K. Brooks.

— The Princeton College Exploring Expedition obtained a skull of the Eocene mammal *Achænodon insolens* Cope, whose position has been heretofore doubtful. It turns out to be a flesh-eater of the family *Arctocyonidæ*, and is the largest species known. It was a formidable animal, as large as a brown bear, and is probably the ancestral type from which bears were derived. Messrs. Scott and Osborne will publish a memoir on it in the Contributions of the Museum of Geology and Archæology.—*E. D. Cope.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—The Academy met in the National Museum, Washington, on Tuesday, April 18, 1882, President W. B. Rogers in the chair. The papers of the first day were:

1. The course of the Gulf stream since the Cretaceous period, Alexander Agassiz. 2. The Pre-cambrian rocks of Italy, T. Sterry Hunt. 3. Notes on the geology of Yucatan, Alexander Agassiz. 4. Desiccation of the Plateau of Mexico, Alexander Agassiz. 5. On the brain of Phenacodus, E. D. Cope. 6. On the young stages of a few osseous fishes, Alexander Agassiz. 7. The affinities of Palæocampa Meek and Worthen, as evidence of the wide diversity of type in the earliest known Myriapods, S. H. Scudder. 8. On the genesis and development of the Chiropterygium from the Ichthyopterygium, Theodore Gill.

Wednesday, April 19, 1882.—9. Preliminary notice of a new Dividing Engine, H. A. Rowland. 10. On photographs of the spectrum of the nebula in Orion, Henry Draper. 11. Theory of concave gratings, H. A. Rowland. 12. On the influence of time on the change in the resistance of the carbon disk of Edison's Tasimeter, T. C. Mendenhall, presented by G. F. Barker. 13. Note on a special form of secondary battery or electric accumulator, Wolcott Gibbs. 14. Researches on complex inorganic acids (continued), Wolcott Gibbs. 15. Biographical notice of Professor John W. Draper, G. F. Barker. 16. Some discoveries that enhance the value of the cotton and orange crops, C. V. Riley.

Thursday, April 20, 1882.—17. The relation of rain-areas to areas of low pressure, Elias Loomis. 18. Description of an Articulate of doubtful relationship from the Tertiary beds of Florissant, Colorado, S. H. Scudder. 19. Mythology of the Zuñi Indians, F. H. Cushing. 20. On the polarization of the light of the Moon, A. W. Wright. 21. On the results of the incandescent lamp tests at the Paris Exhibition, G. F. Barker. 22. On the infra-red portion of the solar spectrum as studied with the bolometer, S. P. Langley.

Friday, April 21, 1882.—23. On the formation of metalliferous vein formation at Sulphur Bank, California, Joseph Leconte. 24. On a form of standard Barometer, A. W. Wright. 25. On a marsupial genus from the Eocene, E. D. Cope. 26. On a fallacy in induction, C. S. Peirce. The committee to examine into the investigations into the value of sorghum as a source of sugar, made an interesting report. Professor Ira Remsen, of Baltimore, was elected a member.

Philadelphia Academy Natural Sciences, Dec. 13.—Mr. Ryder described the development of fish eggs. He agreed with His and Rauber in the opinion that the rim of the blastoderm goes to form a part of the muscular plates of the side of the body.

Dec. 20.—Mr. Martindale read a history of the connection of Dr. Ruschenberger with the academy, as testimony to his services, on the occasion of his declining re-nomination to the presidency.

Dec. 27.—As the result of the annual election it was announced that Dr. Jos. Leidy was duly elected president of the Academy.

Jan. 3, 1882.—Mr. Ryder confirmed, by the result of his observations on additional types, the formation of vacuoles in the notochord of teleost fishes; and stated that although the tissue of the neural and enteric portions of the neurenteric canal were continuous, no open canal connected those portions. Dr. Leidy called attention to the composition of the gravels of Philadelphia and its vicinity, The commonest pebbles are quartz or quartzite, while those next in frequency are red-sandstone, probably mesozoic. Conglomerates are also found, but fossiliferous pebbles are very rare.

Jan. 10.—Mr. Heilprin called attention to the tidal theory of Professor Ball, and stated that the existence of life upon the coast tended to nullify some of Professor Ball's conclusions.

Mr. Potts described a new sponge, *Heteromeyenia ryderi*, also a new species of *Tubella*, which he named *T. pennsylvanica*. The seed-bodies of this latter sponge range from $\frac{1}{60}$ to $\frac{1}{75}$ of an inch in diameter. He showed how the statoblasts of sponges like *Spongilla fragilis* and *Carterella* form layers upon rocks, etc., after the spicules of the sponge have been washed away. The subject of the algous parasitic chlorophyll cells in certain sponges, infusoria, and mollusks was discussed by the president and Mr. Ryder.

Mr. Meehan related an incident which indicated that sparrow-hawks can see mice when perched at a horizontal distance of 500 feet.

Jan. 17.—Papers upon the new Crinoids of the Chemung period from the State of New York, by H. S. Williams, M. D.; the Species of Odontomya found in the United States, by Dr. L. T. Day, and a new station for *Corema Conradii*, by Aubrey H. Smith, were presented for publication. Mr. Redfield spoke of the extreme rarity of *C. Conradii.*

Middlesex Institute. Feb. 28.—L. L. Dame, president, delivered an instructive lecture, the first in a series of twelve weekly botanical lectures, on the "Growth of the plant from the seed," to a class of nearly fifty members.

March 7.—Mrs. A. J. Dolbear gave the second in the series, her subject being, "Morphology of roots, stems, and branches."

March 8.—President Dame briefly reviewed the first year's work of the Institute, and made some excellent suggestions in regard to the best manner of carrying on the work which the Institute had undertaken.

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ON SOME ENTOMOSTRACA OF LAKE MICHIGAN AND ADJACENT WATERS.

BY S. A. FORBES.

ONE cannot go far in the study of the system of organic life which prevails in a stream or lake, without being made aware of the important part played therein by the neglected but interesting group of the smaller crustaceans. They occupy a central position not only in the classification of aquatic animals, but also in the complicated network of physiological relations by which the living forms of a body of water are held together as an organized society. Feeding, themselves, upon the lowest and smallest of plants and animals, they furnish food in turn to a great variety of the higher animals, and even to some plants.[1]

The fisherman who toils at his nets, the sportsman in pursuit of health and recreation, rarely reflect, even if they know, that their amusements and their labors depend strictly upon these humble creatures, of whose very existence, indeed, many of them are unaware; and yet there is ample evidence that, with few and unimportant exceptions, all young fishes, of our fresh waters at least, live for a time almost wholly upon entomostraca.[2] If de-

[1] In ten "bladders" of *Utricularia vulgaris*, taken at random, I found ninety-three animals, either entire or in recognizable fragments, and representing at least twenty-eight species. Seventy-six of the animals found were Entomostraca, and belonged to twenty species. Nearly three-fourths of both individuals and species were Cladocera. Just one-third of all the animals found in these bladders belonged to the single species *Acroperus leucocephalus* Koch.

[2] On the Food of Young Fishes. By S. A. Forbes. Illinois State Laboratory of Natural History, Bulletin No. 3, November, 1880, pp. 66–79.

On the First Food of the Whitefish. By S. A. Forbes, Normal, Ill. The *American Field*, Vol. XVII, No. 11, p. 171, March 11, 1882.

prived of this resource for the nourishment of their young, fishes would be reduced to an insignificant remnant of their present numbers.

Immense quantities of them are also taken by adult fishes, especially in early spring, and some of the largest species make them a principal dependence. The shovel fish (Polyodon) of our great central rivers—a giant among inland fishes—engulfs untold myriads of them at a meal—thus performing in fresh water the functions of the whale in the great seas. In the lakes of Europe they are the main food resource of several deep water salmonoids, while in our own great lakes, clouds of the higher crustaceans (Mysis) live wholly at their expense; and these Mysidæ, again, contribute largely to the maintenance of the whitefish and black-fin, and other important species. Some insect larvæ likewise prey upon them; and amphipod crustaceans, while they seem to feed chiefly upon vegetable structures of one sort or another, certainly sometimes attack and devour entomostraca with a surprising ferocity. Mollusca, one would say, could afford to be indifferent to them, since they neither eat them nor are eaten by them, nor seem to come in contact with them anywhere, through any of their habits or necessities. But for this very reason these two classes afford an excellent illustration of the stringent system of reactions by which an assemblage of even the most diverse and seemingly independent organisms is held together. To say nothing of the fact that both groups feed to a considerable extent upon the same kinds of food, and thus probably limit each other's multiplication, in some degree, the further fact that vast quantities of both are destroyed by fishes, brings them into a mutually hostile relation. If there were no entomostraca for young fishes to eat, there would be very few fishes indeed to feed upon mollusca, and that class would flourish almost without restraint; while, on the other hand, if there were no mollusca for the support of adult fishes, entomostraca would be relieved from a considerable part of the drain upon their numbers, and would multiply accordingly.

It is through their intervention that fishes and certain carnivorous plants are brought into apparent competition. The number of entomostraca and minute insect larvæ destroyed by the bladder-wort in some situations where the plant fills acres of the water, must be prodigious, taking the season through; and it is not impossible that the food supply of young fishes is sometimes thereby materially diminished.

In short, it would be difficult to mention a single group of aquatic or semi-aquatic animals or plants, whose interests are not affected, immediately or remotely, by these little animals.

But they have other claims upon our attention besides their importance in the general system of aquatic life. To the student of classification, they offer a fresh and inviting field of original work; the physiologist and the histologist may examine here the animal organs and tissues reduced almost to their lowest and simplest terms, and yet easily studied in detail, while they still form living parts of living organisms; and those attracted by natural beauty (as who is not?) will find few lovelier objects for the microscope, or more admirable illustrations of the play of life than these exquisite, crystalline specks, each comprising within its minute anatomy a system of organs and structures which for complexity and for perfection of detail, would scarcely discredit a butterfly or a fish.

I know of but one contribution to an exact knowledge of the Entomostraca of Lake Michigan—a brief paper by Professor E. A. Birge, containing a list of nine species of Cladocera found in the Chicago water supply,[1] with a description of *Latona setifera* O. F. M.; and I have seen nothing upon those of any other of the great lakes, except the notes on a few Cladocera published by Professor S. I. Smith in his paper on the invertebrate animals of Lake Superior.[2]

On the smaller crustacea of the region adjacent to the lakes, we have the valuable "Notes on Cladocera,"[3] by Professor Birge, and a paper by the writer on the Crustacea of Illinois.[4]

The lake material upon which the present paper is based, was obtained chiefly by the towing-net and dredge in Grand Traverse

[1] Notes on Crustacea in Chicago Water Supply, with remarks on the Formation of the Carapace. By E. A. Birge, Professor of Zoology, University of Wisconsin, Madison, Wis. The Chicago *Medical Journal and Examiner*, Vol. XIV, No. 6, Dec., 1881, pp. 584–590, Pl. I and II.

[2] Sketch of the Invertebrate Fauna of Lake Superior. By Sidney I. Smith, United States Commissioner of Fish and Fisheries. Part II. Report of the Commissioner for 1872 and 1873, pp. 690–707.

[3] Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. IV, 1876–77, Madison, Wis., 1879, pp. 77–110, and Pl. I and II.

[4] Bulletin of the Illinois Museum of Natural History, No. 1, December, 1876, pp. 3–25, and Pl. I.

bay, in the north-eastern part of Lake Michigan, and in the south end of the lake off Chicago and Racine. Several of the lacustrine species had been previously received from Mr. B. W. Thomas and Mr. Chas. S. Fellows, of Chicago, by whom they had been strained from the Chicago water supply.

A few additional species from the lakes and pools of Central and Northern Illinois, are described in the appendix to this paper, one of which occurs also in Southern Massachusetts, and probably throughout the country intervening.

One of the most interesting species was obtained in considerable numbers in Grand Traverse bay, associated with the ordinary forms of the lake, nearly all of which were abundant there in October, 1881. It is a copepod of the family Calanidæ, representing a new genus and species, for which the name *Epischura lacustris* is proposed (Pl. IX Fig. 8, and Pl. VIII Figs. 15, 16, 21–23 and 25–27).

The family is easily distinguished from Cyclopidæ and Harpactidæ, to which most of our other fresh-water species belong, by the elongate anterior antennæ of 23–25 articles, by the (usually) two-branched antennulæ and mandibular palpi, by the wide difference in size between the abdomen and thorax, and by the fact that in the male only one antenna is converted into a clasping organ. Epischura is colorless in autumn, although possibly red in spring, .063 in. long by .015 in. wide, and distinguished in both sexes by what seems at first a deformity of the abdomen. On closer inspection it is seen that in the male the last three segments of this region are laterally produced into a grasping organ of peculiar construction, and that the whole abdomen is thus distorted and rendered unsymmetrical. The lateral processes of the first and second segments evidently act against each other as a powerful pair of nippers, while the third, bearing upon the same side a stout toothed plate, must greatly increase the security of the grasp, when brought into play by the strong muscles of the abdomen. A fourth process extending forward from near the base of the right ramus of the furca, also contributes to the formation of this organ. A steel-trap attachment to the tail of an alligator would very well illustrate the vigorous embrace of this little crustacean. Besides this, the right antenna is thickened and hinged as a clasper, and the last pair of legs is also converted into a complicated apparatus of claws and forceps. In the adult female the abdomen is usually bent outward to the left, to leave space for a finger-like process which arises at the hind end of the ovisac and curves upward beside the second segment. This is the spermatophore, the neck of which is firmly cemented to the under side of the abdomen. In this sex the legs of the fifth pair are extremely simple and rather small. They are not branched like the other legs, and are without the delicate and beautiful fringes of feathery hairs with which the swimming appendages are provided, but each consists of a single flat, three-jointed plate, with five spreading spines at and near its tip. The swimming legs of both male and female are peculiar in the fact that the inner branch of all the pairs is reduced to a single joint. The affinities of this genus are with Heterocope Sars, found in the lakes of Scandinavia, Switzerland and Upper Italy, and probably in other parts of Europe also; but the modification of the abdomen as a prehensile organ is a new idea among Copepoda. Mutilated specimens of the female of this species have been taken by Mr. Thomas from the water supply of Chicago; I also found the species common in Geneva lake, in Southern Wisconsin, in October, 1881.

Another beautiful member of this family, occurring abundantly everywhere in the lake and at all seasons of the year, is closely related to the *Diaptomus gracilis* of Europe; but a careful study of it during successive seasons, and a comparison with the original description of Sars and with the descriptions and plates of *D. gracilis* published by Gruber in 1878, have satisfied me that our species is distinct, and I therefore propose for it the name of *Diaptomus sicilis* (Pl. VIII, Figs. 9 and 20). It is the most slender and elegant of our Calanidæ, usually colorless and transparent, but sometimes crimson in spring. The antennæ are long and weak, reaching beyond the tip of the abdomen, and are provided with hairs of unusual length, that on the ninth joint, for example, reaching beyond the fourteenth. It is in the fifth pair of the legs of both male and female that we find the best distinguishing characters in this family—and here the clearest distinctions from *Diaptomus gracilis* occur. In the male both pairs are two-branched. The last joint of the right leg forms a slender, sickle-shaped hook, which is regularly curved from base to apex, while the outer branch of the left leg of this pair is two-jointed, with a pubescent, rounded extremity, bearing two short diverging claws.

EXPLANATION OF PLATE VIII.

FIG. 1.—Diaptomus sanguineus, ♀, × 42.
" 2.—Dorsal outline of the same.
" 3.—Diaptomus sanguineus, ♂, geniculate antenna, × 50.
" 4.— " " ♂, right leg of fifth pair, × 67.
" 5.— " " ♂, left " " × 70.
" 6.— " " ♀, leg of fifth pair.
" 7.— " " second maxilliped, × 63.
" 8.— " stagnalis, antennula, × 48.
" 9.— " sicilis, ♂ fifth pair of legs, × 160.
" 10.— " stagnalis, ♂, fifth pair of legs, × 48.
" 11.— " " ♂, geniculate antenna, × 22.
" 12.— " " ♂, left antenna, × 22.
" 13.— " sanguineus, mandible, × 160.
" 14.— " stagnalis, ♀, leg of fifth pair, × 86.
" 15.—Epischura lacustris, ♀, fifth pair of legs, × 88.
" 16.— " " ♀, side view of abdomen, × 17.
" 17.—Diaptomus leptopus, ♀, leg of fifth pair, × 66.
" 18.— " " ♂, right leg of fifth pair, × 66.
" 19.— " " ♂, left " " × 66.
" 20.— " sicilis, ♀, fifth pair of legs, × 160.
" 21.—Epischura lacustris, mandible and palpus.
" 22.— " " blade of mandible.
" 23.— " " ♀, abdomen and furca from above, × 48.
" 24.—Osphranticum labronectum, first maxilliped, × 180.
" 25.—Epischura lacustris, ♂, fifth pair of legs, 70.
" 26.— " " second maxilliped, × 88.
" 27.— " " leg of first pair, × 70.
" 28.—Osphranticum labronectum, ♀, leg of fifth pair, × 70.
" 29.— " " ♂, fifth pair of legs, × 70.

(To be continued.)

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THE LOESS OF NORTH AMERICA.

BY R. ELLSWORTH CALL.

(Continued from May number.)

Physical Geography of the Loess Era.—The Champlain epoch, to which the loess belongs, was characterized by general continental depression, which lessened the area of the land and increased the average temperature. Such a depression was followed by extensive encroachment of the sea and its arms upon the land, the effects of which would be greatest in the great central basin of the continent. Hence there was a backing up of all the streams and a general sluggishness or complete loss of their currents in the lower portions of their valleys. At their sources extensive denudation was in progress, and the material thus derived was borne downward to the still portions below, and here the burden of the waters was cast as a blanket over their bottoms. The continued recession of the glaciers by dissolution kept the supply of water constant, or often swelled it to floods, thus permitting extensive denudations over large areas. "Below the falls of the Missouri the channel makes its way through the soft yielding clays and sands of the Cretaceous beds for about 250 miles" (Hayden). These beds extend nearly to the mouth of the Milk river, and then begin the Tertiary lignite formations, which are also here composed of sands, marls and clays. For another 250 miles the Missouri flows through rocks of this age, and then the Cretaceous slates again appear, which, according to Hayden, extend nearly to Council Bluffs, a distance of over 500 miles in a straight line. Now the amount of denudation possible to be accomplished by so large a stream, and in some of the most rapid portions of its ancient and present course, cannot be estimated, and especially is it needless to hazard any conjecture when we consider the character of the formations it traversed for a distance much exceeding 1000 miles! It is entirely adequate to form deposits many times greater than the whole extent of the loess in America. Into the ancient Lake Missouri, then, was poured the drainage of a vast area, and over a tenth of Iowa and a fourth of Nebraska the sediment it contained was deposited.

To another cause than the depression of the continent[1] must the great extent of the Missouri valley loess be attributed, and that cause was the narrowing of the valley south of St Joseph, acting as a barrier to the waters which then were spread out into lake-like proportions. With the gradual disintegration of its barrier and the recession of the sea consequent on the reëlevation of the land, the lake was gradually drained, leaving its former silt-covered bed as the surface soil—a waste of mud and lakelets in place of the former broad expanse of water. The changes in level and aspect keep pace each with the other. Soon the desert waste abounds with a rich vegetation, the soil is clothed with grass and flowers, and the forests begin anew to grow. But the rivers were not idle. A period of erosion began—not yet ended—by means of which the great streams plowed them channels to

[1] The estimates of the totality of this depression vary from 200 to 500 feet, any of which would be sufficient to extend the gulf line northward as far, at least, as the mouth of the Ohio.

the sea through sediment of their own deposition. Ten thousand rills and rivulets from the adjacent hills, aided by wind, by storm, by rain, by frost, began the sculpturing of the landscape anew until the beauteous arrangement of hill and dale appears, and which gives the loess regions their peculiar topographical features.

Bibliography.—The literature of the loess is scattered through many volumes, a great majority of which are not easy of access to the general reader. The following list will be found to be nearly or quite as perfect, at least, as opportunity has permitted. It is believed to embrace nearly all yet written on this subject:

AUGHEY, SAMUEL.—*The Superficial Deposits of Nebraska.* Ann. Rept. U. S. Geol. and Geog. Surv. of Colorado and adjacent territory (1874). pp. 243–269.

Contains a general account of the surface geology of Nebraska. Those portions relating to the loess (pp. 245–255) contains the following sub-sections: "The Loess Deposits," recording certain geographical, physical and chemical facts, the last illustrated by five tables of analyses of loess soil. "Cause of these Peculiarities," treating especially of the action of carbonic acid and water. The next section treats of "Fruit on the Loess Deposits," and is followed by one on the "Scenery of the Loess Deposits." Then follows a discussion of the "Origin of the Loess Deposits," in which the aqueous theory is advocated with numerous confirmatory facts. This section is followed by one on the "Length of the Loess Age," and one on its life. The article closes, pp. 266–269, with a provisional list of the mollusks of the lacustrine deposits, in which mention is made of 124 forms. Attention has been elsewhere[1] called to this list which appears in the "Sketches" mentioned below without modification.

AUGHEY, SAMUEL, Ph.D.—*Sketches of the Physical Geography and Geology of Nebraska* (1880). 8vo, pp. 326.

Contains a complete and valuable account of the loess of Nebraska. Discusses the theories relating to its origin, the argument being mainly directed against the views of Von Richthofen. Gives list of life remains, and mentions the finding of human relics. Concludes that the Nebraska loess is of lacustrine origin. An expansion of the previous article.

BLAKE, W. P.—*Geology of the 35th Parallel*, in Vol. III Pacific R. R. Reports. Pt. IV, pp. 11 and 22 (1856).

Notices of the loess in the valley of the Mississippi, and along both sides of the Arkansas as far as Little Rock. Names certain fossils which are, however, European. Notices also a similar deposit on the Red river above Ft. Washita. At this latter point is noted the occurrence of Lymnæa, Physa, Planorbis, Pupa and Helix. The same author, in Vol. II of the same series, repeats substantially the same matter.

BROADHEAD, G. C.—*Origin of the Loess.* Am. Journal of Sci. and Arts, Vol. XVII (1879), pp. 427–428.

Concludes Von Richthofen's hypothesis inapplicable to the loess of the Mississippi

[1] AM. NAT., Vol. XV, p. 585.

and Missouri rivers. Mentions localities of evident *stratification.* Material supposed to be derived mainly from the Tertiary and Cretacean rocks of the Upper Missouri. Considers the deposit lacustrine.

CALL, R. ELLSWORTH.—*Geology and Natural History of Fremont Co., Iowa* (1880). pp. 35. (Extracted from history of Fremont Co., Iowa.)

Mentions distribution and physical features of the loess in this portion of Iowa. and the physical geography of the loess era. The article partakes entirely of the character of a popular treatment of the surface geology of the county.

CALL, R. ELLSWORTH.—*Fossils of the Iowa Loess.* Am. Nat., Vol. XV, pp. 585–586 (1881).

Notices the distribution of the loess in Southwestern Iowa. Calls attention to the number of species of fossils as mentioned by various observers. Lists of fossil land and fresh-water shells found in the counties of Mills and Fremont.

CALL, R. ELLSWORTH.—*The Loess in Central Iowa.* Am. Nat., Vol. XV, pp. 782–784 (1881).

Records the discovery of loess in Central Iowa, over large areas adjacent to the Des Moines river. A section accompanies, exhibiting the relation of the loess at Des Moines to other geological horizons. Lists fossils found.

DANA, JAMES D.—*Manual of Geology.* 2d edition, pp. 547–548 (1876).

General description of the alluvian deposits of the Champlain period. Notes only the loess of the Southern States, quoting Hilgard and Safford. Lists a number of fresh-water fossil shells from the loess of the Mississippi, but no mention is made of land forms, which alone are listed by both Hilgard and Wailes.

D[ANA] J. D.—Review of "*The Loess of the Rhine and Danube,*" by Thomas Belt, F.G.S. Am. Jour. of Sci. and Arts, Vol. XIII, pp. 383–384 (1877).

A brief review of the principal conclusions reached by Mr. Belt with reference to the Rhine and Danube deposits, in the light of the geology of Eastern North America. Controverts the conclusion that various sub-glacial streams were dammed by ice to produce the terraces along the valley of the Rhine, in Europe, and that of the St. Lawrence, in Canada. Contains little on the general subject of this paper.

D[ANA] J. D.—Review of "*China, by Ferdinand Freiherrn von Richthofen.*" Am. Jour. of Sci. and Arts, Vol. XIV, pp. 487–491 (1877).

Contains an elaborate review of the first volume of this great work, the review being largely devoted to a statement of Von Richthofen's subaërial hypothesis of the origin of the loess. Gives all the salient features of the theory, together with the principal arguments relied upon as proof. Quotes the author's objections to Kingsmill's theory of marine submergence, as well as those advanced to Pumpelly's former view of fresh-water origin. The reviewer presents no theory of his own.

HAYDEN, DR. F. V.—*First Annual Report of the U. S. Geol. Survey of the Territories*, pp. 10, 12, 18–19, 45 (1867).

Contains a brief historical and geographical account of the loess in Nebraska. Notices of distinct stratification in certain localities. Remarks on the adaptability of the loess for vine culture.

HAYDEN, DR. F. V.—*U. S. Geol. Surv. of Wyoming and Contiguous Territory*, pp. 98–99 (1870).

Notices the terraces at the city of Omaha, and indicates the probable physical geography of the region at the time of their formation. Considers the loess to be an estuary or lacustrine deposit. The occurrence of Molluscan and Mammalian forms is noted. Herein (p. 99) occurs the first mention of Unio in the loess, "in the banks of some of the little streams."

HAYDEN, DR. F. V.—*Final Report on Nebraska.* H. R. Ex. Doc. No. 19. Part 1. Geology, pp. 3–79 (1871).

Brief remarks on the loess in various parts of the report. Sometimes called yellow marl or bluff deposit. Great fertility and productiveness of the soil of Nebraska attributed to this deposit.

HILGARD, E. W.—*Agriculture and Geology of Mississippi*, pp. 194–197, and many references in agricultural report (1860).

Professor Hilgard herein gives a complete physical and chemical description of the loess. Its range in the State is minutely described, and its fossils are indicated, which, as he remarks, are exclusively terrestrial forms. This list is taken from Wailes' Report, with the addition of two forms. The mammalian remains stand as reported on by Professor Wailes six years previously. The author records the observation of "definite marks of stratification."

HILGARD, E. W.—*The Loess of the Mississippi Valley aud the Æolian Hypothesis.* Am. Jour. of Sci. and Arts, Vol. XVIII, pp. 106–112 (1879).

This paper is the most elaborate review of Richthofen's hypothesis which has come under notice. The author states that it was not his "intention, at this time, to discuss exhaustively the question of the origin of the loess in general, but rather to formulate some of the more prominent objections lying against the application of the æolian hypothesis to some of the loess regions with which a long study has made me familiar." The author then proceeds to state Richthofen's objections, and to array certain facts in refutation. Certain structural peculiarities illustrative of aqueous action are adduced; and these are in turn succeeded by full notes of chemical peculiarities. Summing up the evidence the author concludes, "the sum total of anomalous conditions required to sustain the æolian hypothesis, partakes strongly of the marvelous."

H. H. HOWORTH.—*Traces of a Great Glacial Flood.* Geological Magazine, Jan., Feb., 1882.

MCGEE, W. J.—*Superficial Deposits in Northeastern Iowa.* Proc. Am. Asso. for the Adv. of Sci., Vol. XXVII, 1878.

This author frequently mentions a "loess-like clay" of very variable thickness in this portion of Iowa. Reference is made to its physical characters which seem to be precisely similar to those of true loess. Its marked peculiarities as a topographical feature is noted, and likewise the fact of its occurrence on hills relatively higher than those surrounding. Its relation to the subjacent drift proper is quite marked, but it often grades insensibly into the drift; its origin is referred to glacial action.

MCGEE, W. J.—*The Surface Geology of a part of the Mississippi Valley.* In the Geological Magazine, August, 1879. pp. 354–356.

Herein are given more fully the loess features of Northeastern Iowa, than in the article last cited. The formation is here characterized as "a whitish-yellow, loess-like clay, unstratified, free from gravel, sand and boulders." The author notes absence of stratification "except where it has been rearranged by fluviatile agencies." Numerous peculiar and anomalous features of distribution are noted; it was found sometimes to cover the summits of kames. It formed the upper surface of hills and ridges rising forty or fifty or even more feet above the general level, over which the same materials were never deposited.

NEWBERRY, J. S.—*On the Surface Geology of the Great Lakes and the Valley of the Mississippi.* Annals of the Lyceum of Nat. Hist. of New York, Vol. IX, pp. 213–234 (1869); also in Am. Nat., Vol. IV, p. 193 (1871).

This paper is a general discussion of the surface geology of the central portions of the United States, "bounded on the north by the Eozoic highland of Canada, on the east by the Adirondacks and Alleghanies, and on the west by the Rocky mountains." The portion—a small one—relating to the loess is to be found near the close of the article. The author describes it as "a lacustrine, non-glacial, drift deposit." Its distribution is noticed, and the manner of its deposition.

OWEN, DAVID DALE.—*Report of a Geological Survey of Wisconsin, Iowa and Minnesota, and incidentally of a portion of Nebraska Territory* (1852).

Pages 132–133 and 135–136 of this valuable report contain some of the earliest published data with reference to the loess deposits of Iowa and Missouri. The remarkable contour of the hills bordering the valley of the Missouri is noted; and, though the occurrence of both land and fresh-water shells is mentioned, only land and semi-aquatic forms are indicated, as follows: *Helix thyroides*, *H. alternata*, *H. monodon*, *Helicina occularia* (quere *occulta*), *Succinea campestris?* and *Pupa armifera*. The generally accepted theory of lacustrine origin is alluded to, and an illustration of "hills of silicious marl, below Council Bluffs" is given. On p. 135 the same formation as it occurs at St. Joseph, in Missouri, is noted, and the same fossils are quoted with the addition of *Helix fraterna*. Dr. Owen considered these deposits and those of the Wabash equivalent.

OWEN, DAVID DALE.—*Geological Survey of Kentucky*, pp. 17–22, 27–29 (1856).

The author mentions "frequently recurring beds" of "very fine silico-calcareous earth of pale reddish-gray or ashen flesh tint." He states that the calcareous matter is derived in great measure from the land and fresh-water shells disseminated through the formation. The following genera are indicated: Helix, Helicina, Cyclostoma, Succinea, Pupa, Cyclas, Planorbis and Lymnæa. In accounting for the calcareous concretions, found in considerable abundance, Owen says they are "formed by the percolation of water charged with carbonic acid, which, dissolving the calcareous matter in the upper part of the deposit, carries it by filtration to the lower part of the bed, re-depositing it in the form of hard masses." He gives a description of the physical geography at the period when these beds were formed.

PUMPELLY, R.—*The Relation of Secular Rock-disintegratiom to Loess, Glacial Drift and Rock Basins.* Am. Jour. of Sci. and Arts, Vol. XVII, pp. 133–144 (1879).

This paper was originally read before the National Academy of Sciences, April 10, 1878. It opens with a general notice of the features of the loess, and makes especial reference to its lithological character. In this paper he abandons the view formerly presented in his "Geological Researches in Mongolia," &c., and says the formerly received theories "required inconceivable conditions and are full of contradictions!" Accepts fully Von Richthofen's hypothesis of subaërial origin. The paper is a very suggestive one, but however applicable to China fails in America.

SAFFORD, JAMES M.—*Geology of Tennessee*, pp. 114 and 433–434 (1869).

Gives a general account of the loess of West Tennessee. Remarks that it is distinctly stratified. Gives a list of six species of land and four species of fresh-water shells, found fossil in the loess of that State.

SMITH, DR. E. A.—*Outline of the Geology of Alabama.* (From Berney's Handbook of Alabama.) No date. pp. 67–68.

A brief mention only of the loess and the theory of Von Richthofen. Urges as an objection to its subaërial deposition the existence only, in Alabama, of the loess on the "immediate banks of streams." Mentions Tuomey's identification of the loess on the Lower Tombigbee and Alabama.

SWALLOW, G C.—*Second Annual Report of the Geological Survey of Missouri,* pp. 69–76 (1855).

This report contains one of the earliest and best descriptions of the loess of Missouri. Swallow gave it the name of "Bluff Formation" (p. 74), which term he employs throughout the volume. The origin is considered as lacustrine. In an appendix, p. 215, is given a catalogue of fossils, all determined by that eminent palæontologist, the late F. B. Meek. Chemical analyses are given, which have been elsewhere alluded to.

TODD, J. E.—*Richthofen's Theory of the Loess, in the light of the Deposits of the Missouri.* Proc. A. A. A. S., Vol. XXVII (1879). Read Aug., 1878. Also author's edition, pp. 10.

A very full and valuable criticism of the subaërial hypothesis. Considers separately the four principal points made by Richthofen. Contains valuable lists of fossils, and some novel observations on the depth to which roots penetrate the soil of the loess. This portion of the *brochure* is very valuable. The author concludes: "Even now we probably express the opinion of many students of the loess when we say that the subaërial theory has received attention and consideration, mainly because of the boldness and novelty of its conception, and the high rank and well-deserved reputation of its author, rather than on account of its real merits."

WAILES, B. L. C.—*Agriculture and Geology of Mississippi.* First Report, pp. 213–214 (1854).

Gives geographical distribution of the loess in Mississippi. Statement made that below the highlands of Arkansas, the formation is not met with on the western side of the Mississippi river. States that the fossils found are all terrestrial, and lists nine forms. (This is the list quoted by Hilgard.) Mastodon remains also noted.

WHITE, DR. C. A.—*Geology of Iowa.* Vol. I (1870), pp. 103–117, and numerous references in the sections devoted to county and regional geology.

The boundaries of the Missouri river loess are described, together with its general and chemical characters. The physical properties of the loess herein receive the most complete treatment yet accorded them. Dr. White concludes that "the deposit was formed as sediment in a fresh-water lake." Believes the material of the loess to have been derived from the Cretaceous and Tertiary strata of the Upper Missouri—"the most friable formations on the continent." In the Chemical Report, by Rush Emery, occur analyses of soil—those used in table preceding.

WITTER, F. M.—*History of Muscatine County, Iowa.* (The chapter, only, on Geographic and Geologic Features.) pp. 330–332. (187–).

This is extracted from a work of the above title, the date of the publication of which does not accompany the *brochure.* It contains a general account of the loess of

Southeastern Iowa, its distribution, aspects, fossils and deposition. The author accepts the theory of lacustrine origin.

WITTER, F. M.—*Notes on the Loess.* From the Muscatine Tribune (1879).

This is the title of a paper read before the Muscatine Academy of Science, February 10, 1879. It contains a general discussion of the Iowa loess, with incidental references to the same deposit in Nebraska and Missouri. Lists fossils from various localities in Iowa. "Entire absence of the families of Unionidæ and Viviparidæ in the loess" of various parts of the State is noted and commented on. Concludes in favor of the aqueous origin.[1]

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ORGANIC PHYSICS.

BY CHARLES MORRIS.

(Continued from June number.)

IN the life history of the Metazoa, or many-celled animals, the products of cell division enter into a new relation. Instead of the new cells existing as separate, they exist as united individuals. But there is nothing to show that they otherwise differ in any essential respect from the results of Protozoan division. The germ still separates into its constituents, which become more and more polarly diverse, until a vast mass of new cells is produced, in which those with male excess of vigor are just equal to those with female excess.

But in this development of a matured body from its germ, several interesting features appear, which we must successively consider. The first of these is the separation of the body into two bilaterally similar halves, a result which, although partly or completely masked in the lowest classes of the Metazoa, is very distinctly declared in the higher classes. Under our hypothesis this separation of the body into two similar halves has a special significance. The two halves of the body are polarly distinct, being respectively male and female in chemical constitution, so that the body of the offspring represents that of both its parents.

This conclusion seems to necessarily arise. If the simplest animal cell be a polar organization, with acid and basic, or male and female poles, then its division is a sexual separation. If the two new cells continued to cohere, they would form a bilaterally

[1] In connection with these references information of much value and direct bearing may be found in an article by Professor J. D. Whitney on "The Chinese Loess Puzzle" in AM. NAT., Vol. XI, pp. 705–713, in which the author inclines to the subaërial hypothesis. See also the reports of the geological surveys of Illinois, Ohio, Indiana and Michigan.

symmetrical organism, with a male and female side. Such may be the result of division of the germ of the higher animal. Produced by the union of male and female cells, and thus being sexually balanced, its first step of division is into two cellular halves, respectively male and female in their excess energies. Each of these continues to divide, and we can, with some show of reason, believe that each is the foundation of a separate development, which results in two complete organisms, intimately connected across their median line, yet polarly distinct.

Such is a not illogical deduction. The male and female constituents being polarly separated in the germ, and in the primary results of its division, might naturally continue polarly separated in the ultimate results of its division. The mature body consists of two halves, answering organ for organ, and so intimately connected by communicating nerves that practically no separation exists. The lateral halves of the body are as like and as intimately combined as were the lateral halves of the germinal cell, and the mature state is only a complete unfoldment of conditions which existed undeveloped in the germ.[1]

Had we space, several significant facts might be brought in illustration of this idea. The character of these illustrative facts may be briefly described. The frequent difference in degree of development of the two sides of the body, is indicative of differences of vigor in the germinal poles, the male or the female pole having an excess of energy. Certain malformations of the body are strongly indicative of such a relation of its opposite halves. In that form of malformation in which clefts or fissures appear, this takes place invariably in the median line of the body. What is called hare-lip is one such case of fissure, but many diverse cases have been observed, and they are all of one general character, a lack of continuity in the median line of the body, as if its two halves had failed to fully unite. In another kind of malformation, in which lack of development produces coalescence of organs, this always takes place across the median line. Thus cases are known in which the two eyes were merged into one, and others in which the lower part of the face was so undeveloped

[1] Each half of the body is, in fact, under the direct control of the other half, since the nerve center of each half is connected with, not its own organs, but those of the other half. This peculiar relation between the nerve centers and the lateral halves of the body is a fact of considerable significance in this connection.

that the two ears became conjoined. Similar coalescence has affected the viscera and the lower part of the body, but there is no instance of a coalescence that has not equally affected both sides.

In malformations in which some part of the body is abnormally developed, the rule is the same, the abnormality always extends across the median line. It is very rare that there appears any marked excess or deficiency of one side that is not shared by the other, and we know of no case of such lateral excess or deficiency sufficiently marked to be considered a monstrosity, though slight differences are of very usual occurrence.

There is another abnormality of great significance in this connection, that of hermaphroditism. In every case of true hermaphroditism in the higher animals, the male and female organs of generation occur on opposite sides of the body. This is not usually the case in the normally hermaphroditic animals, in which the two organs are often combined in a single gland, but so far as it goes it is an indication of sexual difference of the two halves of the body.

And such a conception aids us in comprehending the results of hermaphroditic generation. For if the two sides of the body are thus related, germs coming from opposite sides might be capable of proliferation, and thus unisexual generation be a normal process.

In the development of plants there does not, at first sight, seem to be any trace of bilateral division. And yet if we consider that the active layer of plants is a cylindrical tissue, bounded internally and externally by the most vital layers of the wood, we may surmise that the polar halves of the plant consist of its internal and external active layers, between which flows the nutrient fluid, in a cylindrical vascular tissue. This idea is sustained by the position of the hermaphroditic organs of the plant, the female organ always being central and the male organs disposed in a circle around it.

Evidently, under such a sexual law as that here proposed, there might be great differences in the sexual energy, and also in the life energy of new individuals. Where the polar energies of the germ were weak, the life energy would be reduced. And the degree of sexual differentiation would depend upon the excess of energy of one sexual pole over the other. Strength or weakness of special tissues might result from the same cause, an excess or lack of polar energy in the chemical constituents of the germ which give rise to these tissues.

We have so far considered protoplasm as consisting of molecules of similar chemical constitution, and differing only in acid or basic energy. But in the protoplasm of the higher animals a special chemical differentiation takes place. The molecules of the unit of each tissue have a special chemical constitution of their own, which differs from that of any other tissue.

The simplest organisms have, in all their parts, identical relations with the environment. But as development goes on, this identity of relations ceases to exist. Fixed duties are assigned to fixed parts of the body, until finally every region of the organism has its definite office to fulfill. Chemical variation necessarily accompanies this functional variation. The special duties given to special tissues are chemical duties, or motor duties dependant upon chemical action. For their proper performance each tissue must have a special chemical constitution. Such a chemical divergence is a necessary result of divergent relations with the environment. In the higher animals all the internal tissues are removed from contact with external conditions. Their environment is the nutrient fluid. But this differs in different parts of its course. Certain organs take certain elements from it. More internal organs must employ as nutriment other material for which they may have a less vigorous affinity. But this assimilation of varied nutriment produces a divergence in chemical constitution, so that each tissue finally accepts from choice what it first may have accepted from necessity. This process of differentiation has gone steadily on, from the first to the last step of organic development, every change in the environment of a tissue producing a change in its chemical organization.

If such be the case we should look upon functional variation not as causing but as caused by chemical specialization. Many circumstances, having that undetermined origin which is called chance, may produce variations in the relations of the tissues to the external or the internal environment. In consequence, their chemical character changes. As a secondary result of this change their organic function varies. A new and perhaps more diverse relation is established between the parts of the organism in consequence of specializations in its chemical constitution, arising from specialized relations with the environment. By a continuance of this process all functional differentiation is produced. Thus organic development is primarily chemical specialization.

One necessary result springs from this form of differentiation. Unspecialized cells may exist independently. All specialized cells must be coherent. They owe their existence to conditions produced by the action of other cells, and therefore can only exist in intimate connection with those cells. Thus chemical specialization is necessarily followed by cellular coherence, and the production of many-celled organisms. It is the basic cause of all life evolution beyond the Protozoan.

The considerations here taken render necessary certain underlying laws of organic evolution. Variation in the environment necessitates chemical specialization, followed by coherence of cells and functional differentiation. But a yet more primary principle lies at the basis of evolution. If the simplest life form depends for its vital energy upon chemical polarity, then an essential step to evolution must be some means of increasing the vigor of this polarity. Organic forms may have begun in colloid units with very feeble polar differentiation. If so, the first step in the evolution process must have been an increase of this differentiation, so as to increase the growth vigor and the power of germinal reproduction, or cell division. The tendency of such units is to neutralization, through chemical satisfaction. Oxidation overcomes this tendency by reproducing the original polarity. May not oxidation do more than this, and in some cases yield an increased polarity? If so, organic evolution resolves itself into this. Primarily the life energy of organisms grows greater and greater, as continued oxidation yields a slowly increasing vigor of chemical polarity. Secondarily the life energy becomes more diverse as successively new relations with the environment arise, and new chemical specializations in consequence. As oxidation produces the one, activity aids the other, the active organism varying its relations much more rapidly than the passive one.

If such be the chemical character of the mature organism, what is most probably the chemical character of the germ from which it arises? If in the process of growth only chemical agencies are active, and only chemical results produced; if chemical affinity is alone concerned in the two processes of physical growth and organic differentiation, then the germ can need none but chemical powers, and all the physical actualities of the body must exist as chemical possibilities in its germ. The germ must represent, not physically but chemically, the fully developed organism.

If such be the case the molecules of the germ must be adapted to develop, by chemical assimilation, not only into every tissue of the body, but into every special portion of every tissue. Every region must be potentially present in the germ, each molecule of which must have its special polarities, and be adapted to a special mode of development.

Molecules are not produced by a "fortuitous concourse of atoms." Complex molecules are built up by successive steps of synthesis, and the mode of arrangement of the atoms is more important than their numbers and kinds. Even slight changes in this particular may cause marked changes in the physical character of the molecule.

The energies of the molecule are solely those of affinity. Two molecules of different formation differ in their chemical polarities, and their relations with exterior matter depend strictly upon the character of these polarities. Oxygen and hydrogen atoms unite to form a polar molecule of water. A number of water molecules combine with carbon to form a polar molecule of starch or sugar. This may in some way combine with ammonia to form a nitrogenized molecule. And so, perhaps by many steps of synthesis, the most complex molecule is finally attained. But in the formation of the final and of every intermediate molecule, an undeviating chemical principle must be obeyed. Each must be composed of acid and basic, or positive and negative constituents, and thus be a chemically polar organism. Thus it will be polar not only as a final compound, but each of its constituent molecules, down to the lowest of all, will also be a polar compound. And each minor polarity in the mass will retain its special character intact, and must manifest its peculiar affinities should it be set free by disintegration.

Instead of considering the polarities of constituent molecules, we may approach the subject from another direction. An organic being, a man for instance, is a vast mass of chemical molecules, aggregated primarily into cells, and secondarily into variously divergent tissues. The physical characters of these tissues depend on the chemical affinities and polarities of the cells composing them, and these again upon those of their molecules. A greatly dwarfed being would have the same organization but must be composed of a vastly decreased number of cells and molecules. Yet dwarfing might continue until a very minute being resulted, so greatly reduced in size that the tissues would be represented by cells only. In such a case specialization would have become generalization, the cells which replace the tissues being adapted to reproduce these tissues if growth again take place. But if the dwarfing process still continue, the cells must disappear, and the nuclear bases of the cells, or minute groups of the nuclear molecules, replace them. But such nuclei, or groups of molecules would probably aggregate to the formation of cells of heterogeneous instead of homogeneous molecular constitution. Such seems a probable result of a continued dwarfing of a mature being. It begins with an aggregation of diverse and homogeneous tissues, specially arranged. It yields, if continued far enough, an aggregation of homogeneous cells, representing in character and arrangement the tissues. If continued still farther it yields an aggregation of heterogeneous cells, whose molecules represent in character and arrangement the homogeneous cells above mentioned. Each such cell would be a potential representative of a group of tissues. But if the dwarfing process be still continued, these generalized cells must also be reduced to groups of molecules, which would aggregate to form fewer and still more generalized cells. And a final completion of the dwarfing process would be a single cell, representing potentially the whole body. Such a germinal cell must contain molecules so constituted and arranged, that in their development each molecule, or each homogeneous group, will yield homogeneous cells, arranged as their molecules were arranged in the germ. And a final development of these cells must yield the special tissues which they are adapted to form.

Thus by dwarfing the body to microscopic dimensions, or until it be reduced to a single cell, this cell must represent in its molecular organization the physical organization of the whole body. Its molecules must possess the special polarities of the tissues, and be arranged as the tissues were arranged. And the interaction of the molecular polarities, must render this arrangement as necessary in the germ as the physical duty of the tissues renders it in the mature organism.

It might be imagined that such a germ would be greatly diversified in the character of its molecules. Yet no such necessity exists. The divergence from homogeneity in these molecules would probably be very slight. For diverse as are the physical characters of separate tissues, it is improbable that they vary greatly in chemical character. The protoplasmic bases of all the tissues are perhaps nearly homogeneous, minute differences in their chemical constitution, and in their polar affinities, yielding the wide divergence in the physical characters of the tissues.

The physical analysis of a tree yields us striking evidence on this point. Here we find solidified woody fibers; there vascular tubes of varied form; here gum, there cork, there mucilage; here at least two varieties of starch; in the sap dissolved sugar; in the flower and fruit, liquid or solidified sugar, of several varieties. In these diverse tissues we have almost all the material of the tree. Yet when we come to examine them chemically we find them to be nearly the same thing. They are all composed of carbon with slightly different equivalents of water. And if the divergent tissues have but this slight chemical difference, how much less may be the differences in the protoplasmic nuclei to whose chemical activity they are due?

It is probable, therefore, that the protoplasm of the varied animal tissues has but minute differences in its chemical constitution, these minute differences being capable of yielding marked divergences in the physical results of their action. And the germ, which must contain molecules derived from every portion of the body, may be a nearly homogeneous mass of protoplasm, the minutest differences in its molecules being capable of yielding marked differences in the tissues arising from them.

The marvelously intricate germ of the human body is not produced but once, or but a few times. It is, on the contrary, continually produced, as if the body was incessantly employed in forming such minute and generalized copies of itself. For such a continual reproduction there must be some important physiological agency constantly affecting every tissue, or perhaps every cell of the body, so that these tissues, in addition to their ordinary duty, perform an unceasing generative labor. They are adapted to work not only for the needs of the single individual to which they belong, but for a possibly great number of future individuals, since, could the germs produced by each individual develop, it might yield myriads of mature offspring. For such an important and continued function, provision must be made, and this provision must exist in some duty naturally arising from the chemical and organized constitution of the body.

Efforts have been made to explain this phenomenon, of which the most notable are those of Spencer and Darwin. Spencer advances a hypothesis of physiological units, in some way intermediate between the molecular and the cellular units of the body, and being in themselves generalized copies of the body. He does not think it possible that this generalism can exist in the molecules themselves.

The hypothesis advanced by Darwin is more satisfactory, though equally without visible support. He proposes the idea that every portion of the body is constantly throwing off invisible gemmules of excessive minuteness, some arising from the body itself, some brought into it from ancestral bodies. These gemmules, he thinks, contain the special characteristics of the part from which they arise, pass into the blood current, multiply by self division, and finally aggregate into a reproductive germ, whose development may reproduce the parent organism and, to some extent, that of more remote ancestors.

This pangenesis hypothesis approaches a physical explanation of the difficulty, although it seems in certain respects insufficient. In fact, no such hypothesis may be needed. If the body is engaged in so incessant a labor we might reasonably expect to discover some visible evidence of such an important function. And certainly a very cursory examination of the body yields us evidence which seems to offer a satisfactory solution of this difficult problem. It may seem strange if we assert that every portion of every tissue is constantly giving off, or in some way influencing the formation of organized substance; that this substance is not invisible, like the pangenetic gemmules, but perfectly visible; that it has no discoverable office in the body, and that its organization is that of a fully vitalized germ.

Yet such a material does exist, and is that known as the leucocyte, or the white blood corpuscle. The office of this corpuscle has been, and still is, a puzzle to physiologists. They suppose that it may be converted into the red blood corpuscle, yet this remains a supposition only. If we closely examine the origin and character of the leucocytes we may feel warranted in ascribing to them another duty and destiny. These corpuscles exist abundantly in the blood, but they also exist in equal abundance in the lymph, from which the blood seems to derive them. It is known that they arise independently in the lymph, and in any exuded blastema in contact with a living surface, as in the fluid of pus cavities.

But the lymph is a liquid which exists in direct contact with perhaps every cell of every active tissue of the body. It apparently originates in a nutrient fluid which exudes from the blood through the walls of the vessels. It bathes and yields nutriment to the active cells, and carries off their waste materials. And it seemingly carries off more than this, for the white corpuscles make their appearance in the most interior lymphatic channels, anterior to the lymphatic glands. Thus they arise in the blastema in direct contact with every portion of every tissue, and are possibly formed under the direct influence of the tissues in which they appear, if they are not indeed exuded and vital portions of the living tissues.

Their increased numbers in the lymph as it approaches the blood indicates a continued life action, a division resembling that of the individual Protozoan. In fact the whole behavior of these corpuscles significantly reminds us of that of the lower Protozoa. If existing outside the body, they would be taken for individual Amœbæ, for they are in organization and behavior indistinguishable from the lowly organized animal known as the Amœba. They constantly advance and retract pseudopodia, which process constitutes the amœboid life function, and are, like the Amœbæ, composed of a nucleated mass of protoplasm. Thus they in every respect simulate the lower Protozoa.

If the white blood corpuscles increase in numbers by division, as seems evident, they must also assimilate nutriment and grow. The constant change of form of the Amœbæ is a nutrient function, and it must have the same significance in the white corpuscles. In fact, we have direct evidence of this. They have been proved by the addition of coloring matter to their containing fluid, to absorb material from this fluid, retain it for a while, and then reject the innutritious colored granules.

There is only one function wanting to complete the whole cycle of Protozoan life, that of conjugation, or sexual union. This has not been shown to occur in the case of the leucocytes. But there is no reason to conclude that it does not occur, and it is by no means improbable that their nutrient process consists, partly at least, in an assimilation of the molecules, or the budded gemmules, of other leucocytes.

With these preliminaries we may proceed to consider the hypothesis that the leucocytes are the true germinal particles, which embrace in their organization the chemical and physical characteristics of every region of the body, this generalism of constitution being produced by successive combinations of the leucocytes, until they finally produce composite germs which are true generalized copies of the whole body.

From this point of view the hypothesis which looks upon the animal body as a colony of individual cells may not be an untrue one. Each cell depends for its individual life upon the nutrient pabulum elaborated for it by the combined labor of all the other cells of the body. It does not go forth as an individual in search of food, for its proper food is brought to it. But though fixed in position, its individual life resembles that of the Protozoan. It assimilates food, grows, and divides into new cells. And it is quite possible that all these cells do not remain united. Some of them may be thrown off into the lymphatic fluid which bathes the mother-cell. Each cell may thus, in addition to its coherent offspring, send off independent offspring, to wander out into the world at large of the nutrient fluid.

Thus from every cell of the body may come wandering offspring, each a perfect copy of the mother-cell. The inducement to their being thrown off may be the better chances for nutrition offered by a free existence in the nutrient fluid. It is one phase of the struggle for existence and adaptation to circumstances, which displays itself everywhere in nature, from its lowest to its highest conditions. Possibly each cellular unit of the body performs a double duty. It acts both as a constituent part of the body and as a free individual. In its former office some of its daughter-cells remain coherent, and aid in the growth of the tissues. In its latter office some of its daughter-cells are budded off into the surrounding fluid to pursue an individual life of their own. In this respect it reproduces the Protozoan mode of life, in which all new cells are budded off into the surrounding fluid as separate individuals.

Such a process is not improbable in itself. We can with some justice look upon the cells as individuals, and as, in their methods of development, concerned only for their own private interests. In the Protozoa the new cells are all set free because there is no advantage to be gained by their remaining coherent. In the Metazoa there is an advantage to be gained by coherence. They are adapted to a special nutriment, which is brought to them, and which they would fail to obtain unless united into a specialized organism. But the nutrient fluid from which they derive food, offers also a sphere of advantageous free existence. The cells are equally well situated when free as when coherent, and therefore the newly-formed cells are as likely to become free as to remain coherent. Possibly they have a somewhat better chance for life in the free state, as they are surrounded by a nutrient fluid exactly suited to their needs. Hence the free buds rapidly develop into actively vital cells, yielding what are known as the lymph corpuscles.

But these corpuscles are contained in a moving fluid. They are quickly borne away from their point of origin and thrown into the blood. Here the conditions for their free life are less favorable. They may fail to obtain the specially elaborated nutriment to which they are adapted, and thus may lose their vitality and possibly become modified into the red blood corpuscles.

The struggle for existence may be active between the leucocytes in the blood. Beale and Max Schultze describe minute globules in the blood which they suppose to be fragments (or gemmules) budded off from the white corpuscles. These may serve as nutriment to other corpuscles. If so the corpuscles must gradually acquire molecular conditions arising from varied regions of the body, and thus become more generalized in constitution and better adapted to the nutrient conditions of the blood. Possibly a considerable degree of generalization may be attained in this manner.

This process of cellular budding and the formation of free cells, is continuous throughout life. It has its phases of variation in the daily life of organisms. The leucocytes appear more abundantly after meals, and decrease in number during abstinence. But the nutrient and developing activity of the cells must display this same variation. Possibly the process of free budding may be more active in mature life than in youth. The rapidity of growth in youth indicates a strong tendency to coherence of cells, though perhaps the more vigorous assimilative energy at that period of life may render both the coherent and the free cell formation very active. In mature life the cessation of growth seems to indicate a loss of the coherent energy. The great mass of the new cells are perhaps budded out as free individuals into the lymph, while only enough remain coherent to keep up the integrity of the tissues. In old age even this fails, and the body shrinks. It is becoming disintegrated by the growing preponderance of free over coherent cell formation. It is not improbable that the increasing thickness and density of the tissues may have some influence upon this result. Nutriment reaches them less readily, and the new cells are more advantageously situated in the free than in the coherent state.

Thus the independent life of the cells becomes, as life goes on, less and less subordinated to the needs of the body. Each coherent cell buds off minute gemmules, or organic units, which quickly assimilate nutriment from the rich plasma surrounding them, and grow into amœboid cells. These buds may be, in many cases, very minute, for corpuscles will arise in an apparently homogeneous blastema. Some writers argue that this blastema is structureless, but it is not easy to credit that it is destitute of the germs of organized structure. These may be excessively minute masses of molecules, invisible gemmules derived from the tissues, but they must be present as centers and controlling agents of the organized corpuscles which quickly appear. We are, therefore, forced to believe that the colony of coherent cells which forms the body as a whole, gives rise to a colony of free individuals, which swim off and develop in the surrounding fluid, precisely as the budded offspring of a lowly organized animal float away to develop as independent individuals. The body continues to absorb nutriment, but the products of its nutrition flow away and resolve themselves into a swimming colony of single-celled organisms. Cessation of individual life becomes necessary from the increasing tendency of the body to resolve itself into its elements.

If now we hastily review the process of reproduction throughout the range of animal life, we shall find it to favor the hypothesis here proposed. Everywhere there seems a struggle between the opposite tendencies of new germs to remain coherent and to become independent. The result undoubtedly strictly depends upon the advantage in nutrient relations between the free and the coherent state. In the simplest organisms the new cells remain free. They would derive no advantage from coherence with the mother-cell, and they are fully capable of continuing the species, since they contain all the molecular conditions of the type. Here there is no growth, the whole life process is a reproductive one. In less simplified forms, such as the Foraminifera, both tendencies are displayed. Possibly the armored condition of the type renders it advantageous for coherence to continue up to a certain stage, yet independent cells are incessantly budded off. In the highest Protozoa a molecular differentiation seems to arise between the different parts of the single celled organism, and this is probably the primitive stage of the cellular differentiation in the Metazoa. The special molecules of the Infusorian represent the special cells of the Metazoan. In the latter type of animal a considerable degree of coherence becomes absolutely necessary, yet it is probable that in the lower forms free cell formation is very active. There are two purposes to be subserved in the organism, the continuance of individual life and the reproduction of the species. For the one, cell coherence is necessary. For the other, cell freedom. And both of these are favored by the nutrient conditions. The specialized nutriment bathes the cells, and the new cell products can gain nutrition both as coherent and as free cells. But the process of reproduction is not as simple as in the Protozoa. No longer does every portion of the body represent the whole body. The free buds thrown off by the cells into the nutrient fluid represent only a special section of the body. Only by some process of combination can cells be produced containing the molecular constituents of the whole body. And it is probable that this combination is a natural resultant of food assimilation by these free cells. They take in nutriment, grow, divide or bud off minute gemmules, and these gemmules are taken up as nutriment by other cells. Thus fully generalized cells are produced, capable of existence outside the body, and adapted to develop into a copy of the parent organism.

As the animal becomes of higher grade the process of tissue formation preponderates over that of germ formation, the number of developing germs decreases and the resolution of the body into its offspring becomes less declared. From being total it becomes partial. In fact, as specialization increases the combination of the cell germs is not so readily achieved, while it becomes necessary for the reproductive germ to be provided by the parent organism with suitable food for its first stage of development. In the most advanced stage of this process the germ must be retained and develop within the parent organism until its specialization has become nearly complete. This necessity adds to the importance of individual life. Where the germs ask no further aid from the parents, the latter cease to exist, all their strength going into the germs. Where the germs ask considerable aid from the parents, the latter must retain much of their vital strength, and cannot completely disappear in their offspring. Where, as in man, the offspring is fully developed through parental aid, the life vigor of the parent cannot be exhausted by that of its offspring, particularly as the continuance of the species needs long continued successive production of offspring. The vital strength necessary for this purpose only slowly declines, and continues long after the period of child-bearing is past.

Thus there is a gradual advance from the condition in which all new cellular individuals become free, to that in which the greater number of new individuals remain coherent. Where the organic specialization is slight, the cells are more likely to be budded off into the free state than to remain coherent. In such organisms the reproductive power is great. Countless buds are thrown off by the cells of the tissues. The aggregation of a few of these suffices to yield a cell containing all the molecular conditions of the parent form. Thus reproduction is specially vigorous, and the life of the race greatly preponderates over that of the individual. As specialization increases, this process is gradually checked. Growth power gains upon reproductive power; the life of the individual upon that of the race. Gemmules may be budded off into the nutrient fluid as freely as before, but fewer of them attain full generalization, as this process is a much more complex one. And those which fail to do so are probably reconsumed by the body as nutriment, and go to aid the growth process.

(To be continued)

NOTES ON THE HABITS OF SOME WESTERN SNAKES.

BY H. A. BRONS.

WHILE connected with the Geological Survey of the Western States, I had the opportunity to note some peculiar, and as far as I am aware, unreported habits of some of the snakes.

Several of the summers I passed upon the plains were preceded by rainy springs, swelling to unusual height the small streams which became inhabited by small fishes. During the drought of hot summers, the receding waters left the fishes in shallow pools within creek beds, an easy prey to their numerous enemies.

The mid-day heat caused numbers of snakes to seek shelter from the sun, and the garter snake *(Eutænia radix)* in particular, chose water at this time. Here the fishes, unable to escape or find deep cool water, were unwilling co-tenants with the snakes. The latter are fond of fish, and would devour great numbers of the smaller ones, chasing them from one part of the shallow pool to another. When the fishes were in water too shallow to swim in, or were struggling upon the sand, they would be seized by the snakes, who would feed upon them until unable to contain more. The snakes would follow the fish through the water, diving and remaining submerged some time. I did not observe them swallow air (see AM. NAT., Jan., 1880). Snakes evince more than ordinary energy and sagacity in capturing fish; half a dozen will congregate within a small pool, all acting in concert.

Mr. J. L. Wortman, who had charge of a scientific party last year, informs me that while fishing one day he caught numbers of chub *(Cyprinidæ)* and, throwing them on the sand, was surprised to see that but few remained. While quietly continuing to replace those so singularly missing, he observed a garter snake seize and swallow one of the fish six inches in length. There were two of these snakes reaping the reward of Mr. Wortman's skill. Upon opening the snakes one was found to contain six fishes. The head-waters of the Smoky Hill and Big Horn rivers abound in this aquatic *Eutænia radix.*

In Texas, while fishing with a common hook and line, baited with a small scale fish, I had the rare fortune to hook what at first seemed to be an eel, but proved a "cotton mouth" snake *(Ancistrodon piscivorus).*

One morning on examining a line set over night, found the pole as left the previous evening, but the line drawn to shore, and my curiosity was excited as to the catch. It proved to be one of these snakes, coiled upon the bank, the bait, a small scale fish, mashed within its mouth, and the hook well caught. Upon being disturbed it at first showed fight, but took quickly to water, and was landed with the same effort as a fish or eel of equal size, *i. e.*, about twenty-six inches in length. That season I caught three of these venomous snakes in this way while fishing with a hook and line. By Mexicans living on the banks of the San Antonio and San Maguil rivers, I was informed that it is no unusual thing to catch cotton mouths while fishing.

Running short of bait one day, I caught several large toads and tied them together by their hind legs. On nearing the water a snake started to cross the stream; having nothing else to throw at it, I gave the toads a toss in front, hoping to change its course; the snake seized quickly on the struggling mass. Toads exhibit great fear of snakes; it will afford considerable amusement to take a toy or stuffed snake skin and trail it towards one; it will make a strange cry, at the same time making vigorous jnmps to escape. Frogs act in the same way, though they are not so readily captured.

Nearly all animals show unmistakable signs of fear when confronted by a snake, though many that do not prey upon them take delight in destroying them, as do the deer family, etc.

Prairie dogs *(Cynomys ludovicianus)* seem to have a most intense dread of rattlesnakes *(Crotalus confluentus)*. This little animal dreads not only its venomous bite, but more the loss of its young, which serve as food for these snakes that enter their burrows, take possession and drive them from their homes. Where does one find a prairie dog town but that it is teeming with snakes and the strange little owl *(Speotyto cunicularia)* that "ducks" to passers in ludicrous solemnity? These, though billeted upon the dogs do not constitute a "happy family." The owls, though they generally occupy an abandoned hole or burrow, destroy the young dogs. Nor do the eggs and nestlings of the owls fare with any better treatment from the snakes; between these exists much enmity. One afternoon while passing through one of these dog towns, in Wallace county, Kansas, we heard a most unusual noise and stir (in the town) as though they were holding a bellicose council. They were collected around a hill,[1] into which they were scraping dirt vigorously. On examining the burrow it was found to contain a large rattlesnake that the dogs were trying to entomb. I noticed this several times, as did other members of our party. To leave no doubt upon the subject we dug out the snakes after shooting them.

The habit of swallowing whole eggs is too well known to merit more than mention. But few persons realize the mischief snakes work in destroying the nests and young of our valuable birds. It is not an unusual occurrence to find whip *(Bascanium flagelliforme)*, racers *(Bascanium constrictor)* and bull snakes *(Pityophis sayi)*, with the entire contents of quail, prairie hen or domestic fowl's nests within their capacious stomachs. With a little care they may be compelled to disgorge the ingesta unbroken.

During the breeding season the odor of many snakes is quite distinct and perceptible at some distance. This is markedly so in the rattlesnake *(Crotalus confluentus)*, its musky and fœtid emanations are quickly recognized by frontiersmen.

The manner of union of the sexes at this season is rather instructive. The female among the racers (Bascanium) is larger and darker than the males, and not so graceful in form or movements, she, at times, seems to toy with the male, indisposed to yield to his importunities, though pressed with ardor. To avoid his suit, at times, she will dart through grass, among stones, or enter a crevice. Should he be able to reach his mate while within a hole, he is not slow in bringing her to the surface, again to be repulsed. Upon an unbroken ground the sexual communion is less prolonged. Here she is unable to free herself from his quick and effectively directed moves. In case she attempts to quit him, a coil is thrown about her body, and his head laid flat upon her neck, and replaced as promptly as dislodged, evidently in the endeavor to propitiate her.

Of all strange habits in snakes, none equals that observed in the blowing adder *(Heterodon simus)*. One afternoon returning to camp, I came upon a box turtle *(Cistudo ornata)* trailing along one of these snakes, which had a firm hold upon the turtle's left hind foot. The turtle was unable to free itself of its tormentor, as its hold was quite secure; so persistently was it maintained that I lifted the turtle by grasping the body of the snake. Con-

[1] The prairie dogs throw up a bank levee about the mouth of their burrows.

siderable force was required to separate them. The snake was about twenty inches long, the turtle eight inches. The foot was bleached, and blood was still flowing; none had apparently escaped from the mouth of the snake. Two toes were missing, having been digested from the foot. The entire foot appeared as though it had been subjected to a continued maceration within the mouth of the snake.

Twice afterward I noticed this strange habit of the puff adders. The late Professor Mudge mentioned to me that he had observed this habit in these snakes. I have not been able to find any signs indicating that the snake ever attaches itself to a fore foot. It seems as though they choose a foot that the turtle is unable to defend. The neck can not reach the hind foot as it can the front, and free it of any object that may attempt to lay hold upon it. The carapace may protect the tail.

I took pains to examine many box turtles *(Cistudo ornata)* that occur along the Smoky Hill rivers, and many, one can safely say one-half, are deformed in their hind feet. Very little deformity is found in the front feet. It must not be taken that all, or even a majority of these deformities are caused by adders. It is not on account of want of food, for there is never a lack of the insects here upon which the snakes generally subsist. It is not thirst, as the habit is practiced where there is water. The appearance of the foot, and the inability of the snake to masticate, would preclude any solution other than the desire to obtain blood as it flows from the lacerated parts.

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THE LIMIT OF THE INNUIT TRIBES ON THE ALASKA COAST.

BY IVAN PETROFF.

CIRCUMSTANCES over which I had no control detained me for several months during last summer and autumn in the section of Alaska where the Innuit and Thlinket tribes meet and to a certain extent intermingle with each other. I refer to the Alaskan coast between Prince William sound and Mt. St. Elias.

During a former residence and subsequent continuous travels in Alaska, I have paid particular attention to the distribution of the Innuits. It had always been a question of practical interest to me, because progress through Innuit territory was always comparatively easy and uninterrupted except by natural obstacles, while every excursion into the country occupied by other tribes was attended with open or secret opposition on the part of the natives, and occasional threats of violence or even overt acts of hostility.

In the course of my explorations, extending over a period of several years, of all the coast from Bering strait to the vicinity of Mt. St. Elias and of the river systems, I had found the Innuits occupying the coast and interior wherever nature has thrown no obstacle in the way of free navigation in their kaiaks or skin-covered canoes; and consequently this eastern limit or boundary of the long chain of homogeneous orarian tribes was a locality of peculiar interest to me. The tribes who now have their homes in this vicinity are the so-called Chugach, of purely Innuit extraction; the Oughalentze, or Oughalakmute of Innuit extraction, but now mixed with Thlinkets; and thirdly, the so-called Chilkhaat tribe of the Thlinket family, settled on Comptroller's bay and up to the left bank of Copper river. The Chugach, whose name is a Russian corruption of their own tribal name of Sh-Ghachit Shoit (the latter word means simply "people"), partake of all the characteristics ascribed to the Innuits of the Alaskan coast south of Bering strait. They hunt marine mammals in preference to land animals, and their whole domestic economy and mode of life rests upon the use of the kaiak or bidarka. The Ougalakmutes have always been the easternmost branch of Innuit stock along the coast. The earliest Spanish and English visitors to Prince William sound described more than a hundred years ago, the natives of that region just as we find them now, and I have been unable to discover any proofs of the existence of these tribes farther down the coast. It is true that in one instance Lieutenant Ring, of the U. S. Army, reported the discovery of relics apparently of Innuit type, in shell heaps near the mouth of the Stakhine river, and a few skulls, said to be of the same type, have been foun l in Santa Barbara county, California. Both of these can be easily accounted for by the compulsory wanderings of Aleuts and other Innuits under the Russian rule at the end of the last and the beginning of the present century. Thousands of Innuit hunters who accompanied their iron-willed masters down the northwest coast of the American continent were slain and captured by the more warlike Thlinkets, and a few skulls in Santa Barbara county may be all that is left of the prisoners taken on that very coast from sea-otter hunting expeditions undertaken by English and American skippers who were furnished with Innuit hunters by the Russian authorities at Sitka.

I am aware that my classification of these tribes conflicts with that adopted by Mr. William H. Dall in his essay on the Distribution of the native tribes of Alaska, in Vol. 1, Contributions to North American Ethnology. Mr. Dall's personal intercourse with these people must have been of brief duration, or he would not have confounded the Chilkhaaks and the Oughalentzes. The name of the latter in its proper form of Oughalakmute simply means "far away people;" Oughaluikhtuk in the Chugach dialect meaning "far distant." Mr. Dall also was mistaken in his assertion that the Copper river or Ah-Tena Indians had forced their way between the Thlinkets and the Innuits, and hold a small part of the coast.

These Indians do not hold now and never did hold, as far as it is possible to learn, any portion of the coast. A small number of them, consisting of traders only, visit the post of Nuchek or Port Etches every year, but to enable them to accomplish this voyage, they purchase large bidars or skin-covered boats of the Innuits. In their own country birch bark canoes form their only means of navigation.

We have every reason to believe that formerly the Innuits occupied the coast as far as the indentation commonly called Icy bay, but the constant pressure of the stronger Thlinket tribes has caused them to recede gradually to the localities occupied by them at the present day. In the vicinity of Icy bay the glaciers of the Mt. St. Elias range of Alps reach down to the coast, forming a long line of icy cliffs, a stretch of coast affording absolutely no landing place for boats or canoes. This feature has proved an insurmountable obstacle in the way of kaiak navigation, necessitating as it does a continuous sea voyage of between two and three days without making a landing. The Innuit in his kaiak could not accomplish this, but the Thlinkets in their large wooden canoes, provided with masts and sails, could easily traverse this distance, with favorable winds, without being obliged to land.

When the Russians first came into this neighborhood, they found the two tribes struggling for supremacy; the Muscovite invaders, consulting their own interests, gave their assistance to the weaker tribe, and during their occupation of the country put a stop to a further advance of the Thlinkets. Only fifteen years have elapsed since this restriction was removed and already we see the effect in the absorption of former Innuit territory by the Kolash.

Every fact I have been able to collect in connection with tribal movements over this debatable ground, points to a migration of the Innuits along the Alaskan coast southward and eastward until they met the Thlinkets, and until stopped by the long stretch of inaccessible cliffs and icy promontories already mentioned. I am also inclined to believe that the whole movement originated from the American Arctic coast at a period subsequent to the invention of the kaiak. Within the last twenty years I have observed instances of individual migration at various points of the Alaskan coast, but always in the same direction. I have found individuals and families from the Lower Yukon in the vicinity of Bristol bay and in the interior of the Alaska peninsula. The Mahlemute or Koikhpagamute of to-day looks to the southward and eastward as the direction in which to find a better country, just as his ancestors did centuries ago.

Mr. Dall, in the paper above referred to, seems to adopt the theory of the gradual advance of the Innuits from the interior of North America to the coast before the impulse of successive waves of other tribes behind them. This theory, first promulgated by Dr. Rink, is entirely tenable if we suppose that these waves of retreating Innuits reached the coast first in high altitudes, in a region devoid of timber, such as would lead to a change from the habits of an inland people to those of the modern Innuit, and to the final invention of the kaiak. If, in accordance with this theory, the Innuits were driven northward along the coast to their present homes before the onset of the Thlinket tribes, the natural conclusion would be that the rear guard of the vast Innuit army stopped about the region of the Copper river country, where we find them to-day. This region and the whole of Prince William sound, as well as the shores of the Kenai peninsula, are densely wooded, and the question arises, how came these people to adopt the use of the kaiak when they are surrounded with every facility for constructing canoes from the same material that they must have known and applied to the same purpose in their southern or interior home? The natural barrier to kaiak navigation mentioned above, has been passed ages ago by the Thlinket tribes, but these never adopted the use of the kaiak; they still hunt and travel in their dugouts that they brought with them from their former homes in the south-east. The exclusive use of the kaiak or bidarka in this Alpine region, with dense forests and dangerous beaches, can only be explained by the emigration of the people from other regions devoid of timber. From whatever direction the Innuit people of Prince William sound and the Copper river delta came, they brought with them the kaiak or it never would have been invented there. The Oughalentze, who are now confined to two villages, Alaganuk and Ikhiak (called Odiak by the traders), have already ceased to construct bidarkas, owing to the preponderance of the Thlinket element among them. Their houses are constructed on the Thlinket plan and the younger generation speaks the Thlinket language only, while the older men and women speak both the latter and the Innuit. The Chilkaats, on the other hand, offer to the observer but few faint traces of their Innuit intermixture, and in their intercourse with Chugach Innuits and the traders, they use interpreters. They wear blankets exclusively.

The end of the Innuit element is here very clearly defined. Here, as everywhere on the Alaskan coast, the traveler will at once observe the extreme caution with which the Innuit moves and acts as soon as he finds himself among people of another tribe. In their own country they always endeavor to pass the night at some village, but as soon as they enter foreign or even debatable territory, the camp is pitched far away from the habitation of man, even when they are escorting a white man. On this terminal line of Innuit population, the feeling amounts to abject fear. Money will not tempt the Chugatch to advance into the Thlinket country.

An argument in favor of my theory concerning the more recent period at which the Innuits spread over the Alaska coast may perhaps be found in the existence of a branch of this tribe on the Aleutian islands. I fully agree with Mr. Dall that the theory of an Asiatic influx of population over the Aleutian chain of islands is entirely untenable, and that they were peopled from the east, but I do not think that this migration took place before the invention of the kaiak. Timber evidently never existed on these islands; the only equivalent being the drift wood collected along the beaches and promontories, but this kind of material, water-logged and sodden, was entirely unfit for the manufacture of wooden canoes, or even for the construction of rafts, by which means Mr. Dall supposes the early Aleuts advanced from island to island. The frequency of gales, the violence of currents and the width of channels between these islands would also prevent the use of rafts as means of transportation and traffic. The assumption that the earliest inhabitants of the Aleutian islands were without a kaiak or boat of some kind, is based upon researches in the shell heaps of abandoned village sites on those islands; but a kaiak with a whalebone or even a wooden frame without its modern ornaments of ivory and bone, contained no material that would withstand decay and final absorption. The skin covering when worn out and unfit for use as such, was, no doubt, then as now, cut up into straps and patches, or served as food in time of famine, while the frame could be utilized in many ways that would leave no trace behind. The mere absence from the lower strata of shell heaps of anything pointing to the existence of the kaiak, can scarcely be considered as proof conclusive of its non-existence. My personal observations have led me to believe that the remains of former villages and dwellings found on the Aleutian islands and on the continental coast of Alaska, are not of the antiquity ascribed to them. Wherever I had the opportunity to observe such localities at long intervals of time, I was astonished at the rapidity with which nature extinguished the traces of man by a growth of sphagnum and other vegetation, giving to the site of the village abandoned but a few years, every appearance of great antiquity.

The absence of stone and bone implements of more delicate construction from the lower strata of the shell heaps can easily be attributed to the same cause that explains the absence of iron implements from the upper layers that must have accumulated within historic times. Such articles were the product of much labor, and consequently too precious to be lost. At every successive removal from one dwelling place to another all such products of their ingenuity were carefully collected and removed by the ancient Aleuts, just as it is done now with regard to iron by the natives of the present day.

On these treeless isles the removal from one hunting or fishing ground to another of a few families or a community, always involved the transportation of every log or plank and every particle of wood to be found about the place. As an instance of this kind, I may point to the removal of the people of Makushin, on Oonalashka island which took place in the early part of the year 1879. In the summer of 1880 I visited the spot from which the people had removed, and found the outlines of every house indicated by a slight depression in the ground and enclosed by low ridges of earth covered already with a dense growth of sphagnum and grasses. Every piece of wood about the whole settlement had disappeared simultaneously with the people, and I have no doubt that an explorer unacquainted with the circumstances could dig up these remains without finding a scrap of iron, or anything indicating their recent occupation by at least semi-civilized people. Another example of this kind, and even more forcible in total absorption of all signs of recent occupation, can be found on the island of Atkha at the site of the former settlement of Korovinsky, the people of which removed to Nazan on the other side of the island, less than fifteen years ago.

In the settlements remote from the trading centers the people of Innuit stock live to-day as they did probably centuries ago, in a manner not at all inconsistent with the remains found in the lower strata of shell heaps. Even the presence of stone and bone arrow and spear heads is no true indication of age, as they are manufactured at the present day, as I had an opportunity to witness frequently during my travels in remote regions.

The time required for the formation of a so-called layer of "kitchen refuse" found under the sites of Aleutian or Innuit dwellings, I am also inclined to think less than indicated by Mr. Dall's calculations. Anybody who has watched a healthy Innuit family in the process of making a meal on the luscious echinus or sea urchin, would naturally imagine that in the course of a month they might pile up a great quantity of spinous débris. Both hands are kept busy conveying the sea fruit to the capacious mouth; with a skillful combined action of teeth and tongue, the shell is cracked, the rich contents extracted, and the former falls rattling to the ground in a continuous shower of fragments until the meal is concluded. A family of three or four adults, and perhaps an equal number of children, will leave behind them a shell monument of their voracity a foot or eighteen inches in height after a single meal. In localities in Prince William sound I had an opportunity to examine the camp sites of sea-otter hunters on the coast contiguous to their hunting grounds. Here they live almost exclusively upon echinus, clams and mussels, which are consumed raw in order to avoid building fires and making smoke, and thereby driving the sensitive sea otter from the vicinity. The heaps of refuse created under such circumstances during a single season were truly astonishing in size. They will surely mislead the ingenious calculator of the antiquities of shell heaps a thousand years hence.

On the coast of Cook's inlet I have observed other instances of the rapid transformation of dwelling sites.

In the year 1869 I erected a substantial log house in the vicinity of the village of Chkituk. I visited the spot last summer and discovered nothing but faint lines of the foundation of my house indicated by low ridges overgrown with mosses and grasses, and two young spruce trees growing up from the spot where my fireplace had been located. In the same locality, at the mouth of the Kaknu or Kenai river, the remains of the first log building erected there by the Russians in 1789, can now be seen protruding from the almost perpendicular river bank fifteen or twenty feet under the present surface.

As an instance of the rapidity with which the tides of this region will change outlines of coast and other land marks, I may cite an observation made by me during my stay on Nuchek island last summer. At a short distance from the settlement there was a cave in a rocky cliff situated about three or four feet above high water mark. I visited the place frequently, as it afforded a view over the approaches to the harbor. About the middle of June an eclipse of the moon occurred when it was full or nearly so, causing tidal commotion of unusual extent and violence. When I visited my cave on the day following the eclipse, I found it almost filled with shingles and débris. This cave was situated at about the same height above the water as the cave of Amaknak, from which Mr. Dall extracted such voluminous information as to the antiquity of strata of refuse found therein. I cite these instances only for the purpose of showing that it is not safe to ascribe great age to any and all accumulations of débris found on the coast of Alaska, and also as a support for my theory of a general Innuit migration along the coast at a comparatively recent period, subsequent to the invention of the kaiak or a similar structure.

The lines of demarkation between the Innuits and Thlinkets in the St. Elias Alpine region are very clearly drawn, and we can account for the presence of the former with the very customs and habits characterizing their kindred in the north and west among entirely different surroundings only by a migration southward after these habits were formed, and thus far I have been able to obtain no authentic information of any real traces of Innuit occupation beyond the point indicated.

The existence of man on the Aleutian islands and the coast of Alaska prior to the arrival of the tribes, we know is at best problematical. Traditions pointing in that direction are by no means wanting among the Aleuts, but our only authority for their existence is Veniaminof. The fable of supernatural beings dwelling in the interior mountain fastnesses of the islands related by Mr. Dall is based upon a failure to recognize a common Russian word. The " Vaygali " or " Vaygli " referred to by that gentleman were fugitives or outcasts who fled from the villages on account of crimes committed, and led a brief and wretched existence among the barren hills. The Russian word " Vaglai " means simply " fugitives."

From a Shaman of the Chilkhaak tribe, who boasted of his pure Thlinket extraction, I learned that a tradition exists among his people that in times past their ancestors held all the territory to the westward clear to the shores of " another big sea," but that the Innuits came from the north, as he expressed it, like " herrings "—each in his own kaiak. The sea was covered with men, while women and children trudged along the shore. There was much fighting and a final retreat of the Thlinkets, but they would one day recover their own.

One unsupported tradition of this kind, of course amounts to nothing. I give it here only for what it is worth. One thing, however, has become clear to my mind during last summer. Unless unforseen events interfere, the southern limit of Innuit tribes on the Alaskan coast will not be the same as it is now a century hence. Wherever a mixture with the Kolash has taken place, the latter rapidly gain the upper hand, and in a comparatively brief time the Innuit element is completely absorbed.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Perhaps the Secretary of the Treasury desires to aid the friends of repeal by a *reductio ad absurdum* of some of the provisions of our tariff law. By a ruling of his department made some time last month, all books coming through the foreign mail for private persons are charged a duty of 25 p. c. if of the value of $1.00 and over. To collect this amount the book must be sent from the post-office to the custom house, then from the custom house to the appraiser's store, where a valuation is put on it. It is then returned to the custom house, from which a notice is issued to the addressee. All this requires the filling of blanks and the obtaining of the signatures of eleven or twelve officials, by which the government is richer frequently by 25 or 50 cents. A more disreputable law it would be difficult to imagine. Only the poor student is taxed in his efforts to elevate himself above the general dead level. The aspirations of the seeker for knowledge have, it seems, to be paid for, although by following them the student usually resigns the opportunity of financial success in life. We know very well that it is not the producers of books in this country that desire protection. The sale of their wares abroad depends on their merits, and the production is not to be stimulated by a protective duty. It is the publisher who, like another noted character, sits

"Hard by the tree of knowledge,"

to whom we are indebted for this beautiful piece of legislation. Of course we may be wrong. It may be clear to greater minds than ours, that by taxing the books of Gegenbaur, Claude Bernard and Owen, we develop our native genius, and cause little *fac-similes* of these gentlemen to come immediately into being. By increasing the pressure we might squeeze out Meissoniers and Whistlers. Tighten the prohibition, and hear the land resound with the harmonies and melodies of a crop of Verdis, Wagners and Sullivans. But possibly the framers of this law were moved by far different aims. They wish to prevent the influx of corrupting scientific literature into the country. Haeckel, Darwin and such men should not be permitted to instill poison into the minds of our young men and women. Or if people will have it, like poison, they must pay for it.

No doubt the tax on foreign animals for zoölogical gardens was also intended to prevent the spread of immorality—animals imported for breeding purposes being free. The tax on natural history collections from foreign countries is without exception, because the animals being in bottles, cannot breed.

We are not opposed to a protective tariff under certain circumstances, but we are opposed to a tax on the intellectual development of our people. It is worse than blood-money, it is soul-money. It is a discrimination against the cultivators of thought and mind, and intelligent members of our National Legislature must surely, ere long, see it in this light.

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RECENT LITERATURE.

KNOWLEDGE.[1]—We hail with pleasure the advent of a new scientific periodical, devoted not to any one branch of scientific inquiry, but to all, and giving promise, from the character of the issues of the first four months of this year, to prove not only a valuable but also a highly interesting addition to the periodical literature of the English language.

This weekly magazine, ably edited by the well-known astronomer and lecturer, Richard A. Proctor, seconded by numerous scientific men whose names are guarantees of an excellent quality of work, is conceived upon a somewhat different plan to the now well-established *Nature*, to which it bids fair to prove a formidable rival. While *Nature* is principally a scientific newspaper, giving reviews of recent works and notices of current scientific events, *Knowledge* is chiefly occupied with lively short articles upon the topics which at the moment possess most interest. Among these we notice a series of papers in which the editor gives a common-sense explanation of the purposes of the Great Pyramid, refuting utterly the wild fancies indulged in by Piazzi Smith and others, and showing that the passages in the vast pile were most probably formed for the orientation of the pyramid, and used afterwards for astronomical or rather astrological observations during and in connection with the life of Cheops, the king whose sepulchre it finally became. Among other contributors we notice the names of Professor Grant Allen, who in his usual happy style gives us a "Beetle's view of life," and also a series of papers upon "Our Ancestors," the Euskarian or Silure, the Celt, the Teuton; of Dr. Ball, astronomer royal for Ireland; of Dr. W. B. Carpenter, Dr. Andrew Wilson and H. J. Slack, all of them writers whose power of description is equal to their acknowledged acquaintance with the subjects they treat upon. The old prejudice against the popularization of science is rapidly passing away; the leaders in scientific thought, the Huxleys, the Darwins, and their friendly rivals, find time to tell the people some of what they know, with

[1] *Knowledge*, an illustrated Magazine of Science, plainly worded—exactly described. Conducted by RICHARD A. PROCTOR. Wyman & Sons, Gt. Queen St., W. C. London, England.

the full belief that what is good for them is good for all. It is only the little minds, the confirmed scarabeists (to make use of Dr. O. W. Holmes's amusing example), the men who cannot rise above the level of a list of species or an account of the metamorphoses of a monad, that affect to believe that science is a sacred thing, that should, like the mysteries of the Egyptians, be the sole property of a few priests.

Let all, then, who wish for information combined with the entertainment of the highest faculties of the brain, promptly subscribe to *Knowledge*.

ANIMAL ANALYSIS.[1]—This work is a series of blanks to be filled by the student, like those which have been introduced into the study of botany with such success. They are essentially necessary to a proper study of zoölogy in schools, and we are glad to see so good a beginning made in supplying the need. We hope, however, that some changes will be made in them as presented in this first edition. The Batrachia and tortoises are omitted—a serious error, since these animals, especially the former, are the most available and most easily analyzed of all the Vertebrata. In the snakes, examination of the teeth is not required—a great omission. Finally the order to which a species belongs is not required, thus losing one of the principal points of diagnosis in the Vertebrata.

BIOLOGISCHES CENTRALBLATT.[2]—It is not often that a new scientific journal attempts more than to represent either some well acknowledged department, or more frequently some specialty, since every year brings us new specialties clamoring for recognition. The fortnightly publication, which we wish to notice here, is distinctly general in its scope and aim. The first volume, now completed, shows that this periodical fills an unoccupied and important field with marked ability and success. This *Centralblatt*, one of many, attempts chiefly to give abstracts of the *most valuable and important* researches, as far as possible those of general interest; special prominence is given to summaries of the results obtained concerning any subject, our knowledge of which has been increased by several separate investigations. The sciences included are botany, zoölogy, physiology, scientific psychology and a little pathology. The selection of matter has thus far been extremely judicious, so that we have an excellent presentation of the greater part of the most noteworthy current biological discoveries. Indeed we think the *Biologisches Centralblatt* may be justly described as indispensable to the general student. The

[1] *Animal Analysis for use in Schools and Colleges*, especially adapted to accompany Jordan's Manual of Vertebrates. By B. W. EVERMANN. Jansen, McClurg & Co., Chicago.

[2] *Biologisches Centralblatt.* Unter mitwirkung von Dr. M. REES, und Dr. E. SELENKA, herausgegeben von J. ROSENTHAL. Vol. I, 8vo, Erlangen. Edouard Besold, 1881–82.

appearance of the journal in point of mechanical execution is excellent, though the substitution of simple *T* for *Th* in all cases, being unusual, seems at first amusing.

We will only add a brief mention of some of the general summaries or essays, to indicate the range of subjects: *Berthold*, Fertilization of Algæ; *Klebs*, Movement of vegetable Protoplasm; *Sprengel*, Orthonectidæ; *Wiedersheim*, North American Palæontology; *Bischoff*, Weight of the human Brain; *Kraepelin*, Duration of simple Psychic Processes; *Exner*, Functioning of the facetted Eye. The list might be greatly lengthened, but we believe that the titles quoted suffice to demonstrate the wide scope embraced. Several of the original articles are meritorious contributions, and the numerous abstracts make up a good introduction to the best current biological literature. We hope that American naturalists will support this valuable enterprise by their subscriptions. The price is very moderate, fifteen marks for a yearly volume of 800 pages.—*C. S. M.*

PAGENSTECHER'S GENERAL ZOOLOGY, 4TH PART.[1]—The fourth part of this voluminous work relates to the excretory organs of animals, thus ending the consideration of the organs of vegetative life; and also to the external covering or integument of the body of animals. We have to make the same criticism regarding the cuts as in our former notice, the illustrations being too diminutive and not clearly drawn and engraved. The lack of subdivision into sections is only partly made up by a detailed and excellent table of contents. It is a useful work, valuable for reference, and the author is careful to cite his authorities.

BROOKS' INVERTEBRATE ZOOLOGY.[2]—It is with great pleasure that we have examined this work, and in a hasty manner read portions of it. The scope of the work is best indicated by the following extract from the preface: "This is a hand-book, not a text-book, and the entire absence of generalization and comparison is not due to indifference to the generalizations of modern philosophical morphology, but rather to a wish to aid beginners to study them." Following out this idea, Dr. Brooks, in a very thorough manner, takes up in succession the Amœba, Vorticella, Paramœcium, Grantia, Eucope, Mnemopsis, starfish, sea urchin, earth-worm, leech, crab, lobster, Cyclops, grasshopper, Lamellibranch and squid. The method of treatment is modeled somewhat after that in the well-known and much used "Biology" of Huxley and Martin, and we think will be found to be a great improvement upon it. With each form we have detailed accounts

[1] *Allgemeine Zoologie oder Grundgesetze des thierischen Baus und Lebens.* Von H. ALEXANDER PAGENSTECHER. Vierter Theil. Mit 414 holzschnitten. Berlin, Verlag von Paul Parey, 1881. Preis 21 mark. 8vo, pp. 959.

[2] *Hand-book of Invertebrate Zoology for Laboratories and sea-side Work.* By W. K. BROOKS, Ph.D., associate in biology and director of the Chesapeake Zoological Laboratory of the Johns Hopkins University. Boston, S. E. Cassino, 1882. 8vo, pp. VIII + 392. $3.

of the various steps to be taken in order to acquire an autoptic and thorough knowledge of its structure and, in all but one or two forms, of its development as well. These directions for study are almost invariably full, clear and explicit, while the numerous outline figures (of which there are 202) give one an idea of what to look for, and at the same time form a useful basis for comparative study. These figures are for the most part clear and easily understood, and possess one very pleasing feature, they are original and have a freshness not always found in books of like character. The book is well printed, and is a credit to its publisher; the typographical errors are few, as are those of the text; to one or two of the illustrations and a few of the statements of the text, we would not agree, though the points in question are of minor importance. On the whole we regard the work as by far the best text-book for laboratory work.—*J. S. Kingsley.*

HARTMAN ON PARTULA.[1]—The genus *Partula* was founded by Ferussac in 1819. The species of this genus have been referred to various genera by authors, as to *Helix*, by Müller; *Ottis*, Hump., 1797; *Awris*, Klein, 1753, to which they were referred by Chemnitz; *Bulimus*, Scopoli, 1777, this generic name being employed for certain of the species by Bruguiere; Volute (*Voluta* Linn., 1758), by Dillwyn; *Partulus*, Beck, 1837; and *Partula* by Pfeiffer, W. H. Pease, O. Semper, W. G. Binney, and our author. In the first of these brochures the author gives a catalogue of the known species, with authorities for specific nomenclature, and indicates also the remarkable synonomy of the genus. He divides all the forms into the *auriform* and *bulimoid* divisions, each of which seem to be sufficiently well marked. The major part of the work is devoted to the erection of sub-genera, having more or less claim to consideration. The characters of these several sub-genera are succinctly stated, accompanied by a figure of the species used as its type. It is a matter of regret that the author has adopted for a sub-generic nomenclature so many mythologic names, originally applied to Roman deities of more or less note. In this, however, he follows the example of the illustrious founder of the genus, and in view of the great beauty of the forms he studied may well be pardoned. However, it must be admitted that the use of names embodying, in some sense at least, the sub-generic characters would much aid the student. The number of sub-genera erected is fourteen, among which the species are very unequally distributed.

The second of these papers is one of the most valuable contributions to the literature of Partula yet made, inasmuch as in it the author has incorporated numerous full notes on synonomy

[1] A Catalogue of the Genus Partula, Ferussac. By W. D. Hartman, M. D. Printed for the author by F. S. Hickman, West Chester, Pa., 1881. Also,

Observations on the species of the Genus Partula, Ferussac, with a Bibliographic Catalogue. By William Dell Hartman, M. D. Bull. Mus. Comp. Zoöl. Vol. IX. No. v. pp. 171–196. With two maps, Dec. 1881.

and geographical distribution. The facts pertaining to the latter phase are further illustrated by two maps, showing the distribution of the species by islands, and in individual islands. They are, the author states, the work of Mr. Andrew Garrett, a resident of Huaheine, from whom we are promised further descriptions of species based upon the MSS. of the late W. H. Pease, and his own copious collections. From the facts brought out by Dr. Hartman it appears that Partula illustrates the influence of environment as do but few other genera of land shells. It is true that some of the species are said to be remarkably uniform in specific character and somewhat widely distributed over the islands in which they do occur, but the instances of variation, when away from the centers of distribution, appear to be much more numerous. To this fact must be attributed some of the vast quantity of synonomy indicated. Another peculiar feature is the common occurrence of hybrids amongst certain forms "*the result of the union of proximate species.*" Dr. Hartman states that hybridization even occurs between the arboreal and ground species, and here is another fruitful source for re-description, as in Achatinella, and we might add Goniobasis as found in the southern United States, there is a marked mutation of species consequent on change of food and station. "It often happens that the gravid females are washed by heavy rains from a favored position to drier levels, where after a few generations the progeny become depauperated, and so stunted in size as to be mistaken for distinct species." In this connection it might be proper to call attention to certain helices of the United States, *e.g. Zonites friabilis*, *Z. caducus*, *Z. capnodes*, *Z fuliginosus*, and *Z. lævigatus*, which, without doing violence to any racial principle, may be perhaps considered extreme geographical varieties. A fact calling for deep regret in connection with American conchology is the utter neglect of authors thus far, in studying the habits, the food, and the distribution of certain forms. We are convinced that a vast deal of work remains to be done in this direction; a work which Hartman has performed for Partula; a work which will sensibly limit the number of accepted species. Especially will this be true of the two great fresh-water families of our country, Unionidæ and Strepomatidæ. In the case of Partula, Dr. Hartman finds the lingual dentition to vary within rather wide limits in the same species, a fact which apparently indicates that the basis for final and ideal classification *does not lie therein.* It is to be hoped that his unrivaled facilities will induce this author to further elaborate the data bearing on the evolution of forms, of which he now gives us vague but suggestive hints. In summing up we should not fail to remark that of one hundred and seventy-four species enumerated, all go into synonomy save seventy-three, or over fifty per cent. The genus, by the way, is declared to be confined to the Pacific islands. "They have never been found at the Sandwich group, or New Caledonia; its western limit is New Guinea, and they are not found in New Zealand or Australia. North of the equator, they are found at the Pelew islands, and as far north as Tuam in the Ladrone islands. The New Hebrides and Solomon's island have afforded a few species," while the *metropolis* is situated in the Polynesian islands. Woodward, who makes, with others, the genus a section under Bulimus, gives its distribution as "Asiatic, Australian, and Pacific islands, South America."—*R. Ellsworth Call.*

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GENERAL NOTES.

BOTANY.[1]

AN ACTIVE DESMID.—I have been much interested lately in observing a species of desmid, *Cosmarium botrytis.* When in bright sunlight it has a slow rotary movement, turning successively from right to left and from left to right, with now and then (if my eyes did not deceive me) what might be called a spasmodic jerk. The play of the protoplasm within the plant-body is exceeding rapid, resembling, in the words of some writers, "the swarming of bees." There seems to be three centers of movements among the granules in each half of the desmid, but as to this I am not quite positive.

I have never seen the revolving motion of the plant excepting when in the full glare of the sun, even when it gave evidence of being alive by the movement of its protoplasm. I call attention to this because in the few books of reference accessible to me, I find no mention of a *revolving* desmid.—*Eloise Butler, Minneapolis, Minn.*

THE COFFEE-LEAF FUNGUS ONE OF THE UREDINEÆ.—In an interesting paper in the January number of the *Quarterly Journal of Microscopical Science*, H. M. Ward describes and figures all the known stages of the coffee-leaf fungus *(Hemileia vastairix)* of Ceylon, and demonstrates its affinities with the ordinary Uredineæ, Puccinia, Uromyces, Melampsora, etc. When Berkeley described it in 1869, he considered it to be " with difficulty referable to any recognized section of fungi," and regarded it as intermediate between the old group Mucidines and the Uredineæ. Abbay and Morris subsequently came to the conclusion that the bodies considered to be spores by Berkeley, were sporangia, thus entirely unsettling for a time all previous notions as to the relationship of the parasite.

The gross anatomy of the coffee-leaf fungus is thus described by Dyer (*Qr. Jour. Mic. Sci.*, April, 1880): " To the naked eye

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

the first appearance of the Hemileia is indicated by a slight transparency or palish discoloration, easily noticed when the leaf is held up to the light. These transparent spots indicate the points where infection of the leaf has begun. As the spots becomes larger and older, it assumes a faint yellow color; ultimately on the under side of the leaf, it becomes covered with a bright yellow dust, and this later on changes to a bright orange."

Ward studied the development of the parasitic hyphæ in these spots, and found that after ramifying between the leaf-cells, from which they draw nourishment by means of haustoria (Fig. 1), they develop in great numbers in the lacunæ beneath the stomata, through which they finally protrude. The apex of each hypha expands into an ovoid sac, which eventually acquiring a thickened, roughened wall, becomes a spore (see Fig. 2), the uredospore, according to Ward. Later the same mycelium gives rise in a very similar way to smooth napiform bodies—the teleutospores (Fig. 3).

FIG. 1.—Portion of a hypha with haustoria penetrating leaf-cells.

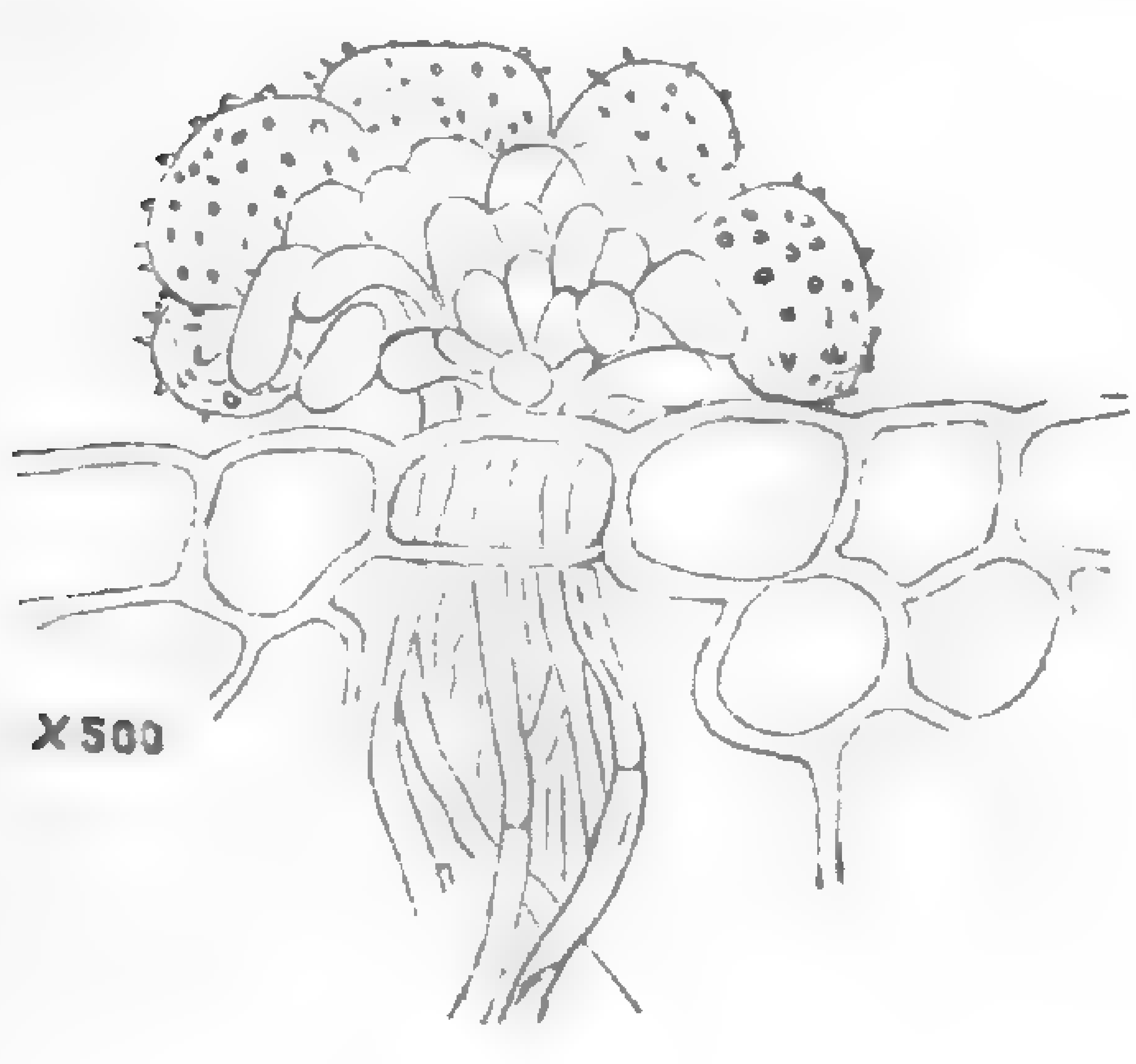


Fig. 2.

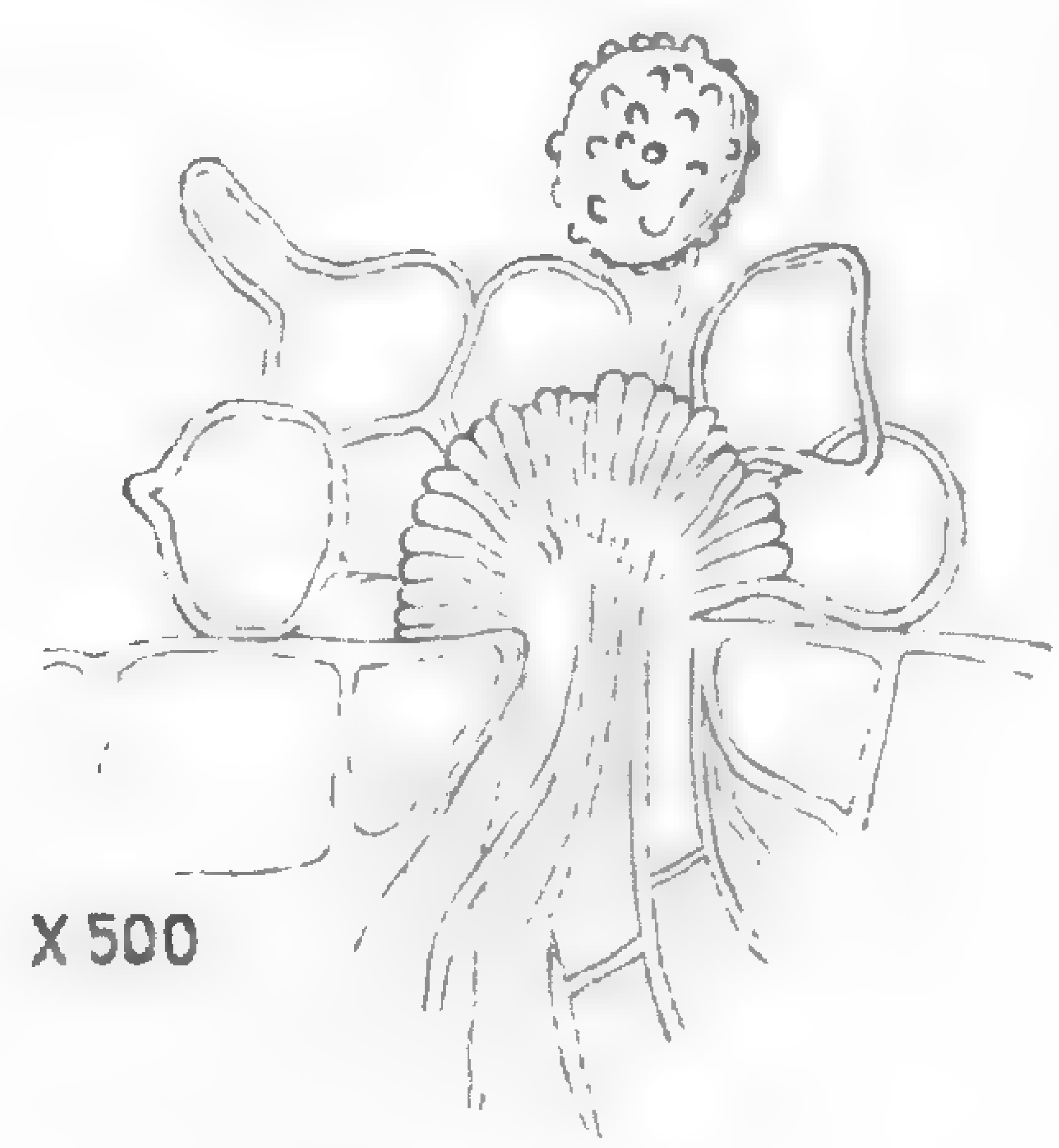


Fig. 3.

FIG. 2.—Vertical section of leaf through a cluster of uredospores. FIG. 3.—Vertical section of a leaf through a cluster of teleutospores; one uredospore still remains.

The germination of the uredospore (Fig. 4 *a*) agrees with that of the uredospore of ordinary Uredineæ, one or more hyphæ being sent out from it, which eventually penetrate the leaf. This was repeatedly seen in the many excellent cultures made by Mr. Ward. The teleutospore germinates very readily, it being the rule for it to do so while yet attached to its hypha. A tube (the *promycelium*) is sent out (Fig. 4 *b*) which becomes septate, and eventually bears sporidia (erroneously called *conidia* by Mr. Ward). In this the resemblance to the corresponding process in Puccinia, Uromyces, etc., is so great as to leave little doubt as to the identity of the teleutospores of Hemileia and those of the Uredineæ. It is

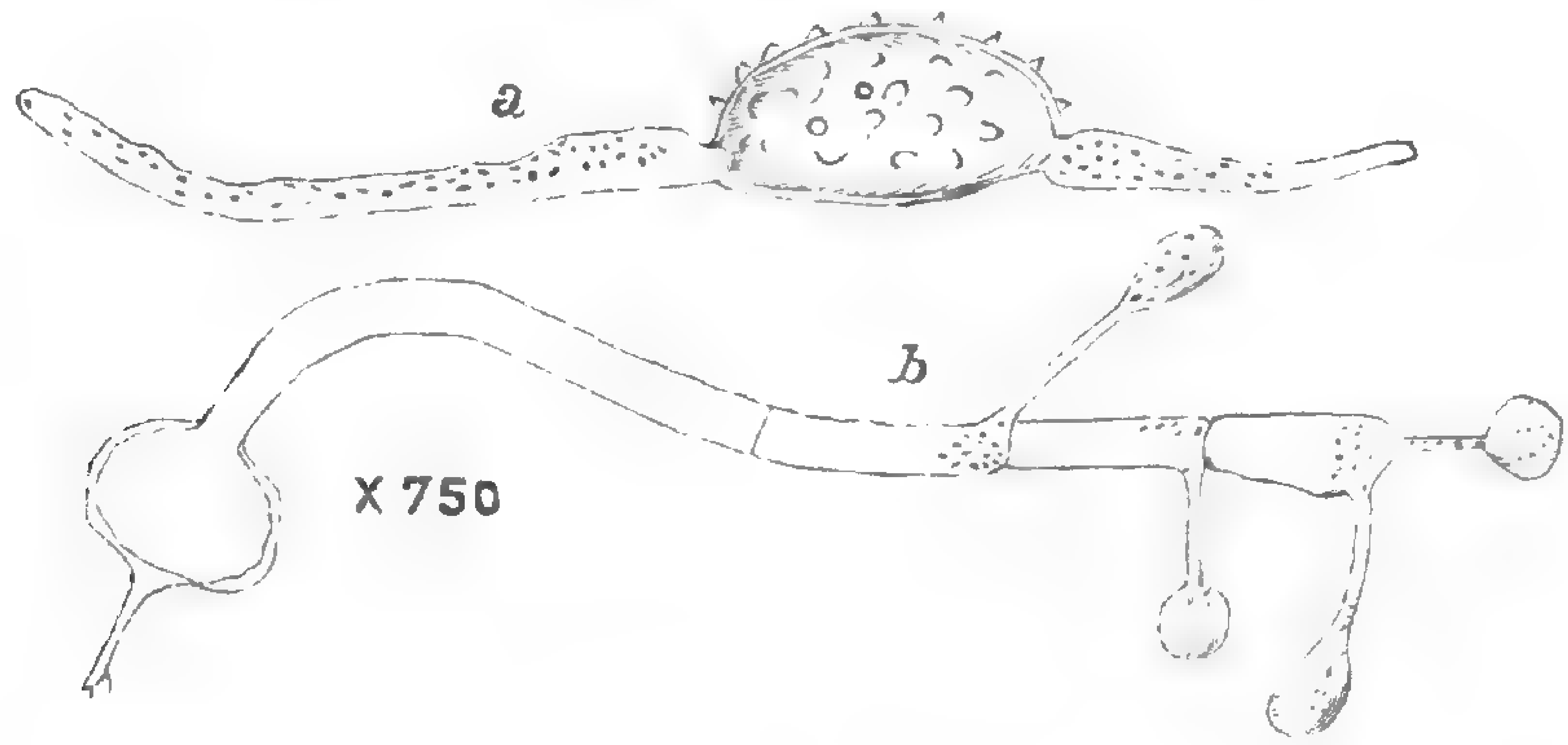


FIG. 4.—*a*, germinating uredospore; *b*, germinating teleutospore bearing four sporidia.

a significant fact that although the sporidia were readily germinated, they soon shriveled up and died, and this took place even when the culture was made upon living coffee leaves. The probable explanation of this is to be sought in the heterœcism of the Uredineæ; it will be well, therefore, for those who are investigating this parasite to direct their attention to the discovery of the alternate host. May it not be possible that *Hemileia vastatrix* has but recently fixed itself upon the coffee-plant, and that the latter is capable of serving for its host in only two of the stages of the parasites? Indeed, may not the query be entertained here whether the heterœcism of the Uredineæ, so particularly noticeable in those species which affect the grasses, is not simply the sort of transition stage in the change of habitat of the parasite from one host to another?—*C. E. B.*

POPULARIZING CRYPTOGAMIC BOTANY.—One of the hopeful signs in the botanical world, so far as we in this country are concerned, is that some of our masters in certain lines of research are writing in simple English about the lower plants. Dr. Halsted's paper, "Fungi Injurious to Vegetation," read before the Conn. Board of Agriculture, and published in the last report of the Board, is a model worthy of being followed by many others. In this paper spurred rye, the potato rot, the wheat rust, the corn smut, the onion smut, the black knot, the apple-leaf fungus, the peach curl fungus, the American grape mildew, the lettuce mildew, and the raspberry fungus, are discussed in a very instructive and entertaining way. It is astonishing how much can be said—and accurately said too—in simple English, if the subject matter be well understood by the writer or speaker. A second admirable example of the treatment of a subject so recondite as to be generally avoided even in botanical classes, is found in Dr. Rothrock's "Captive Plants," which appeared in *Our Continent*, of April 5. The substance of Schwendener's theory as to the nature of lichens is clearly set forth in a manner which leaves nothing to be desired. It is interesting to note that the article is written from the standpoint of Schwendener's view, that is, that a lichen is primarily an ascomycetous fungus parasitic upon certain algæ, the latter being the green bodies known as gonidia. Seven excellent figures accompany the article.

ABNORMAL SPATHES OF SYMPLOCARPUS.—The past spring I have been on the lookout for abnormal growths in *Symplocarpus fœtidus* Salisb., and herewith transmit the result, trusting that it may lead to further investigation.

I found on examining several hundred specimens, five containing one spathe within another. They were, to all outward appearance, in a normal condition, but contained an inner spathe having a short peduncle (see Figs. 1 and 2). In a cluster of three spathes, one was single, one contained a single perfect inner spathe with a spadix, while the other contained a double inner spathe with one spadix. The double spathe faced toward the rear of the outer spathe. In the single spathes I found specimens facing to the front, to the rear, and to one side.

FIG. 1.—Double spathe, laid open to show inner spathe and spadix.

FIG. 2.—Vertical section of a spathe containing an inner spathe with spadix.

I also found three spathes containing abortive spadices. In one case the spathe was three inches in height and contained a minute spadix one-eighth of an inch high upon a short peduncle. This small spadix was yellowish white in color, hollow, and of a spongy consistence. It contained minute undeveloped flowers (see Fig. 3).

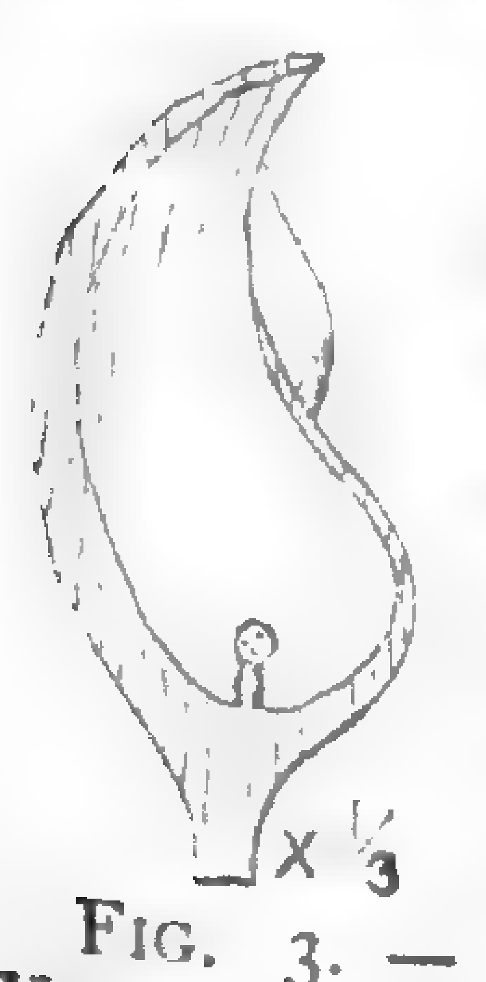


FIG. 3.—Vertical section of spathe containing abortive spadix.

Now comes the question as to what causes the malformation in one case and the abortion in the other. Thomé says: "As poverty of soil leads to abortion, so an unusual increase in the development of the axial or foliar organs is the result of too powerful nutrition." This, however, is not a satisfactory explanation. There could not have been enough difference in the plant food near the roots of these plants (often crowded together) to produce these differences. Nearly all the specimens were found growing upon rich loam or muck which had never been under cultivation.—*Chas. S. Plumb, Amherst, Mass.*

Ellis' North American Fungi.—When, in 1878, the first century of "North American Fungi," by J. B. Ellis, appeared with the timidly expressed hope of its author that the work might be continued until a thousand species had been distributed, but few of the subscribers dared hope for a speedy completion of the first decade of centuries, and doubtless most looked for an early suspension of the work. So many attempts have been made to furnish sets of fungi, mosses, lichens, algæ, etc., etc., which have been abandoned long before completion, that subscribers to such sets scarcely expect any other conclusion. It may be that Mr. Ellis will weary of the good work he is doing so well, and thus add his "North American Fungi" to the long list of incompleted exsiccati, but present indications are hopefully to the contrary. Already we have nine centuries, although scarcely more than four and a half years have elapsed since the beginning of the work. The publication of a century every half year involves an amount of labor and a degree of patience and perseverance which only those who have attempted to make up sets of plants can fully appreciate. The two centuries (VIII and IX) which came to hand the middle of April, fully maintain the previously high reputation of the series. Like their predecessors, they include representatives of most of the orders of the fungi, the Hymenomycetes and Pyrenomycetes, however, predominating. No. 775 is *Diatrype tremellophora* Ell., which was critically described in the March Naturalist of the present year, under the caption of *Diatrype disciformis* Fr. Excellent specimens of this curious species are given showing every stage. We shall look with interest for the tenth century, and hope in due time to see Mr. Ellis bravely undertake the second thousand.

ZOÖLOGY.

Preliminary Classification of the Brain of Crustacea.—The following provisional grouping of the brain of Crustacea appears to be justified by known facts, although excepting the brains of Decapoda and Limulus, no special histological work has been accomplished.

The terms archi-cerebrum and syn-cerebrum have been proposed by Professor Lankester, the first to designate the simple worm-like brain of Apus, and the second to designate the composite brain of the Decapoda, etc.

Syn-cerebrum	Decapoda. Tetradecapoda. Phyllocarida. Cladocera. Entomostraca.
Archi-cerebrum	Phyllopoda. Merostomata (Limulus). Cirripedia?

The syn-cerebrum of the Tetradecapoda, Amphipoda and Isopoda, judging by Leydig's figures[1] and our own observations on that of Idotea and Lerolis,[2] is built on a different plan from that of the Decapoda The syn-cerebrum of the Phyllocarida is somewhat like that of the Cladocera and Copepoda (Calanidæ); being essentially different from that of the majority of the Malacostracous Crustacea. The Copepodous brain is an unstable, variable organ, but on the whole belongs to a different category from the syn-cerebrum of other Neocarida.

We have, then, probably two types of archi-cerebra, and three types of syn-cerebra among existing Crustacea.—*A. S. Packard, Jr.*

THE COLORING OF ZOO-GEOGRAPHICAL MAPS.—Having had occasion to prepare a colored map to illustrate the geographical distribution of the phyllopod Crustacea of North America, for Hayden's 12th Annual Report of the U. S. Geological Survey, we would propose for the consideration of zoölogists, the following scale of colors, which we have adopted. In the colored maps already published, one by Mr. W. G. Binney on the Western Mollusks, and one by Dr. John L. LeConte to illustrate the distribution of the Coleoptera, the coloring does not at all agree. It is highly desirable that such maps should, if possible, be uniform, as much so perhaps as geological maps.

Arctic Realm.................	Very pale carmine.
Boreal (Canadian) Province....	Blue.
Eastern (Atlantic) "	Pale yellowish-green.
Antillean Region	Deep green.
Central Province..............	Pale (Vandyke) brown.
Western (Pacific) Province.....	Sepia, dark brown.
Central American Region......	Yellow ochre.
Annual Isothermals...........	A deep red heavy line.

This combination of colors seems appropriate to the nature of these regions. The pale carmine is like ice; the blue, yellowish-green and deep green characterizes the wooded portions of the continent, and the light brown forms the treeless plains and plateaus of the West. The Alpine summits of the White mountains and Rocky mountains are concolorous with the Arctic regions, and the summits of the Alleghanies with the Boreal province.—*A. S. Packard, Jr.*

PROFESSOR E. A. BIRGE ON THE FIRST ZOEA STAGE OF PINNOTHERES OSTREUM.—In the summer of 1878 I accompanied the Johns Hopkins Laboratory to Cresfield, Md., and occupied my time with study on the development of decapod Crustacea. I was so fortunate as to obtain from the egg specimens of the first zoëa of Pinnotheres, and so unfortunate as to be unable to rear them beyond the first molting. I therefore send figures of the zoëa in

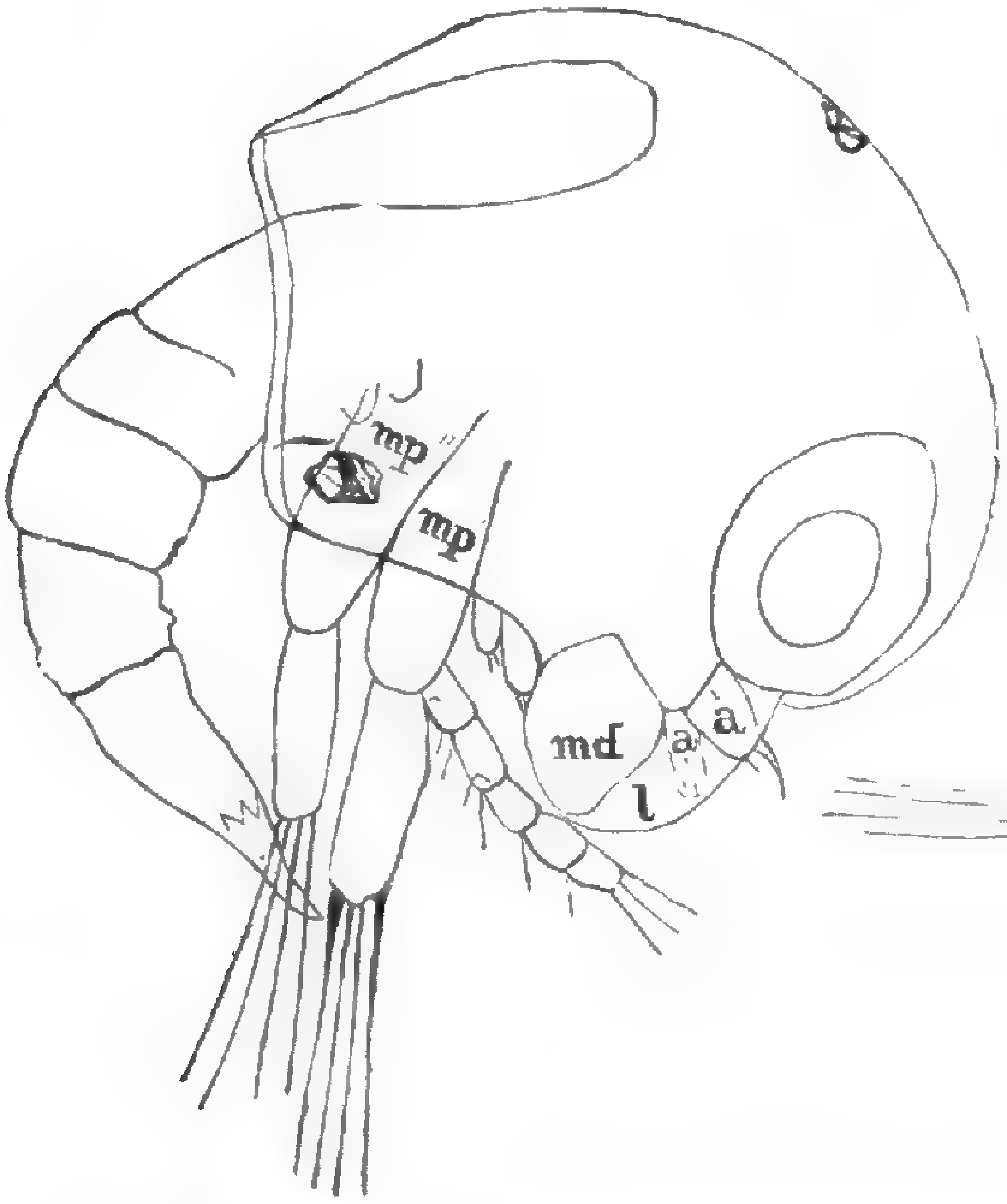
[1] Tafeln zur Vergleichenden Anatomie. Von F. Leydig. Tübingen, 1864, folio.

[2] Zoölogy for High Schools and Colleges, Figs. 255, 256. Drawn by Mr. Kingsley.

order that future observers may be able to connect the free larvæ with the proper adult form.

The female was found in an oyster with the eggs already well

1.



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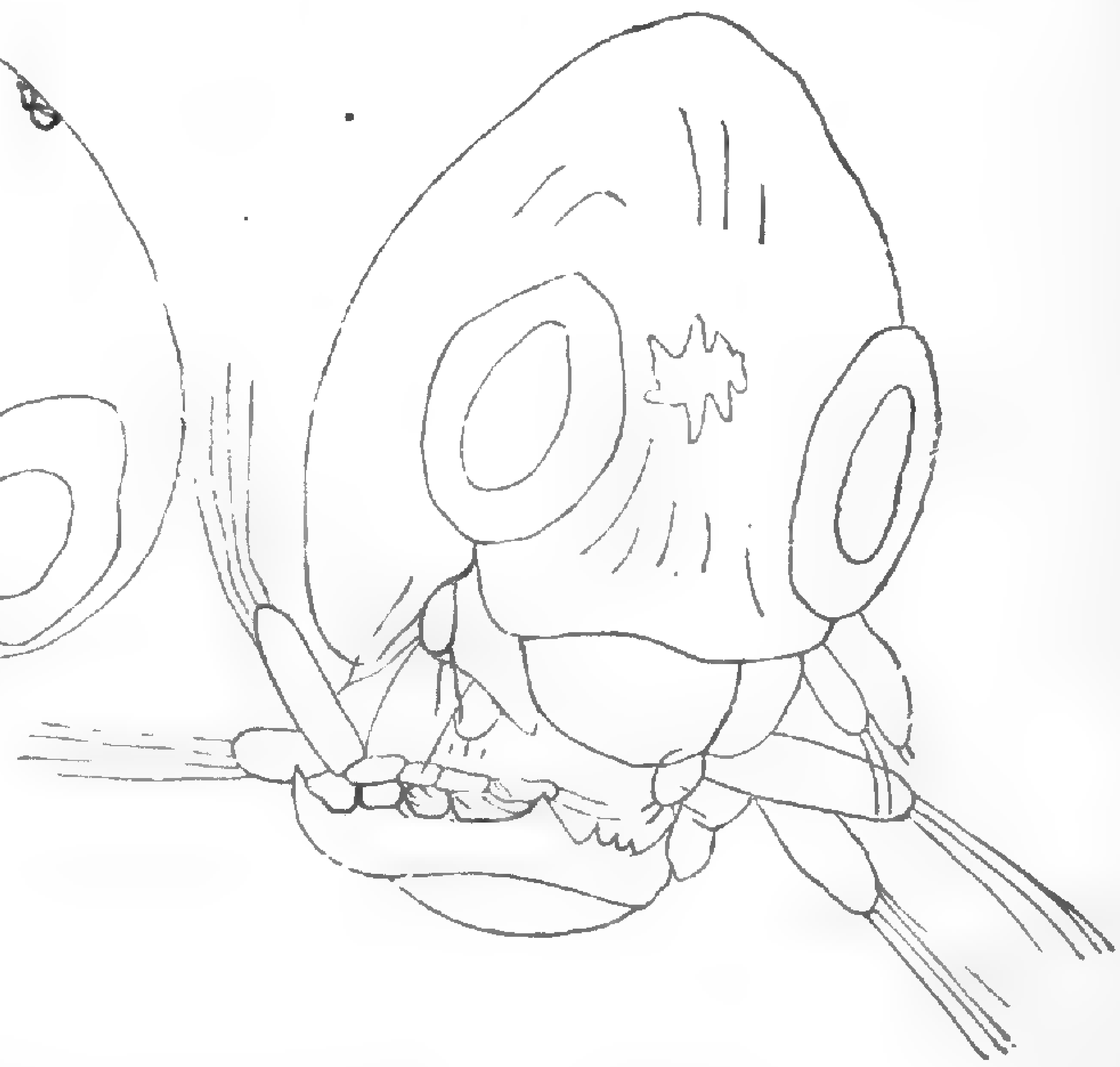


FIG. 1.—Zoea of *Pinnotheres ostreum* (Say) from side. *a′*, antennule; *a*, antenna; *l*, labrum; *md*, mandible; *mp′ mp′′*, maxillipeds. FIG. 2.—Zoëa from front.

developed. She was put into a large glass jar and given an oyster shell under which to hide, and so lived for more than two weeks. During that time her shell increased greatly in thickness and strength—a fact of which I was made aware by a sharp nip

3.

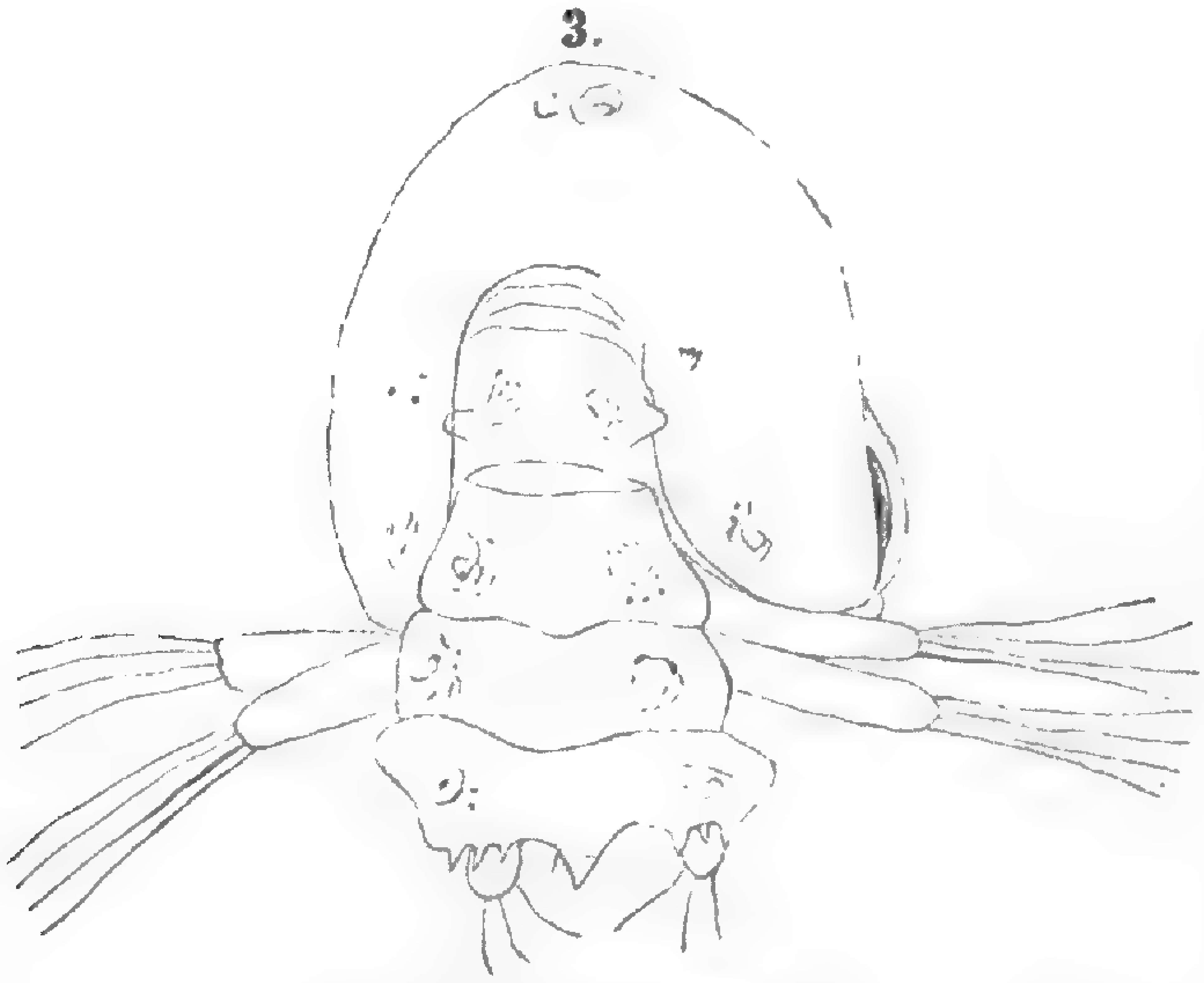


FIG. 3.—Zoëa from rear.

which she gave me one morning as I was putting fresh water into the jar. Evidently the change of environment did not injure her and she seemed well able to live indefinitely in her new quarters.

The eggs all hatched in the course of one night, throve for some days, but died before the first molting, in spite of all possible care.

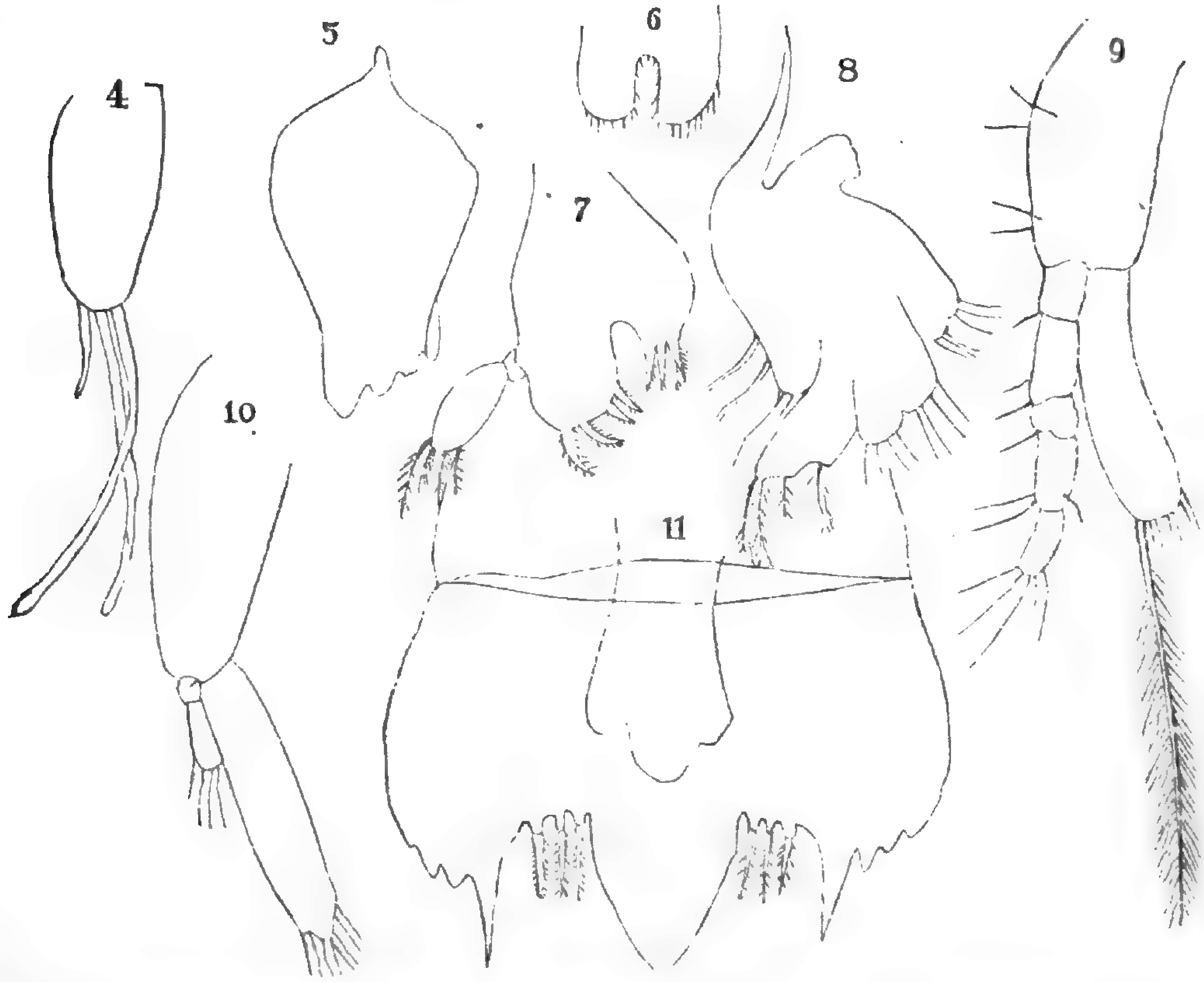


FIG. 4, antennule; 5, mandible from outside; 6, labrum; 7, 1st maxilla; 8, 2d maxilla; 9, 1st maxilliped; 10, 2d maxilliped; 11, end of abdomen.

No special description is needed for the zoëa further than to say that the total length was about 1½^{mm}. No special drawing of the rudimentary antenna was made. The cuts are all traced from camera lucida sketches.

BOPYROIDES LATREUTICOLA, A NEW SPECIES OF ISOPOD CRUSTACEAN PARASITIC ON A GULF-WEED SHRIMP.—Amongst a bottle of marine Crustaceans caught with a fine net out of Sargassum or gulf-weed, near Beaufort, N. C., by Mr. Geo. E. Woodruff, of Brooklyn, N. Y., in October, 1881, I selected eleven specimens of *Latreutes ensiferus* Stm.,[1] having a lateral thoracic protuberance, for the purpose of examining them for Bopyridæ.

The swelling out is very peculiar, being directed outward and forward in looking at the host from above; a front view of the protuberance does not exhibit the star-shaped drawing as in *Bopyrus palæmoneticola* Pack., on *Palæmonetes vulgaris* Stm., owing to the fact that in the present case the female of the para-

[1] *Latreutes ensiferus* Stimpson, Proceedings Acad. Philad., 1860, p. 27.
Hippolyte ensiferus, Milne Edwards in Histoire Naturelle de Crustacées, 1837, Vol II, p. 374.
Bulletin of the Essex Inst., Salem, Mass., 1878, Vol. x, List of North American Crustacea, sub-order Caridea, by J. S. Kingsley, p. 56, No. 16.

site is not at all pigmented. The position of the latter is exactly the same as in Bopyrus, the dorsal side being directed toward the gills of the host and the ventral side toward the swollen carapace of the same.

The examination of our parasite revealed an isopod crustacean belonging to the sub-genus Bopyroides established by Dr. Wm. Stimpson,[1] being closely allied to both the genus Bopyrus and Gyge.[2]

The female of our parasite measures $1\frac{4}{5}^{mm}$ in length and 1^{mm} across its widest diameter. It is not as flat but more of a globular shape than Bopyrus, its integument also less chitinized, the whole body therefore softer. The body is unsymmetrical in shape, similar to Bopyrus, differing also in this respect from the genus Gyge, which is unsymmetrical anteriorly only. Dorsally the segments of the pleon, or tail, are distinct, whereas in Bopyrus they are fused or connate in the central dorsal axis. In this respect it agrees with Gyge as well as in some respects concerning the form of the gills. The latter do not consist of short, thick, fleshy, transversely placed lobes, but of fleshy, roundish ridges attached within the ventral lateral extremity of the six segments of the pleon.

Seven pairs of legs (pereiopods) are developed on one side and only one pair on the opposite side, the remaining six being obsolete through parasitism. They are similar to those of *Bopyrus palæm.*, but even less distinct and not pigmented centrally. The side having but one leg is curved outward.

The marsupium or breeding cavity is bounded posteriorly by the transverse prolonged lamella of the last pereiopod, anteriorly by the cephalic piece and the lamellæ of the first pair of pereiopods, laterally on one side by the fleshy longitudinal ridge along the other developed pereiopods, which are, if I see rightly, there without lamellæ. On the opposite side, where only the first pereiopod remained, the marsupium is covered by two fleshy, sparsely pigmented lamellæ (Figs. 1 and 2 *a*, *a*), and three or four very thin and delicate broad membranes (Figs. 1 and 2 *b*). The membranes and lamellæ are evidently the prolonged margins of the thoracic segments.

The eggs measure 0.12^{mm} in diameter. There are scarcely more than sixty eggs in some marsupia, the greater part of marsupia containing but a few eggs. On account of the scarcity of material but little was done to study the eggs; they were all in the earlier stages of development, without any pigmentation and of a yellowish color.

The cephalic portion, or head, consists apparently of but one triangular fleshy piece. I was somewhat surprised to find in the

[1] See *Bopyroides acutimarginatus* Stm., in Proceed. Acad. Nat. Sciences, p. 165, Vol. xv, 1863.

[2] Emilio Cornalia and Paolo Panceri in Mem. Acad. Reale di Torino, Ser. 2, Tom. XIX, p. 85, Turin, 1861. Also Bate and Westwood, II, p. 223.

otherwise very degenerate female a pair of pigment spots of irregular shape, the eyes, a pair of very minute, short, anterior,

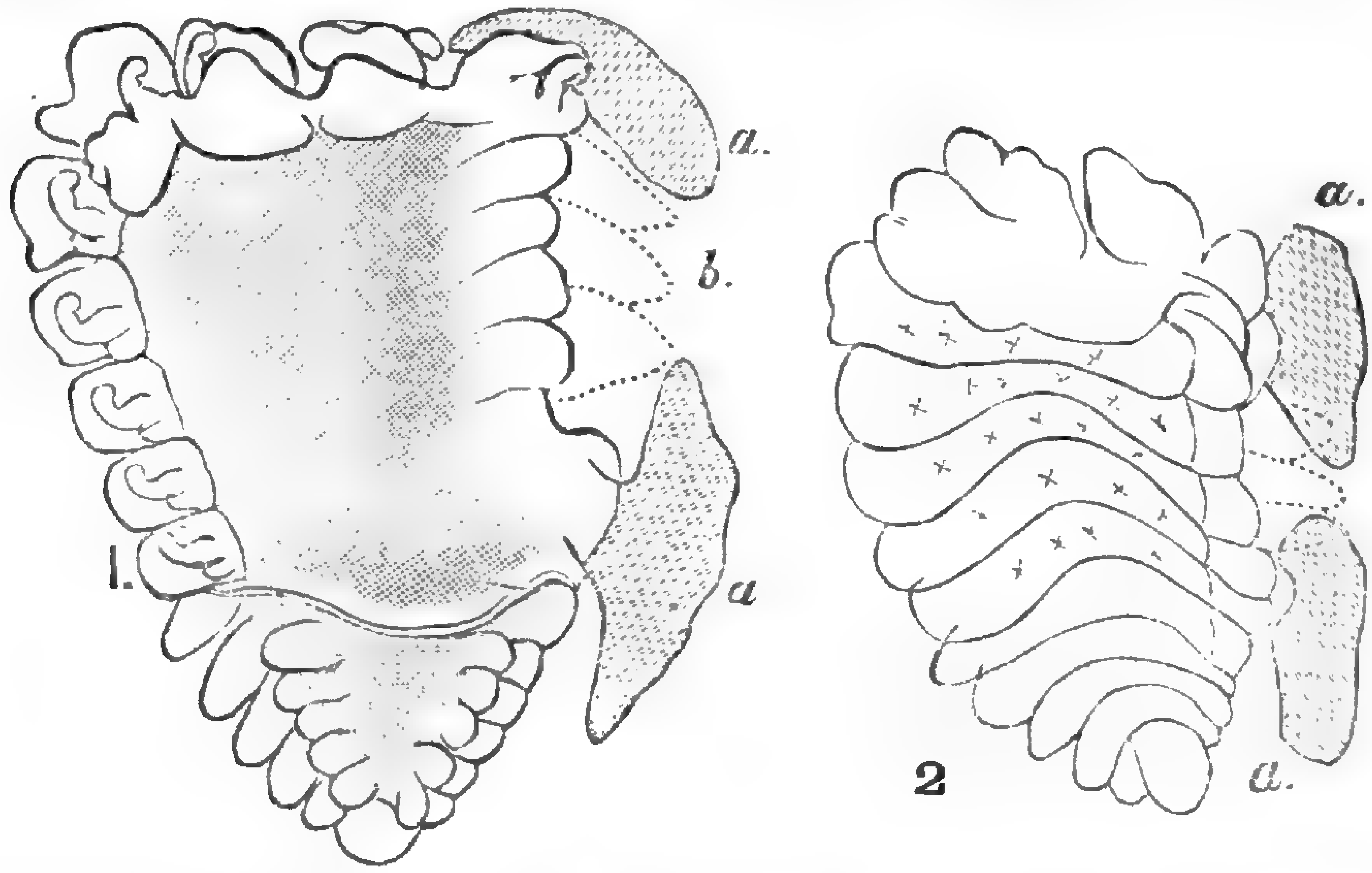


FIG. 1.—Ventral view of female. *a*, *a*, fleshy marsupial lobes; *b*, membranous extensions of pereion, drawn shorter than in reality. FIG. 2.—Dorsal view of female with lobes *a*, *a*, on the opposite side in nature from Fig. 1.

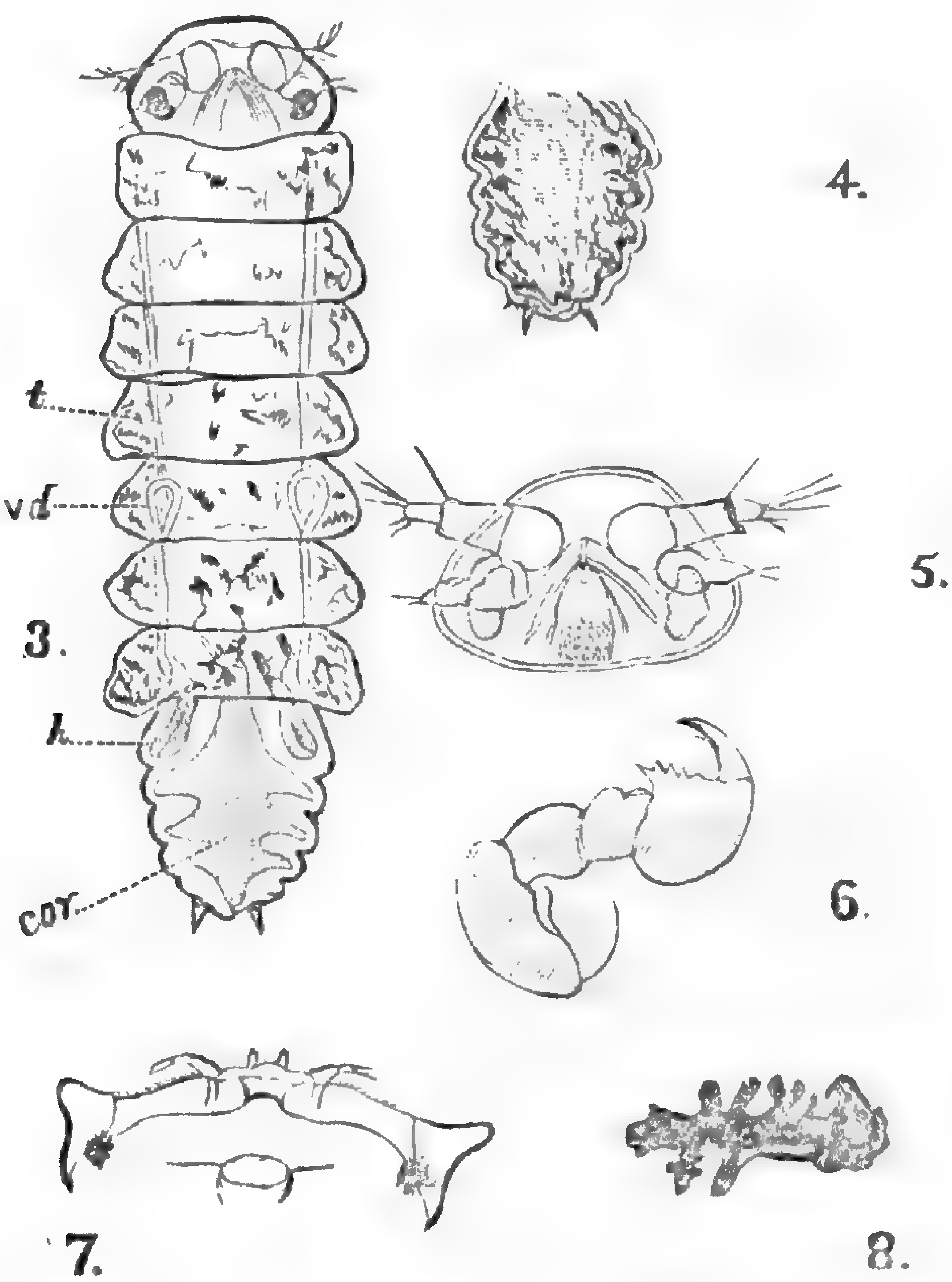


FIG. 3.—Ventral view of transparent male, legs omitted. *A*, pleon without pigment; *t*, testis; *vd*, vas deferens; *h*, liver; *cor*, heart. FIG. 4.—Pleon with pigment of male. FIG. 5.—Head of male. FIG. 6.—Thoracic leg of male. FIG. 7.—Cephalic piece of female. FIG. 8.—Pigment spot of first pereiopod near its lamella of the female Bopyroides.

and a pair of two (three?) jointed, larger, posterior antennæ (Fig. 7).

The maxilla, if I properly recognized it, consists of a small flat basal piece with a rounded subtriangular flat terminal piece.

The first pair of pereiopods is provided, near the junction of its basal piece and the prolonged lanceolate lamella, with a conspicuous large peculiar pigment spot, as seen in Fig. 8.

The male of our Bopyroides is smaller but higher specialized than that of *Bopyrus palæmoneticola.* It is always found on the same spot—on the ventral side between the breathing appendages of the pleon of the female. It measures $\frac{4}{5}^{mm}$ in length, and nearly $\frac{1}{5}^{mm}$ in width. It is but sparingly pigmented and therefore very transparent.

The head is slightly longer than the first segment of the pereion. Two moderately large pigment eyes are situated a little behind the middle of the head. I have examined five individuals and found in every case the anterior pair of antennæ larger (three-jointed) than the posterior pair (two-jointed). The oral parts are conical and not very distinct.

The first thoracic segment is sub-quadrate, the second to sixth segments are equal in length, width and shape, so is the seventh segment, but with a faint lateral emargination. The propodus of the seven pairs of legs (eight in Bopyrus, male) is sub-chelate with its inferior margin dentate, the dentation not being equally developed in all the legs.

The pleon, or tail, of the male is narrower than the pereion, has six sub-segments, sixth sub-segment with a lateral short spine, an indication of which is also found on the margin of the preceding two sub-segments. The spines may be regarded as rudimentary pleopods.

The heart can be distinctly seen in the pleon, also a narrower string extending laterally from the first to the fifth thoracic segment, where an indistinct twist occurs, after which the string is somewhat flatter, reaching down into the seventh segment, where its terminus is obliterated by pigment. The part of this string anterior to the twist, I regard as the testis, while the posterior may be the *vas deferens.* I did not observe an anastomosis between the two lateral strings, nor have I distinctly seen the anterior terminus of the same. An elongate lobe can be noticed in the first sub-segment of the pleon, which Dr. Fritz Müller also observed in the male of *Bopyrus resupinatus,*[1] and which is regarded by him as the liver.—*Carl F. Gissler.*

Zoological Notes.—The Bulletin of the U. S. National Museum No. 11, is devoted to a Bibliography of the Fishes of the Pacific Coast of the United States to the end of the year 1879, by Theodore Gill.—— New birds from the Sandwich Islands, and a new species *(Asio portoricensis)* from Porto Rico, are described by Mr. R. Ridgway, in the Proceedings of the U. S. National Museum, who also contributes a list of the old world birds

[1] Jenaische Zeitschrift fuer Med. und Naturwis., VI, I, p. 53, 1870.

in the Museum, and notes on Costa Rican birds.——A new genus of deep sea fishes (*Benthodesmus*) from the Banks of Newfoundland, is also described by Messrs. Goode and Bean, while Messrs. Jordan and Gilbert describe thirty-three new species of fishes from Mazatlan.——To the same serial Dr. Shufeldt contributes remarks on the osteology of the glass snake (*Opheosaurus ventralis*).——The Proceedings also contains Mr. Dall's description of certain limpets and chitons from the deep waters off the eastern coast of the United States.——At a recent meeting (April 18), of the London Zoölogical Society, Professor Flower read a paper upon the mutual affinities of the animals composing the order of Edentata, in which the usual binary division into Phyllophaga (or Tardigrada) and Entomophaga (or Vermilingua) was shown not to agree with the most important structural characters. These, according to the interpretation put upon them by the author, indicates that the Bradypodidæ and Megatheriidæ are allied to the Myrmecophagidæ, and also, though less closely to the Dasypodidæ, all the American forms thus constituting one primary division of the order, from which both the Manidæ and Orycteropodidæ of the old world are totally distinct.——A communication was also read from Mr. Charles Darwin, introducing a paper by Dr. Van Dyck, of Beyrout, on the modification of a race of Syrian street dogs by means of natural selection.——Mr. O. Thomas likewise read an account of a small collection of mammals from the State of Durango, Central Mexico, in which examples of several northern forms, not hitherto recorded so far South, and several southern forms not hitherto known so far North, occurred.——In an essay on certain points in the morphology of the Blastoid crinoids, Messrs. Etheridge and Carpenter discuss in a way preliminary to their larger forthcoming work, some points which will interest our western palæontologists.——Dr. J. Gwyn Jeffreys continues in the Proceedings of the Zoölogical Society his account of the deep sea mollusks procured during the *Lightning* and *Porcupine* Expeditions in 1866–70.——In the Bulletin of the U. S. Fish Commission, Mr. J. A. Ryder has a very interesting paper on the Protozoa and Protophytes considered as the primary or indirect source of the food of fishes. He has also found that the food of the very young shad consists almost entirely of very small crustaceans, the very youngest Daphnidæ, etc. Larger shad swallow small larval Diptera, besides Entomostraca. He says that the mode in which the young fish capture their entomostracan prey may be guessed from their oval armature. Most fish larvæ appear to be provided with small, conical somewhat backwardly recurved teeth on the jaws. "Rathke in 1833 described the peculiar hooked teeth in the lower jaws of the larvæ of the viviparous blenny, and Forbes has observed minute teeth in the lower jaw of the young *Coregonus albus*. I have also met with similar teeth in the lower jaw of the larval

Spanish mackerel." The mouth of the adult shad is practically toothless, and multitudes of small copepods are caught in the meshes of its branchial arches.——The new Acalephs from the Tortugas and Key West, and also from the east coast of New Zealand are described and well illustrated by Mr. J. W. Fewkes in the Bulletin of the Museum of Comparative Zoölogy. Vol. x. Nos. 7 and 8.

ENTOMOLOGY.[1]

REPELLING INSECTS BY MALODORANTS.—Mr. J. A. Lintner, State Entomologist of New York, has recently published an interesting paper, in which (assuming that the parent insect is guided to her food-plant, or to that destined for her offspring by the sense of smell), he advocates the use of strong-smelling or malodorous substances, as counter-odorants to prevent noxious species from laying their eggs on cultivated plants This theory is put forth as a " new principle, in protection from insect attack."

As remarked in a notice of the paper elsewhere, we have one serious criticism to make of it, viz: that it lacks both proof and substantial foundation in fact. To give force to the theory, Mr. Lintner has to assume that substances like kerosene, coal-tar, naphthaline, carbolic acid, gas-lime, bisulphide of carbon, smoke, etc., repel by their odor; whereas the ordinary belief that they repel because of their toxic properties seems to us far more reasonable. Our attempts to prevent the oviposition of the Cotton-worm moth, the Colorado potato-beetle, the apple-tree borers, and the Plum curculio, by the odor of carbolic acid and of coal-tar, of infusions of Ailanthus, Walnut, and decoctions of Horehound, or cabbage worms by the odor of creosote, have proved unavailing. Those of others in the same direction, and notably of Mr. I. W. Taylor, of Poland, N. Y., with such pungent odors as musk, camphor, spirits of turpentine, asafœdita, kerosene, etc. (*Rural New Yorker*, Nov. 2, 1872), used especially to prevent the oviposition of *Pieris rapæ*, equally failed of the intended result; so that, so far as experience will warrant an opinion it is adverse to the " new principle." The senses of sight, touch, and taste, which are more palpable and readily located, play their part in insect economy, and both experiment and observation would indicate that, except perhaps for certain special families, particularly of Lepidoptera, this part is greater than that represented by the sense of smell, even in guiding the female to lay her eggs.—*C. V. Riley*.

HABITS OF BITTACUS APTERUS.—Baron Osten-Sacken communicates in the *Wiener Entomologische Zeitung* (May number, p. 123) an interesting note on the above named Neuropterous insect, which is not rare in open grassy places in parts of California. He states that the insect replaces the want of wings by a great dex-

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

terity in climbing, swinging itself, monkey-like, from halm to halm, often suspended only by the front tarsi. One specimen was observed devouring a Tipula, and if this Dipteron should be the usual food of the Bittacus, the existing mimicry between the two insects would be significant, and in this particular case the more so as the Californian Tipula has, at least in the male, only rudimentary wings. According to Mr. H. Edwards's observations both species are frequently found in the same localities.

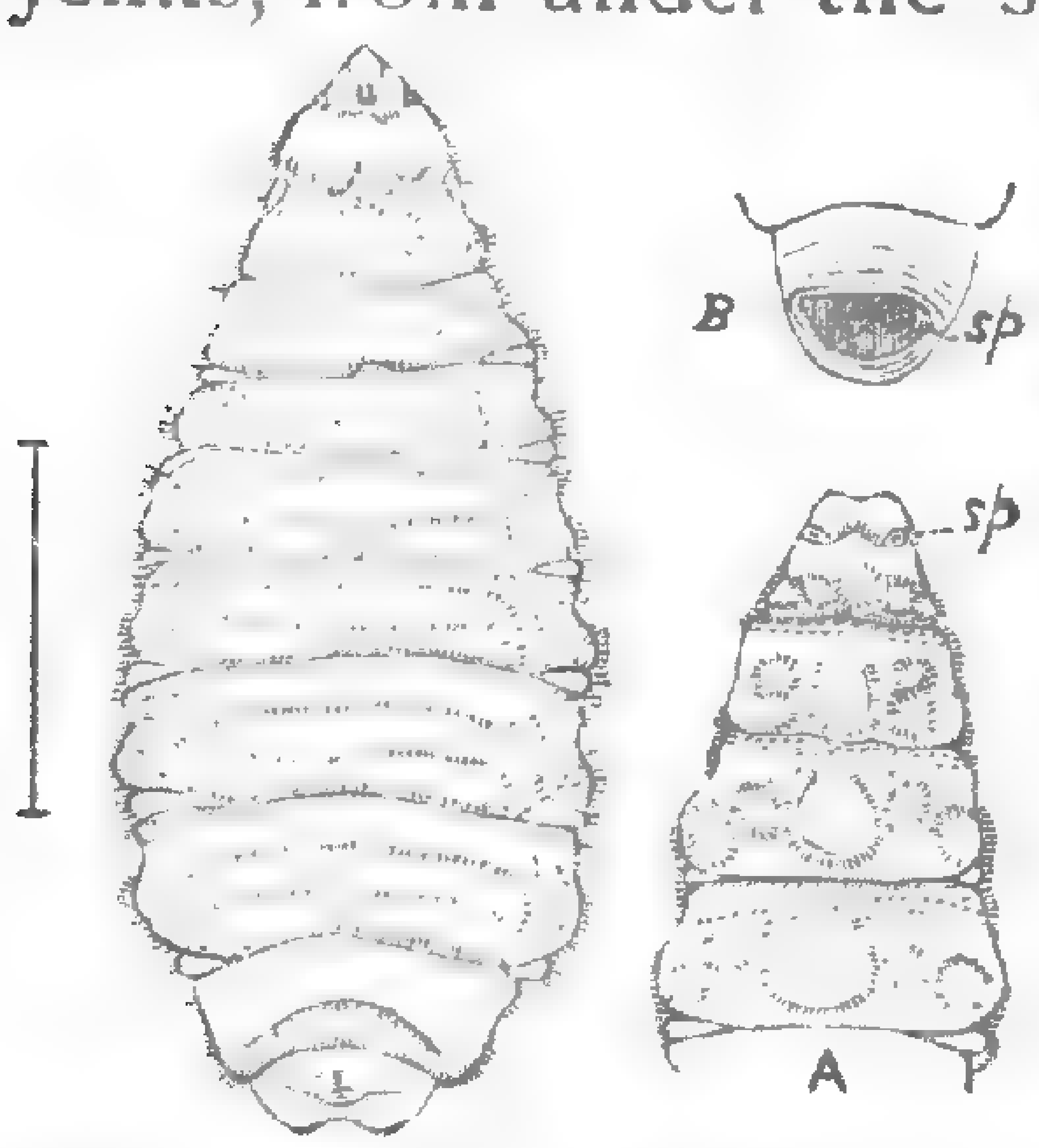
STRANGE HABIT OF METAPODIUS FEMORATUS Fab.—The "thick-thighed metapodius" is a common insect in the Southern cotton fields, attracting attention by its buzzing flight and ungainly form. The numerous observers connected with the cotton insect investigation have observed it preying upon the cotton caterpillar, while Glover states that it has been observed to injure cherries in the Western States. Mr. Schwarz informs me that he has seen it sucking the moisture from the newly dropped excrement of some unknown bird. Its eggs, according to Glover, are smooth, short, oval, and have been found arranged around a pine-leaf like a bead necklace.

In May of the present year, while studying the Northern army-worm *(Leucania unipuncta)* in the wheat fields near Huntsville, Alabama, I found that among the other new natural enemies which this Southern irruption occasioned the Metapodius was very conspicuous. Immediately upon entering the fields I was struck with its buzzing flight, and it was not long before I discovered one flying with an army-worm impaled upon its beak. Watching its flight I soon saw it alight in the line of May-weed *(Maruta cotula)*, which surrounded the field, and hastening to the point, found it busily engaged in sucking the blood of the captured worm. I was about to step closer and bottle the specimen, when it began to crawl down the branch upon which it had alighted, with that ridiculously slow and majestic motion peculiar to Reduvius and other Heteropters, until it reached a crotch where it dropped the shrivelled corpse of the worm so that it hung exactly suspended. Up to this time I had been so interested in watching this individual that I had not looked about me closely, and now I was surprised to find that the whole long line of May-weeds was fairly garnished with the empty skins of Leucania larvæ, each one hung with great nicety in some crotch. This same field I visited for three successive days, and in that time there was quite a perceptible increase in the number of the worms so placed. The sight of these suspended larvæ was certainly one of much interest, and, without seeing the great bug at work I might have puzzled over it for a long time without any satisfactory explanation.

I shall not attempt to explain this curious procedure on the part of the Metapodii. It is seemingly as unexplainable as the somewhat similar habit of the Southern loggerhead or shrike in impaling insects and other small animals upon thorns and sharp twigs. The worms are useless as further food, and certainly cannot be used as nidi for the eggs of the destroyer.—*L. O. Howard.*

Habits of Coscinoptera dominicana.—Large numbers of the larvæ and pupæ of this case-bearing beetle were recently found by Professor F. H. King, at River Falls, Wis., in a large ant hill. In our account of the earlier stages of this beetle (6th Mo. Ent. Report, pp. 127–130), the larvæ, which we succeeded in feeding with old dry leaves, etc., were raised from the egg and their natural habitat remained, therefore, unknown. We have no doubt from Professor King's experience that it is an inquiline in ants' nests, especially as other species of this group, *e. g.*, the European *Clythra quadrisignata*, are known to have this habit. No North American species of the *Clythra* group has heretofore been known to live among ants, though we lately received numerous cases of a *Clythrid* larva, found in ants' nests in Arizona, by Mr. H. K. Morrison, indicating, by their peculiar form and sculpture, a species (or perhaps genus) allied to *Coscinoptera dominicana* whose larva presumably feeds upon the vegetable débris in the ant hill. What benefit the ant derives from its presence it is difficult to perceive.—*C. V. Riley.*

Bot-Fly Maggots in a Turtle's Neck.—The Museum of Brown University has received specimens of a bot-fly maggot, of which eight or ten were taken, according to Professor J. W. P. Jenks, from under the skin of the back of the neck, close to the shell of the box turtle (*Cistudo carolina*). The turtle was collected at Midleboro, Mass. Fig. 1 represents the larva magnified three times, seen from beneath, *a* the anterior part of the body seen from above, and *b* the spiracles (*sp*) at the end of the body.



It appears to be a genuine bot-fly, but quite unlike any genus figured by Brauer in his work on the Œstridæ.

The body is long and slender, cylindrical, tapering so that each end is much alike. The segments are provided with numerous fine spines, which are not entirely confined to the posterior half or two-thirds of the segment. The body is slenderer and the spines much smaller than in *Gastrophilus equi.*—*A. S. Packard, Jr.*

Sun-spots and Insect Life.—Mr. A. H. Swinton, in a communication to *Nature* (April, 1882, p. 584), gives a condensed table intended to show the relation existing between sun-spot cycles and the appearance of insects. A number of Lepidoptera that are rare in Great Britain, and at the same time so conspicuous as to not easily be overlooked, are selected for this purpose.

That there exists a relation between sun-spot periods and meteorological phenomena, and as a consequence between such insect phenomena as depend on meteorological conditions, will scarcely be doubted; but we do not believe that any such connection can be proved from the recorded capture of certain species even in a country like England, which, entomologically, is so thoroughly explored. However that may be, his table shows that the maximum appearance of the species enumerated follows the years of the minimum of sun-spots, and *vice versa.*

A MITE INFESTING A PORK-PACKING HOUSE.—I send you by this mail a few specimens of a mite which I do not identify by means of the literature in my reach. It is found in a pork-packing house here and seems to develop from the livers, lungs, and kidneys after they have been cooked and dried by steam. They are treated in this way to reduce to a fertilizer. Where this material lies in sacks on the floor the mite is found forming a layer half an inch thick in places.

If you are familiar with it will you be kind enough to send me its name on the enclosed card?—*W. E. Wilson, Professor Natural Science in Coe College.*

This mite proves to be *Tyroglyphus longior* Gervais, and this is the first occurrence of this species in the United States so far as we are aware.

LARVÆ OF A FLY IN A HOT SPRING IN COLORADO.—I send you a bottle containing four specimens of animal life new to me, and those to whom I have shown them. Having no works of reference I would respectfully ask you to describe them for me. They were found in Gunnison Co., Col., in a hot spring, temperature 157° F., attached to the rock by the long end at about an angle of 45° and continually moving. Having no alcohol they were put into strong alum water. The color has not materially changed. The rocks were covered with them, as well as in other springs which were examined. Any information regarding them will be thankfully appreciated.—*H. G. Griffith, 317 N. 4th street, Burlington, Iowa.*

The larvæ are of those of a species of Stratiomys, and are like those from Borax lake, California, described and figured by us in the American Journal of Science, February, 1871, p. 102. The specimens received from Mr. Griffith are much larger than those from Borax lake, and differ decidedly in the much longer and narrower terminal, anal segment; this segment in the Borax lake species is half as wide as long, with a radiating tuft of respiratory filaments; in the present species it is nearly four times as long as wide, and tapers to an obtuse point, with a transverse opening, and it is provided with minute short respiratory filaments. The head is as in the Borax lake specimens, but the body is a little more flat, and spindle-shaped, being broader in the middle and tapering more rapidly towards each end. It is of a dark horn brown. Length 37^{mm}, breadth $5\frac{1}{2}^{mm}$.—*A. S. Packard, Jr.*

DESCENT OF DYTISCUS DURING A SHOWER.—In the October No. of Vol. 3, *American Entomologist*, mention is made of a "veritable shower" of water-beetles, supposed to be a species of *Dytiscus*, as having occurred in a certain locality in Kentucky during the summer of 1880. I am reminded of this phenomenon by the singular manner in which some of my friends came into possession of two remarkably fine specimens of *Dytiscus fasciventris* Say. Just after one of our light September showers, a goblet, that had been left on the outer ledge of a window, was found pretty full of the fresh rain-water in which were swimming about, in apparent content, the two water-beetles referred to.

How they came there was the question—the opinion prevailing that they "rained down." They could not have bred within a considerable distance from the house where they alighted, and the fact that they dropped into the glass of water was also most singular. They made no attempt to escape from the glass and lived there until the water was frozen late in November. No food was given them except that the water was occasionally replenished. Is it known to be a habit of this insect to rise into the air at certain times on the approach of, or during the progress of a shower?—*Mary E. Murtfeldt, Kirkwood, Mo.*

ANTHROPOLOGY.[1]

A WELL MERITED HONOR.—It will be a source of gratification to the many friends of Professor Charles Rau, the Nestor of American archæologists, to learn that the University of Friburg has conferred upon him the honorary title of Doctor of Philosophy.

A CORRECTION.—In looking over the contents of the last number of the *American Antiquarian*, we were astonished to find that Dr. Yarrow, who has come to be our standard authority on dead Indians, should turn aside to treat of the superstitions of *live* Indians. We have the doctor's permission to state that his paper in the *Antiquarian* was upon the superstitions of the Sioux Indians.

THE WASHINGTON SATURDAY LECTURES.—By the joint action of the Anthropological and the Biological Society of Washington, in February last, a course of eight free lectures at the National Museum was organized. Four of them were upon anthropology and its kindred topics, with the following titles: March 18—What is Anthropology? by Professor Otis T. Mason; April 1—Outlines of Sociology, by Major J. W. Powell; April 15—Paul Broca and the French School of Anthropology, by Dr.

[1] Edited by Professor OTIS T. MASON, 1305 Q. street, N. W., Washington, D. C.

Robert Fletcher; and April 29—How we see, by Dr. Swan M. Burnett. The lectures of Mason, Powell and Burnett were on topics somewhat familiar to our readers. They are all published separately by Judd & Detweiler, and will appear in a volume when the course is completed. On account of the freshness of the subject and the great care bestowed upon the production, the lecture of Dr. Fletcher deserves more than a passing notice. The avowed object of the speaker was to state, not what is anthropology, but "the reason of its existence, and the circumstances attending its establishment and recognition in the scientific world." A brief reference is made to separate branches of the study even in classic times, but the origination of the science as a whole is taken from the foundation of the Paris Society of Anthropology, some twenty-three years ago (1859). The associations devoted to kindred branches and to anthropology, are:

La Société des observateurs de l'homme, Paris. 1800.
La Société philanthropique, Paris. 1803.
The Society for the protection of Aborigines, London. 1838.
La Société Ethnologique de Paris. 1839.
The American Ethnological Society. 1842.
The Ethnological Society of London. 1844.
La Société d'anthropologie de Paris. 1859.
Versammlung der Anthropologen in Göttingen. 1861.
The Anthropological Society of London. 1863.
The Anthropological Institute of Great Britain and Ireland. 1871.
La Sociedad de anthropologia de Madrid. 1865.
The Imperial Society of anthropology and ethnology, Moscow. 1866.
Berliner Gesellschaft für Anthropologie, &c. 1868.
Anthropologische Gesellschaft in Wien. 1870.
Societa italiana di antropologia, &c. 1871.
The Anthropological Institute of New York. 1871.
Academy of Sciences, Cracow, Poland. 1877.
The Anthropological Society of Washington. 1879.
Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. 1870.
Congres international d'anthropologie et archéologie préhistorique. 1865.

The publications of these societies are also indicated.

The biography of Broca is drawn mainly from the article of Professor Pozzi in the *Revue d'Anthropologie.* Broca, among his many talents, had a great deal of ingenuity for devising mechanical helps. Among those noticed are the *craniograph*, the *new goniometer*, the *stereograph, cadre à maxima, micrometric compass, occipital goniometer, cranioscope, porte-empreinte intra-cranien, endograph, millimetric roulette, endometer, sphenoidal crochet, optic sound, pachymeter, turcica crochet, craniosphore, craniostat, facial demi-goniometer, auricular goniometer, flexible bi-auricular square, cyclometer, facial median goniometer, orthogon, goniometer of inclination, flexible goniometer* and *tropometer.*

Paul Broca was the founder of the Société d'Anthropologie de Paris (19th May, 1859), the *Revue d'Anthropologie*, the Laboratory of Anthropology, and the Ecole d'Anthropologie, united in the Institute d'Anthropologie. The total number of his printed articles and volumes is 534, of which 109 are on comparative anatomy and general anthropology, 48 on general craniology, 35 on special craniology, 27 on ethnology, and 19 on miscellaneous subjects.

As mentioned above, the Saturday lectures can be procured from Judd & Detweiler, of Washington, at 75 cents for the volume containing the whole course.

GEOLOGY AND PALÆONTOLOGY.

LESQUEREUX ON THE TERTIARY FLORA AS RELATED TO THE TERTIARY ANIMALS OF THE WEST.—In regard to Professor Cope's recent papers on the Cretaceous and Tertiary groups of the Western Territories, Mr. Lesquereux writes us that he has carefully examined his conclusions and must say that he approves them fully and that they agree well with his own. "As to the Laramie group, while I call it Eocene, Cope must decide according to the animal remains. I must stick to the plants. The difference is only in name and it will be better understood hereafter. For the so-called Green river group, I have always found a great difference of type between the plants of Green river station, including Alkali station, and those of White river, Florissant and Elko. I therefore readily admit, as I have already done, two different stages of this group, as indicated by the plants. A lower one for Green river station and Alkali and an upper stage for that of White river, so far we agree.

"But now let us see what the Miocene will say. From the Laramie group upwards there is already a number of permanent types recognized in subsequent formations. There is a marked identity between the plants of the Laramie group and those of the Union group, and then between those of the last group and White river, we find the Lower Miocene very clearly characterized, then follows the Middle Miocene or the Carbon and Alaska groups, and then the upper Miocene or Pliocene of the Chalk bluffs of California. All these facts considering the character of the plants, constitute by persistent species a continuous flora which it is extremely difficult to separate. Indeed if we admit that all the plants described from the Union group represent the same geological stage, we can scarcely draw any lines of separation for the Tertiary, which continues uninterruptedly from the Eocene of Black Butte and Golden City to the flora of our present epoch. Thus our present living flora would appear quite as Cretaceous in some of its characters as that of Golden City.—*F. V. Hayden.*

THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.—The Report of Progress of this Survey for 1879–80 forms a bulky octavo, accompanied by five maps of the regions explored, and illustrated by nineteen plates. The work of the Geological corps in 1880 embraced surveys in the Northwest Territories, Manitoba, Quebec, New Brunswick, Nova Scotia and the Magdalen islands. The report embodies the results of an exploration from Fort Simpson on the Pacific to Edmonton on the Saskatchewan, conducted in 1879 by Dr. Geo. M. Dawson, with maps containing all the available information regarding a region of about 130,000 square miles. The Skeena river is the most important stream of British Columbia north of the Fraser, with the tributaries of which its affluents interlock. About 2000 Indians of the Tshimsian and and Tinneh stocks are the sole inhabitants of the region. The Douglas fir or "Oregon pine" finds its eastern limit near McLeod's lake, which empties into the Parsnip, a branch of Peace river. The area of actually cultivable land on this river is estimated at 23,500 square miles. The fossil plants of the Peace river district represents a flora akin to that of the Dakota of the United States, and is the oldest in which broad-leaved exogens of similar types to those existing predominate. Dr. Dawson appends some valuable notes on the distribution of some of the more important trees of the region, such as the Douglas fir *(Pseudotsuga Douglasi)*, which attains occasionally a height of over 300 feet, and frequently surpasses eight feet in diameter; *Tsuga Mertensiana*, the western hemlock, which near the coast attains a height of 200 feet, *Thuja gigantea*, which on the coast not unfrequently surpasses fifteen feet in diameter and 100 to 150 in height, and other conifers of smaller size. Extensive lignite deposits exist in the Tertiary on the Souris river, and among the fossil plants of this district are *Platanus nobilis* (Newberry), the leaves of which are a foot in diameter, a *Sequoia*, and a sassafras.

Dr. Robert Bell contributes an interesting report upon Hudson's bay, and some of the lakes and rivers to the west of it. This body of water, no part of which is in the Arctic circle, and the southern extremity of which is south of London, measures about 1000 miles in length to the end of James bay, is over 600 miles in width, and has an area of about 500,000 square miles, or upwards of half that of the Mediterranean. Its drainage basin extends eastward to the center of Labrador, and westward to the Rocky mountains, while southward it is extended by the Winnipeg basin, emptying by the Nelson river, as far as latitude 45°. It thus includes nearly 3,000,000 of square miles, a great part of which enjoys a temperate climate, while large tracts are very fertile. About thirty rivers of considerable size flow into Hudson's bay. The Albany and the Churchill have the longest courses, but the muddy Nelson, though only 400 miles long, discharges the greatest body of water. The Albany can be navigated by shallow draft steamers for 250 miles, the Nelson for 70 or 80, while the Churchill, a beautiful clear-water stream, somewhat larger than the Rhine, has at its entrance a splendid harbor. Geologically Hudson's bay lies within the Laurentian, the Winnipeg division excepted. To the south and south-west of James bay much of the land is good; to the south-west the country is well wooded, and valuable minerals, including iron-stone, galena, gypsum, petroleum-bearing limestone, etc, are known to exist. The land around Hudson's bay is rising from five to ten feet in a century. It is not improbable that, possessing a sea-port in the very center of the continent, 1500 miles nearer than Quebec to the fertile lands of the Northwest territories, Hudson's bay may prove the future highway between those territories and Europe.

This portion of the report concludes with a memoir upon the northern limits of the principal forest trees of Canada; a list of thirty-eight species of fossils collected in Manitoba, principally cœlenterates, brachiopods and gasteropods; a list of 261 species of plants collected at various spots around Hudson's bay in 1880, and a catalogue, by Dr. J. L. LeConte, of the coleoptera collected between Lake Winnipeg and Hudson's bay. Other appendices are devoted to the mollusca, the analysis of the waters of Hayes' and Nelson rivers, and weather statistics.

The Magdalen islands are thirteen small islands in the Gulf of St. Lawrence, inhabited principally by French Acadians, and capable of becoming an unrivaled sea-side resort on account of the clean sandy beach backed by rich greensward.

Absence of Ancient Glaciers in Eastern Asia.—In an article on glaciers and glacial periods in their relations to climate, in *Nature*, A. Wœikof refers to the fact that the great interior plateaux of Central Asia are too dry for glaciers. China, Mandchooria and Amoor are destitute of glaciers owing to the want of moisture in the winter time, dry north-west winds then prevailing. This has been the case since the Pliocene period. Pumpelly and Richthofen found no traces of ancient glaciers in China nor on its western and northern borders, neither did Dr. Schmidt find any in the Amoor. As to the plateaux of Central Asia, they must have been exceedingly dry since the rise of the Himalaya and Karakoram to the south and the Pamir heights to the west of them, and thus have had nothing corresponding to the later glacial periods of Europe and North America.

A New Genus of Tæniodonta.—*Tæniolabis sulcatus*, gen. et sp. nov. *Char. gen.*—This genus is established on a tooth whose position is on the arc of the alveolar line which connects the molar and middle incisor regions. It is probably either the third incisor of the superior or inferior series, or the canine of the inferior series. In either case it differs from the corresponding tooth of any known genera of *Tillodonta* or *Tæniodonta*. The long diameter of the root being placed antero-posteriorly, that of the crown makes with it an angle of 30°.

Section of the crown oval; the grinding surface scalpriform in the manner of a rodent incisor; but beveled on side of the long diameter instead of on the end as in that order. Enamel consisting of a wide band on the external side of the tooth, which embraces more of the circumference near the apex than elsewhere. Apex grooved behind.

If this be an inferior canine tooth it differs from that of the *Tillodonta* in its large size and incisor-like form. It most resembles the external or third inferior incisor of *Calamodon*. From this it differs in the scalpriform wear, and the oval instead of triangular section, and in the absence of cementum layer.

Char. Specif.—The enamel band does not cover the entire width of the external face, but leaves exposed a part of the dental surface anterior and posterior to it except at the apex. At the latter point there are seven coarse shallow grooves of the enamel surface; the posterior of these split up below, and become narrowed, while the anterior run out at the more curved anterior edge of the enamel band. The posterior apical groove has a flat bottom. At the front of the apex the enamel is involute to the inner side for a short distance. The inner face of the tooth displays five facet-like bands of the dentinal surface, which soon disappear inferiorly.

Measurements.—Length of tooth (root restored) .058; length of enamel band .031; width of enamel band at middle .0095; diameters of middle of tooth, anteroposterior .0130, transverse .009 long; diameter of apex of tooth .008.

This tooth indicates a new and interesting type, perhaps of *Calamodontidæ*, and one of which more information will be awaited with interest. Judging from the size of the tooth its possessor was as large as a sheep. From the Puerco Eocene of New Mexico, from D. Baldwin.

Geological News.—The Philosophical Transactions of the Royal Society of London, 1880, contains Part x of Professor W. C. Williamson's researches into the organization of the fossil plants of the coal measures. The memoir is illustrated by eight plates. Certain small objects with projecting spines from the coal measures have been described as radiolarian, but Professors Haeckel and Strasburger concur with the writer in believing them vegetable. There is strong cause for the belief that they are cryptogamic macrospores, and Professor Strasburger suggests that their nearest allies may possibly be *Azolla* and other rhizocarpous genera.——In the same transactions Professor Owen gives a description of some remains of an extinct gigantic land-lizard (*Megalania prisca* Owen) a contemporarary in Australia with correspondingly large marsupials, also now extinct. Megalania possessed upon its skull several horns, provided with osseous cores. The principal of these horns correspond with those of the living small Australian lizard, *Moloch horridus*, but the horn-cones of the latter are formed of fibrous corium, without bone-deposits. The skull is 1 foot 10½ inches wide. The premaxillaries are edentulous and sheathed with horn. The creature seems to have been phytophagous, and its defensive weapons probably preserved it until it finally fell before the Australian so-called "Aborigine." The memoir is illustrated with several plates.——The Geological Magazine, April, 1882, contains contributions to the palæontology of the Yorkshire oolites, by W. H. Hudleston. This is one of a series, and treats of the Gasteropoda. The zones which contain Gasteropoda are the Dogger, with *Nerinæa cingenda* and numerous other shells; the Millepore bed; the Scarborough or gray limestone; the Kelloway rock, with numerous *Trigonias;* the Oxford clay; and the lower Calcareous grit. Estuarine beds separate the lowest four of these. In all the beds the Cephalopoda are more conspicuous than the Gasteropoda. In the same magazine are "Some Points in the Geology of Anglesey," by Dr. Roberts, forming part of a discussion respecting the nature of certain beds; figures and descriptions of some fossils from the red beds of the Lower Devonian, Torquay, by R. Etheridge; a note on *Homalonotus Champernowni*, by H. Woodward, with a figure of the tail; remarks on the classification of the European rocks known as Permian and Trias, by the Rev. A. Irving; a continuation of W. Flight's history of meteorites; and the concluding part of the life of Linnarson, by Professor Chas. Lapworth. Mr. Irving's paper is a review of the arguments respecting "Permian," as it was named by Sir Roderick Murchison. In Germany these rocks are known as the Dyas, and consist of "two series of strata sharply distinguished from each other, both petrographically and palæontologically," as remarked by Professor Credner, of Leipzig. The argument will be continued in the next number. Mr. Mudd suggests that what is known to engineers as "water-hammer action" may come into play as a factor in producing the phenomena of earthquakes and volcanoes.——At a recent meeting of the Geological Society of London, Mr. D. Macintosh remarked upon some additional discoveries of high level marine drift in North Wales.——Professors King and Rowney have recently published a work with a title too long to transcribe, upon ophites in general and *Eozoön* in particular. The reviewer of this work in the *Philosophical Magazine* states that the structures figured by the authors have only a rough general resemblance to those claimed to be organic.——In the *American Journal of Science*, Professor J. D. Dana continues his series of articles upon the flood of the Connecticut River valley from the Quarternary glacier. Writing of the retreat of the glacier, he gives a most interesting account of the present condition of Greenland, with a shaded map of its surface. In the same periodical Ben. K. Emerson describes the dykes of micaceous diabase that penetrate the bed of zinc ore at Franklin Furnace, N. J., and M. W. Iles treats of the occurrence of vanadium in the ores at Leadville. Mr. C. A. White explains the continuity of genetic lines of gill-bearing fresh-water mollusca, now separated from each other by barriers of land and sea that they are incapable of passing, by showing that the rivers in which kindred forms occur, once formed part of the drainage of inland lakes that have since become obliterated, and thus there was formerly a continuity which is now destroyed.——Chas. U. Shepherd follows with a notice of Monetite and Monite, two new minerals obtained from the twin islands Mona and Moneta, near Porto Rico, W. I. Both are phosphate of lime, formed in the caverns of limestone rock by the infiltration of the soluble ingredients of the bird-guano upon the surface.——Dr. Lemoine has communicated to the French Academy the result of his late palæontological researches upon the mammals of the Eocene beds around Rheims. The study of cerebral casts of *Arotocyon* and *Pleuraspidotherium* show relations to the embryonal brains of living mammals, and to those of certain marsupials, since the cerebral hemispheres leave the quadrigeminal tubercles completely uncovered. The dentary formula of *Pleuraspidotherium* and *Plesiadapis* recalls that of certain Australian phalangids. M. Lemoine has formed the genus *Adapisorex* to include some very small mammals, equally related to the Phalangidæ, found by him in the environs of Rheims. ——The Proceedings of Acad. Nat. Sci. Phil., contain Part II. of a revision of the Palæocrinoidea, by Chas. Wachsmuth and F. Springer. This extensive paper occupies 238 pages, and is illustrated by three plates. It is devoted to the families, Platycrinidæ, Rhodocrinidæ, and Actinocrinidæ. Two species of *Batocrinus*, and three of *Eretmocrinus*, all from the Burlington and Keokuk limestones of Indiana and Iowa, are described. In the same Proceedings, Angelo Heilprin has a "Revision of the Cis-Mississippi Tertiary Pectens of the United States;" "Remarks on the Molluscan genera *Hippagus*, *Verticordia*, and *Pecchiola;*" a "Note on the Approximate Position of the Eocene Deposits of Maryland," in which those deposits are referred to a horizon nearly equal to that of the Thanet sands and London clay of England and the Braccheux sands of the Paris basin, that is, near the base of the Eocene series; and a "Revision of the Tertiary species of Arca."

MINERALOGY.[1]

PROCEEDINGS OF THE MINERALOGICAL SECTION OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES.—The second number of the Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences has just been published. The first number was published in 1880, and contained the Proceedings from 1877 to 1879, inclusive, consisting of fifty-one articles, a number of which have been noticed in foreign periodicals.

[1]Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

This society, founded in January, 1877, and consisting of between fifty and sixty members, is the only society in the country especially devoted to mineralogy which publishes Proceedings. A large proportion of the communications are brief and of local interest. It is greatly to be desired that a society of larger scope—a *Mineralogical Society of America*—may be organized ere long. With the leading mineralogists of this country as active members, such a society should be at least as successful as the mineralogical societies of Great Britain and of France. The NATURALIST will give such a society all possible assistance.

The volume before us consists of thirty-seven communications upon mineralogy and geology, contributed during 1880 and 1881. The mineralogical articles are here briefly reviewed under the titles as given.

Some new Pennsylvania mineral localities.—Chas. M. Wheatley reports new localities for aurichalcite, melaconite, byssolite and azurite in Berks and Montgomery counties.

Pseudomorphs of Serpentine after Dolomite.—H. Carvill Lewis describes at length some serpentine pseudomorphs from the Wissahickon creek, which have the cleavage planes and external characters of dolomite, resembling those described by Professor Dana from the Tilly-Foster iron mine. Their mode of origin is discussed.

New localities for Barite.—H. C. Lewis gives three new Pennsylvania localities for barite.

New localities for Chabazite.—L. Palmer announces two new localities for chabazite in Delaware county, Penna.

On a new ore of Antimony.—H. Carvill Lewis describes a new ore of antimony from Sonora, Mexico. It has the following characters: Isometric. Habit octahedral. Generally massive. Hardness 6.5–7. Spec. grav. 4.9. Luster of the crystals, glassy; of the massive mineral, sub-resinous or sub-vitreous. Color, pale grayish-yellow. Streak uncolored. Transparent in crystals, opaque when massive. Fracture sub-conchoidal. Before the blowpipe fuses with difficulty to a gray slag, decrepitates strongly and gives a white coating. In the closed tube decrepitates strongly, turns yellow when hot, gives off water but does not fuse. It contains 3.1 per cent. of water, and consists mainly of antimonious oxide. (This communication was made Feb. 23, 1880, six months before Professor Cox's paper before the A. A. A. S. upon this same mineral. Professor Cox supposes it to be stibiconite, but it is more nearly allied to senarmontite.

Menaccanite from Fairmount park.—John Ford exhibits a large curved crystal of this mineral from Fairmount park, Phila.

Note on Damourite from Berks county, Penna.—F. A. Genth describes a shaly, talcose mineral from Rockland Forges, Pa., an alkali determination of which gave him: H_2O, 5.60; K_2O, 10.32; Na_2O, 0.36.

On the Stalactites of Luray cave.—A. E. Foote describes the cave near Luray, Va., and states that the curving and twisting of the stalactites was due to the fungi which grew upon their surface, and so caused lateral growth of carbonate of lime.

New localities for Gypsum. — H. C. Lewis reports Easton, Penna. and Richmond Coal-field, Va., as new gypsum localities.

New locality for Sphene.—A. E. Foote describes the new locality for sphene at Egansville, Renfrew county, Canada, where crystals weighing from twenty to eighty pounds occur in a vein of apatite. A crystal of apatite weighed 500 lbs.

A new locality for Hyalite.—H. C. Lewis describes green hyalite from Germantown, Pa.

Note on Autunite.—H. C. Lewis gives the optical characters of the Philadelphia autunite. It is orthorhombic, with an optic axial divergence of 24°.

Crystalline cavities in Agate.—Theo. D. Rand exhibits specimens of agate containing crystalline cavities once occupied by calcite crystals. The method of taking type-metal casts of these cavities was explained.

Note on Halotrichite.—H. C. Lewis states two localities for halotrichite.

On twin crystals of Zircon.—A. E. Foote records the discovery of twin zircon crystals at Egansville, Canada.

Disks of Quartz between laminæ of Mica.—Theo. D. Rand exhibits circular disks of quartz, showing a rotating black cross in the polarizing microscope, which occur in muscovite from Amelia county, Va.

On two new localities of Columbite.—H. Carvill Lewis records the occurrence of columbite at Mineral Hill, Pa., and at Dixon's Quarry, Del. The crystallographic characters of the specimens were described.

On the occurrence of Fahlunite near Philadelphia.—H. C. Lewis states that he has found fahlunite at two localities in hornblendic gneiss near Philadelphia. It is of a pale apple-green color, and has a scaly structure and felspathic cleavage. It resembles the variety known as chlorophyllite, and appears to be a product of alteration.

On a mineral resembling Dopplerite from a peat bed at Scranton Pa.—H. C. Lewis describes the black jelly-like substance from the Scranton peat bed, already noticed in the NATURALIST.

Titaniferous Garnet.—H. A. Keller describes a black garnet from Darby, Pa., whose color is due to enclosed particles of menaccanite and sphene, as shown both by microscopical examination and by chemical analysis.

Pyrophyllite and Alunogen in coal mines.—E. S. Reinhold states that the coatings of pyrophyllite from the coal slates of Mahanoy City, already described by Dr. Genth, have now been found in four collieries. Other coatings have proved to be alunogen, the origin of which is discussed.

New locality for Mountain Cork.—T. D. Rand finds this mineral near Radnor, Pa.

New locality for Aquacreptite.—G. H. Parker finds aquacreptite in decomposed gneiss in West Philadelphia.

Note on Aquacreptite.—H. C. Lewis remarks that at each of the localities for aquacreptite the rock differs; at West Chester it is serpentine, at Marble Hall limestone, and at Philadelphia gneiss. Experiments are described which he had made to discover the cause of decrepitation, which he finds due to capillary attraction. He concludes that the mineral is of mechanical origin, and differs from bole merely in a greater amount of mechanical action when placed in water, and that it is therefore not entitled to a special name.

Quartz crystals from Newark, Del.—W. W. Jefferis finds doubly terminated quartz at this locality.

A new mineral from Canada.—A. E. Foote draws attention to some olive-green crystals from Hull, Canada, which he supposes to be new.

A peculiar twinned Garnet.—W. W. Jefferis exhibits a twinned garnet where the smaller crystal fitted loosely in a cavity in the larger.

On Diorite.—E. S. Reinhold describes a diorite from Placer county, Cal., closely resembling the "Napoleonite" of Corsica.

A new locality for Allanite.—Isaac Lea finds allanite with zircon at Yellow Springs, Chester county, Pa.

A new locality for Copiapite.—E. S. Reinhold finds copiapite at Mahanoy City, Pa.

On Phytocollite.—H. C. Lewis describes more fully the mineral from Scranton, giving an analysis, and suggests the term phytocollite as generic for the related jelly-like hydrocarbons found in peat.

A new locality for Hayesine.—N. H. Darton[1] has found hayesine in soft fibrous crystals coating datholite and calcite in cavities in the trap of Bergen Hill, N. J. An analysis gave

CaO	BO_3	H_2O		
18.39	46.10	35.46	=	99.95.

The slender crystals were grouped together, and lay like little white mats upon the calcite crystals. This is an interesting occurrence of hayesine.

The third appendix to Dana's Mineralogy (Wiley & Sons, N. Y.).—Professor E. S. Dana has done a great service to mineralogists in the careful preparation of a volume bringing our knowledge of mineralogical species up to the present time. Since the last appendix was prepared, seven years ago, a large number of new species have been added, and much mineralogical work has been done. The present appendix contains descriptions of

[1] *Amer. Journ. Sc.*, June, 1882, p. 458.

about 300 species announced as new, and also refers to many mineralogical articles, quoting new analyses and new facts as to physical characters and localities. The appendix is designed to make Dana's Mineralogy (5th ed.) complete up to January, 1882, and should be in the hands of every owner of that noble volume.

ORTHITE FROM VIRGINIA.—F. P. Dunnington[1] and G. A. Koenig[2] have described and analyzed orthite from Amelia county, Va. It occurs in blade-like crystals several inches long, of a black color and pitchy luster, sometimes enveloped by an altered material. It has the following composition:

	SiO_2	Al_2O_3	Fe_2O_3	Ce_2O_3	La_2O_3	Di_2O_3	FeO	MnO	CaO	K_2O Na_2O	H^2O	
(1)	32.35	16.42	4.49	11.14	3.47	6.91	10.48	1.12	11.47	.46	2.31	= 100.62
(2)	32.90	17.80	1.20	8.00(CeO_2)	14.20		10.04	1.	11.32	—	3.20	= 99.66

Analysis (1) is by Dunnington, (2) by Koenig.

NEW ANALYSES OF COLUMBITE AND MONAZITE.—F. P. Dunnington[3] gives the following analyses of the columbite and monazite of Amelia county, Va.:

Columbite. Hardness 5.5; spec. grav. 6.48; luster sub-resinous; color dark-brown, streak light-brown, red when in thin splinters.

Ta_2O_5 Nb_2O_5	SnO_2	MnO	FeO	CaO	MgO	Y_2O_3 (?)	
84.81	trace	8.05	5.07	1.27	.20	.82	= 100.22

Monazite.

Ce_2O_3	Di_2O_5	La_2O_3	Y_2O_3	Fe_2O_3	Al_2O_3	ThO_2	P_2O_5	SiO_2	
16.30	24.4	10.3	1.1	.9	.04	18.6	24.04	2.7	= 98.38

OBITUARY.—William S. Vaux, a well-known amateur mineralogist, died at Philadelphia on May 5th, in his 71st year. As vice-president of the Academy of Natural Sciences and of the Numismatic and Antiquarian Society, as president of the Zoölogical Society and as treasurer of the American Association for the Advancement of Science, he showed an active interest in the progress of science.

The chief object to which he devoted his ample means was the collection of choice minerals, and as a result of extensive traveling and constant collecting throughout a lifetime, he left one of the finest collections in this country. His cabinet was remarkable for the beauty of the individual specimens, in many cases unsurpassed. He has bequeathed it to the Academy of Natural Sciences of Philadelphia.

[1] *Amer. Chem. Journ.*, Vol. IV, p. 138.
[2] Proc. Acad. Nat. Sc. Phila., 1882, p. 103.
[3] Loc. cit.

GEOGRAPHY AND TRAVELS.[1]

The Chukches and the Kuro-Sivo.—Captain Hooper, lately in command of the U. S. steamer *Corwin*, in an address before the Geographical Society of the Pacific, spoke of the habits and customs of the Chukches who inhabit the arctic coast of Siberia. In the winter they travel west on their way to the Russian trading posts in the interior, which they reach by ascending the rivers west of Cape Jakan; in the spring they travel to East Cape, cross Behring Strait, and continue their journey to Cape Blossom, Kotzebue Sound, where they meet the Eskimo from the entire coast of Arctic Alaska, from Point Barrow to Cape Prince of Wales, for purposes of trade, returning to their houses by the same route in the latter part of the summer.

Captain Hooper is of the opinion that a branch of the Kuro-Sivo, or Japanese warm stream, passes through Behring Strait, but subject to the varying conditions of wind and ice. A southerly wind accelerates it, while a northerly wind stops it entirely for a time; and in some cases of a long-continued northerly wind, it is not impossible that a slight southerly set may be created, but such an occurrence must be rare and of short duration. The current is much stronger in August and September than in the early part of the season when the ice-pack extends entirely across the Behring Sea. This branch of the Kuro-Sivo follows the direction of the Kamchatka coast to the northward through Behring Sea, passing between St. Lawrence Island and the coast of Asia, and thence through the strait, after which it is controlled in a great measure by the condition of the ice-pack. Captain Hooper stated that he had never known the current through the Strait to exceed three knots per hour, the average being probably not more than two knots. Near Herald and Wrangell Islands the current was found setting to the north and eastward about two knots per hour, and no tidal change was detected; off the south coast of Wrangell Island a slight westerly current was observed. In the Arctic, as well as in the Behring Sea, there is no doubt a tidal current, but it is so dependent on the conditions of the ice that only the mean of a long series of careful observations could determine its characteristics.

Six cases containing the zoölogical and anthropological collections, made by the brothers Krause in the Chukchi peninsula, have arrived at Bremen. Dr. Arthur Krause will remain in Alaska during the summer, but his brother is now on his way home.

Geographical Notes.—Mr. A. R. Colquhoun, an officer in the employ of the Government of India, who has spent ten years in surveying and engineering work in British Burma, has undertaken a journey through southern China, and across the frontier through

[1] Edited by Ellis H. Yarnall, Philadelphia.

Burma to Rangoon. He proposes to start from Canton and attempt the ascent of the Si-kiang or Canton river to the highest navigable point, and thence pass through the southern part of the Yunnan province and the Shan states by way of Kiang-hung, Kiang-tung, Zimmay, and Shuaigyeen or Tonghoo, to Rangoon. He expects to travel over one thousand miles of new ground, and to bring back a full description of fifteen hundred miles of country hitherto undescribed. The two great objects of Mr. Colquhoun's adventurous journey are to collect information of permanent value to geographical science, and to gather materials for a journal of travel likely to prove interesting to the general public.——The town of Tokio, Japan, by a recent census was found to contain 1,064,331 inhabitants.——Dr. Crevaux, when last heard from, had reached the sources of the Rio Pilcomayo, S. lat. 21°, W. long. 68° 20′ 15″, in the Republic of Bolivia. Some very important geographical observations had been made in connection by telegraph with the Cordova Observatory.——The *Nature* states that a Russian naval officer has invented a very ingenious apparatus for ascertaining the depth of the sea without the use of a costly and heavy line. Indeed, no line at all is used. The instrument consists of a piece of lead, a small wheel with a contrivance for registering the number of revolutions, and a float. While the apparatus sinks the wheel revolves, and the registered revolutions indicate the depth. When the bottom is reached, the lead becomes detached, the float begins to act, and the machine shoots up to the surface, where it can easily be fished up by a net and the register read off.——The celebrated Indian explorer, Nain Singh, or the Pundit No. 9, is dead. He was one of the most remarkable travelers of this century; his explorations in the Trans-Himalayian regions, and especially in Thibet in the service of the Trigonometrical Survey of India, were most successful and important.——The Rev. W. S. Green has undertaken the exploration of the great glaciers of New Zealand, and the ascent of some of the highest peaks of those islands, several of which have never been attempted. He is accompanied by two well-known Swiss guides. Afterwards Mr. Green proposes to visit New Guinea and ascend Mount Owen Stanley.——Captains Burton and Cameron have been visiting gold deposits in Apollonia and other districts near Axim, west coast of Africa. They were to start for the interior via the Ankobra river on February 25th last. They are making a valuable collection of objects of natural history.——It is thought that the American Mission will fix their station at Bailundo, fifty miles from Bihé, in the center of the region in which the Ganguela language is predominant, and on the line of the densest population towards the center of Africa. ——The following papers were to be read at the German Geographical Congress, which met at Halle on April 11–14: On some scientific results of the voyage of the *Gazelle*, particularly from a zoögeographical point of view, by Professor Studer (Berne); On the progress of our knowledge of Sumatra, by Professor Kan (Amsterdam); On the alleged influence of the earth's rotation upon the formation of river-beds, by Professor Zöppritz (Konigsberg); On the colonies of Germans and their neighbors in Western Europe, by Herr Meitzen (Berlin); On the historical development of geographical instruction, by Dr. Kropatschek (Brandenburg); On the treatment of subjects relating to conveyance in geographical instruction, by Professor Paulitschke (Vienna); On the introduction of metrical measures in geographical instruction, by Professor Wagner (Göttingen); On the relation between anthropology and ethnology, by Professor Gerland (Strassburg); On the ethnological conditions of Northern Africa, by Dr. Nachtigal (Berlin); On the Polar question, by Professor Neumayer (Hamburg); On the geographical distribution of Alpine lakes, by Professor Credner (Greifswald); On the true definition of the development of coasts, by Professor Günther (Ansbach); On geographical instruction in its relation to natural sciences, by Professor Schwalbe (Berlin); On the Guldberg-Mohn theory of horizontal air currents, by Professor Overbeck (Halle); On the systematic furtherance of the scientific topography of Germany, by Herr Lehmann (Halle).

MICROSCOPY.[1]

Micro-chemistry.—In a paper by H. Reinsch on the detection and separation of certain minerals under the microscope, it is claimed that the use of the microscope in chemical analysis is not only rapidly increasing, but that it is approaching the spectroscope and in some respects surpassing it in usefulness. It is admitted, however, that great skill is required in manipulation, and in preparing test objects to verify results, as appearances vary according to the degree of concentration of the solutions used, and different reactions will sometimes be obtained from the same salt. The following are some of the more interesting experiments, as translated in the *Scientific American Supplement.*

"Silica, of all substances, yields the most varied and beautiful forms, resembling plants and ferns, often presenting, in the most glowing colors, five-leaved flower forms in infinite varieties. To obtain these forms, we place a drop of a four per cent. solution of potassium silicate on an object slide, and then add a drop of a two per cent. solution of sodium bicarbonate, and then allow the liquid to evaporate at the ordinary temperature; after a few hours have elapsed the most beautiful flower forms will be found spread over the slide, and will be readily recognized by a pocket lense, but when examined by the microscope with the Nicol at 90°, will exhibit the crystals gleaming with a most magnificent play of colors. By moistening the object with a drop of copal varnish, and covering it with a thin glass, these forms may be permanently

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

preserved. If we mix a drop of the four per cent. solution of the silica solution with a drop of the one per cent. sodium bicarbonate solution, we fail to obtain any plant forms, but find polarized spheres, which, when the Nicol prism is at 90°, exhibit a dark cross, just such as are obtained with calcspar; on further turning of the prism it seemed to revolve visibly, and at 0° almost entirely disappears or passes over into a green cross. The most minute traces of silica can, by this means, be readily detected in a mineral, by melting a small sample of the substance with a little potassium hydrate and dissolving it in a little water, and then placing a clear drop of the solution on an object slide in the manner previously indicated.

It is just as easy to microscopically determine aluminum oxide as it was to detect the silica. It may be recognized as well from its sulphates as from its alkali solutions. If we place a drop of a four per cent. solution on an object slide and allow it to evaporate, spherical crystals will be obtained, which, turning at 90°, show a white cross formed of pencils of rays; if we cover the object with a mica plate, and place the Nicol at 0°, the rays of the little spheres appear as if composed of a number of small black grains; placing it at at 60°, they appear as two blue rays opposite to each other, which at 90° assume a corresponding position, and on further turning of the prism disappear entirely. If we mix a saturated aluminum oxide solution in potassium hydrate with sufficient water to produce a two per cent. solution, and place a drop or two of it on the slide, then mix the sample with a drop of a one per cent. solution of sodium bicarbonate, after evaporation, there will remain a dull white spot, which when still moist shows peculiar spheres; by means of these alumina can easily and positively be distinguished from silica; for they appear when the prism is at 90° as a white cross whose diagonal axis ends in two round or rhombic scales. If we mix the alkali solution of silica and aluminum oxide with a drop of sodium bicarbonate solution, the silica will appear as silvery, partly closed dendrites, while the alumina assumes lengthy forms which, when covered with a mica plate, seems blue, while the dendrites of silica are seldom colored.

Glucina may be very easily distinguished microscopically from both of the preceding earths. A drop of a four per cent. solution of glucium sulphate when evaporated on the slide leaves large stars, which may be detected by the naked eye; whose fern-like leaves spread themselves over the entire surface of the drop. The star in the center, when the prism is at 90°, exhibits prismatic colors, the leaves appear of a dull silver white or brownish color, and they are often perforated.

Boric acids is likewise very easy to detect, for from its two per cent. aqueous solution there is obtained, after evaporation, a series of very small plates hardly 2 mm. in diameter, which, when they are magnified 80 times, do not show any cross. If the residue of the boric acid be moistened with a drop of the two per cent. solution of sodium bicarbonate, the dried drop will be found to consist of beautiful polarizing spheres, which in their center inclose a small white cross; this on turning the Nicol prism also revolves. Occasionally dendritic stars instead of the spheres are formed.

The alkalies possess such optic properties that they can be definitely and certainly distinguished by the microscope. In making these tests it is best to employ the sulphates for the examination, as they are the most constant in their composition, and in the drying the samples will not absorb moisture from the air and so produce forms which may readily be recognized. Four per cent. solutions were made of the alkalies soluble in water.

The test with potassium sulphate gives, at 0° of the Nicol, a series of rhombic plates, which are not very well defined; at 90° blue rims with yellow or red spots are developed; these cannot be taken for any other alkali.

Sodium sulphate will be recognized just so soon as it becomes dry by its percipitation. In the darker field of the microscope it appears dull, and silvery-white in hopper-shaped quadratic crystals.

The ammonium sulphate assumes such peculiar shapes that it cannot be mistaken for any other salt. At 0° the crystals are hardly recognizable; at 90° they appear like partly decomposed walls built of gray blocks, with blue and brown rims.

Lithium sulphate forms clusters of prismatic needles which at 0° show beautiful colors and a blue cross, which at 90° becomes black. The most minute quantities of lithia can be recognized by their optical behavior.

Lime may be detected in several different ways: if a drop of a two per cent. solution of calcium chloride is mixed with a drop of a one per cent. sodium bicarbonate solution, the drop will become cloudy, and after drying it appears white and shows distinct dendritic stars which consist of an accumulation of small crystals. Barium and strontium salts fail to show this reaction, or only in a very indistinct manner. Lime is best recognized under the microscope when it is in the form of the sulphate, and is prepared by mixing a drop of a soluble lime salt with a drop of sodium sulphate. The sulphate crystallizes in stellar-shaped crystals, which cannot readily be mistaken for any other forms.

Barium nitrate assumes mossy, glistening like silver, colorless dendritic forms; while strontium nitrate takes the form of radiating needles, which are bluish at 0°, and at 90° are blue, green, and red.

Magnesia may, even when present in the most minute quantities, be detected by the microscope. The sulphate forms colorless clusters of needles, which do not become colored even at 90°.

The copper sulphate takes the form of step-like prisms, which at 0° are almost colorless, becoming at 70° light blue with green stripes, and at 90° show brilliant colors.

The four per cent. solution of manganese sulphate shows broad scales, silver white to gray in color, and which are partly serrated at 0°, as well as at 60° and 90°. If the sample is left by itself for several days, polarizing spheres will appear; these are so peculiar that the manganese can readily be recognized from them, especially as no other metal forms such spheres.

Cadmium presents the most characteristic formations of all the metals; a four per cent. solution of the sulphate produces large spheres containing ellipsoids, which radiate from the center and are marked by regular transverse depressions. This formation can be recognized without a Nicol's prism, and therefore it is not the result of the polarized light, but evidently depends upon the mechanical arrangement of the crystals. On using the Nicol the spheres show at 0° a beautiful blue or green cross, whose color zones increase with the turning of the prism until 90° is reached, when the most beautiful colors of the rainbow are manifested, while the ellipsoid becomes darker, better defined, and the transverse depressions are marked by dark spots. These phenomena become still more characteristic when observed over a plate of mica. From more dilute solutions of the cadmium sulphate, it is possible to obtain the spheres, but the peculiar structure is not observed.

If a two per cent. solution of iron sulphate be mixed with a one per cent. solution of sodium bicarbonate, the drop soon becomes cloudy, and is covered with a gold lustrous film of the oxide; after drying the specimen shows no spheres, but if it is allowed to remain quiet for two days, small crystals of iron carbonate are formed; these show the phenomena of polarization distinctly, but in a very peculiar manner.

Uranium sulphate assumes the most beautiful forms of all the metals; a four per cent. solution is taken, and at least twelve hours are necessary to produce the desired formation. It can readily be recognized with a pocket lens, and resembles beautifully colored asters or corn-flowers. Less frequently it occurs in the form of envelopes with velvet-blue, narrow, and purple-colored broad triangles, which may also be recognized without the Nicol, and therefore are not produced by polarized light but result from the mechanical arrangement of the crystals.

The mercuric sulphate is difficultly soluble, but it can easily be brought into solution by the addition of a few drops of nitric acid. It forms figures similar in shape to a Maltese cross, of superimposed scales, which are very unstable.

Silver may easily be determined, and in such a way that it is not easily mistaken for any other metal. A drop of a two per cent. solution of silver sulphate deposits bright points which may be detected with the naked eye; at 0° these appear as complete rhombic octahedrons, with the edges cut off; at 90° they glisten with the most beautiful play of colors, like the diamond; at times groups are formed which seem exactly like a set of diamond jewelry.

Protector for Objectives.—A very convenient and useful contrivance for covering the front surface of an objective, and thereby protecting it from injury from corrosive fluids or gases, and also for enabling the objective to be plunged directly into water so that different layers of the liquid may be rapidly examined for microscopic constituents, or sediments at the bottom examined *in situ*, is made by T. H. McAllister, of 49 Nassau street, New York. Fig. 1 gives an external view of the instrument, and Fig. 2 shows it in section as applied to an objective. It is made of brass and closed at the lower end with a thin cover glass. It is applicable to any objective of sufficiently narrow mounting and long working focus, and it works well with powers from a 1½ inch to a low-angled ¼th or ⅙th.

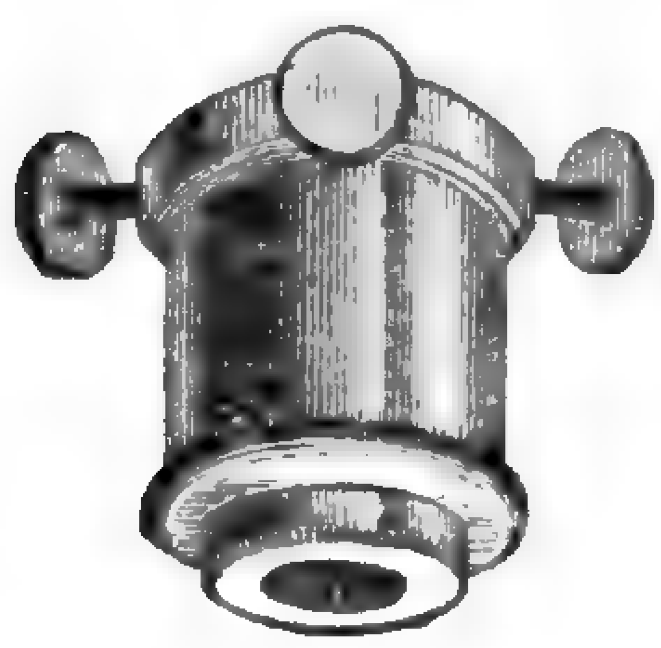


Fig. 1.

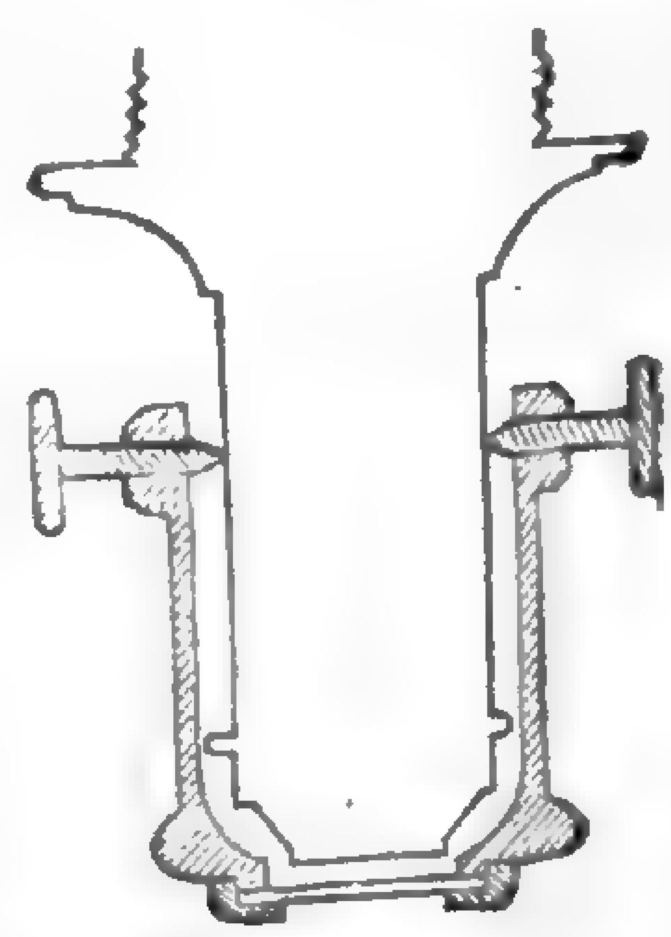


Fig. 2.

Living Objects for the Microscope.—Living specimens of animals and plants are supplied, for microscopical study, by A. D. Balen, of Plainfield, N. J. Single packages are sent by mail for 30 cents, or contracts made for a weekly supply, throughout the season, at a still lower rate.

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SCIENTIFIC NEWS.

— At a meeting of the New England Historic Genealogical Society, held April 5th, Dr. William Barrows read the following memorial to Congress:

"To the Honorable the Senate of the United States:—Your petitioners, the members of the New England Historic Genealogical Society, would respectively represent that there are in the Territories of New Mexico and Arizona twenty-six towns of the Pueblo Indians, so called, in all containing about ten thousand inhabitants; that the number of their towns was once very much greater; that those remaining are the remnant of very ancient races in North America whose origin and history lie yet unknown in their decayed and decaying antiquities; that many of the towns have been abandoned by the decay and extinction of their inhabitants; that many of these relics have already perished, and so made the study of American ethnology vastly more difficult; that the question of the origin of the Pueblos and the age of their decayed cities, and the use of some of their buildings, now magnificent ruins, constitute one of the leading and most interesting problems of the antiquary and historian of the present age; that relic hunters have carried and scattered wide through America and Europe the remains of these extinct towns, thus making their history's study still more difficult, and in some particulars nearly impossible; that the extinct towns, the only monuments or interpreters of these mysterious races, are now daily plundered and destroyed in an almost vandal way; that for illustration the ancient Spanish cathedral or pecos, a building older than any now standing anywhere in the original thirteen States, and built two years before the founding of Boston, is being despoiled by the robbery of its graves, while its timbers are being used for camp-fires and sold to relic-hunters, and even used in the construction of stables. Your petitioners therefore pray that at least some of these extinct cities or pueblos be carefully selected, with the land reservations attached, and dating mostly from the Spanish crown of 1680, may be withheld from public sale, and their antiquity and ruins be preserved, as they furnish invaluable data for ethnological studies, now engaging the attention of our most learned, scientific, antiquarian and historical students."

— It is proposed by a committee, signed by S. F. Baird, Drs. S. D. Gross, H. C. Wood, Weir Mitchell, Mr. Fairman Rogers, and others, to make a suitable and substantial acknowledgment of the preëminent services rendered to science by Professor Joseph Leidy, who has held the chair of anatomy in the University of Pennsylvania for thirty years, and to provide a testimonial which, while expressing the admiration of those who unite in it for his disinterested and self-sacrificing devotion to science, will relieve him from some elementary teaching and enable him to devote himself hereafter to those fields of profound investigation in which he is unrivaled. It is proposed, therefore, that the sum of $100,000 shall be raised, the interest of which shall be annually paid to Professor Joseph Leidy during his lifetime; and that, after his death, the said income shall be applied in perpetuity to the maintenance of the Joseph Leidy Chair of Anatomy in the University of Pennsylvania. The names of the contributors will be perpetuated in a suitable manner. Subscriptions will be received by Dr. William Pepper, No. 1811 Spruce street, Philadelphia.

— At the request of Dr. Anton Dohrn, Director of the Zoölogical station at Naples, Dr. W. B. Scott has accepted the Honorary Secretaryship for America for the publications of the Naples station. Monographs on the Ctenophores, by Dr. C. Chun; on the genus Fierasfer, by Dr. C. Emery; on the Pantoda, by Dr. A. Dohrn and on the Corallines, by Professor Solms, have already been issued, and a number of others are in preparation. These works are of a high order of excellence, and very fully illustrated. Dr. Simon Syrski, Professor of Zoölogy in the University of Lemberg, a well known ichthyologist who discovered the male of the common eel, died January 14, aged 51. Professor A. W. Malm of Göttenberg, Sweden, died March 4, aged 61.

— The death of Professor William B. Rogers, the President of the National Academy of Science, and late President of the Massachusetts Institute of Technology, occurred very suddenly May 30, while delivering the opening address of the commencement exercises of the Massachusetts Institute of Technology at Boston. Professor Rogers was born in Philadelphia in 1805. In 1835 he organized the geological survey of Virginia and conducted it until its discontinuance in 1842. He published numerous papers on mechanics, physics and geology. He was a fluent, elegant speaker and debater, most genial and kindly, hearty, ready and sympathetic in his intercourse with young scientists, and was in all respects a rare and admirable man.

— It is the intention of the writer to publish an account of the spawning season of as many marine forms as possible, with a brief description of the methods of oviposition, places to look for eggs and embryos, and such other details as will aid one in obtaining and recognizing such material as is necessary for embryological work. To this end he would request that all who are working at the development of marine forms would send him notes covering the points in question for which due credit will be given. It is thought that the desirableness of such a paper will be evident to all, and it is hoped that the responses will be numerous. Address all replies to J. S. Kingsley, care Boston Society of Natural History, Boston, Mass.

— Dr. Joseph Szabo, Professor of Mineralogy and Geology in the University of Budapest, Hungary, in a recent letter announces his intention to be present at the meeting of the American Association at Montreal in August. He will start from Liverpool for Quebec in the early portion of July, and will visit as much of our country as possible in the short space of time that he can remain. He is especially desirous of visiting the Yellowstone National park. He is especially anxious to secure a great variety of the igneous rocks of this country, especially those from our Western territories. His writings on the volcanic rocks of Hungary and other portions of Europe are numerous and valuable.

— The French Government is to establish a zoölogical laboratory on the shores of the Mediterranean at Villafranche, near Nice, under the care of Dr. J. Barrois. We have received from Professor Lacaze-Duthiers a brochure giving a full account, with plans, of his prosperous seaside laboratory at Roscoff, and the winter zoölogical laboratory which he has founded at Banyuls-sur-mer.

— Mr. E. W. Nelson has returned from a sojourn of four and a half years in Northern Alaska. Besides his meteorological work, in connection with the U. S. Signal Service, he has brought to Washington an extensive and complete series of specimens, among which are about nine thousand implements and carvings, illustrating the mode of life of the Esquimaux and their handiwork. His notes of their customs, his vocabularies, and his collection of photographs, are very interesting and important. He has also secured a large collection of the birds and fishes of Alaska.

— Among the new fellows elected at the last meeting of the Royal Microscopical Society, says the *English Mechanic*, was Mr. W. A. Thoms, baker of Alyth, who for the past ten years has been engaged in tracing the origin of leaven, which he concludes is identical with the fibrin of gluten and the granular contents of embryo-membranes. Mr. Thoms has also devoted a great deal of time to an investigation of the potato disease, and the salmon fungus.

— Charles M. Wheatley, who was well known for his important discoveries of a Mesozoic Saurian bone-bed near Phœnixville, and of a Quaternary cave in eastern Pennsylvania, containing bones of the Megalonyx, tapir, peccary, etc., died May 6th. Mr. William S. Vaux died in Philadelphia May 5th, leaving a bequest of $10,000 to the Academy of Natural Sciences.

— Among the papers read at the recent meeting of the American Forestry Association, held at Cincinnati, was one paper on forest tree culture in California, and another on the growth of certain California forest trees and the meteorological influences suggested thereby, by R. E. C. Stearns.

— The next meeting of the American Association for the Advancement of Science will be held at Montreal, beginning Aug. 23, under the presidency of Principal J. W. Dawson. A number of British and other foreign scientists will be present, and the meeting will undoubtedly be one of unusual interest.

— Professor Kowalewsky, of Moscow, has gone to the Caucasus to examine the petroleum deposits of that region.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Philosophical Society. Nov. 4, 1881.—Dr. E. R. Heath described his exploration of the rivers Beni and Mamore in Bolivia, illustrating his remarks with maps of the region explored, and giving many particulars relative to the productions of that part of Bolivia.

Nov. 18.—Dr. Brinton explained the substance of his paper on the names of the gods in the Kiche Myth.

Mr. Lesley read a paper from Dr. Newberry on the origin of the Lake basins, and remarked upon the relations of Dr. Newberry's claims to Professor Spencer's discoveries and views. He then gave a sketch of the progress of the excavations at Assos during the last few months, under the auspices of the Boston Archæölogical Society.

Dec. 2.—"Notes on the Laramie group, in the vicinity of Raton, New Mexico," by Professor J. J. Stevenson, was read by title.

Dec. 16.—Mr. Price described the rockery on the grounds of the University of Pennsylvania.

Professor Cope presented two papers of the geological exploration of the Big-Horn region, with special reference to the Eocene period.

Philadelphia Academy Natural Sciences. Jan. 24.—Mr. Skinner called attention to specimens of *Dryocampa imperialis*, which he exhibited. The insect had reached perfection in the chrysalis stage but had failed to emerge.

Dr. Koenig exhibited a specimen of monosite from the mica mine of Amelia Court House, Va. This monosite contained 25.82 phosphoric acid, 4.22 oxide of thorium, and 69.65 of oxides of cerium, lanthanum, and didymium. The formula derived from this differed from that obtained for North Carolina monosite, and the speaker suggested the possibility of the existence in it of an undetermined metal of the cerium group.

A discussion upon the cause of the timber line on high mountains and of the treeless nature of prairies was carried on, Mr. Meehan stating his belief that water rather than fire was the cause of forest destruction. Messrs. Leidy, Heilprin, Redfield, and Koenig opposed this view.

Dr. Horn spoke upon *Platypsyllus*, a small roach-like beetle parasitic upon *Scalops*, and made by Dr. Le Conte the type of a new family.

Feb. 7.—Professor Heilprin combated the opinion of Professor Sterry Hunt relative to the replacement from the interstellar space of carbonic acid abstracted from the air in the formation of coal of limestone. The speaker held that the limestones of the older geological formations were, like those of our days, formed from those still older, while the amount of carbonic acid stored up in the coal beds of the world would, if again mingled with the atmosphere, only amount to one half of one per cent. of its bulk, or still 3½ per cent. below the quantity necessary to destroy life.

Mr. Ryder described and illustrated the mesoblastic origin of the ribs from cylindrical vacuolated tracts, and the segmentation of the notochord in *Gambusia patruelis*.

Dr. Leidy exhibited specimens of worms from the black bass. They were bright red, 3 to 6 inches long, and lived coiled up in the muscles and other tissues of the fish. The worm is probably identical with one of the genus *Agamonema*, found in fresh water turtles.

Mr. Potts exhibited a specimen of the sponge to which the unfitness for use of the Boston drinking water had been attributed. The specimens were composed in part of a *Meyenia* and in part of a *Spongilla*. The *Meyenia* was new, and he proposed for it the name of *M. acuminata*. He believed that a sponge is usually the product of many statospheres, and that hybridism was, from the manner of germination of the statospheres, probably of frequent occurrence. The speaker stated that he had never yet been able to detect the ciliated chambers that have been described in sponges.

Dr. Parker stated that the effect of colloids upon crystalline substances was to retard growth except in the direction of the axes. He believed that the various forms of spicules were caused by this retarding influence of the sarcode, acting with greater or lesser intensity.

Mr. Potts stated that in all spicules of sponges there was an axial space, branching towards the spines; moreover, the larger spicules can be seen to be formed of a series of annular layers.

New York Academy of Sciences, April 10.—Mr. F. J. G. Wiechmann read a paper on the fusion-structures in meteorites (illustrated with microscopic sections).

April 24.—Professor J. J. Stevenson read a paper on the economic importance of the mineral resources of Southwest Virginia.

May 1.—Dr. B. N. Martin read a memorial notice of the life and works of the late Professor John W. Draper.

May 8th.—Professor H. Le R. Fairchild lectured on the methods of animal locomotion.

May 22.—Dr. A. A. Julien presented notes and observations made during a recent visit to the islands of Curaçoa, Buen Ayre and Aruba, W. I. Mr. J. C. Russell read a paper on sulphur deposits in Utah and Nevada.

June 5.—Dr. W. Miller, read a paper on the prevention of tubercular disease in men and animals by Vaccination. Mr. N. L. Britton remarked on a glacial "pot-hole" near Williams Bridge, N. Y.

Boston Society of Natural History, General Meeting, April 19.—Mr. Frederic Gardiner, Jr., described the methods of propagating salmon, and Dr. W. S. Bigelow spoke on the study of Bacteria and allied forms.

Annual Meeting, May 3.—The curator, secretary and treasurer presented their annual reports on the condition and work of the society during the past year. The officers for 1882-83 were elected, after which the discussion of the general question of glacial erosion suggested by recent communications on the formation of lake basins was opened with a paper by Mr. W. M. Davis.

Mr. S. H. Scudder spoke of an interesting discovery of older fossil insects west of the Mississippi.

Geographical Society of the Pacific, San Francisco, March 29.—The secretary read a letter from the president of the Board of Trade, requesting the Geographical Society to discuss the merits of the Nicaragua Interocean canal The following gentlemen were appointed a committee to act thereon: Captain Oliver Eldridge, Andrew McFarlane Davis, William Aldrich, B. B. Redding and Thomas E. Slevin. A paper entitled "Memoir on the River and Harbor of Guayaquil," was then read by Thomas E. Slevin, LL.D. The president gave notice that a paper would be read at the next meeting by B. B. Redding on the Gallapagos islands.

American Geographical Society, April 13.—The president, Chief Justice C. P. Daly, delivered an address upon Spain, Straits of Gibraltar and Tangiers in 1881.

Middlesex Institute, March 14 and 21.—Mr. R. Frohock delivered the third and fourth lectures of the course on the "Morphology of Leaves," and the "Arrangement of leaves on the stem."

March 28 and April 4.—Mr. F. S. Collins lectured on the "Arrangement of flowers," and the "Morphology of the flower; calyx and corolla."

April 11.—Mrs. A. J. Dolbear explained the "Morphology of stamens and pistils" and "Æstivation."

April 12, Regular Monthly Meeting.—Informal remarks were made by President Dame and others. Resolutions of respect to the memory of Professor Thomas P. James were read, ordered to be placed on record, and a copy to be sent to the family of the honored deceased. A committee on floral exhibitions for the current year was appointrd, and the executive committee instructed to arrange with the Essex Institute for a joint field excursion in the Middlesex fells in June.

Biological Society of Washington, May 26th.—The following communications were made:—Exhibition of Eskimo carvings of animals by E. W. Nelson. Appeal for an exploration of the molluscan Fauna of the District of Columbia by Wm. H. Dall. Exhibition of a rare Arctic bird, the Spoonbilled Sandpiper (*Eurynorhynchus pygmæus*), by T. H. Bean, M. D. Air sacks of vertebrates, by R. M. Shufeldt, M. D. About mules, by Professor M. G. Ellzey.

Appalachian Mountain Club, May 12.— The report of Mr. J. B. Henck, Jr., the delegate of the Club to the Alpine Congress, held at Milan last summer, was read.

Mr. W. M. Davis read a paper on the little mountains east of the Catskills.

A paper by Henry L. Stearns, entitled "An Ascent of Pike's Peak," was read.

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ON THE COMPASS PLANT.

BY BENJAMIN ALVORD.

SINCE the publication of my paper on the compass plant, *Silphium laciniatum* (see page 12 of "Proceedings of American Association for Advancement of Science at Cambridge, Mass., in August, 1849"), I have made no communication concerning it to any scientific journal, constantly hoping that my army station would bring me where I could make more satisfactory experiments. In the meantime it has been made the topic of several papers (about fourteen in all) which will be enumerated at the end of this article.

The *Silphium laciniatum* is a perennial plant of the order Compositæ; the first year it bears only radical leaves, the second year and after, it is a flowering herb with four or five leaves on the stem; very rough bristly throughout; leaves pinnately parted, petioled but clasping at the base. Root very thick. Flowers yellow. Found on rich prairies of the Mississippi valley from Minnesota to Texas, not found on the Pacific slope. Stem stout, from three to five feet high; leaves ovate in general outline, from twelve to thirty inches long.

It was first seen by me in the autumn of 1839, on the rich prairies near Fort Wayne in the north-eastern portion of the Cherokee nation, near the Arkansas line. I felt assured that its curious properties had not been made known to the scientific world, and after I had explored all those regions on horseback, and satisfied myself of the verity of the peculiarity, I made it known to the National Institute in Washington, the officers of the army having been requested by that enlightened Secretary of War, Joel R. Poinsett, to aid that society as opportunity should offer. The first communication was dated August 9, 1842, when I delivered in person to the Secretary of the Institute, Francis Markoe, Jr., a dried specimen of the plant. My second letter, published, like the first, in the Proceedings of the Institute, was dated January 25, 1843.

My principal object now is to record the various experiments which have, from time to time and in different places, been made by me or under my direction, to demonstrate that the meridional position of the plane of the leaf is due to the action of light.

Silphium laciniatum, or Compass Plant of the Western prairies. Radical leaf from twelve to thirty inches in height.

The property is best exhibited in the radical leaf, which presents its faces to the rising and setting sun. The flowering plant also exhibits the property, though imperfectly, but its leaves take a medium position between their normal and symmetrical arrangement in reference to the stalk, and the tendency to point toward the north. But I have been not a little surprised to find the figures of the plant, as given by A. W. B. (Professor A. W. Bennet) in *Nature*, Feb. 1, 1877, and by Sir Joseph D. Hooker in the London *Botanical Magazine* for January, 1881, present not the radical leaf, but the flowering plant. The reader of those journals will look in vain at the drawings to comprehend the polarity of the plant.

The experiments to which I refer were made on the radical leaves, which grow to the height of from one to two feet, and are strong and robust, and not easily disturbed by winds or other extraneous objects, and therefore the more useful as a guide on the prairies.

These experiments have been made since my paper was read in 1849 to the American Association. By them I became satisfied that Dr. Gray was right, in 1849, in attributing the peculiarity to the action of light.

1st.—I applied a very delicate galvanometer to the points of the leaves, so delicate that it should have detected the minutest quantity of magnetic or galvanic action, and no deflection was apparent.

2d.—Powerful magnets did not appear to deflect the leaves.

3d.—The plant was grown in a box, and after the leaves presented their edges north and south, the box was turned ninety degrees, and in a few days the leaves were seen to struggle to get back to their former meridional position.

4th.—Neither J. W. Bailey, LL.D., professor of chemistry at West Point, nor Professor John Torrey, at Princeton, after careful analysis in 1842, could detect any traces of the magnetic oxide of iron in the plant, or iron in any shape.

Mr. Edward Burgess, by request of Professor Asa Gray at Cambridge, about 1870, examined with a microscope the two surfaces of the leaf of the *S. laciniatum*, and found the structure of the epidermal tissue of the two surfaces to be similar, and also the number of *stomata* in each face to be about equal. Leaves generally turn toward the light, and the under surface in such cases is more "copiously furnished with *stomata*, or breathing pores as they are often inaccurately termed, which serve to promote a diffusion of gases between the external air and the intercellular cavities within the tissue, and especially an abundant exhalation of aqueous vapor" (W. F. Whitney in American Naturalist for March, 1871).

My theory is this: all leaves will turn their upper faces toward the light. But in the compass plant (I speak now of the radical leaf) the stem comes up vertically and stiffly from the root.

Compelled to move on a vertical axis, the leaf can have no upper and no lower face, and thus as they struggle toward the light they face the rising and the setting sun for a position of stable equilibrium. This is facilitated by the number of stomata on each face being equal. If the glare of mid-day should attract one face toward the south, with plane of the leaf east and west, it would be a position of unstable equilibrium. Some of the observers have, in rare instances, found exceptions in which this last named posture of the leaf was found.[1] But it could not remain long in that situation; once diverted, it would settle finally into the meridional position as that of stable equilibrium. This action of light in its full effect is of course best exhibited on the open prairies, where both faces would have the equal light of the sun during the day.

But in the case of the plants grown by Dr. Gray in his botanical garden at Cambridge, they are near houses and trees, and not in a position assimilated to their native region on the prairies. Their failure to show the property was a fact stated by Dr. Gray in 1849 before the American Association when my paper was read, and it was the cause of his contradiction of the existence of the property in the edition of his "Botany of the Northern U. S. for 1846." Down to the present day these plants in his garden do not show the peculiarity, evidently because they do not, as on the prairies, have the equal light of the sun during the morning and the afternoon.

Thus I was fully prepared to expect the result of the experiment by Stahl in Germany, referred to in the number for February, 1882, of the *American Journal of Science.* It was performed not on the *Silphium laciniatum*, but on the *Lactuca scariola*, and it is but just to Dr. George Engelmann, of St. Louis, to say, that he made known the existence of polarity in that plant in August, 1878, to the American Association at St. Louis, also in the number of the *Gardeners' Chronicle*, London, for 26th February, 1881.

Stahl states that he "took two plants of the *Lactuca scariola* growing in pots and placed one where it would be exposed to direct sunlight from 10 until 3, and kept in the dark for the rest

[1] I recommend to observers in Minnesota and Wisconsin to see if the exceptions, when the plant is east and west, are more numerous there than in Arkansas and Texas, where the sun at noon is higher than in more northern latitudes. The lower the sun at noon the greater the disturbing effect.

of the day; the other was placed so that from sunrise until 10 o'clock, and from 3 o'clock until sunset, it was exposed to the sunlight, but from 10 to 3 was in the dark. In the first case the leaves did not assume a meridional position, but in the second they did. All this shows that the meridional position is produced by the *sun when near the horizon.*"

To this can be added that Dr. Engelmann, in a letter to me of 28th Feb., 1882, as also in his article in the *Gardeners' Chronicle*, above mentioned, adds that observations with a microscope show that the number of *stomata* on the two faces is equal, thus "showing a similar anatomical structure" to that of the *Silphium laciniatum.*

The compass plant shows its peculiarity best in mid-summer, when the plant is in full growth prior to the changes which the approach of autumn makes in most plants. It is also best shown in the little hollows on the prairies, where the radical leaves are somewhat sheltered from the winds, and where they will be seen all parallel to each other. There are also great varieties in the size and growth of the *S. laciniatum*, both in the radical leaf and in the flowering plant. I have myself seen the polarity exhibited in a much more marked manner in some regions than in others. In this respect in Iowa it was never so apparent as on the prairies in Missouri, Arkansas and the Cherokee nation.

And I was pleased to hear from Dr. Gray that Sir Joseph Hooker saw it in Southwestern Missouri, and in mid-summer. On reaching Boston in 1877, Dr. Gray says, that one of the first requests of that distinguished botanist was to be shown the compass plant, and Dr. Gray took him to that region. So that in the *Botanical Magazine* for January, 1881, he says:

"I have not been able to detect any orientation of the leaves in the Kew cultivated specimens, but these not being planted in a good exposure all round, are out of court as witnesses. On the other hand, when traveling on the prairies with Dr. Gray in 1877, I watched the position of the leaves of many hundred plants from the window of the railroad car, and after some time persuaded myself that the younger, more erect leaves especially, had their faces parallel approximately to the meridian line."

Dr. Gray in the same article (as quoted by Sir Joseph Hooker) says: "But repeated observations upon the prairies with measurements by the compass[1] of directions assumed by hundreds of

[1] In the remarks which followed my paper read in August, 1849, to the Am. Assoc. (see page 18 of Proceedings), Professor R. Morris said: "In surveying on

leaves, especially of the radical ones, have shown that as to prevalent position, the popular belief has a certain foundation in fact."

I wish now to refer to the *exceptions.* Besides the fact above stated, that great differences are shown in the growth of the plant in different states and regions, it has repeatedly been reported to me that an east and west position of the leaf has been discovered. In 1843 letters to the National Institute made the statement that occasionally a leaf would be found east and west. In a letter to me from St. Louis county, Mo., June 19th, 1866, from Mr. A. Fendler (a very careful painstaking botanist), he said: "Of the thirty-four leaves examined on the hill, eleven were in the true meridian, *one was due east and west,* one was as much as 60° east, and but three deviating more than 25° from the true meridian. The 'compass plant,' although its leaves do not invariably point due north and south, is yet entitled to the name it bears, not only from observations made on the open prairies, but even from those made on the hills. For in the latter case I find that about one-third of the number of their leaves exactly coincide with the meridian, and more than another third is of so small an angle as 3°—10° from the true north."

Professor Gray, in the article in the *Botanical Magazine* above referred to, says: "As to their orientation,[2] not only is this rather vague in the cultivated plant, but subject to one singular anomaly. I have several times met with a leaf abruptly and permanently twisted to a right angle in the middle, so that while the

the prairies for several years, I have observed that in running compass lines north and south, the edge of the leaf was seen, so that the plant was not at all conspicuous; but in running lines east and west, the whole plant was seen, and it was a very conspicuous object." The Rev. Thomas Hill, LL.D., then president of Harvard Univ., in the number of *American Journal of Science* for Nov., 1863, communicated the result of careful observations on the prairies near Chicago, with compass in hand, on the 8th of August. He appears to have examined the flowering plant, not the radical leaf. He speaks of twenty-nine plants which bore ninety-one leaves. He says the average of sixty-nine leaves was "about half a degree east of the meridian," and that twenty-five were less than 1°. If the flowering plant would give such results, the average of radical leaves would have been still more satisfactory. He has a paper on the same subject in AMERICAN NATURALIST for 1870.

[2] The word "orientation" is, I find, used by some scientists to describe north and south position, but it is ambiguous, for the compass plant faces the west as much as the east. It was called, when I first saw it, the "polar plant" by the officers of the army and the frontiersmen. But the name of "compass plant" is much better, as the other name might be mistaken as referring to some plant near the polar regions. If I use the word "polarity" in this paper it is only in the sense of its tendency to assume the meridional position.

lobes of the basal half pointed say east and west, those of the apical half pointed north and south."

My explanation of the east and west position observed by Mr. Fendler is, that while under the action of light the situation of the leaf for a position of stable equilibrium, is to face the rising and setting sun, it might, under the glare of the mid-day sun have temporarily, as a position of unstable equilibrium, taken a posture east and west. This would be when the whole leaf faces toward the south. But the anomaly of "an abrupt torsion of 90° in the middle of the blade" (again referred to by Dr. Gray in reference to Professor Farlow's note on Stahl), is one for future observers to scan, who live near the plant on the prairies. If the basal half was not from any cause free to change its direction, the phenomenon would appear to be explained.

Now as to other plants, reports, after my first communication to the National Institute in 1842, were received from the West by that society, stating that other plants on the prairies were found to possess the same peculiarity. My paper of August, 1849, said: "Proper observation and experiments may discover traces of some general law for these results." We have mentioned above the experiment on the *Lactuca scariola*. All tends to confirm the idea that the polarity is due to the action of light.

Besides that plant, Stahl names *Aplopappus rubiginosus*, *Lactuca saligna*, and *Chrondrella juncea*, and he "believes that many other examples will be found, especially among the plants of dry and exposed regions."

I have now to add that observations made during the last twelve months on the Chinese arbor-vitæ, or *Thuja orientalis*, in this city (Washington), convince me that when raised in a hedge only three or four years old and three or four feet high, its broad leaves will face the rising and setting sun. In the courtyard of Professor C. V. Riley, corner of 13th and R streets, N. W., there are two such hedges of the plants; one running east and west, the other north and south. Both exhibited the property. In reference to the former hedge running east and west, if it might be supposed that the pointing north of the leaves well in view, might be due to the other leaves, except at the ends, being hidden from view, interlocked by the closeness of the hedge, I answer: look at the other hedge running north and south, and the verity of the meridional position of the leaves is there also clearly apparent. Dr. J. G. Hunt, of Philadelphia, a distinguished microscopist, examined some of the leaves of the *Thuja orientalis* which I sent him, and says, June 19, 1881, that "there is no structural difference in the two sides of the leaves on the plant." It is only in the young plant three or four feet high that this is seen, for in the beautiful clumps of the *Thuja orientalis* eight to twelve feet high, the leaves, all vertical, radiate in every direction from the trunk of the tree.

A friend from Louisiana, the late Professor C. G. Forshey, wrote me that he had formed the same conclusion concerning this plant as to its meridional position under certain circumstances.

Mr. William Saunders, superintendent of the garden at the Agricultural Department in this city, informs me that the leaves of the *Eucalyptus polyanthemus* are vertical and have the number of stomata the same on both faces. But confined in a conservatory nothing is known of any tendency of the leaves to face the rising and setting sun.

If it is asked why I was at an early date disposed to look to other agencies than light as possibly concerned in causing the peculiarity of the compass plant, I answer that I was fresh from the study of electro-magnetism. Read section 105 of Roget's Electro-magnetism on the electrical spiral coil (the "Solenoid"), by which currents of electricity cause it to act when suspended on a vertical axis, like the magnet in pointing to the north. Read the treatises on vegetable physiology which speak of the spiral coils in the leaves of various plants, and "that one of the most remarkable properties of vegetable membrane is its power of allowing fluids to pass slowly through it, even though no visible pores or apertures can be detected in it." "The spiral filaments are found in leaf-stalks from which their spiral fibers can be uncoiled." Thus it experiment and dissection of the compass plant could in any way favor the idea of such anatomical structure, its polarity might be sought for in electric currents. To this day the best received theory of the magnetism of the earth is Ampere's, that it is due to electric currents from west to east around the crust of the globe; and that a steel magnet is caused by electric currents transverse to its axis and permeating its entire length.

But when one agency is sufficient to account for the phenomenon, it is unnecessary to search for another. And this brings me to refer to the admirable drawing of the transverse section of the leaf, magnified 235 times, of *Silphium laciniatum*, given on page 157 of Botany by C. E. Bessey, professor of botany in the Iowa Agricultural College. He says, "Its chlorophyll-bearing parenchyma is almost entirely arranged as palisade tissue, so that the upper and lower portions are almost exactly identical in structure;" on page 103 he says, "there are in the true upper surface 52,700 stomata per square inch, and on the under surface 57,300 per square inch."

This magnifying of a section of the leaf is a dissection, and thus there is no cause to suppose the existence of any spiral ducts such as are above referred to. Professor Bessey, living in the prairié region has the best possible opportunities to observe the compass plant. He says, page 515: "Its large pinnately lobed leaves twist upon their petioles, so as to present one surface of the blade to the east and the other to the west, the two edges being upon the meridian." This language applies to the leaves of the flowering plant, for in the growing of the radical leaf there is no cause for the twisting of the petiole in order that it may assume its meridional position.

As to the history of the plant in Europe. The following is an extract from the article by Sir Joseph Hooker in the London *Botanical Magazine* for January, 1881, above quoted, which is preceded by a drawing of the flowering plant:

"This noble plant was introduced into Europe in 1781 by Thouin and flowered for the first time in the Botanical Garden of Upsala in Sweden. It has been in cultivation in Europe ever since, though its name and fame as the compass plant of the prairies are of comparatively modern date, it having before that borne the popular names of turpentine plant and rosin weed, except among the hunters and settlers in the Western Sta' With regard to the history of its reputed properties as an indicator of the meridian by the position of its leaves, I am fortunate in having recourse to my friend Professor Asa Gray, now in England, who has most kindly furnished me the following very interesting account of this matter:

"'The first announcement of the tendency of the leaves of the compass plant to direct their edges to the north and south, was made by General (then Lieutenant) Alvord of the U. S. Army, in the year 1842, and again in 1849, in communications to the American Association for the Advancement of Science. But the fact appears to have long been familiar to the hunters who traversed the prairies in which this plant abounds. The account was somewhat discredited at the time by the observation that the plants cultivated in the Botanical Garden at Cambridge, U. S., did not distinctly exhibit this tendency.'"[1]

Nature for Feb. 1, 1877, contains the first of a series of articles by "A. W. B." on "Remarkable Plants," and begins with the compass plant as No. 1. It says: "Our illustration is taken partly from the plate in Jacquin's 'Eclogæ,' the only good drawing of the plant published, assisted by comparison with dried specimens in the Kew Herbarium." The full title[2] of Jacquin's book, published in Latin in Vienna in, 1812, is, "Selections of rare and little-known plants, described from living plants with colored illustrations." Like the plant in Upsala, Sweden, in 1781, it was cultivated, but its true rarity, and its claims for interest and investigation, were quite unknown.

If it is asked what remains for the observation of scientists in this connection, we answer, that besides the occasional torsion of 90° referred to by Dr. Gray, and the exceptions to the rule in which the whole leaf is east and west, to which we have briefly alluded, we will add: the whole subject of the reason (the entire *rationale*) of leaves turning towards the light is worthy of more full experiment and elucidation.

I had written the above sentence when I was pleased to see in the *American Journal of Science* for March, 1882, a communication by Dr. Asa Gray, stating the substance of a paper by Francis Darwin, in Journal of the Linnæan Society, 1881, "On the power possessed by leaves of placing themselves at right angles to the direction of incident light." Dr. Gray concludes his abstract by saying: "The experiments varied in many ways, and with arrangements to eliminate epinastic and hyponastic ten-

[1] Dr. Gray adds: "The lines in 'Evangeline' were inspired by a personal communication made by Gen. Alvord to the poet Longfellow." This was in January, 1847. Sir Joseph Hooker adds in a note after quoting the lines, "I cannot congratulate the poet on the fidelity of the plant as a 'delicate one.'" The same criticism is made by the article in *Nature*. The truth is, I wrote Professor Longfellow after "Evangeline" first came out that the plant was not a "delicate" one, but on the contrary, stout and robust, and therefore a better image of faith. "Such in the soul of man is faith," &c., &c., and in all the later editions of "Evangeline," Mr. Longfellow calls it a "vigorous plant." But in England the first editions are most read.

[2] Eclogæ plantarum rariorum et minus cognitarum, quas ad vivum descripsit et iconibus coloratis illustravit. Fehr. Jos. Fry. Jacquin. Fasc. I–X. Fol maj. Wien, 1812.

dencies, plainly bring out the conclusion 'that the power which leaves have of placing themselves at right angles to the incident light is due to a specialized sensitiveness to light, which is able to regulate or govern the action of other external forces, such as epinasty.'"

Professor Bessey, in his recent admirable work on botany, page 193, says: "The explanation for heliotropism which is commonly given, is that the light retards the growth on the illuminated side, while the shaded side elongates, resulting in a tension which necessarily produces a curvature."

This is the most plausible statement we have seen, but we are not informed how far it is founded on any actual experiment. It is satisfactory that Mr. Darwin has undertaken the task in such a careful and systematic manner. It is an interesting field of observation and worthy of being thoroughly examined by different persons and in different localities.

LIST OF PAPERS ON THE COMPASS PLANT, ETC.

BENJAMIN ALVORD, U. S. Army.—Proceedings of National Institute, Washington, D. C., 1842 and 1843.

Proceedings of American Association for the Advancement of Science (page 12) at Cambridge, Mass., August, 1849.

THOMAS HILL, LL.D.—American Journal of Science for November, 1863, p. 439. American Naturalist, 1870, p. 495.

J. A. ALLEN.—American Naturalist, 1870, p. 580.

W. F. WHITNEY.—American Naturalist for March, 1871, p. 1.

PROFESSOR ALFRED W. BENNETT, Lecturer on Botany at St. Thomas Hospital, Eng.—Nature for Feb. 1, 1877, p. 298, with figure of the plant.

DR. GEORGE ENGELMANN, of St. Louis.—American Association for Advancement of Science, St. Louis, Aug., 1878.

PROFESSOR C. E. BESSEY.—American Naturalist for August, 1877, p. 486.

Botany. Henry Holt & Co., N. Y., 1880, pages 103, 157, 515, with figures of section of leaf magnified.

DR. ASA GRAY.—Ed. of 1880 of Botany of Northern U. S.

——American Journal of Science for March, 1882, page 245. On Francis Darwin's paper in Journal of the Linnæan Society, No. 112, Vol. 18, pp. 420–455, June 1881, on "The power possessed by leaves of placing themselves at right angles to the direction of incident light."

SIR JOSEPH D. HOOKER and DR. ASA GRAY.—London Botanical Magazine for January, 1881.

——Gardeners' Chronicle, p. 276, for Feb. 26, 1881.

"W. G. F.," or PROFESSOR W. G. FARLOW, of Harvard University.—American Journal of Science for February, 1882, p. 157, giving extracts from Stahl in the Jen. Zeitschrift, Germany.

THE DEVELOPMENT OF THE TREE-TOAD.[1]

BY MARY H. HINCKLEY.

A RECORD of several seasons gives the appearance of *Hyla versicolor* in the spring, in Milton, Massachusetts, from about the 1st to the 10th of May. Tadpoles of this species I have found most abundant in the water of small, still, shadowy ponds near large trees. The eggs are attached singly and in small groups for a distance of one or two yards along the grasses which grow up and rest on the water. Unless the grass is parted they are not readily seen. The gelatinous substance surrounding the eggs is exceedingly thin. When first laid they are of a drab color on the upper surface, which becomes lighter after a few hours in the water. The under surface is white; the extent of this color varies; in some cases only a spot of drab is seen on an otherwise white egg. The period of egg-laying, according to my observations, extends from the first week in May to July. The development of the egg is rapid, being accomplished within forty-eight hours. When first hatched the tadpole is about a quarter of an inch long, of a pale yellow color, dotted with olive on the head and sides of the body. During the first week the external gills are developed and resorbed. At the same time the olive color gradually increases and deepens till it extends over the upper surface of the tadpole. A fine dotting of gold color also appears on both upper and under surfaces. In the water, however, they look black. The holders, at first so prominent, disappear within ten days. The head and body are short. The tail is broad and thick. The eyes are prominent, set widely apart, and of a brilliant flame color; the iris in some specimens is quartered by dark lines. The lips are broad. The nostril openings and two perpendicular lines on the muzzle, also a line from before the eyes down each side to the tail, are gold colored. Transverse bars of the same tint on the upper edge of the tail are sometimes seen.

The tadpoles are shy and quick in movement as young fishes, moving through the water with the least perceptible motion of the tail. They do not collect together, but where there is room enough, each tadpole goes its own way independently. They are hardy, and probably owing in some degree to their quick move-

[1] Abstract of a paper published in the Proceedings of the Boston Society of Natural History, Vol. XXI, Nov. 17, 1880.

ments, are more exempt from mutilation by water enemies than other species, rarely losing eyes or tail.

HINCKLEY, DEVELOPMENT OF HYLA VERSICOLOR.

When about three weeks old the hind legs are in sight as small white buds in front of the base of the tail near the lower edge on each side. An iridescence of great brilliancy is seen on the white surface of the abdomen and sides of the body. The head and upper portion of the body show a bluish, metallic sheen, and the tail, which is more or less flecked with brown or black, becomes in some specimens a bright red color. It would be difficult to exaggerate the beauty of coloring of these tadpoles, it exceeds in brilliancy and variety any species found in this locality.

As the legs become more fully developed, the coloring of the head and body tends from dark olive to a light, grayish-green. In the seventh week the body begins to lose its roundness, and the arms are seen to be moved under the skin, as if the tadpole were impatient to get them free. The head then appears disproportionately large. At this stage the tadpoles vary from gray to pea-green in color. They are found in the shallow water near the shore, where many fall prey to various aquatic birds. During the eighth week they appear to take little food; the arms are thrown out, the tail is gradually resorbed, the mouth developed, and the frogs leave the water. While a few specimens retain the color of gray up to this time, nearly all will be found of various shades of tender green on the upper surfaces, bordered with different tints of gray or salmon color. The abdomen is white. Green asserts itself much earlier in some specimens than others; but I have never seen a tadpole of this species develop into the frog that did not sooner or later become green. The markings on the back also vary in time of appearance; but the coloring of black on the head, body and limbs, the smooth shiny patch below the eyes, the granulated appearance of the skin, and the yellow coloring in the folds of the legs, usually appear in the order of their mention, and after the frogs have left the water.

Last season a small pond in an open pasture, about fifteen rods from a wood, furnished a good opportunity for observing their movements on leaving the water. From the 19th to the 24th of July, numbers of the young frogs, with tails in different stages of resorption, were found on the ground, weeds, and grasses about the pond, which by this time had become reduced by evaporation to a shallow pool. They represented a variety of shades of green; a few were gray, and occasionally one was scarcely to be separated in color from the mud on which it rested. I observed those on the ground frequently capture the small spiders which were numerous there. As soon as they left the water their object, evidently, was to reach the wood. Apparently aware of their danger in this exposed journey, they drew attention to themselves, when approached, by continually springing out of harm's way; but after the shrubbery was reached they rarely made any attempt to escape when discovered, trusting wholly, like the mature frogs, to their disguise of coloring for safety. I found several of them on a small apple tree which was in the line of their journey. They were on the new growth which was overrun with Aphides, and the frogs had assumed a deep emerald-green, so like the leaf that it was difficult at first glance to distinguish them from it. After they reached the wood I could trace them no farther. I think it probable that some observers have mistaken *H. versicolor* at this age for the adults of another species of Hyla.

My knowledge of the frogs from this stage till they reach maturity, is confined chiefly to those reared in a fernery. For the first three months they retained the green color, as a rule, with occasional changes to tints of brown and gray, matching the earth or branches to which they clung. After that time shades of gray became the rule and green the exception. The black markings on the head, body and limbs did not change excepting to vary in distinctness. Their food, which they never took unless alive, was Aphides at first, but soon flies formed their chief diet. During the day they commonly remained motionless, hidden behind the bark of the branches, with feet and hands, which are evidently extremely sensitive, compactly folded under the body, so that only their outer edges came in contact with the surface on which they were seated. Occasionally they would pat the disks against the sides of the body as if to moisten them. Their activity was reserved for the night, although rain accompanied by a south wind, caused them to move about uneasily. About the 1st of October they left the branches and ferns and nestled away in the damp earth and moss, where they remained through the winter, unless exposed to a temperature above 60°. They took no food from the first week in October till the 14th of the following May, when I gave them their liberty. They were then placed on an oak tree, where, after climbing till a suitable crevice or hiding place was found, they backed themselves into it and became to all appearance like a part of the bark of the tree.

ON SOME ENTOMOSTRACA OF LAKE MICHIGAN AND ADJACENT WATERS.

BY S. A. FORBES.

(Continued from July number.)

A THIRD Calanid deserves special mention as a species of Limnocalanus, a genus known hitherto only from Scandinavian lakes. It is readily distinguished, without dissection, from the other fresh-water Calanidæ, by the extraordinary length, size and prominence of the five or six terminal setæ of the first maxillipeds. The second maxillipeds are also very long. The legs are all bi-ramose, the inner ramus of the fifth pair resembling the same appendage of the other legs. This species, which may be *Limnocalanus macrurus* Sars, was first sent me by Mr. C. S. Fellows, of Chicago, about four years ago, a mutilated female having been obtained by him from the city water supply. The furca is as long as the entire abdomen. The rami are hairy, parallel, about seven times as long as wide, and provided with five subequal terminal setæ, and one some distance in front of the external angle. It has been collected thus far only in the south end of the lake. I have found it abundant in the city harbor, even in the polluted water near the mouth of the river, where it is associated especially with *Diaptomus sicilis* and the Cyclops next to be described.

The Calanidæ seem to have an unusual development in this country; and to facilitate their study and comparison, I have described further on all the species which I have hitherto clearly distinguished.

Smallest and most abundant of the Copepoda of the lake, is a minute Cyclops (*C. thomasi*, n. s., Pl. IX Figs. 10, 11 and 16), only four hundredths of an inch in length (without setæ) and about eleven thousandths of an inch in width, slender and colorless, with remarkably long caudal stylets; and especially noticeable for the great difference in the length of the caudal setæ. The inner and outer ones are inconspicuous, while the outer of the two median setæ is longer than the furca, and the inner of these two is as long as the whole abdomen. This Cyclops was first received from Mr. B. W. Thomas, and I have since found it excessively abundant in the lake. I have not encountered it, however, in any other waters.

Its nearest European ally is apparently *Cyclops bicuspidatus*

PLATE VIII.

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Claus, but from this the description on another page will serve easily to distinguish it.

This is the only Cyclops which I have yet noticed in Lake Michigan, and is certainly far the most abundant species.

Of the many species of Cladocera occurring here, I have selected but three for especial comment. The first of these, *Leptodora hyalina* Lillj. (Pl. IX Fig. 3), which occurs also in Europe, is a most interesting creature. When in its native element it is almost perfectly transparent, and consequently invisible—a true microscopic ghost—a fact associated by Professor Weissmann with its predaceous habit and feeble locomotive power. To the little Cyclops host it must indeed be a dreadful and mysterious enemy. Concealed by its transparency, it need not lurk in obscure hiding places, like grosser robbers, but can wing its way unnoticed among its prey.

The common Daphnids of the lake are, however, almost equally transparent, and as these are not at all carnivorous, we must either suppose that they have developed independently the same peculiarity for a directly opposite purpose—that of self-protection—or else we must conclude that there is something in the conditions of life here which tends to render the bodies of all entomostraca transparent.

A single mutilated specimen of Leptodora was dredged by Professor S. I. Smith in Lake Superior; it has been found in both ends of Lake Michigan, and I have also collected it in the Illinois river and the small lakes adjacent, and in a muddy pond in Northern Illinois only half a mile across and twenty feet in depth.

A careful comparison of my specimens with the descriptions and figures of Lilljeborg and Weissmann, leaves no room for doubt that they belong to the European species.

This is likewise the case with the remarkable *Holopedium gibberum* Zaddach (Pl. IX Figs. 12–15) found as yet only in Grand Traverse bay, where it occurred not rarely with Epischura, Diaptomus, Cyclops and *Daphnia hyalina*. In this animal the bivalve shell has undergone a truly monstrous development, the brood cavity on the back being elevated to a height greater, when filled with young, than that of the remainder of the animal. On the other hand, the lateral valves of the shell are so shortened that they do not completely cover the branchial feet. For the protection of the creature and its young, and partly also, according to

P. E. Müller's supposition, to restore the balance of the body and enable it to float feet downwards, the shell secretes a layer or cloak of a gelatinous character and of an enormous thickness, relatively to the size of the animal. Through a slit in this mantle the antennæ and feet are thrust out; but otherwise the animal is completely buried in a lump of gelatine.

Bosmina (Pl. IX Fig. 17) was less abundant in my collections than the other forms mentioned, but occurred very commonly in the stomachs of *Mysis oculatus* dredged from the deeper waters of the bay.

The commonest Cladocera in the lake are two forms of Daphnia, remarkable for their thinness and exquisite transparency. They are allied to *galeata* and *pellucida* of the old world, recently reduced by Adolph Lutz to varieties of *Daphnia hyalina* Leydig. Although our specimens do not agree strictly either with the descriptions or the figures of those varieties extant, their differences probably do not pass the limits of allowable variation in this excessively variable species. The head is keeled, convex in dorsal outline and either rounded *(pellucida)* or pointed *(galeata)* in front, the shell is compressed and reticulate, and terminates posteriorly in a long, straight, dentate spine.

An allied species, from the smaller Illinois lakes, where it is in autumn by far the most abundant entomostracan, resembles *Daphnia cederströmii* Schödler, but differs especially in the still more enormous development of the head. This is as high as the body and more than two-thirds as long, deeply concave on the upper border, the apex curving upwards far beyond the dorsal line of the body. The head is expanded inferiorly also to such a degree that the sensory hairs of the antennules fall much short of the tip of the rostrum. The shell is reticulate, and its spine long and straight, there is no *macula nigra*, and the caudal claws have a row of teeth at their base. For this curious form I propose the name of *Daphnia retrocurva*.

I have not found it in Lake Michigan, although in the smaller lakes it is mingled with both varieties of *Daphnia hyalina*. Even in the young, before they have left the brood cavity of the mother, the helmet is developed far beyond that of the adult of any of the latter species.

The female carries but one or two eggs, and the young sometimes attain a size more than half that of the body of the mother within the shell, before they leave her protection.

This is the farthest extreme of a development of the head, which, beginning with such forms as *pellucida*, runs through *galeata*, *apicata*, *berolinensis*, *vitrea*, *kahlenbergensis* and *cederströmii* to the present species, where it reaches truly enormous proportions. The meaning of such a character I am not able to imagine. The expansion of the head is a thin and flexible plate, affording lodgment to no organs, and seems an utterly useless encumbrance.

In Geneva lake, Wisconsin, the most abundant entomostracan in October, was an extremely variable Daphnia approaching *hyalina* on the one hand and *retrocurva* on the other, but still separable from both. It is evident that this group of helmeted Daphnias is still in process of active evolution, and it is possible that there are no actual breaks anywhere along the line from *hyalina* to *retrocurva*, although in the former the head may be scarcely larger than in *Daphia pulex*, while in the latter it is often more than half as large as the body.

Comparing the Daphnias of Lake Michigan with those of Geneva lake, Wis. (nine miles long and twenty-three fathoms in depth), those of Long lake, Ills. (one and a half miles long and six fathoms deep), and those of other still smaller lakes of that region, a curious progressive predominance of the large-helmeted forms is very evident in passing from larger to smaller lakes. If we extend the comparison further, and include the other entomostraca, and the swamps and smaller ponds as well, we shall be struck by the inferior development of the entomostraca of the larger bodies of water, in numbers, in size and robustness, and in reproductive power. Their smaller numbers and size are doubtless due to the relative scarcity of food. The system of aquatic animal life rests essentially upon the vegetable world, although perhaps less strictly than does the terrestrial system; and in a large and deep lake vegetation is much less abundant than in a narrower and shallower one, not only relatively to the amount of water but also to the area of the bottom. (In all the lakes which I have dredged, life of all sorts was much more scanty in the interior deeper portions than along the margins.) From this deficiency of plant life results a deficiency of food for entomostraca, whether of Algæ, of Protozoa or of higher forms, and hence, of course, a smaller number of the entomostraca themselves, with more slender bodies suitable for more rapid locomotion.

The difference of reproductive energy, as shown by the much smaller egg-masses borne by the lacustrine species, depends upon the vastly greater destruction to which the paludinal crustacea are subjected. Many of the latter occupy waters liable to be exhausted by drought, with a consequent enormous waste of entomostracan life. The opportunity for reproduction is here greatly limited—in some situations to early spring alone—and the chances for destruction of the summer eggs in the dry and often dusty soil are so numerous that only the most prolific species can maintain themselves under such conditions.

Further, the marshes and shallower lakes are the favorite breeding grounds of fishes, which migrate to them in spawning time, if possible, and it is from the entomostraca found here that most young fishes get their earliest food supplies—a danger from which the deep-water species are measurably free. Not only is a high reproductive power therefore rendered unnecessary among the latter by their freedom from many dangers to which the shallow-water species are exposed, but in view of the relatively small amount of food available for them, a high rate of multiplication would be a positive injury, and could result only in wholesale starvation.

EXPLANATION OF PLATE IX.

FIG. 1.—Osphranticum labronectum, second maxilliped, × 123.
" 2.— " " mandible and palpus, × 75.
" 3.—Leptodora hyalina, ♀ (After Weissman).
" 4.—Osphranticum labronectum, ♂, antennæ, × 38.
" 5.— " " ♂, part of left antenna, showing olfactory clubs, × 120.
" 6.—Cyclops insectus, ♂, × 38.
" 7.—Osphranticum labronectum, leg of fourth pair.
" 8.—Epischura lacustris, ♂, × 42. (Some of the basal segments of the antenna are concealed. The segmentation of the cephalothorax is incompletely shown. See text.)
" 9.—Osphranticum labronectum, antennula.
" 10.—Cyclops thomasi, leg of fifth pair.
" 11.— " " ♀, × 38.
" 12.—Holopedium gibberum, ♀.
" 13.— " " abdomen and furca.
" 14.— " " marking of shell.
" 15.— " " eye and macula nigra.
" 16.—Cyclops thomasi, antenna, × 65.
" 17.—Bosmina (after Gerstaecker).

PLATE IX.

NEW GENERA AND SPECIES OF COPEPODA.

Genus Osphranticum, gen. nov.

(Plate VIII Figs. 24, 28 and 29; Plate IX Figs. 1, 2, 4, 5, 7 and 9.)

This genus is similar to Diaptomus in general appearance, but differs especially in the structure of the fifth pair of legs of male and female.

The antennæ are 23-jointed, the right of the male geniculate between the 18th and 19th. Joints 13–18 are dilated on this antenna, and the 19th and 20th are united, reducing the number to 22.

The antennules and mouth-parts have the same general structure as in Diaptomus, but the former are unusually large. The legs of the first pair have both rami 3-jointed. In the male both legs of the fifth pair are bi-ramose and armed with plumose cilia (Pl. VIII Fig. 29). The inner ramus of each is 3-jointed and unmodified. In the outer ramus of the left leg the second and third joints are consolidated, and bear three plumose terminal setæ, a strong spine on the outer margin and a pubescent tubercle at the inner base. The outer ramus of the right leg is 3-jointed, bears two setæ at tip and is unarmed within.

In the female the legs of the fifth pair are nearly alike and only the third joint of the outer ramus is modified (compare Fig. 28 Pl. VIII, with Fig. 7 Pl. IX).

1. *Osphranticum labronectum*, sp. nov.

The cephalothorax is oval, symmetrical, and composed of six segments regularly decreasing in length from before backwards. The head is not distinct from the first thoracic segment, and the posterior angles of the cephalothorax are evenly rounded. The abdomen is cylindrical and unarmed; of five segments in the male, four in the female. The antennæ scarcely surpass the cephalothorax, and are very richly supplied with olfactory clubs. The second joint is nearly as long as the three following. The setæ of the antennules reach to the 20th joint of the antennæ. The egg-sac in the female is unusually large, obovate, widest posteriorly, flattened vertically, and extending to the tips of the setæ. The latter are five in number to each ramus, the fourth from the outside being much the longest.

This species is readily distinguished in life by the short and compact thorax (its depth being contained but two and a-half times in its length), and by its steady movement in the water, as it does not commonly swim with the jerking motion of Diaptomus. Those taken at Normal were pale brown in color, without markings. Found in a wayside pool at Normal, Ill., in February, 1877, and in swamps in Iroquois county, in the same month of 1882. The females of the latter lot were bearing eggs.

Genus Diaptomus.

1. *Diaptomus sicilis*, sp. nov. (Pl. VIII Figs. 9 and 20.)

This is the American representative of *Diaptomus gracilis* of Europe. It differs from that species as described by Sars, as follows: The antepenultimate joint of the right male antenna is not armed with a hook, but with a long and slender spine-like process, nearly equaling the following joint. The last joint of the fifth pair of legs of the female is not distinct, nor indeed at all distinguishable, and its terminal spines reach less than half the distance to the tip of the claw of the penultimate joint. The inner ramus of this leg is much longer than the basal joint of the outer ramus, and is not 2-jointed in any specimen which I have examined. The terminal claw of the right foot of the male is regularly curved from base to apex.

The species is usually colorless, although I have seen occasionally individuals of a uniform crimson. Equally conspicuous differences are apparent on comparison of the legs of the fifth pair of the male with the descriptions and figures of Gruber[1] (see Fig. 9).

The thoracic segments corresponding to the two last pairs of legs are not distinct, but the head is divided into an anterior and a posterior part by an evident constriction and an incomplete suture. The body is .065 in. long (without caudal setæ) by one-fourth that depth.

This species has a special economical value as constituting, with one species of Cyclops, hereafter to be described, almost the entire first food of the whitefish. I have not found it anywhere outside of Lake Michigan, but there it occurs in immense numbers; sometimes being the most abundant species appearing in the net. A similar but not identical form occurs in the small and shallow lakes of Northern Illinois and Indiana. The latter is possibly the *D. pallidus* of Herrick,[2] although neither his description nor figures are really specific.

2. *Diaptomus leptopus*, sp. nov. (Pl. VIII Figs. 17–19.)

This species resembles the foregoing in general appearance, but may be easily distinguished by the relative robustness of the antennæ and the shortness of their hairs and spines, by the width and shortness of the rami of the furca (the width being a little more than two-thirds the length), by the serrate setæ of the swimming legs and the different shape and proportions of the fifth pair.

An average male measures .07 in. in length by .015 in. in depth. The cephalothorax is a little the widest before the middle, with angles rounded and terminating in a single acute spine. The second segment of the female abdomen is very short. The antennæ reach to the tip of the furca, and the antepenultimate segment of the right antenna bears a small hook at the tip in the male.

The outer ramus of the first pair of legs has three long bristles at its tip, of which the outer is dentate externally and plumose within, while the short spine at its base is dentate on both margins. The outer edge of this ramus is fringed with long delicate pubescence. On all the swimming feet the terminal seta is dentate externally. The characters of the fifth pair of legs of male and female are sufficiently shown by Figs. 17, 18 and 19 of the first plate.

This species is of especial interest and value, since I have collected it from pools in Southern Massachusetts, near Wood's Holl, and also from similar situations at Normal, Illinois.

The characters of specimens from these widely separate localities agree very closely, thus affording a most useful indication of the constancy of such characters as I have used in separating our species of this genus.

3. *Diaptomus stagnalis*, sp. nov. (Pl. VIII Figs. 8, 10–12 and 14.)

This species is the largest of its genus which I have seen, measuring .11 in. without the caudal setæ. It is apparently nearest to *Diaptomus cæruleus* (= *castor*) of Europe, but differs constantly from that form in several particulars in which the various figures of *castor* and *westwoodii* given by Baird, Lilljeborg, Lubbock and Brady agree with each other.

The lateral angles of the cephalothorax are salient in the male and bifid in the female. The branches of the furca are nearly as broad as long, are hairy within and

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[1] Ueber zwei süss-wasser-Calaniden.

[2] Microscopic Entomostraca. By C. G. Herrick. The Geological and Natural History Survey of Minnesota. The seventh annual report for the year 1878. Minneapolis, 1879.

about equal in length to the last abdominal segment. The antennæ are robust and long, attaining the middle of the abdomen, and the antepenultimate joint of the male bears at its tip a stout conical process about one-third the length of the joint.

On all the swimming feet the lateral spines of the outer ramus are bi-serrate, and the outer seta of the terminal three is strongly and sharply serrate without. This seta is about twice as broad as the others, and is but sparingly plumose within.

The inner ramus of the right leg of the fifth pair is rudimentary and unarmed, about half the length of the basal joint of the outer ramus.

The third joint of the outer ramus of the fifth pair of legs in the female is distinct and bears three setæ, while the inner margin of the tip of the preceding joint is coarsely toothed. The inner ramus is bi-articulate and terminates in two long feathered spines, which are longer than the whole ramus.

Several specimens were taken from pools in Central Illinois, in early Spring. All were red throughout.

4. *Diaptomus sanguineus* Forbes. (Pl. VIII Figs. 1–7 and 13.)

To the description of this species published in the first Bulletin of the Illinois Museum of Natural History, I will add but a few details. The posterior angles of the cephalothorax in the female are bifid, and its dorsal outline, regular in the male, is broken in the other sex by an elevation at the anterior margin of the penultimate segment, within which one of the levator muscles of the abdomen takes its rise. I know of no other Diaptomus possessing this character. None of the bristles of the anterior feet are serrate, although the lateral spines of the outer rami are so. The outer margins of these feet are not hairy.

Genus EPISCHURA, gen. nov.

(Pl. VIII, Figs. 15, 16, 21–23, 25–27, and Pl. IX, Fig. 8.)

In the general character of the legs, both natatory and clasping, this genus stands near Heterocope of Sars, but is remarkably distinguished from all the other Copepoda known to me by the development of the abdomen of the male as a prehensile organ. The abdomen has five segments, the second and third of which are produced on the right side as large and strong processes which act against each other like forceps, while a toothed plate on the fourth segment and a spatulate one on the fifth, assist to form a peculiar and powerful grasping apparatus. The cephalothorax has six segments, of which the last bears both the fourth and fifth pairs of legs. The head is very distinct from the following segment. The eye is single, small.

The female abdomen is four-jointed (the first joint very short), and is usually provided with a curved, cylindrical spermatophore, firmly cemented to the under side of the ovisac and extending upwards on the right, beside the third segment.

In the male the legs of the fifth pair are both one-branched, the left ramus three-jointed and the right two-jointed. In the former the second and third joints oppose an enormous, curved and flattened process of the first. In the right leg the second joint is conical and hinged upon the first.

The fifth legs of the female are likewise one-branched and simple. They are three-jointed, small and unarmed, except at the tip where they are palmately toothed.

In all the remaining legs of both sexes, the inner ramus has but one joint, and the outer three.

The antennæ are 25-jointed and the right of the male is geniculate.

1. *Epischura lacustris*, sp. nov.

The second segment of the abdomen of the male is twice as long as the first, and produced to the right as a large, elongate, triangular process, somewhat hooked backwards at the tip. The third segment is similarly produced, but rounded and expanded at the tip, which is roughened before and behind.

From the right side of the fourth segment arises a stout process bearing at its apex a hatchet-shaped plate with seven broad obtuse serratures on its anterior margin. This process is roughened behind, where it is opposed to the concave side of the left ramus of the furca. From the same side of the fifth segment, a short flattened plate, of a spatulate or paddle-like form, extends forward above or beyond the toothed process just mentioned.

The antennæ are 25-jointed, and reach to the second segment of the abdomen. There are especially prominent sensory hairs on the first and third joints, borne at the tips of long spines. The antennules are short, the ramus apparently but three-jointed, the short, median joints common in this appendage being only obscurely indicated. The mandible has but seven teeth, the first simple and acute, separated from the second by an interval about equal to the second and third, the second to the sixth bifid, the seventh entire and acute. The usual plumose bristle is replaced by a sharp, simple spine.

The outer ramus of the fourth pair of legs has two teeth at the outer tip of each of the two basal joints. The terminal joint of this ramus is armed as follows : a short simple spine at middle of outer margin and another at the distal outer angle; a single large and long terminal seta, strongly and sharply toothed externally and plumose within, and four long plumose setæ attached to the inner margin.

The left leg of the fifth pair in the male, viewed from behind, has the basal joint very large, broader than long, with the inner inferior angle produced downwards as a long, stout, curved process or arm as long as the two remaining joints. The second joint is trapezoidal, shortest within. The third joint is about half as wide at base as the first, is straight without, with a sharp, small tooth at its distal third, and bifid at tip. On the inner margin this joint is at first dilated a little, and then deeply excavated to the narrow tip, to receive the lower end of the left leg, the lower two-thirds of this margin forming the segment of a circle.

The right leg is two-jointed, the first joint twice as long as broad, enlarged at the lower end forming an auriculate expansion at its inner inferior angle. The second joint is conical in outline and about two-thirds as long as the first.

The terminal bristles of the rami are very broad and strong in the female, the outer one especially having an extraordinary size and thickness. There is also at the outer angle of each ramus a short, stout spine, that on the left ramus being inflated like the outer bristle.

The legs of the fifth pair in the female are three-jointed and similar, the basal joint short and broad, the second two and one-half times as long as wide. The leg terminates by four diverging teeth, preceded by two others, one on each side.

Taken in the towing net abundantly in October, 1881, at Grand Traverse bay; also obtained rarely by Mr. B. W. Thomas, from the city water of Chicago.

Genus LIMNOCALANUS.

1. *Limnocalanus macrurus?* Sars.

Our specimens are distinguished from *Limnocalanus macrurus* as described by Sar ,[1] by the antennæ, which are 24-jointed instead of 25; by the mandibles which

[1] Oversigt af de indenlandske Ferskvands copepoder. Forhandlinger i Videnskabs-Selskabet i Christiana. Aar, 1862, pp. 212–262.

have but eight teeth instead of nine—only one setiform tooth where the other has two; and by the second pair of antennæ, which are rather slender, and armed with long but weak setæ. The penultimate abdominal segment has a terminal circlet of spinules.

Genus Cyclops.

1. *Cyclops thomasi*, n. s. (Pl. IX Figs. 10, 11 and 16.)

Elongate, slender, broadest in front and tapering backward, antennæ 17-jointed, reaching the middle of the third segment.

The first abdominal segment in the female is broad in front and slightly emarginate on each side before the anterior angles, and the last segment has a terminal circlet of small spines. The rami of the furca are more than half as long as the abdomen, and each bears two short rows of transverse spinules outside, one at the anterior the other at the posterior third. With the latter a spine occurs about as long as the outer terminal seta. The inner seta at the tip of the ramus is about half the length of the furca, the outer still shorter. The inner median seta is as long as the abdomen and furca, and the outer about half as long.

In the outer ramus of the first pair of legs the terminal joint has one spine and two setæ at the tip, one spine on the outer margin and two setæ within.

In the second, third and fourth pairs the last joint has one spine and one seta at tip, two spines externally and two setæ within. The inner rami of the second and third pairs terminate in one spine and one seta, that of the fourth pair in two spines, the inner of which is only half as long as the other.

The legs of the fifth pair are two-jointed, with the basal joint quadrate, broad, and bearing one long spine. The second joint is narrow and longer, parallel and truncate, with one terminal spine about equal to the preceding, and one about half that length.

From *C. bicuspidatus* Claus, this species may be distinguished by the armature of the outer ramus of the first pair of legs, and from *C. bisetosus* Rehberg., by the armature of the outer rami of the other legs.

It shares with *Diaptomus sicilis* the responsibility of affording to the young whitefish their earliest food.

2. *Cyclops insectus*, sp. nov. (Pl. IX Fig. 6.)

Closely allied to the preceding, but more robust in all its parts, and with the second cephalothoracic segment widest. The abdominal segments are all bordered with spinules posteriorly. The two median caudal setæ are much more nearly equal than in *thomasi*, the outer and the inner are very short, but longer than in that species. The inner in our specimens is longer than the outer—the reverse being the case in *bicuspidatus* as described by Claus.

The legs are armed nearly as in *thomasi*, but the last joint of the outer ramus of the first pair has two spines externally besides the one at the tip, and the terminal spines on the last segment of the inner ramus of the fourth pair of legs are about equal.

This is, perhaps, the commonest of the minute Cyclops of the small, temporary pools in Northern Illinois.

3. *Cyclops agilis* Koch. (= *serrulatus* Fischer.)

This species, distinguishable at a glance by its 12-jointed antennæ and a fringe of spinules along each ramus of the furca, occurs with the preceding, but less abundantly.

ORGANIC PHYSICS.

BY CHARLES MORRIS.

(Continued from July number.)

BUT it is necessary to more particularly examine this peculiar organic synthesis, through which a germinal cell is produced containing molecular energies derived from every portion of the body. The leucocytes appear to generally answer the requirements, but in an organism so complex as that of the human body, we should naturally look for something more than a mere chance aggregation of cellular germs into a completely generalized germ. Such a process would be most likely to yield few perfectly organized germs, and the production of abnormal should far exceed that of normal embryos. Evidently the continuance of the human species would be impossible unless full provision were made for the complete union of these cellular germs. And if such provision be made, the organs adapted to it can scarcely be invisible to us.

In fact, as we have in the leucocyte an active cellular organism whose duty in the body has been a puzzle to physiologists, so we find organs in the body alike puzzling. And significantly these organs seem devoted only to the formation of leucocytes. They constitute the lymphatic vascular system, and the ductless glands, including those of both the vascular systems of the body.

Physiologically there seems no especial necessity for the lymphatic vessels. Why should there be two separate vascular systems, each permeating every portion of the body, and only joining into one at a single point in their whole extensive course? We know the main purposes of the blood system, but the duty ascribed to the lymphatic system is one that inadequately explains the existence of such an extensive system of vessels. If the blood capillaries exude a blastema for the immediate nutrition of the tissues, and if after nutrition is performed there remains a liquid containing the waste material of the tissues, it certainly seems as if the blood capillaries might be capable of reabsorbing this liquid, and that there would not be required for the duty of conveying it to the blood a second system of vessels equally extensive with that of the veins and arteries.

We should naturally look for some other duty in the lymphatic vessels, while the conveyance of waste should be looked upon as a secondary duty. And such a primary duty may present itself in the formation and conveyance of the leucocytes. If we accept the dogma which has certainly not been disproved, that no new cell arises except as a derivative from some preceding cell, then we must ascribe to the leucocytes a cellular origin. And as they arise in immediate contiguity to the cells of the tissues which are bathed by the lymph, we have some warrant for ascribing their origin to these cells.

If, then, the primary duty of the lymphatic vessels be the formation and conveyance of leucocytes, there must be some sufficient physiologic reason why these corpuscles are not immediately delivered to the blood. If our hypothesis of the duty of the leucocytes be the correct one, it is not difficult to conceive this reason. If the combination of the germinal cells from every tissue into generalized cells be an essential duty of the body, then this union may be mainly performed in the lymphatic vessels, and the lymphatic glands may be organs specially adapted to this purpose.

These glands are very numerous. The body contains in all some 600 or 700 of them. At least one of them occurs upon every lymphatic vessel, and the minute ones on the smaller vessels are succeeded by larger ones on the lymphatic trunk vessels, particularly in the upper arm and thigh, the neck, the intestinal region, &c.

In these glands the flow of the lymph is checked. After passing through them it is much richer in leucocytes than before entering them. Evidently they have some essential connection with the development of the leucocytes. May not their main duty be the union of leucocytes into more generalized cells? In the line of flow of the lymph from every minor locality of the body one of these glands is sure to be encountered. Into this flow the leucocytes, or the undeveloped buds, which have arisen from every minute portion, or every cell of that local region. And within the gland some active process of assimilation takes place, which may be the absorption of undeveloped by developed leucocytes, and a rapid growth in consequence. If so, in every gland would be formed germinal cells representing in their molecular conditions all the tissues of the region feeding that gland. Again, as the minor vessels aggregate to form trunk vessels, other glands appear, into which the leucocytes from local regions are poured. In these the process of combination may be continued, so that the corpuscles which flow from every lymphatic gland will be molecular reproductions of all the tissues which send lymph into that gland. Thus the group of glands in the arm-pit may yield leucocytes representing the whole arm; those in the groin, the whole leg; those in the neck, the whole head, &c.

In such an office we have a sufficient and most important duty for the lymphatic system and its numerous glands. The stream of lymph poured into the blood conveys leucocytes each of which represents in its molecular organization some extensive region of the body. An important duty remains yet to be performed; the combination of these leucocytes into generalized representatives of the whole body. And the blood system has a series of glandular organs which are perhaps devoted to this duty alone.

There are no organs of the body which have been a greater puzzle to physiologists than these ductless glands of the blood vessels, the spleen, thyroid, supra renal, &c. Many efforts have been made to explain them, but all that is really known is, that they favor the growth of leucocytes and cause a decrease in the number of red blood corpuscles. This is the only duty that can be ascribed to the principal of these glands, the spleen. Not the least puzzling thing about them is that they seem to have nothing to do with the health and vigor of the body. They may be extirpated and life go on as before without a check. There is certainly something very significant in this fact. It is incredible that such organs should be utterly without vital office in the body, and it is certain that no other internal portions of the body of the same size could be removed without serious injury. Perhaps if the effect upon the reproductive powers of the extirpation of the spleen had been investigated, some important results might have been discovered, for the action of the ductless glands in the increase of leucocytes appears to indicate that they are concerned solely with reproduction, and have nothing to do with the individual life of the body.

The duty of these closed glands, then, may be that of combining the corpuscular representatives of the different organs into corpuscular representatives of the body as a whole. The disappearance of the red blood cells may indicate a vigorous nutritive action of the leucocytes, and in the rapid and continuous flow of the blood through these glands, the best developed cells may complete their molecular generalization and be prepared for excretion from the body by the reproductive glands, as the germs of independent organisms.

A brief re-statement of the hypothesis here advanced may not be amiss. The human body is a colony of cells arranged into organized tissues. Each cell individually considered pursues its life process independently of all others. Its life duty is simply to assimilate nutriment, grow, and to produce daughter cells with the same functions. The life duty of the whole body is the same, to assimilate nutriment, to grow, and to produce daughter cells capable of going through the same process. And these functions as performed by the individual cells are the bases of the same functions as performed by the whole body. Thus the body has a double duty to perform, to subserve the ends of individual life by growth, and those of race life by reproduction. Coherence of the newly budded cells is the organic agency in the former, freedom of these new cells in the latter. And as each cell is adapted to perform both these duties, so is the body as a whole. It has two complete and separate vascular systems, one devoted to the duty of nutrition of the coherent cells, the other to the nutrition of the free cells. The free cells live their life as independent offspring of the fixed cells. It has also two systems of glands devoted to these two duties; the ordinary blood gland is devoted to eliminating impurities from the blood, elaborating special nutriment, aiding in digestion and otherwise subserving the nutrition of the body; the lymphatic or closed gland performs the same duty for the leucocytes; and each system of vessels aids the duty of the other; the lymphatics by bringing the nutriment into direct contact with the tissues; and the blood vessels by their glandular aid to the nutrition of the leucocytes. The action of the glands is probably little more than one of retardation, and the bringing of the elements which enter them into close contiguity. No doubt the leucocytes assimilate material in the open vessels, but this takes place much more rapidly in the glands. And if the red blood cells are merely devitalized leucocytes, then their disappearance in the spleen may signify an assimilation of their molecules by the leucocytes. Thus the latter become more and more generalized in constitution as they absorb molecules originating in the cells of every portion of the body, and they finally reach the reproductive glands as complete molecular representatives of the body.

These reproductive glands, as a final process, excrete the germinal corpuscles from the body to pursue independently their life development. They are either completely thrown out, or else retained for a time in an organ which communicates with the exterior, and is essentially outside the individual organism. The germ is no more a part of the body in the ovary than is food in the mouth.

In the process we have thus indicated, the chemical synthesis of the germ is completed. From this point a reverse process of analysis sets in; the cell grows, divides, its molecules separate and produce specialized cells, these aggregate into special tissues, and finally the composite germ is analyzed into a specialized body, where a particular tissue represents every specific molecular energy in the germ.

But the germs thus produced are derivatives of the whole body, and therefore have male and female polarities arising from its two sides. In some cases they display a hermaphroditic development without further polarization. But in all the higher animals a more complete polarization is necessary, and is gained by the union of germs from separate sexual individuals. This process is preceded by a very significant one in the germs themselves; they continue their growth in the reproductive organs. In the female cell this is done by the process of budding, the result being the protrusion of one or more buds known as the polar bodies. In the formation of these buds one pole of the nucleus is always concerned, and it is evidently a true process of growth, in which the cell suffers a sexual differentiation, its male energy being budded off in these polar bodies. It is the first step in a hermaphroditic growth process which the germinal cell is not capable of carrying further, perhaps from the fact that all the provided nutriment is retained by the female half of the cell.

A somewhat similar process takes place in the male germ, it being here rather a division than a budding. Thus by a natural continuance of the principle of cell growth, the two sexual germs become specially polarized, and suited to unite into a vigorously polar bisexual germ. This final step of synthesis achieved, analysis immediately proceeds as before. Cell growth, division and specialization set in, and a new organic being arises to replace the two in which its germinal organization was elaborated.

In the process here indicated, we may perceive the fundamental cause of one phase of organic evolution, that of growth. The size attained by an animal must be governed, in some degree at least, by the relations of its nutritive and its reproductive energies. If the coherent tendency is favored by any circumstance, the size of the animal must increase, and its reproductive powers lessen. If the free budding tendency is favored, the opposite result must occur. Giants and dwarfs may be the results of abnormal preponderance of one or the other of these energies. There seems to be a constant tendency to vary in this particular, but the struggle for existence vigorously operates to hinder any continual reproduction of an aberration in size not suited to the best interests of the species. The influences which act upon the species, forcibly oppose aberration and restrain it within safe limits.

One influence tending to this result is that of increased or decreased nutrition. We know that in plants diminished nutrition checks growth and hastens the period of reproduction, while increased nutrition has the opposite effect. Probably the same rule holds good in animals. The cells, not fully fed, may cease to form coherent offspring and send off wandering offspring in search of food, reproductive energy being thus hastened. But if fully fed the principle of coherence may predominate to a later period in life and reproductive energy be decreased.

We may close with the presentation of a deduction of some importance from the foregoing hypothesis. It has a specific bearing upon the question of the origin of species. Darwin's theory is based upon the occurrence of innumerable minute variations, of which the most advantageous are preserved. This theory, while explaining in the main the phenomenon of the origin of species, has met with certain awkward difficulties, and perhaps needs to be pieced out with some adventitious hypothesis capable of filling these blanks. It is also desirable that the cause of these variations should be explained if possible.

One of the main objections to the Darwinian theory is the almost total lack of link forms between species. As a nearly absolute rule we find that species boldly succeeds species without a trace of the steps by which the passage from one to the other was made. The only explanation given of this is that of the imperfection of the geological record, but the implication from all the facts known is, that no linking forms existed—or, at least, not as a rule—but that direct steps from species to species have been made.

Nor is such a method of evolution inexplicable. In fact, Darwin has, perhaps, unnecessarily limited the application of his own principles, in confining the molding influences to minute variations. We know that there are many variations which are far from being minute. Extreme variations are occasionally produced, and marked variations which are capable of hereditary transmission are not uncommon.

The minute variations considered in the Darwinian theory are of universal occurrence. Perhaps no case ever arises of a completely normal birth—of an offspring precisely intermediate in all respects between its parents. Variations in size and vigor of the body as a whole, of the separate organs of the body, of the tissues composing these organs, &c., never fail to occur. There is a constant tendency to deviate from the type. And this tendency is in continual conflict with the opposite tendency produced by the struggle for existence and the necessity of preserving the best adaptation to natural conditions.

These minor variations may be due to variations in polar vigor of the molecules. We have already considered the question of molecular energy, and ascribed it to the degree of chemical polarity. The most vigorously acid or basic molecules must have the most vigorous growth energy. But this chemical polarity is constantly affected by cell division. The cells arising from continued division of a primary cell must differ widely in polarity, ranging from the neutral to the extreme of acid or basic conditions. Perhaps the free buds of the tissue cells may be their most vigorously polar offspring, yet differences cannot but occur in their degree of polarity, and the germinal cell into which they aggregate is perhaps made up of molecules considerably differing in chemical activity. In its evolution the growth vigor of the new tissues must be controlled by the chemical energy of the molecules from which they arise. Hence there may be variations from the parental form in every tissue and organ of the new form. The union of germs of two individuals adds a new element of complication to the case. If the molecules of the bisexual germs constitute poles of a galvanic circuit, there may be as many diverse circuits as there are diverse sets of molecules, and the chemical energy of each circuit will be controlled by the chemical vigor of its weaker pole. In developing there is a tendency to reproduce a normal copy of one parent in one lateral half of the offspring, and the other parent in the other half. But this tendency is checked by the influence exerted by each pole of the germ upon the other, so that the two halves of the body are forced into close though not into exact accordance.

Chemical vigor of the molecules must give special nutritive vigor to the tissues arising from them, and it may also yield a tendency to increased cellular coherence, thus doubly aiding the growth vigor of these tissues, while the weaker tissues may be more inclined to bud off free cells from lack of local nutrition.

It is possible that we have in this diversity of molecular chemical activity in the germ an explanation of the marked physical diversities in the tissues thence arising. But there are many cases of abnormal birth which cannot be ascribed to this cause. These abnormalities are very numerous, and differ widely in degree, but may be all grouped under three classes. In one class there is a deficiency in one or more tissues; in another class there is an excess; in a third class the tissues are normal but are displaced. In all these classes the normal type of the body is distinctly departed from.

Surgical records give abundant cases in each of these classes of anomalies. In the first class are deficiencies of every degree, from a very slight lack of tissue to an extreme deficiency. In some cases the limbs are missing, in some the head, in some the brain, in others parts of the viscera. Here a mere trunk appears without head or limbs. In the extreme case a mere shapeless lump of flesh is produced, destitute of any organic differentiation. A frequent case of deficiency is a lack of tissue in the line of junction of the lateral halves of the body. This causes coalescence of organs. In some cases the eyes coalesce, in some the sides of the nose, in some the jaws, this being sometimes so extreme that the ears are united into one. Similar cases of coalescence occur in the viscera, and in the lower limbs, which unite into one.

The second class of anomalies, that of excess organs, is equally marked. In a not unusual case an extra finger appears on each hand, often accompanied by an extra toe on each foot. From this simple duplication there are cases leading up to the most extreme duplication. Three or four eyes, a double tongue, heart, brain, face, and so on, appear, until every organ is duplicated. In more extreme cases we have duplication of the lower limbs, a double head, the head and part of the trunk double, and finally the whole body double, the two halves being united either intimately or by only a slight bond, like that of the Siamese twins. In some cases a triple body has appeared. These twin formations are not the result of a chance union of developing germs, for a complete series of duplications, from the slightest to the most extreme, are upon record.

Another set of anomalies, that of cleft or division between the lateral halves of the body, may perhaps be included in the same class. An ordinary case of this kind is that of cleft or hare lip, but it is found in every part of the dividing line of the body. The two sexual halves seem to have a tendency to develop separately, and this is perhaps a step in the process of duplication.

The third class of anomalies alluded to is that of displacement of organs. This also is of frequent occurrence. A few instances will suffice for illustration. The twin internal organs, the two kidneys, for instance, sometimes occur on the same side of the body. Of the exterior organs, a case is on record in which the thumb was missing on one hand, while a double thumb appeared on the other. A more striking case is one in which one foot had but a single toe, while the other foot had eight, one of these being partly cleft in indication of the ninth. Another case is that of eleven ribs on one side and thirteen on the other.

These anomalous births may have far more importance than has been ascribed to them; possibly, indeed, they may be of essential significance in the question of the origin of species. But before considering their consequences, it may be well to consider their cause. In doing so it becomes necessary to carry the theory of the struggle for existence further back than is usually done. Ordinarily it is made to apply only to the case of survival of the fittest in mature forms or in well developed embryos. But it may be applied with equal justice to the struggle for existence between germs, or between the leucocytes of the blood. These self-feeding amœboid corpuscles battle for nutriment. It is not probable that they all become fully generalized. Those most fully generalized possess the best nutrient relations to the blood, and are most apt to survive. Those only partly generalized are apt to lose their vitality and become nutriment for more vigorous leucocytes, or for the body tissues.

But many imperfectly developed leucocytes may be excreted by the reproductive glands and pass into the ovaries or the testes. Here a new struggle for existence arises, in which the best developed germs are undoubtedly favored, but in which chance circumstances may give an imperfectly developed one an advantage in the struggle. Where the lack of normality is slight, the chances for development are nearly equal. Where it is great, only abnormal conditions in the reproductive organs can give the abnormal germ the advantage; consequently the production of a considerable anomaly is of rare occurrence.

It is probable that cases of reversion to ancestral types are instances of germinal deficiency. The embryo, in its development, seems to pass through phases resembling every ancestral type of the species, and a partial deficiency of molecular organization in the germ may limit the development of some organ or tissue at the point reached by a more or less remote ancestor. Frequently there are reproduced characteristics of an ancestor a few generations removed. Occasionally there may be of a very remote ancestor. The sexual union of a normal with a deficient germ cannot yield a normal offspring, since the opposite polarities necessary to normal development are only partially present. For this reason every anomaly crosses the lateral line of the body, since the molecules of neither sexual side can develop without aid from those of the other.

As for the anomaly of displacement of organs, its cause is not apparent. The mode of arrangement of the germinal molecules controls the direction of their development, and the normal arrangement is forcibly produced through the action of the special polarities of these molecules. Yet perhaps there is some slight possibility of variation in the position of the molecules in the germ. If so, an exceedingly slight molecular displacement might produce a strongly marked organic displacement in the developed body.

The third class of anomalies, that of duplication, can also be met by a conjectural explanation. It may arise from duplication of leucocytes in the glands; two leucocytes coming from the same region of the body, and passing through the same lymphatic gland, may possibly combine, and thus yield a doubly polar corpuscle. If so, the germ thence arising would have a double, or perhaps a triple polarity in some of its molecules. And this duplication will be more complete as the gland producing it is a more central one. It may vary from the production of a slight duplication of tissue to that of a combination of two fully generalized leucocytes. If such a germ, with part or all of its molecules doubly polar, combine with a germ of the opposite sex and develop, the bisexual germ thus produced would be, to some extent, bipolar at one sexual pole and unipolar at the other. But as each pole exerts a controlling influence upon the development of the other, the result might be a bipolar or a unipolar organism, as one or the other sexual pole was preponderant in energy.

If duplication of organs or of bodies has its origin in the action of the glands upon the development of the leucocytes, as here supposed, this must, in some cases at least, result from abnormal organization of the glands. Only thus can be understood the frequent recurrence of the same malformation out of the same parents; this extending to the extreme case of twin births, which may occur more than once from the same mother.

Having thus offered some conjectural explanations as to the physiological cause of abnormal births, it remains to consider their bearing upon the question of the origin of species.

Abnormal offspring do not succumb without a struggle for life. Twin monstrosities often survive to maturity. A deficiency so extreme as the total lack of a brain does not cause immediate death. Brainless children have survived for some time after birth. Of course the chances are enormously against extreme aberrations from the normal type being transmitted. But slight aberrations are sometimes stubbornly transmitted, particularly if they be such as do not specially affect the life chance of the individual. Thus an extra finger may be sent down through several generations, and undoubtedly could, by intelligent sexual selection, be made a type feature. It stubbornly resists reversion through the influence of union of the abnormal with a normal individual.

There is a race prejudice which operates against the transmission of external abnormalities, but which cannot affect that of internal ones. The duplication of a muscle, for instance, would not appear externally, yet might give the animal possessing it some new movement of advantage in the life race. Its tendency to hereditary transmission must be as great as that of an extra finger, while it would escape the checking influence of the race prejudice.

It is equally possible that an extreme development, or an important duplication of brain tissue, might appear. Slight deficiency or excess of brain tissue is often transmitted through several generations. The former is in the line of reversion towards an ancestral type, or towards some new degraded type, in which organs belonging to several types may exist in combination. The latter is in the line of development of a new type. Extreme variations in this respect are, of course, exceedingly unlikely to be transmitted. But minor variations are frequently transmitted, and it is impossible to say where the line must be drawn. It is quite possible that considerable anomalies may be occasionally transmitted to descendants. An animal might appear with an excessive brain development, or some brain duplication, yet this not be sufficient to destroy the due balance of the organs, or prevent sexual fertilization. And if such an excess were transmitted through several generations, the animals possessing it might, through superior mental ability, crowd out and replace their less able kindred. Possibly in this manner the long reach upward, from ape to man, might be made almost in a single step.

In organic, as in inorganic nature, there are dividing lines, on opposite sides of which weights tend to fall in opposite directions; or water-sheds, which divert the flow of waters to opposite oceans. An animal species may be exactly adapted to surrounding conditions; but a scion of this species may arise not fully adapted to the environment, and it may transmit its anomalous organization through several generations. If the anomaly be a marked one, a struggle is at once set up within the organism. The organic formation of the animal may not be out of accord with natural conditions. Its anomalous feature may be a decidedly advantageous one. Two tendencies exist within the animal, the tendency to conform to the hereditary habits of its type, and the tendency to avail itself of its new powers. There is a struggle between instinct and reason. Some divergence of habits will be very likely to arise, but not so great as there would be were there no instinctive pull towards the normal habits. If the anomaly be transmitted to offspring, the newly gained habits will also be transmitted; therefore every successive transmission favors the formation of a new adaptation to nature. If the change of organization be a muscular one, and a new movement of some part of the outer body be gained, the use of this movement may be of decided advantage to the animal, and if it be transmitted through a sufficient number of generations, new instinctive habits are likely to arise. If it be a nervous one, some new mental energy may be gained, which must struggle with the hereditary muscular habits. It may be a new phase of nutritive or reproductive energy, but whatever it be it is not impossible but it may succeed in establishing itself against the two opposing influences of instinctive habits normal to the species, and of imperfect reproductive energy.

Such an anomaly might be preserved without change in the surrounding conditions of nature, but would be specially likely to be preserved under such changes in the environment as favor variation in the normal offspring of the species. And by this means new species might arise through single great deviations from the specific type, as well as in the more general method of successive slight deviations.

The chances are, doubtless, strongly against the hereditary preservation of an anomalous feature, while the natural conditions remain unchanged. But it seems quite possible that if a marked change in conditions occur, or if a group of animals of some fixed type be moved to a new locality, to whose conditions they are not fully adapted, considerable organic changes might take place rapidly instead of with the slowness ordinarily supposed. For it is certainly not improbable that the inharmony between the animal and its surrounding conditions might strongly affect its internal organization and thus favor the formation of anomalous embryos. And some of these abnormal offspring, considerably varied from the normal type, might be particularly adapted to the surrounding conditions. If so, they would have an advantage over the normal forms, and their new powers would have a like advantage over the hereditary or instinctive tendencies.

Such an anomaly, if transmitted to descendants, would possibly constitute a specific change in organization at a single step, while the new, well adapted variation might rapidly replace the old, ill adapted normal form.

The evolution of new species in this manner could but rarely occur; yet every anomaly of excess is a new step forward in organic specialization, and if preserved must yield an advanced species. When it does occur a decided change in organization takes place immediately instead of gradually as in the variation of mature individuals. Instead of natural selection of slight differences in mature beings doing all the work in the evolution of species, the process of germinal selection may be the primary force at work. The lever of change is fixed lower down in the line of development, and thus its lifting power is greatly enhanced. The origin of every new species may be a matured monstrosity, representing either a partial reversion to ancestral conditions, or the gaining of new and increased powers. Upon this long step outward from the normal, selection at once acts. The animal may perish. Its hereditary tendencies may hinder the employment of its special powers, and thus cause them to become gradually obliterated. The sexual union of such an animal with a normal one, must also tend to obliterate the points of distinction. Yet in rare cases all these difficulties may be overcome. The animal may produce offspring possessing and employing its new powers. The exercise of these powers will gradually overcome the hereditary tendencies, produce a new accord with nature, and draw the new form further and further away from its race, until a specific difference is fully established.

The hypothesis of natural selection, as usually advanced, has proved insufficient to explain all the phenomena of organic variation. This hypothesis of germinal selection may serve to fill the gap and explain the lack of linking forms between species.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Progress moves slowly in the Philadelphia Academy. Since the election of a scientific man to the presidency of the institution, several opportunities of recognizing that class of its members have occurred, and have been thrown away. Perhaps the anti-scientifics only needed a reputable figure-head to place them in a more impregnable position than ever. The deaths of two curators of no scientific reputation or position, was an excellent opportunity to honor some of the younger scientists of our city who have already made their mark. But with the grip of the dying miser on his gold, the residuary legatees of reaction have secured the positions for men of the same type as those that now rest from their labors. At the same time one of our most able scientists applied for another vacant position. His services were declined without reasonable explanation. One of the deceased curators held also the position of vice-president. The officering of the academy with wealthy gentlemen of leisure not having proven very profitable to the treasury, a scientific man was selected to fill the vacant vice-presidency. We think it unfortunate, however, that the gentleman so honored should be an active opponent of modern scientific thought, on the question of evolution. So much for the new administration of the academy, of which the friends of progress had reason to expect better things.

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RECENT LITERATURE.

Nordenskiöld's Voyage of the Vega.[1]—This record of the expedition which had the good fortune to accomplish the Northeast passage probably led to the ill-fated *Jeannette* expedition; at any rate the narrative before us will be read by thousands who have followed with so much interest the track of the *Jeannette*, and have traced the wanderings of the unfortunate Lieut. De Long and his party to the place of their sufferings and death near the mouth of the Lena. As a contribution to geographical science, this is a work of the first magnitude, as it not only describes the first successful voyage around Northern Europe and Asia, from Stockholm to Bering straits and thence round the continent to the original point of departure, but the English-reading public have for the first time, in this translation, a clear account of the vast treeless low plains or tundras of Siberia, especially the region beyond the mouth of the Yenisej, and of the two races, the Samoyeds to the west, and the Chukchis to the east, which roam over these barrens. We also have a clear picture of the vegetable and especially the animal life, both terrestrial and marine, of this little known region. There is not a man living better qualified to accomplish this voyage and to report upon the results, than Professor, now Baron Nordenskiöld. In 1868 he went to Spitzbergen, in 1870 to Greenland, where he made valuable observations on the interior ice of that country, which are in part recorded in this volume; in 1872–73 he revisited Spitzbergen, wintering there, and in 1875 and 1876 he made a voyage to the Yenisej river, and thus acquired the knowledge and experience in Arctic travel which he used so successfully in the crowning exploration which has given him a world-wide fame. As a geologist as well as geographer, Nordenskiöld had already acquired a European reputation, and the staff of naturalists (Drs. Kjellman

[1] *The Voyage of the Vega round Asia and Europe.* With a historical review of previous journeys along the north coast of the old world. By A. E. Nordenskiöld. Translated by Alexander Leslie. With five steel portraits, numerous maps and illustrations. New York, Macmillan & Co. 8vo, pp. 756.

and Stuxberg) he took with him had already made successful explorations in Spitsbergen. Nordenskiöld's style is clear and graphic, the plan of the book is comprehensive and well carried out, though the translator's work has not always been successful, as Swedish idioms appear here and there to mar the fluency of the narrative.

Confining ourselves to the scientific results, the ethnological matter is of special interest. Of the polar races whose acquaintance our author has made, he regards the reindeer Lapps as standing the highest, and next to them come the Eskimo of Danish Greenland; next below them in civilization come the Eskimo of Northwestern America, "on whose originally rough life, contact with the American whale-fishers appears to have had a very beneficial influence." Next come the Chukchis, who have had but limited intercourse with Europeans, but whose honesty and hospitality and general good behavior has been tested, not only by Nordenskiöld, but recently in a very satisfactory way by the Rodgers party. Last of all come the Samoyeds, who inhabit the region from Waygats island eastward to the Gulf of Obi. Their contact with the Russians has had "a distinctly deteriorating effect."

A chapter is devoted to the Samoyeds and another to the Chukchis, among whom the *Vega* party wintered.

More is said of the animal life than usual in such works, and this will prove one of the most attractive features of the book to our readers. To the animal world, especially the birds and mammals of Novaya Zemblya, a special chapter is devoted, while the marine zoölogy of the Kara sea is fully discussed, as dredging was carried on at all possible points.

The New Siberian islands, well known among Russian ivory collectors for their extraordinary richness in tusks and portions of skeletons of the mammoth, were visited. The history of the discovery of the mammoth is set forth by Nordenskiöld, who infers from the fact that at least a hundred pairs of tusks come annually into the market, "that during the years that have elapsed since the conquest of Siberia, useful tusks from more than 20,000 animals have been collected." The first frozen carcass, a "mammoth mummy," was found in the frozen soil on the Yenisej, in 1692, by Ides, a Russian ambassador, on a journey through Siberia to China; while the remains of the mammoth are to be found all over Siberia. Nordenskiöld says that the nearer we come to the coast of the Polar sea, the more common are the remains of the mammoth, especially at places where there have been great landslips at the river banks when the ice breaks up in spring. Nowhere, however, are they found in such numbers as on the New Siberian islands. Here Hedenström, in the space of a verst, saw ten tusks sticking out of the ground, and from a single sandbank on the west side of Liachoff's island, the ivory collectors had, when this traveler visited the spot, for eighty years made their best tusk harvest." Associated with the remains of the mammoth, well preserved carcasses of two species of hairy rhinoceros have been found. The last one found was an exceedingly well preserved carcass of a hairy species (*Rhinoceros merckii* Jaeger) discovered on a tributary of the Lena, in 1877. "From the find Schrenck draws the conclusion that this rhinoceros belonged to a high-northern species, adapted to a cold climate, and living in, or at least occasionally wandering to, the regions where the carcass was found. There the mean temperature of the year is now very low, the winter exceedingly cold (—63° ·2 has been registered) and the short summer exceedingly warm. Nowhere on earth does the temperature show extremes so widely separated as here. Although the trees in winter often split with tremendous noise, and the ground is rent with the cold, the wood is luxuriant and extends to the neighborhood of the Polar sea, where, besides, the winter is much milder than farther in the interior. With respect to the possibility of these large animals finding sufficient pasture in the regions in question, it ought not to be overlooked that in sheltered places overflowed by the spring inundation there are found, still far north of the limit of trees, luxuriant bushy thickets, whose newly expanded juicy leaves, burned up by no tropical sun, perhaps form a special luxury for grass-eating animals." The account of the discovery, by the *Vega* expedition, of several skeletons of Steller's manatee on Bering island, has already been noticed in this journal.

We have read this volume with the greatest interest. It is a model book of travel and research.

Huxley's The Crayfish.[1]—This is one of Professor Huxley's most effective works. The crayfish has received repeated attention from naturalists; some of the best memoirs by the most eminent naturalists have been devoted to the natural history, the embryology and anatomy as well as histology of the crayfish, but so far from being a compilation from these authorities, the work before us is a fresh, original study of a well known and most accessible animal, and the subject, as may be expected, is treated in the methods of to-day; not only from a special point of view, but from the modern broad standpoint of the relations of the crayfish to the world about it and to the fossil forms allied to it. Should we want to give one some idea of modern zoölogy in its widest sense, the methods of study and the ultimate questions arising out of any special zoölogical work, we should put this little monograph in the student's hands.

[1] *The International Scientific Series. The Crayfish.* An introduction to the study of Zoology. By T. H. Huxley, F.R.S. With eighty-two illustrations. New York, D. Appleton & Co., 1880. 12mo, pp. 371. $1.75.

Our western and southern streams and wayside ditches or runs abound in these creatures; such is *Cambarus clarkii* (Fig. 1). With one of these crayfish or the more common *Cambarus bartoni* in hand, the student should read this book, identifying all the parts which can be observed without dissection, and then he should verify for himself Professor Huxley's account of its internal anatomy, and then if possible obtain from his own examination some idea of its histology and its mode of development. Then his studies should be comparative. He should, if possible, ex-

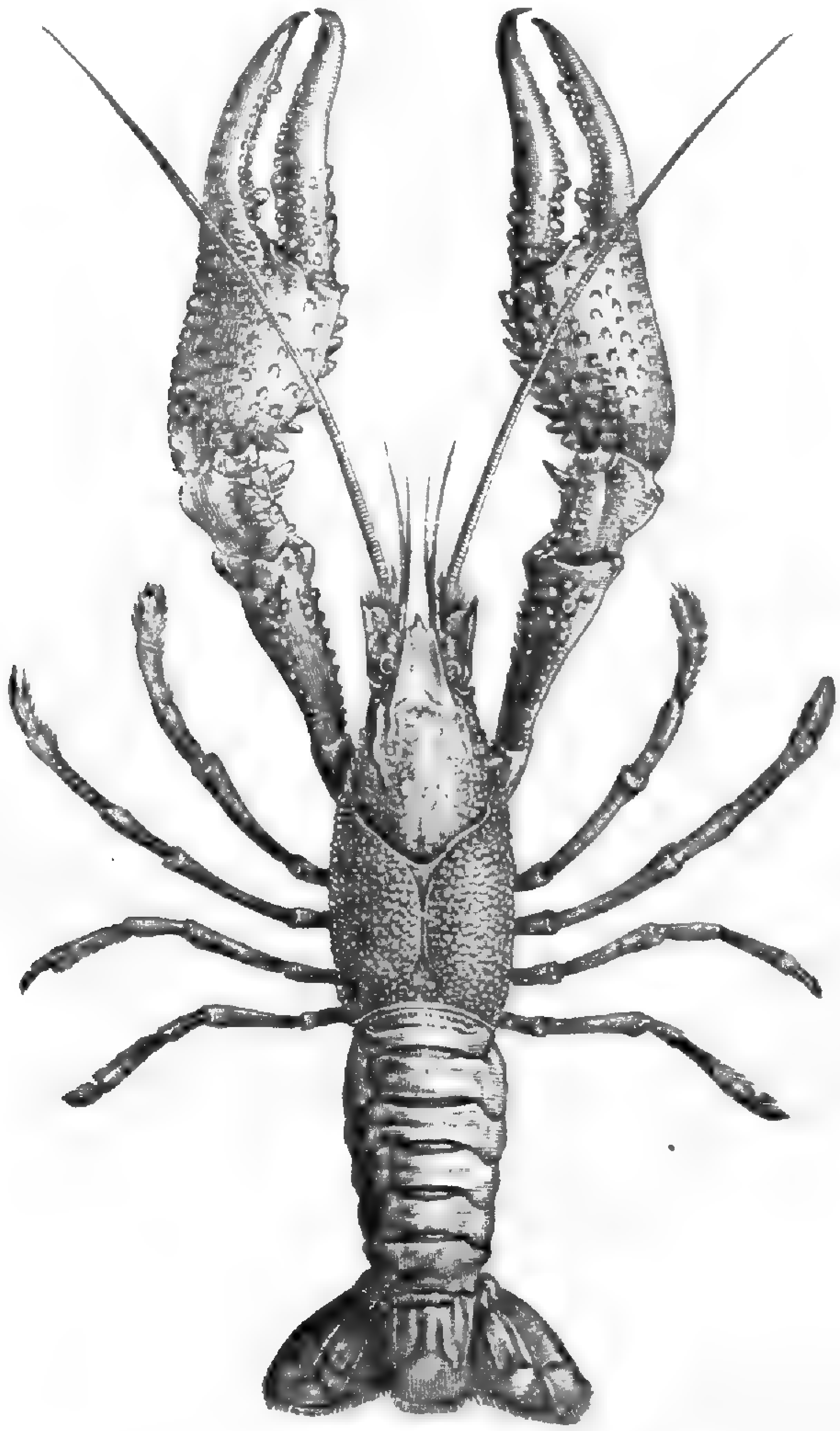

FIG. 1.—*Cambarus clarkii*, nat. size.

amine the prawn (Fig. 2) and other shrimps. He should then compare the mode of direct development of the crayfish with that of the Penæus (Fig. 3.), a prawn whose developmental history throws so much light on the ancestry of all the higher Crustacea, since its development is, in a sense, an epitome of that of the Crustacea as a class, for it begins life as a little six-legged Nauplius, then assumes the zoëa phase of most crabs and shrimps, and finally passes into a prawn. Then, with this excellent guide in hand, he should study as well as may be, the fossil allies of our existing crayfishes, of which the accompanying figures are examples, and we shall see how deeply planted are the roots of the astacine genealogical tree, which extends down into Jurassic strata. Finally we are told by our author that all modern crayfishes have evolved from such forms as the Pseudastacus.

And here it seems to us singular that Professor Huxley, while stating his belief that all crayfish have evolved from earlier forms, should not have attempted an explanation of the causes of change of form and of the variability which has resulted in the production of species of crayfish on all the continents. Why did he not avail himself of the published facts concerning our Mammoth cave and blind species, and discuss the effects of darkness and

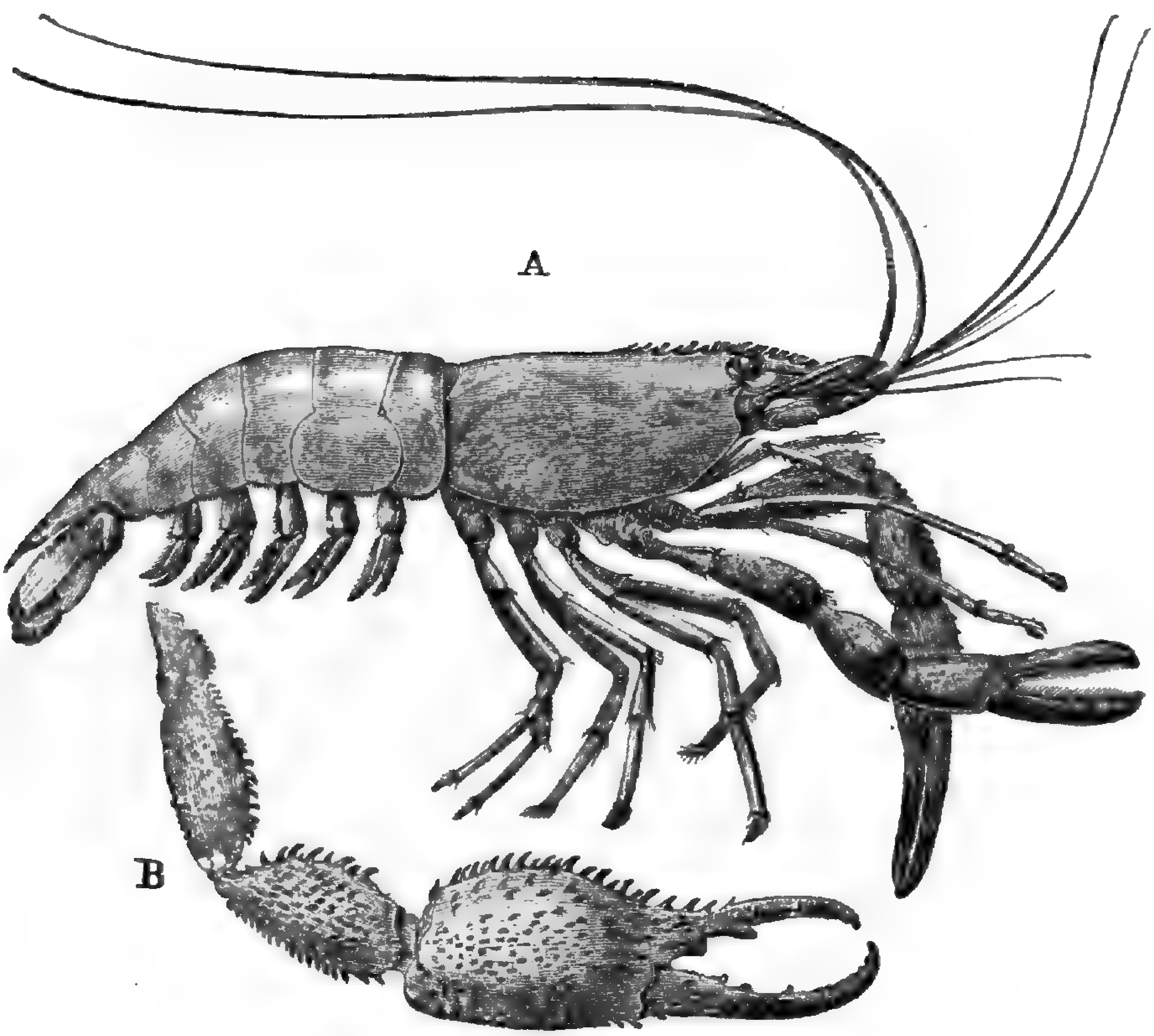

FIG. 2.—Prawn of Jamaica.

lack of food on this species, or even of the Austrian blind form. So also a study of the relations of climatic causes, of the differences in the nature of streams and food supply would have been in place. A little more in this direction would have rendered more defined and circumstantial the author's general remarks on the causes of the evolution of forms so rich in species and varieties as our crayfish, a fact which in this country at least renders their systematic study so perplexing.

There is little, however, to criticize in this as in all of Professor Huxley's works. They are critical as well as broad and philosophical.

We would however venture to take exception to Huxley's conception of the morphology of the carapace, which has long since been shown by Dana to be morphologically a development of the second antennal and mandibular tergites, which grow back so as to cover the thorax. Huxley's "cervical groove" appears, then, to be an artificial line and of no morphological importance. The thoracic tergites being aborted are protected by this large cephalic shield. In the zoëa the shield or carapace is an expansion of the tergal or dorsal part of the consolidated antennal and mandibu-

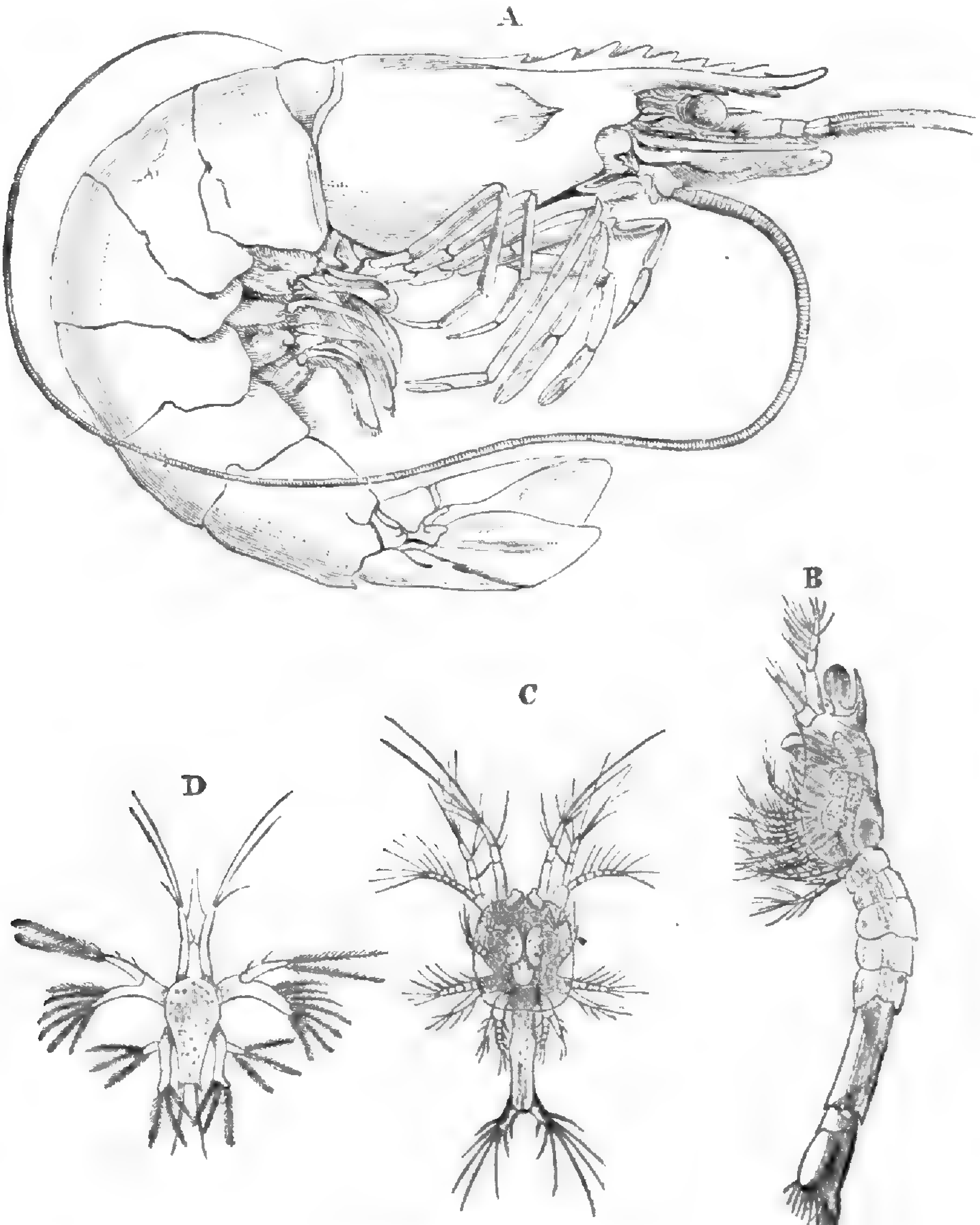

FIG. 3.—A, Penæus; D, nauplius stage C, zoëa stage; B, advanced larval stage.

lar tergites, as his own figures on pp. 281 and 282 would prove; the shield being developed before the thoracic segments appear at all.

So also embryology abundantly proves that the eyes are developed on the antennal segments, and that the eye-stalks of crabs and shrimps are simply functional adaptations occurring after zoëal or larval life. Hence the old-fashioned view entertained by our author, that the eye-stalks represent limbs, is not apparently well founded. We should therefore regard the number of pairs of appendages as nineteen instead of twenty, though there are twenty segments, the telson representing the twentieth. It is a

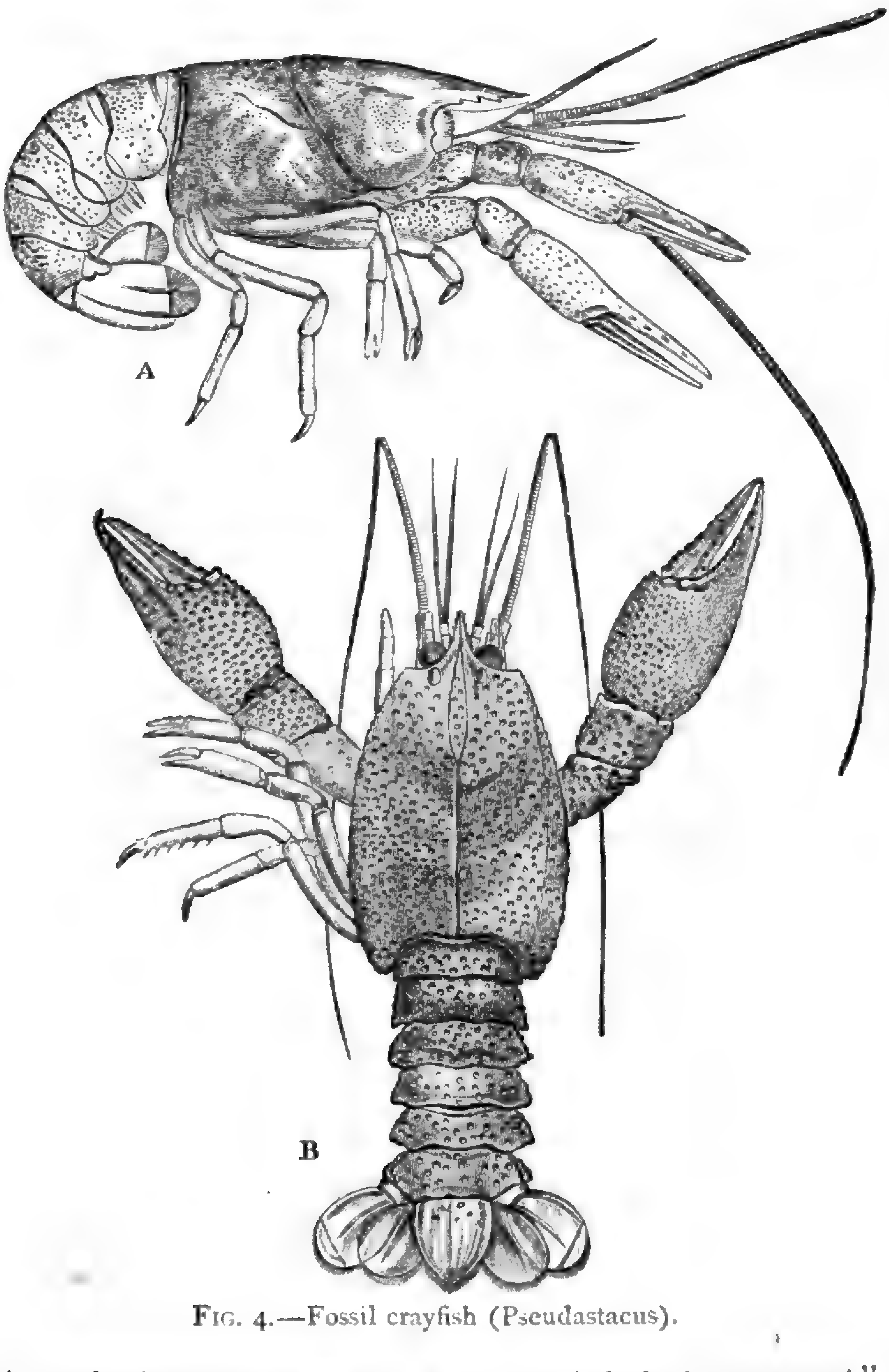

Fig. 4.—Fossil crayfish (Pseudastacus).

question whether the presence of an "ophthalmic segment" can be demonstrated. While treating of the nervous system, an opportunity of describing the brain after the researches of Dietl in 1876, is not taken, although Krieger's more elaborate account of the brain of the crayfish was not published until the present work appeared.

RECENT BOOKS AND PAMPHLETS.—Proceedings of the U. S. National Museum, 1882, pp. 1–48 and 385–400. Washington, 1882. Also Appendices Nos. 13–17. From the department.

Description of new species of Fishes from Mazatlan, Mexico, by D. S. Jordan and C. H. Gilbert. Ext. from Proc. U. S. Nat. Mus., April, 1882. From the authors.

Bulletin of the U. S. Fish Commission, pp. 289–336, pl. 2. May, June, 1882. Washington. From the department.

Catalogue of the Australian stalk and sessile-eyed Crustacea. By Wm. A. Haswell, M.A., B.Sc. pp. 328, pl. 3. Sydney, 1882. From the trustees of the Australian Museum, Sydney.

American Journal of Science, July, 1882.

Bulletin of the U. S. National Museum. No. 19. Nomenclator Zoologicus. By S. H. Scudder. Part I. Supplemental List, pp. 376. Washington. From the department.

Bulletin Mensuel de la Société National d'Acclimatation de France. Paris, Avril, 1882.

Geological Sketches at Home and Abroad. By A. Geikie, LL.D., F.R.S. pp. 332, 29 woodcuts. New York, Macmillan & Co., 1882. From the author.

Boletin del Ministerio de Fomento. Mexico, Diciembre, 1881, Enero, 1882. From the department.

Report of the Board of Regents of the Smithsonian Institution. Washington, 1881. From the institution.

Biologisches Centralblatt, 1881, pp. 752. Also 1882 to page 176.

On the Relation of the Quincy Granite to the primordial Argillite of Braintree, Mass. By M. E. Wadsworth. pp. 4. Ext. from Proc. Bost. Soc. Nat. Hist. From the author. Also by and from the same—

On the Trachyte of Marblehead Neck, Mass.

Jahrbücher der Deutschen Malakozoologischen Gesellschaft, Heft II, 1882. Frankfurt am Main. II Tafeln.

Die Süsswasser perlen auf der internationalen Fisherei-austellung in Berlin, 1880. Von Dr. H. Nitsche (Abdruck aus dem amtlichen Bericht IV, p. 83–94.) pp. 32. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia. Part I. Jan. to April, 1882, pp. 184, pl. I. From the society.

Ueber das Vorkommen eines gemengten Diluviums und anstehenden Tertiargebirges in den Dammer Bergen, im Suden Oldenburgs. Von K. Martin, in Leiden. p. 24. From the author.

Beitrage zur Kenntniss der Fische Afrika's (II) und Beschreibung einer neuen Paraphoxinus Art aus der Herzegowina. Von Dr. F. Steindachner. pp. 18. Tafeln 6. From the author.

:o:

GENERAL NOTES.

BOTANY.[1]

NOTE ON UREDINEÆ.—Those botanists who have given attention to the parasitic fungi, have observed the great and often extreme conservatism of the English fungologists, especially in regard to the later views as to the nature and relationship of the Uredineæ. The old genera Æcidium, Rœstelia, Lecythea, Trichobasis and Uredo have continued to find place in the books although their autonomy was long since disproved, or rendered highly doubtful. It is doubtless better that innovations in science should be slowly accepted, but it is equally without doubt that there has been too great a holding back from the recent sugges-

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

tions made by the continental botanists. It is, therefore, gratifying to find in the last number of *Grevillea*, a paper on "Exotic Fungi," by M. C. Cooke, in which the modern views as to the Uredineæ appear to be fully accepted. In this paper the species of Puccinia are described as including three stages, viz: I. The Æcidium stage; II. The Uredo stage; and III. The Teleutospore stage. This is practically identical with the method followed by Fuckel in his *Symbolæ Mycologicæ*. In the year 1879 Cooke published a rearrangement of the British species of Uromyces, in *Grevillea*, in which he brought together the three stages of the plants of that genus, in a manner similar to that now adopted for Puccinia. We may then fairly conclude that so far as the great English fungologist is concerned, the autonomy of Æcidium is no longer to be admitted. While it may be necessary for us to name the new Æcidia as found, as is done by Cooke in his last article in *Grevillea*, such names are not to be regarded as having right to place in any system of classification. The *Æcidium acanthacearum*, *Æ. plectroniæ*, *Æ. dissotidis*, *Æ. vangueriæ* and *Æ. cardiospermi*, described as new by Cooke, must be considered as so many imperfect forms of Uredineæ, and the names given them are merely for their convenient and ready designation.

If now we are to accept this view of the nature of the Uredineæ, why should we not, for the sake of uniformity, call the first the conidial stage, the second the stylosporous stage, and the third the teleutosporous stage; the first producing conidia, the second stylospores and the third teleutospores. Certainly the homologies would be more fully respected by the use of these terms. It is, perhaps, too early to urge that as the teleutospores appear to be in reality reduced asci, containing one or more ascospores, they should be called asci simply. We have elsewhere given reasons for considering the Uredineæ to be greatly reduced or degraded Ascomycetes, and they need not be repeated here. The conidia (with their accompanying spermatia) and stylospores of Uredineæ have the same general relation to the teleutospores that the conidia, spermatia and stylospores of ordinary Ascomycetes have to the asci and ascospores, and they might well bear the same names.

Allen's Characeæ Americanæ Exsiccatæ. — Of this most excellent work, the second and third fasciculi have recently appeared. The specimens are ample and are so well preserved that they invite even the tyro to their study. In fasciculus II, the species are as follows, the numbers continued from fasciculus I: 11, 12, 13, 14, *Chara coronata* Ziz., various forms; 15, *Ch. excelsa* Allen; 16, *Ch. evoluta* Allen; 17, 18, *Ch. fœtida* A. Br., two forms; 19, *Ch. contraria* A. Br.; 20, *Ch. fragilis* Desv.

In fasciculus III the species are: 21, *Ch. fragilis* Desv., a second form; 22, *Ch. delicatula* Ag.; 23, *Ch. gymnopus* var. *elegans*

A. Br.; 24, *Ch. gymnopus* var. *Humboldtii* A. Br.; 25, *Ch. sejuncta* A. Br.; 26, *Ch. aspera* Willd.; 27, *Ch. aspera* Willd., var. *Macounii;* 28, 29, *Nitella flexilis* Ag.; 30, *N. flexilis* Ag., var. *subcapitata* A. Br.

Readers of the NATURALIST can render a real service to science by collecting and forwarding good specimens of Characeæ to the author of these fasciculi, Dr. T. F. Allen, No. 10 East 36th St., New York city. Specimens should be collected in midsummer.

COLORED FIGURES OF THE LARGER FUNGI.—Fries' "Icones Selectæ Hymenomycetum nondum delineatorum." Of this beautiful and valuable publication begun by the late Elias Fries in 1867, the 6th Fascicle of the 2d vol. has lately been issued bringing the work up to plate 170 and containing, in all, figures of 468 species, mostly *Agarics*. The figures are colored lithographs on sheets of fine heavy paper 11x15 inches, and are justly considered as the *ne plus ultra* of mycological illustrations. No one who has seen them will question their artistic merit and the fact that the original drawings were done under the direct supervision of the illustrious Fries is a sufficient guarantee of their scientific accuracy.

Kalchbrenner's "Icones Selectæ Hymenomycetum Hungariæ," of which only 40 plates have been published, is a work entirely similar in style and character to the above.

The "Figures peintes des Champignons," by Monsieur le Capitaine Lucand (Autun, Saone et Loire, France), are also worthy of high commendation. These are on sheets about 10x13 inches. The figures are beautifully colored and shaded, being, in fact in point of artistic merit, not inferior to those of Fries' Icones. Monsieur Lucand has now issued two fascicles of 25 plates each, at 30 francs per fascicle.

The first two publications mentioned are sold at about $25 per 100 plates.—*J. B. Ellis, Newfield, N. J.*

THE SCARCITY OF ALDER CATKINS.—Professor Bailey speaks in the April number of the *Torrey Bulletin*, of the comparative lack of the alder catkins of the male sex, near Providence, R. I. In this vicinity I notice also but few male catkins, whereas plenty of female flowers are to be found.—*C. S. Plumb, Amherst, Mass.*

BOTANICAL NOTES.—Dr. W. P. Wilson's paper on the respiration of plants in the June number of the *Amer. Journal of Science* is an excellent resumé of our present knowledge of this difficult subject. Respiration of plants, *i.e.* the taking in of oxygen and the giving off of carbon dioxide is now known to be a complex process exactly analogous to the respiration of animals. The carbon dioxide excreted in plant respiration is not, as was formerly supposed, a product of direct oxidation from the free oxygen of the air.——Mr. Darwin in one of his latest papers read before the Linnean Society showed that root hairs are developed only upon particular surface cells, and not indifferently upon any of them. Only those surface cells which contain non-granular contents give rise to root hairs.——In the *Daily Spy* of Worcester, Mass., Joseph Jackson, of the Worcester Natural History Society, is publishing from time to time, lists of the plants of the season as they appear, with pleasant notes upon many of them. It would be a good thing for American botany if plant collectors generally were to follow Mr. Jackson's example.——The Orange Judd Co., of New York, has brought out an American edition of "The Chemistry of the Farm," by R. Warington, F. C. S. The first five chapters are devoted to Plant Growth, Sources of Plant Food, Manures, Crops, and Rotation of Crops, all more or less botanical. In these chapters the matter is unusually good, the latest views generally being adopted. The book can be heartily commended.——A curious paper on "Pollen Tubes," appears in the June *Am. Mo. Mic. Journal*, by J. Kruttschnitt. The writer proposes the theory that "the pollen tubes insinuate themselves amongst the papillæ of the stigma where, on bursting, the fovilla is taken up by the conducting tissue of the style." This conducting tissue is supposed to convey the fovilla to the ovules! The editor of the *Journal* ought to have cut out the theory from the article before publishing it, as it may mislead some of the younger readers who are not well grounded in vegetable histology and physiology.——Mention should have been made in these notes long ere this, of the slides prepared by Rev. A. B. Henry, of Taunton, Mass., to illustrate the sexual and asexual reproduction of the Marine Algæ. In set I six slides represent the sexually produced spores of six different species, each representing a family of the Floridiæ according to Agardh's classification. Set II is made up of similar preparations, taking however a wider range, and including species of lower orders. The sets may be obtained for three dollars each, which, considering their great usefulness, is very cheap indeed. Professor Underwood is at work on the Hepaticæ of North America, and we may hope to receive from his hands, some day, a manual of these neglected plants.——Professor Penhallow, of the Houghton Farm Experiment Station, at Mountainville, Orange county, N. Y., has issued a circular directing attention to many points in the life-history of the disease known as "peach yellows." We trust that as many of the NATURALIST readers as can do so, will aid in this work by correspondence with the professor.——The April *Torrey Bulletin* appeared with nine full page plates, of which eight were illustrative of Dr. Allen's paper on the "Development of Cortex in Chara." The excellent work done by Dr. Allen on the Charæ is one that will commend itself to all students of plants.——In the May *Botanical Gazette* C. H. Peck describes fourteen new species of fungi from California and Arizona. One, a remarkable species of Lycoperdon, is named *L. pachydermum.*

ZOÖLOGY.

THE DISTRIBUTION OF M. MARGARITIFERA.—Professor Call published a note in the last number of the NATURALIST which seems to demand notice from me, inasmuch as the note appears where readers may see it who have *not seen* my articles. There are two of these, published in the Journal of the Cincinnati Society of Nat. History, and subsequently, a synopsis of the first, and the whole of the second, in the *Am. Jour. Sci. and Arts*, March, 1882. My first article appeared in the Cincinnati Journal, January, 1881. My second in July, 1881. In reference to the distribution of the species under consideration, I said, in the first article, pp. 2 and 3, "but among these shells occurs one remarkable anomaly of distribution in the presence of the *Margaritana margaritifera* Lam., an European species which occurs in the New England States, and, though wanting across the whole interior of the continent, reappears in the drainage of the Pacific slope." Having thus put upon record the general fact of the great severance of these two areas of occupancy, I used the language quoted by Professor Call, in the *generalizations* of my *second paper*.

I may say that I have specimens of this species in my collection, from several streams in the different "New England States," and from various points in the "drainage of the Pacific slope," and that, having given evidence of the possession of the necessary knowledge on this head in my first article, I may have been rather careless about the use of language in my second, thinking that I had made my *thesis* sufficiently plain.

I simply wish to put upon record the fact, that my ignorance of the distribution of this curious species is not so great as Professor Call's note would seem to suggest.

As this matter is open for further remarks, I wish to call the attention of the students of this subject to the distribution of the *Margaritana monodonta* Say, originally described by him as a Unio, but which belongs to the present genus without a doubt. Mr. Lea early mentioned the similarity of this species to the *M. margaritifera*, Obs. vol. VII, p. 43, and vol. X, p. 58. In the first of these articles he says (after having described the soft parts of the *M. margaritifera*): "The *Unio monodontus* Say properly belongs to this genus. The soft parts have the same character, and the hard enveloping parts are very closely allied." In the second of these references he says (following a discussion of the soft parts of Monodontus): "The form of the outer hard parts, as well as the soft parts, is so different from other Unionidæ, except *Margaritana margaritifera* that we might expect to find a strong variation in the important part of the embryonic shell, but, unfortunately, we have not yet seen the embryonic shell of either of them," etc. Now while there are differences in these two mollusks, sufficiently emphasized to separate them as species, there are numerous characters pointing to their close alliance, and as I have seen no record of the occurrence of the Monodontus in localities inhabited by the Margaritifera, it may fairly be said to be its representative over the region, or a large part of it, where the latter is wanting. In fact, the suggestion of close relationship, and differences due to undetermined causes, make a thorough study of these two species, by competent histologists, a matter of very great interest. This is only one, and that not a specially emphatic case of equivalents, some of which I hope to cite in part III of this discussion, and every phase of it seems to me to look in the direction pointed out in part II. It remains to say that this shell has a close analogue, and a southern one at that, in Europe, this being the *Unio sinuatus* Lam., a shell found in the Rhine, Meuse, Seine, Rhone, Loire, Garonne, Charente, Adour, Dordogne, Tarn, etc., but of whose northern distribution there seems to be no record. In his Mollusques de France, p. 634, the Abbé Dupuy makes the following remarks on this species:

"Cette espèce si remarquable et dont les caractères sont si tranchés, a été confondue par presque tous les auteurs français, après Draparnaud, avec la *Margaritana margaritifera* Lam., qui en diffère essentiellement puisqu' elle n' a pas les lamelles postérieures qui en ont fait faire un genre particulier par plusieurs auteurs. L'erreur est venue, chez les auteurs français de ce qu'ils n'avient pas en connaissance d'échantillons authentiques d' *Unio margaritiferus* Retz. (*Mya margaritifera* Linn.). D'un autre côté, les étrangers ont donné le nom d' *U. sinuatus* à une grosse var. sinuée inférieurement du véritable *Unio margaritiferus* Retz., parce qu'ils ne connaissaient pas non le veritable *U. sinuatus* Lamk.

I wish to add, that having been favored with numerous specimens of both these species, from authentic localities, I can see how these shells may have easily seemed to collectors to be very similar. The fact that a species so closely allied to the *M. margaritifera*, and yet so evidently distinct from it, exists both in Europe and America, is one of considerable interest, and when taken in connection with other associated facts, becomes somewhat suggestive.

In this connection I wish to invite correspondence concerning the geographical distribution and variation of the Unionidæ, and the exchange of specimens.—*A. G. Wetherby.*

NOMENCLATURE OF EXTERNAL PARTS OF ARTHROPODA.—The following terms have been devised for convenience in anatomical and systematic work on the Arthropoda, and are submitted for the judgment of naturalists. We have adopted them in a forthcoming monograph of N. A. Phyllopoda now in the press.

The term *arthromere*, originally employed in the author's "Guide to the Study of Insects" in 1869, is now restricted to the body-segments of Arthropods, the term zonite or somite being used for the body-segments of worms, as well as Arthropods. The "head," "thorax," and "abdomen" are termed respectively *cephalosome, bænosome* (Gr. *baino*, to walk, locomotion), and *urosome*. The head-segments are termed *cephalomeres*, the thoracic segments *bænomeres*, and the abdominal *uromeres*. For the antennæ, the term *æsthopoda*, and for the mandibles and maxillæ the previously used term *gnathopoda* is adopted.

The thoracic legs are termed *bænopoda*, and for the abdominal legs, Westwood's term *uropoda*, applied by him to the terminal pairs of feet of the Tetradecapoda is extended to all the abdominal feet of Arthropods. The basal abdominal feet of male Decapoda modified as accessory reproductive organs, are termed, for convenience in descriptive carcinology, *gonopoda*, and the jointed anal cerci of certain insects and of Apus, are termed *cercopoda* (*kerkos*, cauda). For further explanations and other more special terms, the reader is referred to the memoir to appear in Hayden's Report, U. S. Geological Survey for 1879.—*A. S. Packard, Jr.*

Zoological Notes.—A series of papers on the comparative morphology of the ear, by C. S. Minot, is appearing in the Journal of Otology. Thus far they relate to the auditory organs of the Medusæ, the Echinoderms, the Mollusca, worms and Crustacea. They will be found to be useful compilations, and are accompanied by cuts and full bibliographical lists.——The mites and other low Arachnids of the Malayan Archipelago are described and well figured by Dr. Thorell in the annals of the Museo Civico di Storia Naturali di Genova.——Dr. H. C. Chapman describes a fœtal Kangaroo and its membranes in the Proceedings of the Academy of Natural Sciences of Philadelphia. The author closes his paper as follows: "On the supposition that the theory of evolution is true, one would naturally expect to find forms intermediate in their structure and development between the reptiles and birds on the one hand and the placental mammalia on the other. As is well known, in the structure of its skeleton and generative apparatus, the *Ornithorhyncus* resembles very closely the reptile and bird, while, as we have just seen, the fœtal membranes of the Kangaroo recall the corresponding parts in the reptilian-bird type and foreshadow those of the placental mammal. If the parts in question have been truthfully described and correctly interpreted as partly bridging over the gap between the non-placental and placental vertebrates, they supply exactly what the theory of evolution demands, and furnish, therefore, one more proof of the truth of that doctrine."——The vagus nerve of the domestic cat is described in detail, with wood cuts, by Dr. T. B. Stowell in the Proceedings of the American Philosophical Society. Having compared the vagus nerve in man, cat, dog, horse, ox, sheep, rabbit and frog, he is satisfied that the cat presents advantages over all others as a basis for comparative study. ——At a late meeting of the French Academy a paper was read by M. Koehlen on some attempts at hybridization between different species of Echinoids. These were successful in the case of a

Spatangus and a Psammechinus.——The Trichina when encysted in salt meat has been found, by M. Fourment, to possess vitality. In salt meat prepared fifteen months back were live Trichinæ, which were fully evolved in the alimentary canal of a new host, and caused death.——Professor Th. Eimer contributes to *Nature* a letter regarding the existence of a voice in lizards, which he has observed in the wall lizard of the rocks of Capri, a peculiarity generally ascribed among reptiles to geckoes and chamæleons alone. This lizard makes a peculiar soft piping sound on being captured, and "uttered repeatedly in quick succession, a series of very sharp tones, sounding like 'bschi,' and reminding me of the hoarse piping of a mouse or a young bird." Dugès also states that *Lacerta edwardsi*, a little lizard peculiar to the shores of the Mediterranean, is apt to utter a sound like the croaking of a Cerambyx, while *Lacerta ocellata*, when angry, will expel its breath so vehemently that a sort of noise is produced. According to Landois *Lacerta viridis* is able to utter a distinctly hissing or blowing sound. *Tapoya douglassii*, a kind of lizard living near the Oregon lake, when irritated, hisses very audibly, while the iguanas are reported to hiss and blow on being caught.——A pigmy pig (*Porculia salvania*), a very rare creature from the Doars of Bhotan, has recently been added to the Zoölogical Society's collection in London. These lively little pigs, says a correspondent of *Nature*, probably weigh hardly as much as a hare, but are most active and energetic, and are ordinary pigs in miniature.——Professor Marey has lately published an article on a "photographic gun," by which he has been enabled to take some most interesting instantaneous photographs of birds in flight.

ENTOMOLOGY.[1]

CHANGE OF HABIT; TWO NEW ENEMIES OF THE EGG-PLANT.—In our writings on the Colorado potato-beetle, we have repeatedly drawn attention to the fact that *Doryphora juncta*, although a native of the Atlantic States and living in the midst of our cultivated species of Solanum, has yet never shown any inclination to leave its natural food-plant, the wild horse-nettle (*Solanum carolinense*) for the cultivated species of the genus. We have now for the first time to record its appearance as an enemy to horticulture, Dr. A. Oemler, of Wilmington island, near Savannah, Ga., having found it—larvæ as well as beetles—feeding on his egg-plants in the earlier part of June. There can be no doubt about the correctness of Dr. Oemler's observations, as the specimens were sent to us for determination. This is another of those instances of remarkable and sudden change in the food-habit of a tolerably common and otherwise well-known species which led us to the remarks made on p. 152 of this volume anent "New Insects injurious to Agriculture." As in other cases of this sort the

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

causes of such change are not readily ascertained. In this particular case the new habit may be only temporarily developed in a restricted region, either by the disappearance or poor condition of *Solanum carolinense;* or it may become permanent and cause *D. juncta*, hitherto looked upon as harmless or even beneficial, to vie with its ten-lined relative in destructiveness. Time alone will indicate, as we have no grounds upon which to base any confident prediction.

Another case very similar to that just mentioned may here be recorded. There is a small tortoise-beetle (*Cassida texana* Crotch) easily distinguished from its congeners by the uniformly pale green color of its upper surface and by the coarse striæ of punctations on the elytra. In 1879, we found it in all stages abundantly in Southern Texas feeding on the leaves of *Solanum elæagnifolium.* Dr. Oemler now writes (June 13th) that he finds eggs, larvæ and imagos of this beetle quite commonly depredating on his egg-plants, though there is no previous record of any such habit, and, indeed, the species is not recorded from the Atlantic States albeit we have found it this very season at Washington on *Solanum carolinense*—*C. V. Riley.*

Notes on Microgasters.—In the Proceedings of the Boston Society of Natural History (vol. XXI, pp. 18-38), Dr. Packard describes, among other parasites of butterflies, certain Microgasters upon which we would make the following remarks:

Microgaster carinata Pack. (p. 25). This, bred from the larva of *Pyrameis atalanta*, should be considered as but a variety of *Microgaster gelechiæ* Riley (1st Rep. Ins., Mo. 178, 1869), bred from *Gelechia gallæsolidaginis* Riley. It differs in nothing but the black anterior and intermediate coxæ and trochanters and darker posterior tarsi and tips of tibiæ—all variable characters within the same species. We have bred the *carinata* form from Penthina.

Microgaster pieridis Pack. (p. 26). This, from the larva of *Pieris rapæ* is a variety of the common, wide spread and polyphagous *Apanteles congregatus* of Say, who bred it from a Sphinx larva. *M. utilis* French (*Can. Ent.* XII, p. 42), as well as the variety of *militaris* referred to on p. 54 of our 8th report on the insects of Missouri are synonymous. The specific name *pieridis* is preoccupied by Bouché (see *Microgaster pieridis* Bé.; Ratzeburg, Die Ichn. d. Forst-insecten II, p. 73), and as variety names are serviceable, especially when, as in this instance, they are entomophagic, we would propose *pieridivora* as a substitute for Packard's variety name.

Microgaster atalantæ Pack. (p. 27). This, from *Pyrameis atalanta* is also but a variety of *Apanteles congregatus* (Say).

Microgaster carduicola Pack. (p. 27). This, bred from *Pyrameis cardui* closely resembles *Apanteles theclæ* Riley, bred from a Thecla larva, but differs in having no median ridge on the metathorax; in the more coarsely punctate basal joints of the abdomen;

in the slightly larger size and paler posterior tibiæ; also in the angulated outer side of first cubical cell and the lack of punctations beyond second abdominal joint.

Microgaster lunatus Pack. (p. 28). This bred from *Papilio asterias*, is an *Apanteles*.—*C. V. Riley*.

Does Parthenogenesis exist in the Bee?—According to the experiments of the Abbé Giotto Ulivi, as reported by Prof. G. F. Kroeh, in the *Scientific American*, March 25, 1882, parthenogenesis is a myth. Ulivi constructed flat hives with glass sides, containing three combs above each other, and furnished with shutters and with a portico having glass sides and a trap to prevent egress at will. One series of these hives was filled with bees, stores of honey and pollen, worker and drone brood, and queen cells, sealed and unsealed; a second series had no queen cells, a third no queen cells, drones, or drone brood. The result of careful observations, as stated by Ulivi, are that:

1. Queens are usually fertilized inside the hive. Queens on their return from the so-called "marriage flight" had empty spermathecas, while the act of fertilization was repeatedly witnessed in the hive.

2. They are fertilized several times.

3. Drones are not mutilated in the act of copulation. No lacerated drones were found after several careful examinations of all the drones in hives in which impregnation had taken place, and the whitish appendage attached to the queen's abdomen on her return from the "marriage-flight" was found to consist of excreta.

4. Every egg that hatches into a male or female has been previously fecundated. Queens that had been allowed to fly were afterwards confined in hives containing no drones or drone brood, and either laid no eggs, or laid eggs that did not hatch.

5. Every queen whose spermatic vesicle is distended and filled with liquid has been fertilized.

6. The eggs of a queen that has never met a drone will not hatch.

7. There is no such thing as a fertile worker. Fertile eggs will keep through the winter and hatch in the spring, and this hatching of fertilized eggs in queenless colonies has led to the belief in fertile workers.

The investigations appear to have been carefully and thoroughly conducted, and every result is based upon repeated observations. Should they be confirmed, not only will the theory and practice of bee-keeping be revolutionized, but another example will be added to the many that go to prove how slow mankind should be to accept as true conclusions opposed to the ordinary laws of life. It may be as well to mention that the continued reproduction of the aphides, sometimes called parthenogenesis or virgin maternity, is really of a very different nature. It is a process of budding, differing from the budding of a zoöphyte, chiefly in the fact that it takes place upon an internal instead of upon an external surface.—*W. N. L.*

ARE HONEY-BEES CARNIVOROUS?—In order to elicit farther facts bearing on this subject we publish the following note received long since from Dr. Müller; and also Mr. Mason's observations.

LIPPSTADT, 27, 10, 1880.

My Dear Sir:—My brother Fritz Müller replies to my question whether Apis or stingless Brazilian honey-bees have been observed by him as carnivorous, with the following notes: "1876 November 23, *Apis mellifica* an bepissten Stellen in trockenem Grase.

"November 24. An frischem Fleische ausser Wespen und Fliegen Zahlreiche Bienen: Apis (einzeln), *Melipona varians, Trigona pinguicosa* und besonders häufig eine (vielleicht zum Schutze gegen Trigona limao) wie Citronen riechende Art, *Tr. citriodora* nov. spec.?

"November 25. An Fleisch auch *Melipona ceyrcpie* und *Gurupu.*"

Regarding the species of Melipona and Trigona here mentioned, I have to add that they are as yet undescribed, and that the names used by my brother are provisional ones.

Yours very faithfully, DR. H. MÜLLER.

THE HONEY-BEE TASTING OF FLESH.—In regard to the alleged case of the honey-bee attacking and killing moths, published in the NATURALIST, Vol. XIV., p. 363, I may say that I have seen at least one, if not several bees (*Apis mellifica*) resting on a piece of meat in a butcher's shop in Providence, R. I., and lapping with its mouth-parts the fresh meat, apparently feeding upon the juice of the beef. This happened in the summer, and within six or seven years.—*Norman N. Mason.*

THE "OVERFLOW BUGS" IN CALIFORNIA.[1]—The following experience from one of my correspondents, Mrs. A. E. Bush, of San Jose, California, is, I think, well worth publishing, as showing how ground-beetles may be so numerous as to become a nuisance to man, the Carabidæ generally being indirectly beneficial to him by devouring plant-feeding species. The insect popularly denominated "Overflow Bug" in California is the *Platynus maculicollis* Dej.

"We lived in Fresno county two years, in the north-eastern part, and in the foot-hills of the Sierra Nevada. It is hot and dry there, no trees and many rocks where we were; thermometer ranging from 96 to 108° for about three months. In June and July, when hottest and dryest, the "overflow-bugs" filled the air between sunset and dark; you could not with safety open your

[1] Communicated by the editor to *Nature.*

mouth. They would light all over your clothes; they filled the house, they swarmed on the table, in the milk, sugar, flour, bread and everywhere there was a crevice to get through. Take a garment from the wall, and you could shake out a cupful. It was a veritable plague. In a shed where the boards had shrunk, and the cracks been battened, the spaces between the shrunken boards were packed full. They were flying for about two weeks, and then they disappeared mostly, or they did not fly much, but were hidden under papers, clothing, and every available place. In November before the rains they spread around but not to fly—make a light in the night, and you would see the floor nearly covered; lift up a rug and the floor under would be black, and they would go scuttling away for some other hiding. I had occasion to take up a floor board after they had apparently disappeared, stragglers excepted. The house was upon underpinning two feet or more from the ground. When the board was raised, there were the overflow bugs piled up against a piece of underpinning, making such a pile as a half bushel of grain would make. They were all through the foothills the same, and much the same in Los Angeles about Norfolk, but they did not fly much in the latter place. In Los Angeles they seemed to be worse before the "Santa Annas," a hot wind from the desert filling the air with sand, and though the chickens were ever so hungry for insects, they would not eat the overflow-bugs. You send for a sack of meal, and when you open it you see a handful of overflow-bugs; in the night you put up your hand to brush one from your face, and then you get up for soap and water to cleanse your hand. In the morning if you put on garments without shaking you get them quickly off and shake them."

ANTHROPOLOGY.[1]

Ethnography of the Philippines.—The mere mention of the Philippine islands carries our minds back to the childhood days when we first learned of Magellan and his tragic fate. The people of these islands are very well described in Stanford's Compendium of Geography and Travel for Australasia. But the most thorough work will be found in the 67th supplement (Ergänzungsheft) of Petermann's Mittheilungen, from the pen of Professor Ferd. Blumentritt, and dedicated to Dr. A. B. Meyer and Dr. F. Jagor. The work occupies 63 pages of the Mittheilungen, and is accompanied by a bibliography and an excellent colored chart. The inhabitants of the Philippine islands are 1. Negritos; 2. Malays; 3. Chinese, Chinese metis and Japanese.

The Negritos are the Aëtas or Itas, which together with the Samangs, of Malacca and the Mincopees, of Andaman, constitute the Negrito, or dwarf negro stock of this part of the world, to be carefully distinguished from the Melanesian or Papuan negroes

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

found in the Oceanic area from Papua to Fiji. Fifty one divisions of the Malay stock are enumerated, their locations given, and, generally, their characteristics.

The tribal names agree mainly with those of A. H. Keane, but each enumerates some not given by the other.

The "Revue d' Ethnographie."—From Ernest Leroux, of Paris, publisher, we have received a new candidate for the favor of anthropologists bearing the title, "*Revue d' Ethnographie* publié sous la direction de M. le Dr. Hamy, conservateūr du Musée d' Ethnographie, aide Naturaliste au Muséum. Tome premier. No. 1.—Janvier-Fevrier, Paris, Ernest Leroux, editeur, Librarie de la Société Asiatique, etc., 28 Rue Bonaparte, 1882." The Journal will appear bi-monthly and the cost for foreign subscribers is 30 francs per annum.

The first number contains the following papers:

Introduction, by E. T. Hamy.

Notes on the archéologie recueillies dans le Cornal, by G. Revvil.

Les Truddhi et les specchie de la Terre d'Otrate, by H. Lenormant.

Observations sur des fétiches de pierre, etc., découverts a l'ıle de san Nicholas (California). L. de Cessac.

Quelques jours chez les indigènes de la province de Malacca. Dr. Montano.

Reviews.—Societies, Expositions, Correspondence.

The Archæological Institute of America.—The third annual report of the executive committee has just issued from the Cambridge University press. With the customary report of activities and finances we have nothing to do, and pass to notice the contributions to archæological knowledge or materials. The Institute has two different departments of labor, differing very widely in character, the American and the Classical. In the former, Mr. Bandelier, having spent four months at Cholula, Mex., has prepared a report, now in press, a brief of which is given in the volume before us. The careful examination of the pyramid of Cholula has led Mr. Bandelier to conclusions of the weightiest importance. A subsequent visit to Atilla enabled the explorer to obtain accurate plans of the buildings and to draw some conclusions as to their functions. Mr. Bandelier subsequently returned to the Pueblos of New Mexico, where he has been prosecuting the work begun two years ago. Mr. Aymé, our consul at Merida, has also been engaged to make explorations in Yucatan.

In the second, or old world department of the Institute's labors, encouraging progress has been made at Assos, by Mr. Clarke and Mr. Bacon, a full account of which will be found in the first of the classical series of the institute.

The labors of the institute are prosecuted through the means derived from the fees and the generosity of the members. The secretary is Mr. Edward H. Greenleaf, of Boston, who will cheerfully respond to all inquiries relating to the subject.

Cist Graves in Ohio.—No. 56 of the Western reserve and Northern Ohio Historical Society's tracts describes ancient burial cists in Northeastern Ohio, similar to those described by Dr. Joseph Jones in Tennessee. The graves opened by Mr. Cornelius Baldwin, are situated near Parkman, Geauga county, Ohio.

Special Collections in the new National Museum.—As we have previously stated, the new National Museum will be entirely anthropocentric in its arrangement. At an early day we shall lay the whole scheme before our readers. Number 7 of the circulars is by Dr. James M. Flint, U. S. N., and gives an idea of what the entire exhibit will be when completed. Dr. Flint's circular is a classification of the forms in which drugs appear and are administered. The collection of medicines when completed will constitute an object lesson on the anthropology of medicine, including those of all ages and races of men.

GEOLOGY AND PALÆONTOLOGY.

New Marsupials from the Puerco Eocene.—In preceding numbers of the Naturalist, the characters of two new species of as many genera of kangaroo-like Marsupialia from the Puerco Eocene were given. I now add to these three additional species, one of which represents a new genus. The bones obtained with the teeth confirm the reference to the marsupial order which has already been made. In one of the species, *Catopsalis pollux* m., the astragalus is preserved. It considerably resembles that of a kangaroo; the reduced navicular facet and the large cuboid facet indicate the predominant development of the external digits, and the reduction of those of the inner side of the foot. Caudal vertebræ indicate a large tail.

Polymastodon taöensis, gen. et sp. nov. *Char. gen.*—Known only from the inferior dentition. Supposed formula: I. 1; C. 0; P.-m. 0; M. 2. The first true molar is large, exceeding the second, and supports three longitudinal series of tubercles. Function of the molars grinding.

In this genus the molar part of the dentition assumes the exclusive control of mastication, having already displayed a predominance in *Catopsalis*. The molars are similar in their general character to those of *Ptilodus* and *Catopsalis*, but the three rows of tubercles distinguish them from both.

Char. specif.—The first true molar is two-fifths of itself longer than the second molar, and viewed from above, it has an oval outline, a little narrowed anteriorly and with rounded extremities. Its tubercles are small and closely packed together, so that those of the middle row have a subquadrate outline. There are eight tubercles in the internal row, twelve in the external and nine in the median. There are no basal cingula. The second and last true molar has a pyriform outline when viewed from above, the posterior extremity being the narrow one. The contraction of the outline is regular on each side, and the posterior extremity is rounded. There are seven tubercles in the external row, five in the middle row and only two in the internal, since the middle row forms the internal edge of more than half the length of the crown. No cingula.

Measurements.—Length of M. I, m. .0225; width of M. I at middle, .0100. Length of M. II, .0140; width of M. II anteriorly, .0115. Besides the three rowed tubercles of the first molar, and the apparent absence of the fourth premolars, this species differs from the *Catopsalis pollux* in the large size and the larger number of tubercles in each row of the molars. New Mexico, D. Baldwin.

Catopsalis pollux, sp. nov.—The size of this species exceeded that of *Macropus giganteus* and still more that of the *Catopsalis foliatus*. The ramus has the form of that of a rodent, being vertically narrowed at the diastema, and deep at the molar region. The inferior face widens and becomes flat posteriorly, and is more oblique than in the *C. foliatus*, from the greater downward extension of the external or masseteric edge. The interior edge on the contrary, ascends a little from the anterior inferior border, enclosing the large internal pterygoid fossa. The inferior plane commences below the anterior part of the first true molar. The symphysis is short, and was not probably strongly united, as indicated by the few rugosities of its surface. The coronoid process rises from a point opposite the posterior extremity of the first true molar.

The incisor is relatively large, and is more curved than that of a kangaroo, having the general form of that of a rodent. The acumination or bevel of the posterior face is less rapid than that of a rodent, and is perfectly gradual. The enamel band covers the antero-external face as far as exposed, which is to below the anterior part of the diastema, and is gently convex in transverse section. It does not cover the entire external face, as its width is equal, while the antero-posterior diameter of the tooth increases below. The posterior face is convex and is not much narrowed. The internal face is slightly concave, and the enamel is recurved so as to form a band on its anterior part, thus differing from most rodents. The enamel surface is delicately obsoletely line-ridged. The length of the diastema is equal to that of the combined P.-m. IV and M. I. The fourth premolar is a simple tooth with a triangular transverse section, the obtuse apex of the triangle looking forward. This edge is continued downwards by reason of the exposure of the anterior root, and is not acute. The first true molar is an elongate-oval, with six tubercles on each side. These are so closely placed that their outlines are angular, and they are only separated by fissures. No cingula. The second true molar is three-fifths the length of the first, and is broadly rounded posteriorly. It supports four tubercles on the internal, and five on the external sides, and a raised edge connecting the sides posteriorly. The tubercles are appressed as in the first molar. No cingula.

Measurements.—Length of ramus without incisor to posterior edge above angle; M. .094. Length from do. to last molar inclusive, .060. Length from do. to fourth premolar, .025. Diameters M. I, anteroposterior, .019, transverse, .009; diameters M. II, anteroposterior, .012, transverse, .010; depth of ramus at middle of diastema, .024; depth of ramus at middle of M. I, .033.—D. Baldwin.

Ptilodus trovessartianus, sp. nov.—This species is represented by three of the characteristic fourth inferior premolars, one of which stands on a part of the ramus, giving its depth. These differ from those of the *P. mediaevus* in their uniformly smaller size, and in their strongly serrate posterior edge. The number of lateral edges is 12, as in *P. mediaevus.* Length of fourth premolar, M. .0055; elevation of do. .0040; depth of ramus at P.-m. IV, .0057. Discovered by D. Baldwin. Dedicated to the distinguished mammalogist, Dr. E. L. Trouessart, of Angers.

Haploconus entoconus, sp. nov.—The largest species of the genus, represented by a right maxillary bone supporting the last five molars. The peculiarity which distinguishes it from the *H. lineatus* is the conical form of the internal lobe of the fourth premolar, which is in the *H. lineatus*, flat and concentric in section. Further, the posterior inner or cingular cusp of the true molars is extended further inwards than in that species, giving the crowns a greater transverse extension. The posterior molar has the posterior external angle less developed than the other molars. The third premolar is a robust cone with subtriangular base.

Measurements.—With base of P.-m. III, m. .007; of P.-m. IV, .008; length of base of do. .0055; width base M. I, .0085; length do. .0050. Puerco beds of New Mexico. D. Baldwin.

Haploconus gillianus, sp. nov.—A small species of the size of the *H. angustus*, but having the same peculiarity of the fourth superior premolar as the *H. entoconus*, *i. e.*, with the internal lobe conic. That tooth is also relatively smaller than in the *H. entoconus*, and has an anterior basal external tubercle not found in that species. The inferior true molars have an anterior median tubercle which is not found in the *H. angustus* and *H. xiphodon*, and the external anterior cusp has not the compressed form general in the genus.

Measurements.—Diameters superior P.-m. IV, anteroposterior .0033; transverse, .0046. Diameters superior M. I; anteroposterior .0040; transverse, .0060. Length last two inferior molars, .0093; length of last inferior molar, .0050. Depth ramus at M. II, .0085. From W. W., New Mexico. D. Baldwin. Dedicated to my friend Prof. Gill, of Washington.—*E. D. Cope.*

Geological News.—In Vol. xv, Part I, of the Geological Survey of India, R. Lydekker, F.Z.S., describes the triassic limestones of Northwest Kashmir, and the palæozoic and metamorphic rocks of the same district, as well as the tertiaries of the lower Kishanganga valley and Kházán. He also describes and figures the entire lower jaw of *Pachygonia incurvata* Huxley, a labyrinthodont from the Panchet rocks, and portions of the mandibles of *Gonioglyptus huxleyi* Lydekker, and *Glyptognathus fragilis* Lyddeker, both labyrinthodonts from the same group.——Professor Whitney has recently published a work on the climatic changes of later geological times, in which he maintains that our globe is gradually becoming desiccated —a process that commenced in cretaceous times. The increasing dryness, within historical times, of Persia, Arabia, the countries around the Aral and Caspian, North Africa and Greece, is proved by abundant facts. Setting aside the removal of forests, and the effects of the glacial period, Professor Whitney refers this decline in precipitation to a diminution of the earth's temperature consequent on lessened solar radiation.——The May number of the *Geological Magazine* contains contributions to the palæontology of the Yorkshire oolites, by W. H. Hudleston, with descriptions of a new genus and two new species of gasteropods.——To the same number Professor Marsh contributes an article upon the wings of Pterodactyls. The "pteroid bone" is maintained to be a part of the first digit; it supported a membrane extending from near the shoulder to the wrist, and was articulated to the "lateral carpal," which is probably the metacarpal of the first digit. Thus the wing finger is the fifth, not the fourth, since the pteroid bone is upon the radial side.——Dr. W. Flight continues his history of meteorites, and the Rev. B. Irving his argument upon the classification of the European rocks known as Permian and Trias. ——In the same magazine Mr. H. H. Howorth considers the evidence of the loams and brick-earths in favor of a post-glacial flood. He believes that the Diluvium of Russia was continuous with the loam of France and Spain until the outpouring of the volcanic mud, which, swept over and mingled with it by the great flood, constitutes the loess. Patches of this loam, occupying valleys in France, Britain, etc., remain undisturbed, and form brick-earth, while the remainder has been altered and its pebbles rolled. The glacial period had passed, and ice would have scooped out the soft loam from the valleys, so that the result could only have been accomplished by a great flood.

MINERALOGY.[1]

A Phosphorescent Variety of Limestone.—Through the courtesy of Professor E D. Cope, the writer has had an opportunity of examining a remarkable substance recently found in one of the mountain mines of Utah, near Salt Lake city. It is a white rock which phosphoresces with a lurid red light whenever struck

[1]Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

or scratched with a hard substance, and on that account has been called by the miners, *Hell-fire rock.*

It proves upon examination to be an almost perfectly pure carbonate of lime, containing occasionally slight impurities of iron, etc. It is a loose grained, white, crystalline limestone, the grains of which are but slightly coherent, giving the rock the appearance of a soft sandstone. Upon slight abrasion in the hand, it crumbles to form a coarse, calcareous sand. Under the microscope the rock appears as a loose mass of irregular, angular grains, which are nearly transparent, and which have a luster resembling that of alum. Portions of the rock are colored slightly yellow by oxide of iron.

Its phosphorescent properties are very remarkable, entitling it to rank as a new variety of limestone. It was long ago noticed by Becquerel that some limestones were slightly phosphorescent, but so far as known, no other limestone possesses this property in a degree at all approaching that now described, the phosphorescence of which is nearly as strong as that of fluor spar.

Phosphorescence is developed when the rock is either struck, scratched or heated. Upon using metal, glass or any other hard substance to strike or to scratch it, a deep red light is emitted, which continues sometimes for several seconds after the blow. Rubbing with other fragments or grinding in a mortar developed a white light. The most remarkable phosphorescence is developed by heating a fragment of the limestone in a glass tube over a flame. It then glows with a deep red light which lasts for a minute or more after withdrawing the flame. The color of the light emitted resembles that of a red hot body. Several seconds before dying out, the light becomes white or bluish-white. Upon cooling and subsequent heating, phosphorescence is again developed in the same fragment, but much more feebly and for a shorter period, and after two or three such heatings, its phosphorescence is destroyed.—*H. C. L.*

PROCEEDINGS OF THE MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.—The Mineralogical Society of Great Britain and Ireland, instituted in 1876, holds general meetings in London two or three times a year, and an annual meeting at the time and place of the British Association meeting. Local meetings may also be held at any time and place. Its proceedings are issued as occasion may demand. The number before us, dated May, 1882, contains the following papers, read at the meetings of December 23, 1880, and September 2, 1881.

Minerals new to Britain.—Professor Heddle contributes analyses of the following British minerals: Halloysite, fibrolite, martite (apparently altered magnetite), turgite (pseudomorphous after pyrite), xonaltite (resembles a granular pink chalcedony), schiller spar (mixed with serpentine), hydrous saussurite (?), tachylite (a fused dolerite), dolerite, pitchstone, spherulite, paulite (hypersthene), zoisite, idocrase, andalusite, withamite, olivine, pinite, gigantolite, chlorophyllite, scapolite, pyrrhotite, pyromorphite, aragonite, reddle, lydian stone, hornstone, chert, lignite, ozocerite. It is to be regretted that a careful microscopical examination, especially in the case of the silicates, did not precede each analysis.

On some ill-determined minerals.—Professor Heddle in this paper again gives new names to species which he himself acknowledges are ill-determined and doubtful.

Plynthite is the name given to a red bole, which falls to pieces in water, and which "probably has resulted from a bed of earth which has been covered and burnt by a trap stream."

Uigite is a zeolite occurring in radiated, sheafy plates at Uig, Skye, which is but partially described. It is perhaps mesolite.

Ferrite is an alteration product of pyroxene, which occurs in brown crystals, soft enough to be bruised by the nail. (The name has already been appropriated by Vogelsang to designate a still worse species, the hydrous oxide of iron found in many rocks.)

Craigtonite. This name is given to a thin, soft coating of blue-black color adhering to red granite. An analysis was made by putting the mineral, together with the attached granite, in acid and attempting to dissolve the former. The result followed that the granite was attacked, as would be expected from such a method of analysis. The author wisely refrained from reducing the composition obtained to a formula. The coating is evidently wad.

Ellonite. "This is an *ad interim* name given to a pale, dull yellow, somewhat unctuous powder, which I got out of small nests, occurring rarely in perfectly fresh, recently blasted gneiss." The analysis proves that it is a mixture of sand and clay.

It would be well if Professor Heddle would follow the advice given in the preface to the third appendix to Dana's Mineralogy.

A peculiar copper ore from New South Wales.—Professor A. Liversidge describes an ore which, though homogeneous in appearance, is probably an intimate mixture of quartz and chalcocite.

On the occurrence of Linarite in Slag.—P. Dudgeon finds well-defined crystals of linarite in the cavities of the slag of an ancient Roman lead smelting place. He supposes that they were formed subsequently to the smelting, during long exposure to the air.

Some artificial forms of Silica.—J. I'anson and E. A. Parkhurst contribute some interesting results of a course of experiments in the artificial production of agates. They divide banded agates into those in which the crystalline mass is outside of the bandings, and those in which it is inside, the first showing growth from within outwards, the second from without inwards. They produce both of these forms artificially, by precipitating an alkaline solution of silica by acid. The acid is introduced through a pipette to the bottom of a vessel containing a solution of silica and an alkaline carbonate. As the stream of bubbles arise, silica is deposited, and in a few minutes a tube is formed, reaching from the bottom to the surface of the solution. The tube is at first thin, but constantly grows in thickness by the deposition of silica on the outside, thus forming a series of bands. The authors suggest that natural agates are formed by a somewhat similar chemical process. By introducing oxide of iron in the solution, they have closely imitated certain jaspers and moss agates.

Description of the Geological Map of Sutherland.—Professor Heddle describes a map published in a former number.

Specular Iron in a Copper Works Slag.—W. Terrill has found hexagonal plates of specular iron in a copper works slag.

Lernilite, and other supposed new German minerals.—In a recent paper by Schrauf in the *Zeitschrift für Krystallographie*, etc., upon the magnesian silicates of Southern Bohemia, a number of new names are proposed for various substances allied to serpentine, most of which are products of alteration. Every mineralogist knows the numerous substances found with serpentine in a more or less altered condition, but every one will regret that Professor Schrauf has thought it necessary to give distinctive names to these substances. Superfluous names, if retained in the science, will cause determinative mineralogy to become burdensome. Enophite, lernilite, kelyphite, siliciophite, berlauite, schuchardite, hydrobiotite, parachlorite, and protochlorite are the names here introduced to designate substances most of which are already well known under more simple designations.

A curious mistake is made in the name "lernilite." This is the name he applies to the vermiculite of Lenni, Delaware county, Pa., already described by Professor Cooke. The name Lenni having been misspelt in Professor Cooke's paper, the error is perpetuated by Schrauf in his "lernilite." As the term "lennilite" has already been appropriated for a variety of orthoclase from the same locality, Professor Schrauf must find another name for the mineral. "Hydrobiotite" is also a term previously used.

Mineralogical Notes.—F. W. Clarke and N. W. Perry in the *American Chemical Journal* for June describe a massive purple mineral from Colorado, which appears to be a decomposed fluor spar mixed with calcite. An analysis is given, and the name "*gunnisonite*" is proposed. Certainly no cause has been shown for assigning this new name to an impure and partially studied substance. —— According to Dr. Heddle, a schist containing andalusite crystals is used in Scotland for millstones. The hard crystals protrude from the surface of the stone and act as grinding teeth.—— Dr. M. E. Wadsworth has found picotite, a chrome spinel, in the basalt of Mt. Shasta, California. —— The Smithsonian Report for 1880, contains an excellent summary of recent mineralogical discovery, prepared by the late George W. Hawes. —— O. A. Derby in a recent number of the American Journal of Science, describes the modes of occurrence of the diamond in Brazil. Diamonds occur in gravel, in clay or decomposed rock, in a compact quartzite conglomerate, and in their original matrix in veins traversing the hydromica schist and itacolumite formation. The diamond-bearing veins are decomposed hydromica schists underlying the itacolumite. —— By making use of the polarizing microscope of Bertrand, Descloiseaux has been able to determine the crystallographic and optical characters of nadorite, and has shown that the crystals are twins. —— Rocksalt of a bright green color has been found in the Douglashall shafts. It contained 59 per cent. of potassium chloride with enclosed crystals of potassio-ferrous chloride ($2KCl$, $FeCl_2$, $2H_2O$), for which Ochsenius has proposed the name "*douglasite*." —— A specimen of chalcedony recently brought by Mr. P. Rathbone, from Monte Video, contains an ounce of liquid, with a large bubble. —— An apple green, clayey substance occurs in crevices in the weathered granite of Upper Austria, which becomes brittle upon exposure to the air, and falls to pieces in water. It is essentially a hydrous silicate of alumina, and appears to be similar to the variety of fuller's earth, known as *razumoffskin*. —— O. Leudecke has studied the fireblende (pyrostilpnite), of Andreasberg, and finds its composition identical with that of pyrargyrite. As the former is monoclinic, and the latter rhombohedral, $Ag_3 SbS_3$ is proved to be dimorphous.

MICROSCOPY.[1]

THE AUGUST MEETINGS.—The Elmira meeting of the American Society of Microscopists, August 15-18, and the Montreal meeting of the A. A. A. S., August 23-30, will both be occasions of unusual interest, and all persons interested should attend one or both if possible. At Montreal the new section of histology and microscopy will meet for the first time, as a full section and with the same standing as the oldest and most important sections of the association.

EYE PROTECTORS.—Nearly every one who has used the monocular microscope to any extent has experienced a peculiar fatigue, due to the unequal use of the two eyes, which is felt most in the unused eye, and which is about equally troublesome whether that eye be kept open and confused by a useless vision, or closed and irritated by the sudden and frequent changes from use to disuse and by the unnatural muscular efforts required to accomplish this. In most cases, as is well known, if this process be continued long enough, the disused eye becomes comparatively worthless, and the person works almost exclusively with one eye, whether with the microscope or without it. A similar effect has been noticed in the habitual use of the telescope and other optical instruments. Persons are often obliged, after some years, to practice using the left eye chiefly, for the sake of restoring as far

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

as possible the equality between the two. In addition to using the two eyes with equal frequency, most microscopists experience the greatest relief by shading the unused eye in such manner as to admit light but prevent vision, and about as many contrivances have been made for this purpose as there are persons who have felt the want of them. Pennock's Eye Shade, fig. 1, made by James W. Queen & Co., leaves but little to be desired for this purpose. It is portable, convenient, and efficient, can be adapted to any instrument, and, by simply turning it over, be used equally well with either eye. One of the best plans for a home-made shade is that recently described by Dr. L. Brewer Hall, of Philadelphia, before the Northern Medical Association of that city. A piece of brass wire, No. 18, about 45 centimeters long, is bent at one end into a loop 4 centimeters in diameter and covered with a piece of black paper folded over and gummed down so as to form a disk. This is supported in front of the unused eye by the rest of the wire, the other end of which is formed into a ring fitting around the drawtube or any available portion of the microscope. The middle portion of the wire is bent down so as to be out of the way of the nose. Any one can make this shade at a nominal cost.

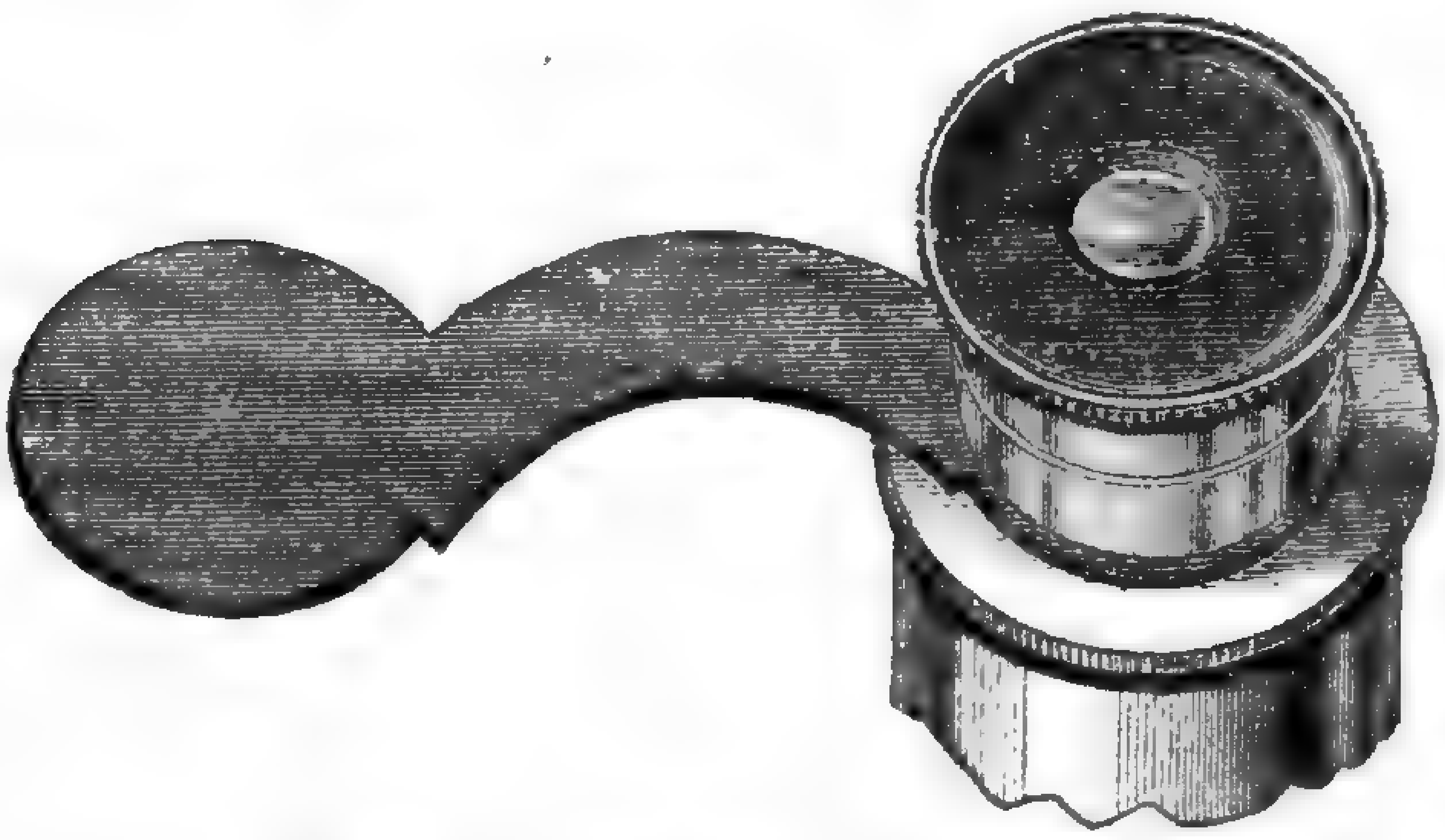

Fig. 1.—Pennock's Eye Shade.

An Adjustable Spring Clip.—The Nassau spiral spring clip, the construction of which is sufficiently explained by Fig. 2, can be instantly adjusted, by a screw movement, to any degree of pressure that may be required upon the cover glass during the process of mounting an object. It is made by J. H. McAllister, of 49 Nassau St., New York.

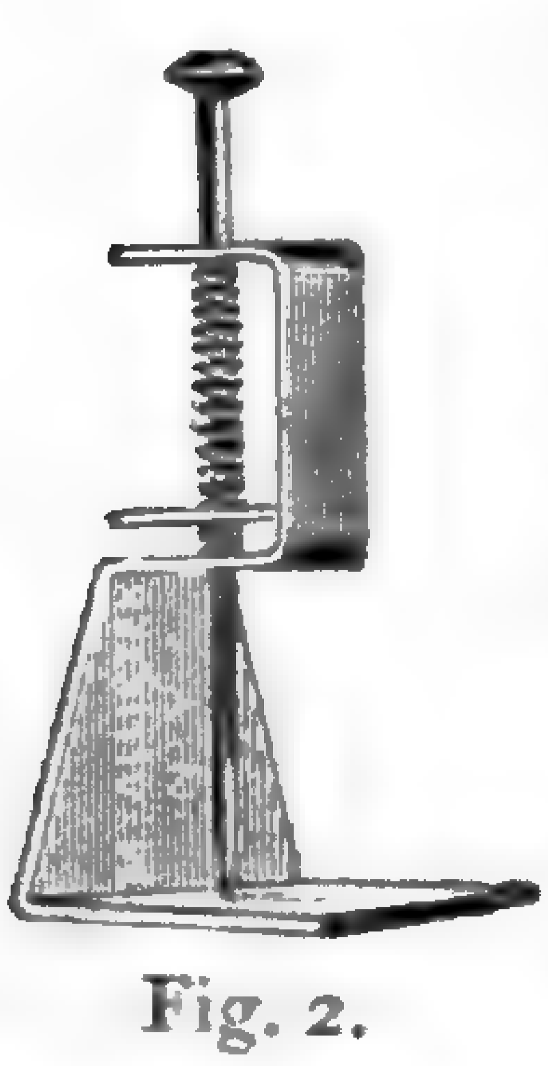

Fig. 2.

Cereal Foods under the Microscope.—Some months ago Dr. Ephraim Cutter, of New York, published an elaborate microscopical analysis of over forty kinds of flour and meal, mostly dietetic preparations used for children's and invalids' food. The nutritive value was assumed to be in proportion to the presence of the so-called "gluten cells," and those preparations were represented as worthless and fraudulent which did not contain a due proportion of these cells. If trustworthy, this report would have been one of the most important contributions of the microscope to practical affairs. We published no account of its conclusions, because of the certainty that the gluten cells did not contain all the gluten, and the want of proof or probability that they represented with any accuracy the proportion of gluten present or the comparative nutritive value of the preparations. Besides, the relative value of the various foods, thus determined, did not correspond with the previous results of clinical experience, some foods of well proved value being classed as spurious, and others being apparently overrated. Dr. J. G. Richardson has recently published a note denying wholly the conclusions of Dr. Cutter's paper, and calling attention to the well known fact that fine flour from which the "gluten cells" have been removed, still contains from seven to twelve per cent. of gluten.

REMOVAL.—A. & A. F. Spitzli, dealers in microscopes and optical goods, have removed to the Hall Building, Troy, N. Y., where they have increased facilities for filling orders by mail for microscopical supplies of every kind.

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SCIENTIFIC NEWS.

— In January last, at the suggestion of Professor C. E. Munroe, a post-graduate course in natural history was inaugurated by the detailing of six midshipmen to duty at the National Museum as assistants to Professor Baird, by whom they were assigned to the care of the different curators. The suggestion of Professor Munroe was made operative through the earnest efforts of Rear Admiral C. R. P. Rodgers and the active coöperation of Commodore John Walker, and it met with the hearty approval of the Hon. Secretary of the Navy. Although at first Professor Baird feared that the plan might fail, owing to the detailing of unsuitable men, still he was willing to give it a trial and permit them to come. It is a pleasure to say that now, after some months' trial, the midshipmen ordered have pursued their studies with such diligence and application, and have performed the duties assigned them so intelligently and faithfully, that the course meets with his entire approval. Professor Munroe calls attention to the fact that it is not intended, and, in fact, it is quite impossible in the time assigned, to make scientific experts, yet it is hoped to make broader men, and, consequently, better officers of these midshipmen, while they are still employed in rendering services of great usefulness to the Government, at a time when they can best be spared from their regular duties. It is believed, too, that in the time assigned they may gain enough acquaintance with the subject to enable them to observe and record the natural phenomena with which they may meet while in the regular pursuit of their profession.

— Dr. C. A. White, palæontologist of the Smithsonian Institution, left July 1st for Glendire, Montana, on the Northern Pacific R. R., to spend three months in palæontological research. Professor Cope is *en route* for Oregon on a similar errand. Mr. S. H. Scudder spent the month of June in Colorado, collecting fossil insects at Florissante in order to perfect his forthcoming work on fossil insects for one of Professor Hayden's final reports. Professor E. S. Morse is now in Japan, *en route* for China, India and Europe, to return the coming winter. Professor R. E. Call is making an extended collecting trip in the Southern States for our rarer mollusks; when last heard from he was at Rome, Ga. Mr. W. A. Stearns has chartered a vessel and takes a party to the Labrador coast for scientific observations.

— *Nature* has been publishing a series of articles by different writers, the first, on Darwin as a geologist, by Professor A. Geikie; others on his zoölogical and psychological works, by Mr. Romanes, while his contributions to botany will be discussed by Mr. Thistleton Dyer. A biography of the great naturalist is to be prepared by his son, Mr. Francis Darwin, who desires the loan of his letters, to be copied and returned. A Darwin fund also is to be raised, the proceeds of which will be devoted to the advancement of biological science.

— The tenth annual report of the Zoölogical Society of Philadelphia, shows that this young society is in a flourishing condition. 34,949 more people visited the garden the past year than the preceding; the number of members is 815, and the gate receipts for the year was $243,427. The menagerie contains 297 mammals, 343 birds, and 37 reptiles and batrachians. A bathing pond for the elephants, and an aviary are among the new improvements. The number of animals which breed in confinement is increasing.

— George W. Hawes, curator of mineralogy, etc., of the National Museum in Washington, died at Colorado Springs in June last, in the 33d year of his age. Dr. Hawes was born in Marion, Ind., of New England parentage, and was educated at Yale College, also studying abroad and receiving the degree of doctor in philosophy from the University at Bonn. He was among the most enthusiastic of our lithological students, and his untimely death will be a severe loss to American science.

— Measurements of the winter movement of a large glacier in North Greenland (the Fjord of Jacobshavn), have been recently made by Herr Hammer, and the summer observations of Herr Helland on the same glacier in 1875 can be compared with them. The velocity is much the same, apparently, in summer and in winter; about fifty feet in twenty-four hours may be taken to represent the rate in the middle of the glacier, where it is greatest.

— At a meeting of the Appalachian Mountain Club, held June 14, 1882, in Boston, a paper by Mr. John Tatlock, Jr., of Williamstown, entitled "Variation of barometric measurements of altitude with the season," and one by Professor J. W. Chickering, of Washington, entitled "Roan mountain notes," were read.

— A society for the "Advancement of Literature and Science in the Dominion of Canada," has been instituted in Canada under the auspices of the Marquis of Lorne. The assembly of scientists at Ottawa, May 25, 26 and 27, included the most notable men of science in the British Provinces. Among the foundation members present were Professor L. W. Bailey and Mr. Matthews, of New Brunswick. Dr. J. W. Dawson is the president.

— A large lacustrine canoe, in excellent condition, has been found near Bex, 4000 feet above the sea-level, and nearly 3000 feet above the valley of the Rhone. No lacustrine relics, says *Nature*, have ever before been met with in Switzerland at such an elevation.

— The fifty-second annual meeting of the British Association for the Advancement of Science, will be held in Southampton, August 23d. The president-elect is C. W. Siemens.

— The eleventh meeting of the French Association will occur at Rochelle, beginning August 24th.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Philosophical Society, Jan. 6, 1882.—The death of Dr. Isaac Israel Hayes, the well-known explorer, on Dec. 17, 1881, was announced.

Feb. 3.—A paper upon the "Inclination of the apparent to the true Horizon, and the errors arising thereof in the Transit, Altitude, and Azimuth Observations," by Professor J. Hagen, was submitted for the proceedings.

Feb. 17.—Dr. Britton exhibited some peats and lignites of Arkansas, also some anthracites and bituminous coals from the same State, showing the progress of the formation of coals.

March 3.—Professor Cope read a paper entitled "On the Structure of some Eocene Carniverous Mammals," illustrating his subject by the exhibition of various fossil remains.

March 17.—Professor Sadtler read a paper by Professor Edgar F. Smith and Mr. Thomas, on corundum and wavellite from localities before unknown to mineralogists, about six to eight miles from Allentown.

Mr. Phillips made a communication in reference to the new Dictionary of the English language, now preparing under the auspices of the Philological Society.

The Philadedphia Academy of Natural Sciences, Feb. 21.—The deaths of Dr. J. W. Draper and Theo. Schwann, corresponding members, and of Dr. Bridges, were announced.

Feb. 28.—Dr. Leidy exhibited a beautiful collection of tourmaline crystals, and a variety of asbestos, known as "mountain leather," from the Hot Springs of Arkansas. This latter mineral contained at times flattened quartz crystals, and he asked if the asbestos could be supposed to influence the crystallization of the quartz.

Dr. Koening stated his belief that the coloring matter of tourmaline is entirely organic, and Dr. Leidy confirmed the belief from his experience of its destruction by heat.

Professor Heilprin remarked upon the erosion of their western banks by streams flowing from the poles to the equator, and of their eastern banks by streams flowing in the reverse direction. This was caused by the earth's rotation, but he suggested that for the same reason streams flowing from east to west ought to have a slower motion than those moving from west to east.

Dr. Parker recorded an anomaly in the common extensor tendon of the fore-limbs of a porcupine. The middle digit was unsupplied, the tendinous slip belonging to it being sent to the fourth digit, which was thus furnished with two slips.

March 7.—Mr. Meehan spoke of the difference in time between the ripening of the male and female flowers of the silver maple. Most of the male flowers on weak shoots open a week or two earlier than the female, leaving the work of fertilization to be performed by the few male flowers which, being on stronger branches, expanded the same time with the female.

Dr. Leidy called attention to the occurrence of *Balanoglossus*. at Atlantic City. He believed this worm to be near to the Nemerteans. He also praised the excellence of soup made from *Solen ensis*. Dr. Leidy also stated that he had found *Scolithus* in pebbles of Potsdam sandstone from near Philadelphia.

Professor Lewis exhibited a large pebble showing glacial grooves.

March 16.—Dr. Horn spoke of the impalement of grasshoppers upon the echinocacti in Arizona by the action of shrikes or butcher-birds.

Mr. Ryder stated that the green color of oysters was not due to salts of copper, but probably to chlorophyll, so that green oysters were perfectly fit for food, as he had proved himself.

The president stated that enough copper to color an oyster would certainly kill it. The green color might be the zoöspores of *Ulva latissima*.

Professor Heilprin drew attention to the occurrence of an ammonite *in situ* in pieces of rock from the Tejon group of California. As all the other fossils in this group were Tertiary, the existence of a tertiary ammonite was thus proved.

Boston Society of Natural History. General Meeting, May 17.—Mr. T. T. Bouvé made some remarks on gems and on the story told by certain sands; Professor H. W. Haynes gave some new evidence of cannibalism among the Indians of New England, from the island of Mt. Desert, Maine; the president described another strange type of Carboniferous Myriapods; and Mr. S. Garman said a few words on the dormant period of sharks.

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METHODS OF MICROSCOPICAL RESEARCH IN THE ZOOLOGICAL STATION IN NAPLES.

BY C. O. WHITMAN.

IN the preparation of this paper Dr. Mayer has allowed me to make free use of his excellent article,[1] published about two years ago. I have added the methods of Dr. Giesbrecht, Dr. Andres and some others who have worked in the zoölogical station. Dr. Mayer has further placed at my disposal such improvements and alterations as he has been able to make since the publication of his paper. I am also deeply indebted to Dr. Mayer for advice and generous assistance, for which I wish here to give expression to my most sincere thanks and grateful appreciation.

I am still further indebted to Dr. Eisig, Dr. Lang, Dr. Andres, Dr. Giesbrecht, Professor Weismann and Professor Dohrn, all of whom I have had occasion to consult with reference to matter contained in this paper.

I. PRESERVATIVE FLUIDS.

Killing, *hardening* and *preserving* are three kinds of work, requiring for their accomplishment sometimes only a single preservative fluid, but in most cases two, three or even more. As the same fluid often does the work of killing and hardening, and sometimes of preserving too, it is impossible to divide them into three classes corresponding to the kinds of work, except by repeating many of them twice, and some of them three times. While it is therefore more convenient to include them all under "preservative fluids," as Dr. Mayer has done, it is none the less

[1] Mayer. "Mittheilungen aus der Zoologischen Station zu Neapel." Vol. II, p. 1, 1880. A summary of this paper by Geo. Brook was published in the NATURALIST, June–Oct., 1881.

important to remember what kind or kinds of work each fluid is expected to accomplish.

Kleinenberg's picro-sulphuric acid, for instance, now so much used in the Naples Aquarium, is not a hardening fluid. It serves for killing, and thus prepares for subsequent hardening.

1. *Kleinenberg's Fluid.*[1]—

Picric acid (saturated solution in distilled water)	100 volumes.
Sulphuric acid (concentrated)	2 "

Filter the mixture and dilute it with *three* times its bulk of water;[2] finally add as much creosote[3] as will mix.[4]

Objects are left in the fluid three, four or more hours; and are then, in order to harden and remove the acid, transferred to 70 per cent. alcohol, where they may remain 5–6 hours. They are next placed in 90 per cent. alcohol, which must be changed at intervals until the yellow tint has wholly disappeared.

Summary of Dr. Mayer's remarks on Kleinenberg's Fluid.—The advantages of this fluid are, that it kills quickly, by taking the place of the water of the tissues; that it frees the object from sea-water and the salts contained in it, and that having done its work *it may be wholly replaced by alcohol.* In this latter fact lies the superiority of the fluid over *osmic* and *chromic* solutions, all of which produce inorganic precipitates and thus leave the tissues in a condition unfavorable to staining. Picro-sulphuric acid does not, like chromic solutions, harden the object, but simply kills the cells.

As this fluid penetrates thick *chitine* with difficulty, it is necessary, in order to obtain good preparations of larger Isopoda, insects, &c., to cut open the body and fill the body-cavity with the liquid by means of a pipette. In larger objects care should be taken to loosen the internal organs so that the fluid may find easy access to all parts.

The fluid should be applied as soon as the body is opened, so that the blood may not have time to coagulate and thus bind

[1] *Quart. Journ. Mic. Sci.*, Vol. XIX, p. 208–9, 1879.

[2] Dr. Mayer uses the fluid undiluted for Arthropoda.

[3] Creosote made from beechwood tar.

[4] Dr Mayer prepares the fluid as follows:

Water (distilled)	100 volumes.
Sulphuric acid	2 "
Picric acid (as much as will dissolve).	

Filter and dilute as above. No creosote is used.

the organs together. *A large quantity of the fluid should be used, and it must be changed as often as it becomes turbid.* The same rule holds good in the use of all preservative fluids. It is well also, especially with larger objects, to give the fluid an occasional stirring up.

In order to avoid shrinkage in removing small and tender objects from the acid to the alcohol, it is advisable to take them up by means of a pipette or spatula, so that a few drops of the acid may be transferred along with them. The objects, sinking quickly to the bottom, remain thus for a short time in the medium with which they are saturated, and are not brought so suddenly into contact with the alcohol. In a few minutes the diffusion is finished; and they may then be placed in a fresh quantity of alcohol, which must be shaken up frequently and renewed from time to time until the acid has been entirely removed.

The sulphuric acid contained in this fluid causes *connective tissue* to swell, and this fact should be borne in mind in its use with vertebrates. To avoid this difficulty Kleinenberg has recommended the addition of a few drops of creosote, made from beechwood tar, to the acid. According to Dr. Mayer's experience, however, the addition of creosote makes no perceptible difference in the action of the fluid.

This fluid must not be used with objects (*e. g.*, Echinoderms) possessing calcareous parts which it is desired to preserve, for it dissolves carbonate of lime and throws it down as crystals of gypsum in the tissues. For such objects *picro-nitric acid* may be used. It is prepared as follows:

Water	95 parts.
Nitric acid (25 per cent. N_2O_5)	5 "
Picric acid as much as will dissolve.[1]	

Picro-nitric acid also dissolves carbonate of lime, but it holds it in solution, and thus the formation of crystals of gypsum is avoided. In the presence of much carbonate of lime, the rapid production of carbonic acid is liable to result in mechanical injury of the tissues, hence in many cases chromic acid is preferable to picro-nitric acid.

Picro-nitric acid is, in most respects, an excellent preservative medium, and as a rule will be found to be a good alternative in those cases where picro-sulphuric acid fails to give satisfactory

[1] This mixture is used undiluted.

results. Dr. Mayer commends it very strongly, and states that with eggs containing a large amount of yolk material, like those of Palinurus, it gives better results than nitric, picric or picro-sulphuric acid. It is not so readily removed from objects as picro-sulphuric acid, and for this reason the latter acid would be used wherever it gives equally good preparations.

2. *Alcohol.*—In the preparation of animals or parts of animals for museums or histological study, it is well known that the chief difficulties are met in the process of killing. Alcohol, as *commonly* used for this purpose by collectors, has little more than its convenience to recommend it. Dr. Mayer has called attention to the following disadvantages attending its use in the case of marine animals :

(1) In thick-walled animals, particularly those provided with chitinous envelopes, alcohol causes a more or less strong maceration of the internal parts, which often ends in putrefaction.

(2) In the case of smaller Crustacea, *e. g.*, Amphipods and Isopods, it gives rise to precipitates in the body-fluids, and thus solders the organs together in such a manner as often to defy separation even by experienced hands.

(3) It fixes most of the salts of the water adhering to the surface of marine animals, and thus a crust is formed which prevents the penetration of the fluid to the interior.[1]

(4) This crust also prevents the action of staining fluids, except aqueous solutions, by which it would be dissolved.

Notwithstanding these drawbacks alcohol is still regarded at the Naples Aquarium as an excellent fluid for *killing* many animals designed for preservation in museums or for histological work. In many cases the unsatisfactory results obtained are to be attributed not to the alcohol *per se*, but to the *method* of using it. Most of the foregoing objections do not, as Dr. Mayer has expressly stated, apply to fresh-water animals ; and Dr. Eisig informs me that he has no better method of killing marine annelids than with alcohol. Judging from the preparations which were kindly shown to me, and which were all beautifully stained with

[1] Dr. Mayer first noticed this in objects stained with Kleinenberg's hæmatoxylin, and afterwards in the use of cochineal, where a gray-green precipitate is sometimes produced which renders the preparation worthless. Such results may be avoided by first soaking the objects a few hours in *acid alcohol* (1–10 parts hydrochloric acid to 100 parts 70 per cent. alcohol).

borax-carmine, Dr. Eisig's mode of treatment must be pronounced very successful. The process is extremely simple; a few drops of alcohol are put into a vessel which contains the annelid in its native element, the sea-water; this is repeated at short intervals until death ensues. After the animal has been thus slowly killed, it may be passed through the different grades of alcohol in the ordinary way, or through other preservative fluids. Objects killed in this manner show no trace of the external crust of precipitates which arises where stronger grades of alcohol are first used. The action of the alcohol is thus moderated, and the animal, dying slowly, remains extended and in such a supple condition that it can easily be placed in any desired position. The violent shock given to animals when thrown alive into alcohol of 40 per cent. to 60 per cent., giving rise to wrinkles, folds and distortions of every kind, is thus avoided, together with its bad effects.

3. *Acid Alcohol.*—In order to avoid the bad effects of alcohol, such as precipitates, maceration, &c., Dr. Mayer recommends *acid alcohol*—

95 volumes 70 per cent. or 90 per cent. alcohol.
3 " hydrochloric acid.[1]

for larger objects, particularly if they are designed for preservation in museums. The fluid should be frequently shaken up, and the object only allowed to remain until thoroughly saturated, then transferred to pure 70 per cent. or 90 per cent. alcohol, which should be changed a few times in order to remove all traces of the acid. For small and tender objects, acid alcohol, although preferable to pure alcohol, gives less satisfactory results than picro-sulphuric acid.

4. *Boiling Alcohol.*—In some cases among the Arthropods, Dr. Mayer has found it difficult to kill *immediately* by any of the ordinary means, and for such cases recommends *boiling absolute alcohol*, which kills instantly. For Tracheata this is often the only means by which the dermal tissues can be well preserved, as cold alcohol penetrates too slowly.

5. *Osmic Acid.*—Dr. Mayer employs osmic acid as a staining medium for the hairs, bristles, &c., of the dermal skeleton of Arthropods. The luster of Sapphirina is preserved by this acid,[2]

[1] Acid alcohol as above prepared loses its original qualities after standing some time, as ether compounds are gradually formed at the expense of the acid.

[2] See corrosive sublimate, p. 705.

and according to Emery, the color of the red and the yellow fatty pigments of fishes.

Van Beneden found osmic acid the best preservative fluid for the Dicyemidæ, and my experience leads to the same conclusion.[1]

Although Dr. Mayer seldom uses this medium where histological details are required, he observes that in those classes of animals whose bodies are easily penetrated with watery fluids, osmic acid is seldom to be dispensed with.

Bleaching.—It often happens that objects treated with osmic acid continue to blacken, after removal from the acid, until they are entirely worthless, and such results are even more annoying than the difficulties in the way of staining. It has been said that the blackening process can be arrested by certain staining media, but it is certain that picro-carmine will not always do this, as some of my preparations of Dicyemidæ show. It is therefore a very important step which Dr. Mayer has taken in finding a method of restoring such objects. The method[2] is as follows: *The objects are placed in 70 per cent. or 90 per cent. alcohol, and crystals of potassic chlorate ($KClO_3$) shaken into the liquid until the bottom of the vessel is covered; then a few drops of concentrated hydrochloric acid[3] are added with a pipette, and as soon as chlorine (easily recognized by its greenish-yellow color) begins to be liberated, the whole gently shaken. As soon as the bleaching is finished the objects are removed to pure alcohol.* By this method Dr. Mayer has been able in half a day to restore large Pelagia, Carinaria, Rhizostoma, &c. Small objects generally require a shorter time and less acid. The process can be greatly accelerated by heating on a water-bath.

Using Sapphirina as a test-object, Dr. Mayer found that the luster which characterizes the living animal entirely disappeared by the bleaching process. As this luster, which has its seat in the epidermis, depends on the interference of light, it is evident that the cells had undergone *some* change, but a change so slight that the tissues could hardly be said to have been injured for his-

[1] One of the best objects for testing methods is found in *Phronima sedentaria.* Here the cells and nuclei are so sharply defined that they can be seen in the living animal, and so the effect of a preservative fluid can be easily studied.

[2] A slightly modified form of the method originally given in Müll. Arch., 1874, p. 321.

[3] Nitric acid may be used instead of HCl.

tological purposes; besides, the removal of the osmic acid leaves the animal in a good condition for staining.

Dr. Mayer's experience with Sapphirina appears to support him in the following conclusions in regard to the nature of the action of osmic acid, viz., that the hardening effect of the acid is due to the formation of inorganic precipitates within the tissues. This is made evident by the fact that the animal becomes soft and flexible as soon as these precipitates are removed by bleaching.

This method of bleaching has been used by Dr. Mayer for removing natural pigment. Alcoholic preparations of the eye of Mysis, for instance, can be fully bleached in toto, but with better success by operating with single sections. To avoid swelling, which is apt to arise by the use of aqueous fluids, staining media of an alcoholic nature should be used.

6. *Chromic Acid.*—Chromic solutions have in common with osmic acid, the peculiarity of hardening by virtue of the chemical combinations which they form with cell-substances, and all the consequent disadvantages with respect to staining. The use of chromic acid in the Zoölogical Station of Naples may be said to have been largely superceded by *picro-sulphuric acid*, *corrosive sublimate* and *Merkel's fluid*, for it is now seldom used except in combination with other fluids.[1] It is sometimes mixed with Kleinenberg's fluid, for example, when a higher degree of hardening is required than can be obtained by the use of the latter fluid alone. It is a common error to use too strong solutions of chromic acid, and to allow them to act too long. Good results are in some cases obtained when the objects are treated with a weak solution (⅓–½ per cent.) and removed soon after they are completely dead.

7. *Merkel's Fluid.*—

Platinum chloride dissolved in water	....	1:400
Chromic acid " "	....	1:400

Professor Merkel,[2] who employed a mixture of these two solutions in equal parts for the *retina*, states that he allowed from

[1] Dr. Pfitzner ("Morph. Jahrb.," B. XVII, p. 731, 1882) has recently made use of chromic acid followed by (1) *osmic acid*, or by (2) *chloride of gold*, *formic acid* and *safranin* (or hæmatoxylin) for the demonstration of nerve-terminations.

Flemming (see his method on a following page) believes that chromic acid is one of the most reliable fixing reagents for the karyakinetic figures, and has proved that objects hardened in this acid can be beautifully and durably stained.

[2] "Ueber die *Macula lutea* des Menschen," &c., Leipzig, 1870, p. 19.

three to four days for the action of the fluid. Dr. Eisig has used this fluid with great success in preparing the delicate lateral organs of the Capitellidæ for sections, and recommends it strongly for other annelids. Dr. Eisig allows objects to remain 3–5 hours in the fluid, then transfers to 70 per cent. alcohol. With small leeches I have found one hour quite sufficient, and transfer to 50 per cent. alcohol.

8. *Corrosive Sublimate.*—Prompted by a statement found in an old paper by Blanchard,[1] Dr. Lang began experimenting with corrosive sublimate as a medium for killing marine Planarians, and his marked success led him and others to employ the same with other animals. In most cases Dr. Lang now uses a *saturated solution of corrosive sublimate in water.* A saturated solution in picro-sulphuric acid, which in some cases gives better results if a little acetic acid (5 per cent. or less) is added, is also used.[2] Blanchard's mode of treatment was to mix a quantity of the aqueous solution with the sea water, and thus poison the animals. Dr. Lang, on the contrary, removes the sea water so far as possible before applying the solution. With Planarians he proceeds in the following manner:

The animal is laid on its back and the water removed with a pipette, the solution being then poured over it, it dies quickly and remains fully extended. After half an hour it is washed by placing it in water and changing the water several times during thirty minutes. It is next passed through 50 per cent., 70 per cent., 90 per cent. and 100 per cent. alcohol. In two days it is fully hardened, and should then be stained and imbedded in paraffin as early as possible, as it is liable to become brittle if left long in alcohol. The time required by the corrosive sublimate varies with different objects, according to size and the character of the tissues. As a general rule, it may be said that objects should be removed from the fluid as soon as they have become thoroughly

[1] "Recherches sur l'Organisation des Vers," by Emile Blanchard. Ann. des Sci. Nat. Zool. Ser. 3, t. VIII, 1847, p. 247.

[2] These solutions given in *Zoolog. Anzeiger*, 1879, II, p. 46.

The original solution (*Zoolog. Anzeiger*, 1878, I, p. 14–15), now little used, stood thus:

Distilled water	100	parts.
Common salt	6–10	"
Acetic acid	5–8	"
Corrosive sublimate	3–12	"
Alum (in some cases)	½	"

saturated by it. In order to kill more quickly than can sometimes be done at the ordinary temperature, the solution is heated, and in very difficult cases may be used boiling.

Corrosive sublimate has been used with success by Dr. Lang and others in the following cases: Hydroids, corals, Nemertines, Gephyrea, Balanoglossus, Echinoderms, Sagitta, Annelids, Rhabdocœla, Dendrocœla, Cestodes, Trematodes, embryos and adult tissues of Vertebrates and, according to Mayer and Giesbrecht, Crustacea with thin chitinous envelopes, *e. g.*, Sapphirina, Copepods and larvæ of Decapods.

The two great advantages of Dr. Lang's method are, (1) that animals so treated are easily stained, and (2) they are killed so quickly that they are left, in most cases, in a fully extended condition. Hot corrosive sublimate kills leeches so instantaneously that they often remain in the attitude assumed the moment before the fluid is poured over them. The color, however, is not so well preserved as when killed with alcohol, or even with weak chromic acid.

It should be remembered that objects lying in a solution of corrosive sublimate must not be touched with iron or steel instruments; wood, glass or platinum may be used.

9. *Dr. Andres' Methods of treating Actiniæ.*—Among the various methods employed by Dr. Andres in killing the Actiniæ, the three following, given in the order of their excellence, are said to have worked most satisfactorily:

A. Corrosive sublimate.—With small animals a hot solution, used in the manner recommended by Dr. Lang, gives good results; with larger animals, where this mode of treatment fails, the fluid must be injected. The cannula of a glass syringe, filled with the hot fluid, is inserted into the mouth at the moment it opens, which act habitually follows on gently touching the lip. After injecting, the hot solution is poured into the glass containing the animal and a small quantity of sea water.[1]

If the operation is cleverly performed, the animal remains fully expanded, as the mechanical pressure of the injected fluid prevents contraction.

After from five to fifteen minutes the animal is washed in distilled water and allowed to remain twelve hours in 50 per cent.

[1] *Andres.* "Intorno all'Edwardsia Claparedii," in the Proceedings of the "Reale Accademia dei Lincei," Vol. v, Ser. 3, Mar. 7, 1880, p. 9.

alcohol,[1] then passed through the higher grades of alcohol. Borax-carmine and hæmatoxylin used for staining.

B. Glycerine and Alcohol.[2]—

Glycerine	20	parts.
Alcohol (70 per cent.)	40	"
Sea water	40	"

This mixture, poured very slowly into the containing glass, often gives very good results, both for anatomical and histological purposes.

C. Nicotine and Tobacco Smoke.—*a.* A solution of nicotine (1 g.) in sea water (1 l.), conducted into the vessel containing the animal fully expanded in a half liter of sea water, by means of a thread sufficiently large to empty the flask holding the nicotine solution in the course of twelve hours.

b. The vessel containing the animal in an extended condition, covered by a bell jar in which tobacco smoke is confined, until the animal becomes completely benumbed.

After being deprived of sensibility by either of these methods, the creature may be killed in corrosive sublimate, or in picro-sulphuric acid.

D. Dr. Andres finds that in the use of chloroform, dropped slowly into the water, or administered in form of vapor, maceration usually sets in before the power of contracting is lost. Good preparations of the internal parts may be obtained by injecting a weak solution of osmic acid. The method of freezing has also been employed with some success. For this purpose three vessels are placed one within the other, the central one containing the actinia, the middle one ice and salt, and the outer one cotton. The ice containing the congealed animal is dissolved in alcohol or an acid.

E. Maceration.—It is often important to see the cells of a tissue *in situ* before freeing them with needles. In such cases Dr. Andres proceeds as follows:

1. Killed with corrosive sublimate.
2. Left in 25 per cent. alcohol twenty-four hours.
3. Soaked for a short time in a very thin solution of *gum arabic*, then in a somewhat thicker solution, and finally imbedded in a very thick solution.
4. Hardened in 90 per cent. alcohol.
5. Thick sections prepared for dissection with needles. The sections are placed on a slide in water, which dissolves the gum.

(To be continued.)

[1] A little camphor (1 ccm. to 100 ccm.) added to the alcohol will facilitate the removal of the sublimate.

[2] This method originated with Salvatore Lobianco.

NOTES ON THE HABITS OF THE "SAVANNAH CRICKET FROG."

BY CHARLES C. ABBOTT.

ONE of the earliest indications of returning spring is the clear, bell-like note of the little batrachian, called by many the "Savannah cricket," known in New Jersey as the "peeper," and scientifically designated *Acris crepitans* Baird.

Abundant as is this batrachian, but little seems to be known of its habits, and certain misstatements concerning them have been long in print, and have never, that I am aware, been either questioned or contradicted.

During the month of April, 1881, I had excellent opportunities for observing these little creatures, and finding that but little had been recorded concerning them, availed myself of my chance, and watched them closely for several weeks.

While a network of ditches in a low meadow were being repaired and cleaned, I followed the workmen closely, for the purpose of gathering any novelties that might be thrown out with the mud and dead leaves that had accumulated in the ditch-bottoms. Much of interest was found, particularly a number of the rare "Muhlenberg" turtles; but the one striking feature of the locality, at this time, was the wonderful abundance of little "rattlers" (*Acris crepitans*), as I prefer to call them. They were in full song, and when not disturbed, made more noise than all the frogs in the neighborhood together. They were quite timid, however, and on being approached were straightway "mum." Their vocal efforts seemed to increase until about May 1st, when their eggs were deposited in little masses, attached to the blades of coarse grass. I did not succeed in following the various stages of developmental growth from the egg to the matured animal, but was enabled to determine that it was more protracted than in the case of the common tree-toad (*Hyla versicolor*). The difference is, I believe, quite seven weeks.

To return to the adult "peepers." From the date of their earliest appearance until May 20, their numbers were incalculable. In every portion of the meadows at all wet, they were to be seen. Extremely active and very shy, they were difficult to catch, provided you pursued a single individual, but by sweeping an ordinary dip net along the grass at the edge of any little pool, several were certain to be caught. They fed ravenously at this time, and even when confined in very cramped quarters, would devour any flies that came within reach. On the other hand, they were the main food-supply of certain fishes, all the snakes, the turtles, and a few species of birds.

I found that all our snakes at this time (April and May) were more abundant in the meadows than elsewhere, and have no doubt were drawn thither for the purpose of feeding on these little batrachians. Even that lover of high, dry and dusty fields, the hog-nosed snake (*Heterodon phatyrhinus*) was found to be stationed at intervals along the ditch banks, on the lookout for "peepers;" the dissection of one of these snakes proved that it had fed upon these small frogs.

About the 20th of May there was a very noticeable diminution of their numbers, and by the 10th of June not a specimen was to be found.

The fact is, that their vigor culminates with the maturity of the ova and spermatozoa, and having spawned, they have no vital force remaining, and in the course of a few days after ovipositing, they die. Weeks then elapse when no representatives of this batrachian are to be found; indeed none exist, except the thousands of tadpoles. Late in August these tadpoles had become fully developed "peepers." Even then they were very rare during that summer (I suppose this is always the case), but in September many were found in damp places, never in the water, but always near a running brook, or a spring. By the middle of September a marked increase in their numbers was noticed; but their haunts were different. I found very few in the meadows, but many in damp places, as spring holes, in the adjacent woodland, and particularly along a brook where the water flows rapidly over a rocky bed.

It was here that I closed my field studies of these batrachians. Early in October I found a number of these "peepers" in a little ravine through which the above-mentioned brook passes. I noticed at this time, that these little creatures had a decided aversion to the water. Necessary as it was for them to keep their skins moist, they had no desire to become thoroughly wetted, and when by chance they made an unlucky jump and settled in the water, they straightway crawled out and took up a high and dry position on some projecting stone. If in the sun-light so much the better. A bath seemed to chill them, and whenever I drove one into the water, I found that for several minutes after it emerged I could pick it up without difficulty; but in time it would regain its ordinary activity, and then quick indeed must be one's movements who would catch them with the hand alone.

It was at this time, too, that I gave close attention to the subject of their color and its changeableness.

While there are certain peculiarities of color that are persistent and characteristic of the species, these become of little prominence at times, so very great is the difference in the entire coloration of the animal. Furthermore, they change their hues with great rapidity, and during the course of a few moments will pass from an ashy paleness or clay color, to an intense black, with the light dorsal stripe scarcely visible, or else either a glowing red or brilliant metallic green. So very beautiful are these changes, and so different will any half dozen prove to be, that it is difficult to realize that the many before you are one and the same species. Of a series of six which I have long kept in confinement (October 20th to January 29th) in a bottle, one specimen was taken from a ledge of pale yellow clay. The "peeper" was of the same color, the post-orbital dark spot and light dorsal line being scarcely discernible. The uniform yellow tint, however, was relieved by minute round points of brilliant bronze. This individual, unlike its companions, did not alter in color for several weeks. The others were very changeable, and particularly so when exposed to direct sun-light. While I noted several instances to the contrary, my impression is that usually the colors pale in direct sun-light, and deepen when the animals are in deep shade. This certainly is true of those I have in confinement, and agrees with my experience in searching for them during the past autumn. One fact with reference to the subject of their color is not in accordance, perhaps, with the above, but should not go unrecorded. The six individuals which I have in a bottle will, at times, present very different tints, although all are subjected to like surroundings. Of the six, two or three would be very dark, the others pale yellow. With some the dark triangular spot between the eyes would be very distinct, in the case of the others it could not be detected, even in outline. It must be remembered, however, that these individuals were kept in most unnatural conditions, and had, at the time of this writing, been without food for one hundred days, and at the same time remained as active as squirrels.

Sensitive as these "peepers" are to changes of temperature, it is by no means the first frost that drives them into their winter quarters. In the autumn of the past year (1881) I found them last as late as Nov. 12th, but even later (Dec. 27th) my son found one in the meadows which was as lively as a cricket. The frogs generally were singing this day. For more than two weeks prior to Nov. 12th there had been several white frosts, and the true frogs (Ranæ) had all disappeared except such few as lingered in the warm waters of the larger springs. Not so, however, with the "peepers;" the cozy, sheltered nooks in the ravine I have mentioned, afforded them comfortable quarters still, and after a severe rainstorm which lasted for three days, I found numerous specimens near the brook, always in moist places but not where it would be called wet. In many instances they were found adhering to the under sides of projecting stones, roots of trees, and even to large oak leaves. I find it stated by De Kay in Natural History of New York, that they cannot retain their hold upon the under sides of projecting objects; that the discs on their toes are not sufficiently large. This is an error; indeed, the specimens I have in a bottle, can retain their hold when the bottle is turned over.

My impression is, that they do not require or partake of any food during their brief experience as matured "peepers" in autumn (*i. e.*, from completion of the growth of their limbs in September to the commencement of their hibernation). My reason for this is based upon the fact that the specimens in a bottle, to which I have referred, were placed in confinement on the 20th of October, 1881, and the date of writing, Jan. 29, 1882, a period of one hundred days has just elapsed. During this time these "peepers" have had no food, have been quite as active as their limited quarters would permit, and yet have not lost weight to any important extent. One which I weighed on the day following its capture weighed forty-four grains, and seventy-five days later had lost but one grain in weight.

It is very different in the spring; then they are voracious feeders, and capture millions of minute insects. At this time their stomachs are always full; and while the size of the animal is not larger than in autumn, the weight is nearly twice as great. Their physiological activity culminates with the maturing of the ova and the labor of depositing it; this effected, they are worn out and in a very short time, die.

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THE EVOLUTION OF FORMS FROM THE CLINTON TO THE NIAGARA GROUP.

BY EUGENE N. S. RINGUEBERG.

WHILE collecting Niagara and Clinton fossils in the village of Gasport during the fall of 1881, I was struck by the peculiarity of texture and character of the fossils contained in the upper band of limestone; which is there found superimposed upon the series forming the upper portion of the Clinton group proper, and I at once recognized a similarity between its fauna and structure, to an analogous layer which I had previously noticed in the western portion of the town of Lockport, but had failed to find at several other points of outcrop.

At the place where it was first noticed, however, its character, both in regard to the fossils contained, which there are generally rare and fragmentary, and the general appearance of the rock, is not so pronounced in distinction from the underlying strata as at Gasport.

This layer is not continuous, but apparently occurs in confined areas. Thus it is found at Gasport and again in the western portion of the town of Lockport. But in the city, about two miles east from the latter point, and on the same line of outcrop, whose general direction is from east to west, it is entirely wanting, as I have ascertained by a careful examination of both natural and artificial exposures at the line of juncture between the Niagara shale and Clinton limestone.

It is extremely variable in thickness, but I should judge its greatest development to be in the neighborhood of two feet. This is merely to be taken as an estimate, as I have not been able thus far to take the proper means of obtaining accurate measurements.

The upper surface is extremely irregular and undulating; having the appearance of being drifted together. This is also corroborated by the position of many of the fossils, which seem to have been swept together by eddies, which at the same time were charged with sedimentary matter by which they were entombed as we now find them.

Thus immense numbers of the cephalic and caudal shields of *Illænus barriensis* will be found in the space of perhaps ten or fifteen inches, and outside of this accumulation there will not be any except a stray one or so.

In one vertical section of the stone in my collection, two inches in diameter, the fracture shows thirteen shields of this trilobite crowded one above the other. It also does not seem to have any very regular lines of stratification. At Gasport the limestone has a light bluish tint, and breaks, when comparatively free from fossils, with a clean flinty fracture, and is very hard, fine grained and compact. The majority of the shells have the interior filled with crystallized calcite, and some of the larger cephalopods are lined with crystals of the same. From all information obtainable, it seems that this layer has always been associated with the Clinton group. Its fossils, however, prove that it is more closely allied to the Niagara.

The most common forms are *Atrypa nodostriata* and *Meristina nitida*, both of which are Niagara forms. After these we may cite *Spirifera radiata*, *Lichenalia concentrica* and *Illænus barriensis;* which are common to both. The first of these reaches its perfection in the Clinton, and is found in a minor degree in the subsequent shales of the Niagara, while the two last are but sparingly found in the Clinton, and are found in the greatest numbers at the opening of the Niagara series.

But the most striking feature of this limestone—for which I propose the name of the *Niagara Transition Group*—is the abundance and perfection of the Cephalopoda, which in all other strata of the Niagara period in Western New York are quite rare, with the exception of *Orthoceras annulatum*, which is found in moderate numbers in the Niagara shale and also is the most common of the Clinton forms. In this respect as in the identity of a number of species, we find a strong analogy to the limestones representing the Niagara group in the Western States. In it we find *Cyrtoceras hercules, C. brevicorne, Trochoceras costatum, Trochonema pauper, Palæocardia cordiformis*, etc., which will be recognized as western species.

The majority of the species, as will be seen by the following lists, are Niagara; next in number come those common to both, after which will be found the Clinton and characteristic species:

NIAGARA SPECIES.

Calymene niagarensis,
Bronteus niagarensis,
Orthoceras medullare,
" *alienum*,
Cyrtoceras cancellatum,
" *hercules*,
" *brevicorne*,
Trochoceras costatum,
Trochonema pauper,
Palæocardia cordiformis,
Cypricardinia undulostriata,
Callopora elegantula,
" *laminata*,
Trematopora ostiolata,
Fenestella cribrosa,
Pentamerus interplicata,
Stephanocrinus gemmiformis,
Atrypa nodostriata,
" *rugosa*.
Cœlospira disparilis,
Rhynchonella cuneata,
" *obtusiplicata*,
Spirifera eudora,
" *niagarensis*,
Meristina nitida,
" *oblata*,
" *maria*,
Orthis flabellum,
" *hybrida*,
" *biloba*,
Streptorhynchus subplana,
Strophodonta striata.

SPECIES COMMON TO THE NIAGARA AND CLINTON.

Illænus barriensis,
Orthoceras annulatum,
Modiolopsis subalatus,
Avicula emacerata,
Lichenalia concentrica,
Caryocrinus ornatus,
Spirifera radiata,
Strophomena rhomboidalis,
Meristina intermedia,
Atrypa reticularis,
Rhynchonella neglecta.

CLINTON SPECIES.

Murchisonia subalata,
Athyris congesta,
Orthis lynx.

CHARACTERISTIC SPECIES OF THE NIAGARA TRANSITION GROUP.

Discina solitaria (n. sp.),
Leptæna sericea var. *intermedia* (n. var.).

As will be seen there are three species which have been considered to pass out of existence with the Clinton, that still survive in the stratum under consideration; unless we should also include the Leptæna described below.

Meristina intermedia has been placed in the list of species common to both groups, as the one from the Transition stratum, as well as those from the Clinton, are indistinguishable from specimens found in the Niagara shale; the only perceptible difference being a gradual falling off in size as we advance upwards in the series, and a slight diminution of the average width, so that some from the Niagara approach closely to the typical *M. nitida*, although others will be found that are fully as wide as those from the Clinton.

In all probability *M. nitida* and *M. oblata* are descendants of

M. intermedia; one branch developing in width while the other became narrow and elongate.

Thus far no Meristinæ have been found with a pronounced mesial fold, of which *M. naviformis* of the Clinton, and *M. maria* of the Niagara may be considered as types, although an intermediate form will, I think, be found.

The three specimens of *Stephanocrinus gemmiformis* found, all show a marked angularity of form similar to some young *S. angulatus.*

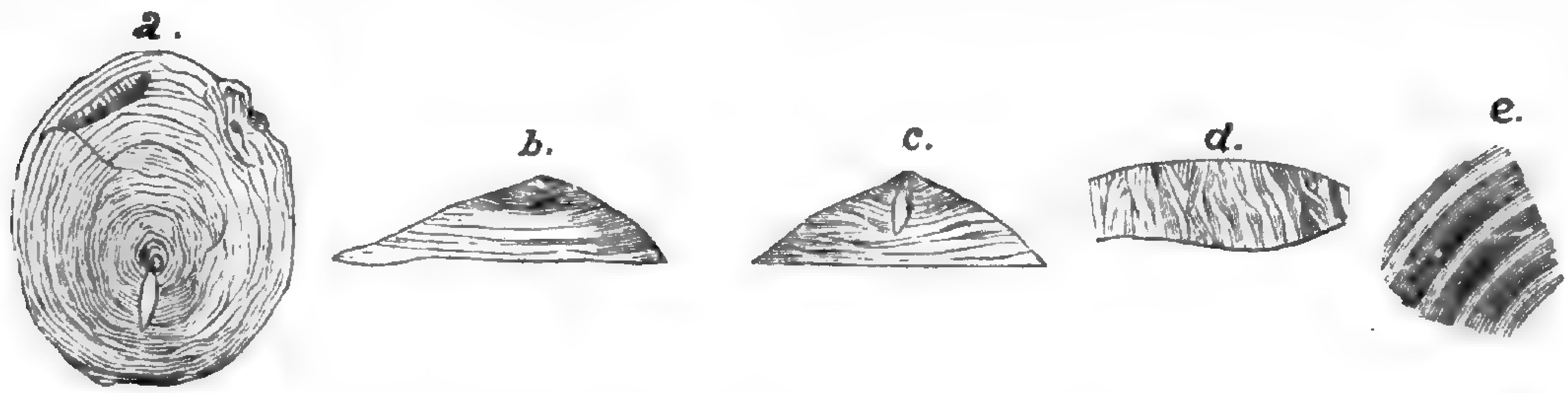
A Leptæna occurs in this rock that seems to be intermediate between *L. sericea* and *L. transversalis*, which it resembles in the convexity of the dorsal and the concavity of the ventral valves, while in texture, which is punctate and not so strongly striate as in *L. transversalis*, and by its wide lateral alation, it is more closely allied to *L. sericea.* Therefore I propose the name *Leptæna sericea* var. *intermedia,* as it undoubtedly represents the stage through which *L. sericea* passed before developing into what is known as *L. transversalis.*

The *Atrypa nodostriata* found here does not have so prominent a mesial fold as the Niagara forms, it being more gradual, and but little more pronounced than is found to be the case in gibbous specimens of *A. reticularis* from the Clinton.

Other species show slight variations from the Niagara types, or perhaps, more properly speaking, the types vary from the transition species.

Thus it will be seen that in many ways this apparently unimportant thin stratum, with its limited areas, that has been overlooked by the hundreds of geologists that have traversed this far-famed geological field, who probably have been lured from greater palæontological wealth by the tempting display of finely weathered-out fossils on the shale banks immediately above, as well as discouraged by the difficulty of wrenching the treasures from its flint-like grasp, plays a very important factor in the connecting chain of palæontological evolution. It binds together in closer unity two formations by its intermediate character, and also by the blending in it of forms before considered characteristic of these two well-defined groups.

Discina solitaria (n. sp.).—Shell oval, ventral valve with prominent apex; slope convex, slightly incurved near the apex on the posterior side; strongly marked by recurved concentric laminæ, of which, near the apex, there are about eight to one-eighth of an inch; these grow more crowded, wider and less recurved as they approach the margin, where they project from the surface on a plane with the valve and lie one against the other; these lower laminæ, when magnified, present a deeply wrinkled and furrowed appearance; these furrows are irregular, and proceed from the shell, growing fainter at the margin of the laminæ, and are scarcely perceptible unless the laminæ above are broken, apex about two-fifths of the length from the anterior edge; length, seven-eighths inches, width, six-eighths inches; height of apex



Discina solitaria (n. sp.)—*a*, ventral valve, nat. size; *b*, ventral valve, lateral view, nat. size; *c*, ventral valve, anterior view, nat. size; *d*, undulate surface of lamina from near the edge, enlarged; *e*, recurved laminæ from near the aperture, enlarged.

one-fourth inch. Foramen commences at the apex and extends half way down the side; shell barely incurved at this point, laminæ continuing without interruption to the edge of the apex here.

NOTE.—Since the above was written I have succeeded in procuring a young specimen of a Meristina with a mesial fold. It appears to be closely allied to *M. maria*, and it has consequently been placed in the Niagara list until other specimens are found which will determine its relationship more clearly.

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HYPNOTISM IN ANIMALS.[1]

BY D. W. PRENTISS.

Mesmerism, or more properly *hypnotism*, has been recognized under various names in the history of all nations.

The same influences which work the modern phenomena of hypnotism are undoubtedly identified with the manifestations of magic found described in ancient history. The magic of Zoroaster, the wonderful performances of the magi of the East—among the ancient Persians, Hindoos and Egyptians—the spells and incantations of the Grecian and Roman oracles, the methods of divination, the remarkable feats of the snake charmers of India and Egypt, all belong to the same category.

And so also might we include the more recent wonderful manifestations of religious mania which swept Europe in the seventeenth century as an epidemic, known as the "dancing mania," and was literally a national calamity. In our own country it was

[1] Read before the Biological Society of Washington, D. C., March 31, 1882.

represented at the close of last century by the witchcraft of New England, and still later within the memory of men now living, by the "convulsive" and "laughing" mania among the Methodists—notably in the State of Kentucky, where it is said that on one occasion as many as 5000 persons in camp meeting were under the "influence" at one time. The victims fell in convulsions and soon passed into a state of ecstatic trance, and were laid out on the grass in rows to recover themselves.

Physicians are brought in contact continually with similar conditions as forms of disease, under the names of hysteria, catalepsy, ecstacy and lethargy. No more marvelous stories can be found in the whole range of fiction than are presented as sober matters of fact in the standard works on nervous diseases—such as of Charcot, Weir Mitchell and Hammond.

In this place are to be classed the modern miracles of the Church. The history of "Our Lady of Lourdes" finds an exact parallel in many of the cases that have been lately so thoroughly studied at the Hospice Salpetriére in France, by Chalcot.

All of these phenomena may be grouped into a single allied genus, of which the various forms of manifestation may be considered species. *Mesmerism* is one of the species, clairvoyance and modern spiritualism may be mentioned as others. No systematic or scientific attempt was made to study into the nature of these phenomena until the time of Mesmer, from whom this term is derived.

Mesmer was a German physician who went to Paris in 1778 to practice his new discovery of "animal magnetism" in the cure of disease. In six years he amassed a large fortune, and during that time kept Paris in a fever of excitement with his doings.

In 1784 a royal commission was appointed, of which Benjamin Franklin was one, to investigate his methods. Their report was unfavorable to the claims of animal magnetism, and Mesmer's popularity soon declined.

Mesmer's exploits in Paris are designated by Mills as the first epoch in "mesmerism."

The second epoch is that of Braid, an English physician, 1841. Braid disclaimed anything like animal magnetism in his operations, and explained them by referring to physiological and psychological influences in the subject.

He gave the name of *hypnotism* to the phenomena produced, and like Mesmer applied his skill to the treatment of diseases; the diseases claimed to be influenced favorably being neuralgia, hysteria, epilepsy and the like. Surgical operations were also performed painlessly during the anæsthesia of the hypnotic state. Teeth pulling, excision of mamma, and even amputations of the thigh, are among the operations performed. Braid published a voluminous book upon the subject, relating his views and experiences.

The third epoch of Mills we are now passing through. The experiments and writings of Heidenhain of Germany, of Charcot and Richer of France, and of Beard, Hammond and Mills in this country, have revived the interest in the subject, and hypnotism is again being subjected to a rigid scrutiny.

The subject is one of great interest in itself, not only from a scientific standpoint, but also from the fact that more precise knowledge of the laws governing the phenomena presented may be of practical value. That hypnotism has been used with apparent benefit in the treatment of certain diseases, appears in the experience of many writers upon the subject, and it is certain that the anæsthesia thus induced may be taken advantage of for the performance of surgical operations. Recently in an exhibition by Dr. Hammond before a medical society in N. Y., a tooth was extracted without pain, and a subject was burned with a red hot iron without conscious sensation. If the application of hypnotism could be reduced to a science, it is among the possibilities of the future that it might supercede the use of such agents as chloroform and ether as anæsthetics.

In the present state of knowledge, however, this is impracticable, as well also as its use as a therapeutic agent. Although the subject has engaged the attention of investigators for centuries, no acceptable explanation of the manifestations of mesmerism has yet been offered.

Undoubtedly a large proportion of the acts shown in public exhibition are due to trickery and collusion, but I think no one can witness such an exhibition as was recently given in Washington, by Carpenter, without feeling that *all* is not deceit, that there is an influence at work which thus far has not been fathomed.

Mesmer called it animal magnetism, and claimed it to be an emanation from his person, as electricity from a battery.

Braid rejected the animal magnetism theory, and referred the phenomena to psychical influences (*neurypnology*).

The latest attempt at a theory is that of Heidenhain, just promulgated: "Hypnotism is due to inhibition of the cortical cells of the cerebrum, caused by gentle, prolonged stimulus of the nerves of the face, eyes or ears."

This definition of Heidenhain's is, to my mind, but little more satisfactory than any preceding one. It merely attempts to describe by an hypothesis a physical effect, leaving out of sight the ultimate cause. I have given more time than I had intended to the general subject of hypnotism, and have perhaps only stated facts known already to the members of this society. I have done so, however, in explanation of my reason for bringing before your notice the subject of hypnotism in animals.

1. The general subject is one of more than passing interest to men of science.

2. It is one the true inwardness of which is but little understood, and which presents a field for further investigation.

3. The study of the phenomena presented by experiments upon animals, and of observations on their habits, offers a promise of more definite results than can be obtained from observations upon man alone.

It is necessary to state that I have no pet theory of my own to propound or uphold, but it is my hope in reviewing and briefly analyzing the history of hypnotism in the lower animals, to develop facts known to naturalists that may have an important bearing upon the subject. The practice of magic on the lower animals has a somewhat parallel history in ancient nations to that already referred to in connection with man. All nations and tribes have their conjurors, more or less expert. Probably the most expert are the "serpent charmers" of India and Egypt. Of these mention is made in the most ancient writings as well as in modern books of travel. The serpent is the favorite animal on which to exhibit the influence of these charms—for what reason may possibly be explained by modern herpetologists. In Dr. Spry's "Modern India," published in 1837, is a description of the method of operating of one of these Indian magicians. He says: "An eminent physician, skeptical on this point (serpents and birds being drawn and held as by a charm), in company with other English gentlemen thus tested the fact. Taking a serpent charmer alone, they brought him to a distant heap of rubbish, and causing him to lay off all his raiment that there might be no deception practiced upon them, they watched his movements.

"Approaching the pile with a serpent-like hiss and nervous working of the features and limbs, which became more and more excited and violent, presently serpent after serpent of the most venomous kind, showed their heads and gradually moved towards their charmer, until reaching out his hand he took them as so many lifeless withes, and deposited them in his basket." Numberless attested incidents of a similar kind might be given, the operator winding the serpent about his neck and pressing coil after coil into his mouth, and rendering it rigid as a stick or pliant as a cord at pleasure.

In a report on the "Manners and Customs of the modern Egyptians," by E. W. Lane, 1836, is an almost identical account of snake charmers of Egypt, and their method of drawing serpents out from the houses.

In 1646 Athanasius Kercher, an Italian monk, described what he termed the "Experimentum mirabile." It was an experiment which has since become sufficiently familiar to all of us, but which appeared to the old monk little less than miraculous.

He tied the feet of a hen together and laid her on the ground, where after cries and violent struggling she became quiet, "as if," says he, "despairing of escape through the fruitlessness of her motions, she gave herself up to the will of her conqueror."

Kircher then drew a chalk line in a diagonal direction from one eye to the other, loosened the ribbon, and the hen, although left perfectly free, remained immovable, even when he attempted to rouse it. Kircher believed that the hen thought the chalk line was a string by which it was bound as at the feet, and attributed its quiet state to this idea.

The most extended observations upon hypnotism in animals have been made by Czermak in the private physiological laboratory of the University of Leipsic. The results obtained were reported in two lectures delivered by him in January, 1873, and published (in translation) in *Popular Science Monthly* for Sept. and Nov., 1873.

Czermak dwells upon the unreliability of untrained observation in such matters, and says that the usual reports, while honest and technically true from the observer's standpoint, are in their conclusions generally false.

To such inaccurate reports he applies the term "events viewed unequally." From this view the "experimentum mirabile" of Kircher is characterized as inaccurate, it is an "event viewed unequally." Czermak repeated the experiment, tying the legs of the fowl, pressing it down upon its side and making the chalk mark in front of its bill. It laid quiet, panting just as Kircher has described. The chalk line was then dispensed with, and still the animal remained quiet; and finally the tying of the feet was left out, and still the same result. It was not therefore the imagination of the hen, produced by the chalk line, as Kircher supposed, that rendered the animal lethargic, but some other cause not yet explained.

A friend of Czermak's told him a story about mesmerizing crawfish; that by making certain passes in the direction of the body, the animal became stiff and soon stood on its head, and after a while by reverse passes it resumed its natural position and crawled off. Czermak was skeptical, but a capture from the neighboring brook dissipated his doubts. Just what has been described took place. Not only this but Czermak himself found he also possessed the same magic power over the Crustacean. He was not satisfied to stop here. Pursuing his experiments, he found that passes were not needed either to put the crawfish on end or to bring him down again. He obtained a basketful of the animals, turned them out on the table, stirred them up a little, and lo! all of them turned tail up and stood so for a short time, when they gradually descended and crawled away. It was further observed that the crawfish would remain motionless in any position in which forcibly held until struggling ceased. Czermak repeated his experiments with ducks, geese and swans with similar results; but whether he is justified in claiming, as he does, with the positiveness of *italics*, "that he has proved the appearance of hypnotism in animals," I think is open to doubt, and it may be, in the light of the naturalists' knowledge, that even he has not viewed his "events equally." Czermak makes another statement with which I very much doubt whether those who have studied the habits of animals, will agree.

He says: "With animals every one feels safe from all thoughts of deception." Evidently he had never surprised a 'possum in a midnight raid upon a hen-roost; or if he had witnessed that interesting animal "playing possum," he may have considered it a very aggravated case of "hypnotism in animals," for certainly the hen and crawfish are entirely eclipsed by the wily marsupial.

No naturalist will say that we are "free from all thoughts of deception with animals," for I am sure each person present can call to mind many instances of deliberate deception, not only on the part of animals in the restricted sense, but cases of insects simulating death appear to be very common.

Indeed it seems to be an instinct of self-preservation with insects, worms and many others of the lower orders of life, in case of danger to draw up into as small a space as possible and remain perfectly quiet until the danger is passed.

In the year 1859, while enthusiastically interested in ornithology, I shot a turkey buzzard (*Cathartes aura*). The bird was winged, and when approached was standing up under a laurel bush, looking brightly about, one wing hanging. As I came up he first disgorged, then as I continued to approach, his head began to droop to one side, and by the time I reached him he lay upon his side apparently lifeless. Believing that he really was dead, I with difficulty forced him into my game bag and proceeded home, a distance of two miles. He was then taken from the game bag and thrown down in the yard, limp and lifeless.

My surprise can be imagined when calling out the family to view the capture a moment later, he was found running around the yard as lively as ever. On our approach, however, the same motions were enacted, and again he lay upon his side dead. This routine followed each approach, until after a while he became accustomed to the presence of persons, and then would simply hiss and disgorge. (In the "Birds of the Northwest," 1874, p. 383, Dr. Elliott Coues recounts a similar incident.)

Mr. Nelson informs me that he has witnessed a like action on the part of the wild goose when wounded. As soon as it finds escape impossible, it will stretch out its neck and remain stiff and immovable, so that it may be handled in this condition, the muscles remaining rigid as in catalepsy. If, however, it is not disturbed, it will soon begin to peep around and gradually attempt to get away.

In the case of the opossum, the simulation of death is so perfect that only the closest examination can determine that life still is present—in the pulsation of the heart and in the almost suppressed respiration. In this condition either the animal has lost the sensation of pain, or else it possesses most wonderful powers of endurance, for it permits itself to be actually vivisected without showing the least sign of consciousness. If, however, attention is withdrawn, the sly rascal opens his eyes, glances around, and, if the coast is clear, gently departs.

I have stated that the various explanations offered of the phenomena of hypnotism, seem unsatisfactory. I have no doubt that you have now the same impression in regard to this paper, that it is unsatisfactory in offering nothing definite in the way of classifying the phenomena under discussion. I have indicated my belief that in the phenomena of the so-called mesmerism, there is *something*, some influence or influences at work not yet understood, and like *life* itself, possibly may never be. We may be obliged to content ourselves with calling this subtle substance by a name, be it mesmerism, hypnotism, or what not, and resting there. The direction, however, in which progress can undoubtedly be made with positive advantage, is in classifying the phenomena presented. In this direction does a knowledge of the peculiarities of animals, learned by both experiment and observation, become valuable. The factors entering into the production of the phenomena noticed in the experiments of Czermak and others, are: Fear, dissembling, curiosity, training, and changes in the condition of the blood.

1. *Fear.*—In the case of the hen and canary, an overwhelming irresistible force is used, reducing the poor creatures to a feeling of utter helplessness in the hands of a giant-man.

They lie in any position in which they are placed, because they fear to move. A chalk line or bright button attract their attention and excite fear because they know not but they might explode like dynamite if a move be made. Through the influence of profound fear also, a state of semi-unconsciousness may be induced, just as we hear of persons being *paralyzed* by fear.

We can realize to a small degree what this state of helplessness may mean to a small animal, by imagining the feelings of a traveler stopped by highwaymen with a loaded carbine at either temple. When he is ordered "*hands up*," up his hands go, and so are likely to remain until the coercion is removed.

Another homely example. Prisoners of war are enclosed in a stockade, sentinels with loaded muskets pace the platform around the top; a line is drawn around the inside space a certain distance from the fence called the *dead line.* It is but a step to cross it, but I need not say that step is not taken. This line is as forbidding to the prisoner as is the chalk line to the hen.

2. *Dissembling.*—Trickery and collusion on the part of the human subject which enters as such an important element into human exhibitions, I dismiss with the mere mention. There is not time to discuss it within the limits of this paper.

Dissembling in animals I have perhaps already referred to sufficiently in taking exception to Czermak's statement that "with animals every one feels safe from all thoughts of deception." I therefore simply refer again to our old friends the opossum, the turkey buzzard and the goose.

Under this head also would be classed the "playing dead" of insects, worms, &c., and the familiar example of the skill shown by birds in pretending to be wounded, fluttering helplessly along the ground, to draw an intruder away from the nest.

3. *Curiosity.*—I believe that curiosity plays a part in the power exercised by the snake charmers of India. The operator goes to a stone pile, and his noises and motions excite curiosity on the part of the serpents. So also is it probable that music has charms.

Another probable element is, that the Indian magician has studied the calls of the serpents, and by his imitation draws them forth. We know how easy it is in this way, by imitating their notes, to call birds. The success of the shooter of "shore birds" depends very much upon his expertness in imitating the whistle of the different species. The phenomena of handling serpents, rendering them stiff or flaccid at pleasure, I do not pretend to understand, but hope an explanation will be developed in the course of the discussion.

Examples of curiosity displayed by animals are numerous and well known. The hunter on the plains decoys deer by simply lying down and kicking up his heels. Ducks are *toled* on the shores of the Chesapeake by waving a red flag, or by having a little dog trained to run up and down the bank barking. The ducks swim in to see what the strange object is, until they are brought within range of the gun.

Mr. Henry Elliott, in his monograph on the fur seal (Census of the Fisheries, 1882) tells how the crafty foxes of the Pribylov islands capture sea birds by working on their curiosity. He says: "One of the curious sights of my notice in this connection was the sly, artful and insidious advances of reynard at Tolstoi Mees, St. George, where conspicuous and elegant in its fluffy white dress, it cunningly stretches on its back as though dead, making no sign of life whatever, save to gently hoist its thick brush now and then; whereupon many dull and curious sea birds (*Graculus bicristatus*) in their intense desire to know all about it flew in narrowing circles overhead, lower and lower, closer and closer, until one of them came within sure reach of a sudden spring and a pair of quick snapping jaws."

Who shall say after this exhibition of craftiness that animals are free from deceit, or that birds are less consumed by the fire of curiosity than their allies, the featherless bipeds.

4. *Training.*—Where experiments are made upon the same animal repeatedly, we may suppose that it becomes, in a measure, *trained.*

It comes to learn what is expected of it, and in the case of the more intelligent animals, as the dog, there is added a desire to please its master.

At the meeting of the Intern. Medical Congress held in London, Aug., 1881, Professor Goltz, of Strassburg, exhibited a dog with certain portions of the cerebrum removed, and from the effects upon the animal, argued against the theory of Professor Ferrier as to certain localizations in the brain. In the course of the discussion, however, it was developed that the actions of the dog were in a great measure due to an unconscious training on the part of his master, Professor Goltz, who had so often exhibited the animal that he had come to know what was expected of him.

5. *Changes in the condition of the blood.*—Another element of influence also in the experiments upon fowls, is the interference with the respiration produced by the forcible compression of the chest walls. In this way proper aeration of the blood does not take place, and the accumulation of venous blood in the nerve centers produces a sort of lethargy.

Ornithologists, when collecting, are in the habit of killing wounded birds by compressing the thorax, this method not injuring the plumage; and they are familiar with the condition first of violent struggles, then of lethargy and finally of insensibility, before death is complete. Frequently when the bird is apparently lifeless, life returns when the compression is too soon removed.

A condition of anæsthesia in man may also be produced by an almost opposite state of affairs. It is known to physicians that rapid forcible inspiration of air will induce anæsthesia, and slight surgical operations have been thus painlessly performed.

We have referred now to the influence of fear, dissembling, curiosity and training. These have their influence over both man and the lower animals alike. But there are still other conditions and qualities of the mind which exert their influence over man alone—such as the power of the imagination, the disposition of imitation, and the influence of the will of the operator.

In regard to the imagination I think it is unnecessary to do more than refer to it. Its power is proverbial, and is especially realized by physicians both in the manner it impresses disease and treatment. We see continually diseases which are produced by imagination and which are as well cured through the same agency.

Witness many miraculous cures. In the case of Mrs. Jennie Smith, R. R. evangelist; she was sixteen years in bed paralyzed, but cured in one night by power of prayer. In hysterical paralyses there is added a suspension of *will power.* If this can be restored, cure is assured. The cure may be sudden, the result of a powerful impression made upon the dormant faculties, or of an intense appeal to the imagination. In this case it is considered by the laity as miraculous. Or the cure may be gradual, under the persevering effort of a good physician. In this latter case no superhuman agency is supposed to have been evoked. This may appear foreign to our subject, but is really germane, as illustrating an important element in hypnotism.

Imitation.—The power of imitation is as well known as that of imagination. Who has not been present in church when, during the stillness of an impressive sermon, some one begins a hacking, irritative cough. Soon it is taken up by one after another, until several will be coughing at once, while many others will, with difficulty repress the desire. So with gaping or yawning.

The hysterical epidemics already referred to, such as the dancing mania, the laughing and convulsive attacks at religious revivals, etc., are evidences of the power of imitation.

So also, undoubtedly, the professional mesmerist owes much of his success in public exhibitions to the same influence. The force of example impels many persons, almost against their will, to take part in the foolish show, while others with difficulty resist the same impulse.

Lastly, as an element in hypnotism, is the *will* of the operator. Undoubtedly the best operators are persons of strong will and great persistence. The influence of a strong will is felt constantly in the daily walks of life, in all our intercourse with our fellows. In the mesmerism of men, those whose minds are naturally weak, or who have become enfeebled by disease, are the ones most easily controlled. This has long been known, but recently very satisfactorily exemplified by Charcot and his associates in France at the Hospice Salpetriére (an institute for the treatment of nervous diseases). In the Biological Society of Washington, there is material for many good masters of mesmerism, but I doubt if a single good subject can be found.

I have now reviewed and classified all the elements entering into the production of hypnotism, as fully as the time will allow.

That a very large proportion of the phenomena exhibited, may be referred to one or other of these divisions, I think is evident from the requisites which Heidenhain lays down as necessary to the development of hypnotism in man.

1. Undivided attention. Concentration of the attention by an upward gaze at a bright object placed near the eyes.

2. Willingness and desire on the part of the subject. Persons cannot be mesmerized against their knowledge and consent.

3. Use of touches, passes, etc. (to stimulate the imagination).

4. Direct command from the operator to sleep.

In regard to the second of these—" willingness and desire on the part of the subject "—much doubt has been expressed, and professional mesmerists are not willing to admit that consent is necessary. The question is of special interest in consequence of its medico-legal bearing, and the statement of Heidenhain is in accordance with the views of experts who have given the subject study. Many cases might be cited to prove the opposite, but an analysis of them show that they " are events viewed unequally."

Persons who have been frequently mesmerized acquire such a frame of mind from habit and intuitive training that they may be thrown into this condition merely by the power of the imagination. Thus a mesmerist so influenced a lady, while in the adjoining room, she being told that he was putting her to sleep. On another occasion she was told that he was mesmerizing her from the next room, and she immediately went to sleep, although the pretended operator was not in the house and knew nothing about it. In a "good subject" it may be sufficient to impress upon their minds the idea that the event is about to take place, in order to secure its occurrence.

I have said that there was still *something* about hypnotism which had not yet been fathomed. By that I do not wish to be understood as saying that there is anything mysterious or supernatural in it. But simply that we do not yet understand sufficient of the intimate workings of mind, or of the relation between mind and matter to follow the connection between various mental attributes. We are accustomed to consider these attributes as seen in the ordinary or normal state, but are not prepared to say what would be the effect of abolishing or suspending certain functions, upon other functions of the mind.

In a well marked case of hypnotism in man, freed from all elements of deceit, the condition of the mind of the subject shows an alteration of normal functions and a perversion of the will power, so that he is completely under the guidance and control of the operator.

Sensation is also so perverted that it too appears to be at the mercy of the operator. Heidenhain expresses it in more exact language by saying that there is "inhibition of the cortical cells of the cerebrum."

(At the close of the reading of the paper, a hen and canary bird were introduced and successfully "mesmerized" by Dr. Prentiss.)

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RECENT LITERATURE.

Oustalet's Monograph of the Megapodiidæ.[1]—In this monograph, as in most monographs of vertebrate groups, the interrelation of whose species is known, the number of distinct forms has been reduced. As this reduction has been made after a thorough study of the examples in the British Museum, London Zoological Society and Leyden Museum, as well as those in the Muséum d'Histoire Naturelle at Paris, there is little doubt that the conclusions arrived at will be generally accepted.

This peculiar family of birds is remarkable for its practice of artificial incubation as well as for the strength and weight of its

[1] *Monographie des Megapodiidés.* Par M. E. Oustalet. Annales des Sciences Naturelles. VIe ser. T. x., No. 4, p. 60. VIe ser. T. XI, No. I, p. 48. VIe ser. T. XI No. 2. p. 134, pl. 2.

bones. According to Parker the entire skeleton of the great hornbill, *Buceros ruficollis*, is not three times the weight of the leg bone of a Talegalla. The real relations of these birds have long ago been proved to be with the Gallinaceæ or Rasores, and more recent researches have proved their close affinity to the Cracidæ. The classification adopted by M. Oustalet is, in the main, that of Huxley, that is to say, the Alectoromorphæ or typical Rasores include the groups Cracidæ, Megapodiidæ, Numididæ, Meleagridæ, Phasianidæ and Tetraonidæ in the order named.

The first part of the monograph is devoted to the consideration of the skeleton, muscles and digestive, respiratory and tegumentary systems; followed by a statement of the relations of the group with those around it.

Then follows a full description of each species, with measurements, habitat, and whatever is known of habits, food, etc. The genus Megacephalon includes one species only, *M. maleo*, the largest of the entire group, a native of the northern coast of Celebes and of the Island Siao, one of the Sanghir group. This fine bird lays in August and September, at which season it leaves the forest in pairs and proceeds to the sea-shore, where in coarse sand, above the level of the tides, it digs a hole four to five feet wide and one to two feet deep. In this the female lays a single egg, but the natives affirm that thirteen days afterwards the same pair return and a second egg is deposited. As many as seven or eight eggs may be contained in one hole, but it by no means follows that they are the product of the same pair. The top of the head of the male is adorned with a black casque about three centimeters in height.

The genus Leipoa contains also only a single species, *L. ocellata* (Gould), a native of the south-west of Australia, where it resides in the brushy prairies. It is of the size of a small turkey, but shorter in the legs. The natives say that it is so timid that in its haste to escape it often becomes entangled in the brush, and is thus easily caught. As a rule it lives on the ground, drinks seldom, feeds upon seeds and orthopterous and hemipterous insects, and sleeps upon the trees. Its nest is a mound forty or more feet in circumference and sometimes five feet high, built by the labors of both sexes out of the ferruginous gravel that forms the soil of the openings in the prairies, with a bed of leaves at its base in which the eggs are deposited. The egg is $3\frac{6}{10}$ inches long, and it is probable that several days intervene between the deposition of the successive eggs. However this may be, the native pheasant contrives to retard the development of the eggs first laid, for the young usually appear at the same time, break unassisted through the walls of their prison, and find ample food in the ants and ant larvæ that swarm within the mound.

The genus Telegalla contains seven species inhabiting Australia, New Guinea and some of the neighboring islands. The mounds built by these birds are entirely composed of vegetable matters collected industriously from the surface of the ground. That of *T. lathami* measures as much as six to seven feet in height and twelve to fourteen in diameter, but this pile is not the work of a single pair, and sometimes seems to contain the eggs of two females in the same season. The heat in the central portions of these mounds reaches 37° to 39° Centigrade. This Talegalla inhabits the whole of the eastern part of Australia, its eggs are highly prized both by aborigines and colonists, and the bird itself is easily tamed and of excellent flavor.

The remaining species of the genus inhabit New Guinea and the surrounding isles.

The most widely spread and largest genus of the family is that from which its name is derived. Nineteen species of Megapodius, distributed over a large part of Oceanica and in some of the Indian isles, are distinguished by our author. Most of these have somber, uniform plumage, and all live in brush or forest, generally near the sea, feed upon fruits, seeds, insects and worms, deposit their eggs in mounds of sand, earth and vegetable matter, and do not care for their young, which are robust and completely feathered when hatched. All run swiftly, but fly heavily. *M. dillwyni* inhabits the Philippine islands; *M. nicobariensis*, the islands from which it is named (it is the *Omaah*, *Meka* and *Dale* of the natives); *M. la perousii*, the Marianne islands; *M. senex*, the Pelew islands; *M. stairi*, Ninafou or Good Hope island near the Tonga archipelago; and *M. layardi*, the New Hebrides. Thus the geographical distribution of the group is much wider than has been hitherto believed.

The mounds of *M. duperreyi*, the best known species, a native of New Guinea and Queensland, sometimes reach a height of fourteen feet and a circumference of a hundred and forty feet, but such mounds are the work of generations of birds, and are only found in places where they have worked undisturbed by egg-hunting aborigines or colonists. A height of five or six feet is usual.

DONNELLY'S ATLANTIS.[1]—The author's purpose in preparing this book, is to demonstrate some thirteen propositions, several of which he claims to be novel; and here we think the author is correct. Some of them are as follows:

1. That there once existed in the Atlantic ocean, opposite the mouth of the Mediterranean sea, a large island, which was the remnant of an Atlantic continent, and known to the ancient world as Atlantis.

2. That the description of this island, given by Plato, is not, as has been long supposed, fable, but veritable history.

[1] *Atlantis: the Antediluvian World.* By IGNATIUS DONNELLY. Illustrated. New York, Harper & Brothers. 1882. 12mo, pp. 490.

3. That Atlantis was the region where man first rose from a state of barbarism to civilization.

4. That it became, in the course of ages, a populous and mighty nation, from whose overflowings the shores of the Gulf of Mexico, the Mississippi river, the Amazon, the Pacific coast of South America, the Mediterranean, the west coast of Europe and Africa, the Baltic, the Black sea and the Caspian, were populated by civilized nations.

Our author having, as he appears to believe, established these points, is fully convinced that not only was this Atlantis the true antediluvian world, the Garden of Eden, the Elysian fields, &c., &c., but that the gods and godesses of the ancient Greeks, the Phœnicians, the Hindoos and the Scandinavians were simply the kings, queens and heroes of Atlantis, and the acts attributed to them in mythology are a confused recollection of real historical events. His thirteenth and last proposition is that when Atlantis sunk under the waves "a few persons escaped in ships and in rafts, and carried to the nations east and west the tidings of the appalling catastrophe, which has survived to our own time in the flood and deluge legends of the different nations of the old and new worlds."

The book is the result of extensive but desultory reading, neither critical nor well directed. We may admire the author's courage, while we may not have so high an opinion of his judgment in dealing with subjects in regard to some of which the ablest investigators might well hesitate to express an opinion. So-called demonstrations based on improbable hypotheses, in this book go hand in hand with a leveling democratic use or misuse of authors, which is characteristic of works of the character of the "Atlantis." He does not seem to recognize the fact that one writer may carry more weight than another.

The author starts with the view that the results of the *Challenger's* researches were to establish the existence of a submarine Atlantean continent; whereas if any one geological fact seems to have been elicited by the soundings made in the North Atlantic, and one about which the soundest geologists are agreed, is the view that the ocean beds have always been such. If this be so, the foundations of a hypothetical Atlantis have been removed; and so one might go through the book and show, in the light of modern anthropology and philology, that the positions soberly advocated by our well-meaning author, are simply absurdities. The book is well written, with excellent illustrations, and type and press work are most creditable to the publishers, but the time for such books has gone by, since the results of recent geological and anthropological as well as philological studies combine to show that man originated somewhere in Central Asia, and migrated westward. If the reader thinks that our criticisms are unjust, let him, after reading the "Atlantis," examine Tylor's

Anthropology and Dawkin's Early Man in Britain, and the late Mr. L. H. Morgan's writings on the North American Indians.

UNDERWOOD'S FERNS.[1]—Last year the first edition of this book was noticed in the NATURALIST. It is with great pleasure that we welcome the new and much enlarged edition which has just come to hand. It has been carefully revised and much new matter has been added. As now published it includes the whole of the Pteridophyta, that is, the so-called vascular cryptogams. Many new paragraphs and a chapter or two are added to the text, and considerable changes and additions have been made in the systematic portion. On pp. 34 and 35 the asexual and sexual generations are respectively called the *Pteridoid* and the *Thalloid* phases, two most excellent expressions, which ought to be introduced into usage in the books. On p. 53, in giving the names of the seven divisions or sub-kingdoms of the vegetable kingdom, the author, for the sake of uniformity, writes *Zygospora*, *Oospora*, *Carpospora*, instead of Zygosporeæ, Oosporeæ, Carposporeæ, which is an attempt in the right direction. The literature of the Pteridophyta is greatly extended, and appears to be pretty full. It is certainly a very valuable part of the book, as it includes, in the case of American works, not only the books, but many papers in periodicals, reports, etc.

The arrangement of the orders of Pteridophytes followed, is as follows:

Class I.—EQUISETINÆ. Orders Calamariaceæ and Equisetaceæ.
" II.—FILICINÆ. Orders Ophioglossaceæ, Marattiaceæ and Filices.
" III.—RHIZOCARPEÆ. Orders Marsiliaceæ and Salviniaceæ.
" IV.—LYCOPODINÆ. Orders Lycopodiaceæ, Lepidodendraceæ, Sigillariaceæ, Selaginellaceæ and Isoetaceæ.

The important announcement is made, at the end of the volume, that the author has under preparation a Synopsis of the Hepaticæ on a plan similar to the work under review. We hope that its appearance will not be long delayed, and trust that it will prove to be as valuable a hand-book as has "Our Native Ferns." —*C. E. B.*

STUDIES FROM THE BIOLOGICAL LABORATORY OF JOHNS HOPKINS UNIVERSITY.—The second number of the second volume of this valuable series is fully equal in interest to those which have preceded it. While it contains some medico-biological and physiological papers, the purely zoölogical ones are the following: List of Medusæ found at Beaufort, N. C., during the summers of 1880 and 1881, and a paper on the development of the ova in Salpa, by W. K. Brooks; On the origin of the so-called "test cells" in the ascidian ovum, by J. McMarrich; Some notes on the development of *Arbacia punctulata*, by H. Garman and B. P.

[1] *Our Native Ferns and their Allies, with synoptical descriptions of the American Pteridophyta north of Mexico.* A second and enlarged edition of Our Native Ferns and How to Study Them. By LUCIEN M. UNDERWOOD, Ph.D., professor of geology and botany in the Illinois Wesleyan University. Bloomington, Ill., 1882.

Colton; On the structure and significance of some aberrant forms of lamellibranchiate gills, by K. Mitsukuri (reprinted from *Quart. Journ. Micr. Sc.*); Observations on the early developmental stages of some polychætous Annelides, by E. B. Wilson.

Recent Books and Pamphlets.—Bulletin of the United States National Museum, pp. 360–415, 1882. From the department.

Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 105–184, 1882. From the society.

Proceedings of the Boston Society of Natural History, Vol. xxi, Part iii, October, 1881–January, 1882. From the society.

Revista Cientifica Mexicana, 1882. From the publishers.

Bulletin de la Société Zoologique de France pour l'année 1881. The same for 1882. From the society.

Mission Scientifique au Mexique et dans L'Amérique Centrale. Recherches Zoologiques. Troisième partie Etudes sur les Reptiles et sur les Batraciens. Par MM. Dumeril et Bocourt. Paris, 1882. 4 plates.

Paleontographica. Beiträge zur Naturgeschichte der Vorzeit. Die Saurier der unteren Dyas von Sachsen. Von Dr. H. B. Geinitz und Dr. J. V. Deichmüller. pp. 46, pl. ix. Cassel, 1882. From the authors.

Ein Beitrag zur Kenntniss fossiler Ueberreste aus der Gattung Arctomys. Von Dr. R. F. Hensel. Mit 2 Tafeln. From Dr. Torrey.

Bidrag till Kännedomen af Crustaceernas Anatomi. Af I. A. Lyttkens. pl. ii.

Prodromus faunæ Copepodorum parasitantium Scandinaviæ. Quem scripsit Dr. Petrus Olsson.

Quarterly Journal of the Geological Society. Vol. xxxviii, Part ii. London, 1882.

Proceedings of the Royal Geographical Society, July, 1882.

Studies from the Biological Laboratory, Johns Hopikns University, Baltimore, Vol. ii, No. 3, June, 1882.

Proceedings of the American Philosophical Society, January to June, 1882. From the society.

On the Origin of Jointed Structure. By G. K. Gilbert. From the author.

Fragments of the coarser anatomy of the diurnal Lepidoptera. By S. H. Scudder, 1882. Reprinted from Psyche. From the author.

U. S. Geographical Surveys west of the 100th Meridian. Capt. G. M. Wheeler in charge. Vol. iii. Supplement, Geology. Report upon Geological Examinations in Southern Colorado and Northern New Mexico, 1878–1879. By J. J. Stevenson, Ph.D. In four parts and an appendix. pp. 458, pl. 4, maps. 3, 49 text cuts. Washington, 1881. From Capt. G. M. Wheeler.

Description of some Iguanodon remains indicating a new species, *I. seelyi.* By J. W. Hulke, Esq., Pres. G. S. Ext. from Quart. Jour. Geol. Soc., May, 1882. From the author.

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GENERAL NOTES.

BOTANY.[1]

Notes on Mistletoes.—In a meeting of the Academy of Natural Sciences of Philadelphia, in October, 1881, Thomas Meehan, in commenting on specimens of *Phoradendron juniperum* var. *libocedri* Engelm. and *Arceuthobium occidentale* var. *abietinum* Engelm., from Nevada, noted a few facts in relation to mistletoes, which are of such interest that we transcribe them verbatim. Mr. Meehan said:

"The mistletoe of the Eastern States had a general resemblance to that of Europe, *Viscum album;* but the old genus Vis-

[1]Edited by Prof. C. E. Bessey, Ames, Iowa.

cum had been divided by modern botanists, although the lines of distinction were somewhat artificial. We had two genera, Phoradendron and Arceuthobium. Among the leading distinctions might be mentioned that the European branch of the family Viscum, as now restricted, had the anther open by three pores or slits, our Phoradendron by two, while the Arceuthobium had but one. There were other slight differences in pollen grains, cotyledons and form of the fruits. The European mistletoe is usually found on deciduous trees only, an instance being recorded where it had been found on the Scotch pine in Germany, and its American representative, *Phoradendron flavescens* Nuttall, seemed also confined to deciduous trees and shrubs.[1] This extends across the continent, a form being found on the Pacific coast, still confined to deciduous plants; while another genus, Arceuthobium, seems wholly confined to the coniferous trees which are mixed with the deciduous ones. The name Arceuthobium is suggestive of this fact, it being derived from two Greek words signifying "living on the juniper," Phoradendron, on the other hand, meaning simply "living on, or stealing from trees." Arceuthobium, however, did not live wholly on junipers. In the herbarium of the academy was a specimen of *A. occidentale* growing on *Juniperus occidentalis*—these Nevada specimens were on *Pinus ponderosa*. The specimens of *Phoradendron juniperinum* were growing on *Libocedrus decurrens*, which, by the way, was, he believed, the first time this pretty cupressineous tree had been reported from the State of Nevada. Among the differences noted by Engelmann in the Botany of California between Phoradendron and Arceuthobium, was that while the former flowered in February and March, and matured its fruit 'next winter,' the fruit of the Californian species opened in the summer, and did not mature 'till the second autumn.' The European mistletoe was stated by Bentham to open in spring, and perhaps this was so; it was formerly supposed to be the case with the American *Phoradendron flavescens*, but Mr. Wm. Canby had shown to the academy recently, that in Delaware the flowers opened in the fall, and the fruit matured in the autumn of the following year, or just one year afterward. The flowers and fruit were on the trees at the same time together. If this were general with Phoradendron, it still lessened the distinctions between the genera. Usually Phoradendron bore leaves, while Arceuthobium was leafless—but the Libocedrus parasite was as destitute of leaves as an Arceuthobium, and the common observer would see little in their general aspects to distinguish them. But there was one great difference in the genus, at least as represented by these two species. In opening the box which contained the specimens, the whole mass was covered with a dense viscid secretion, which rendered it very difficult to separate one branch from another. On leaving the lid open a little while,

[1] Mr. Jos. James believes he saw a specimen some years ago on *Abies Canadensis*.

the watery particles soon evaporated, leaving a dry gummy deposit over the whole surface. While this was going on, the seeds were ejected with great force from their endocarps, being projected against the face with such force as to leave a stinging sensation. Dr. Engelmann has noted this power of ejection in the berries of this plant. The Phoradendron exhibited no trace of any such power, though there seemed to be little difference in the structure of the berries. The facts raised a nice teleological question. Birds did not seem to use the berries. As they were so viscid that the famous bird-lime is made from some species, it is probable the very viscidity would prevent the free use of the beak in any attempt to use the seeds. But it was believed that by becoming attached to the feet or feathers of birds, the seeds were widely distributed, and that in this way the plant had all the advantage necessary for distribution in the 'struggle for life.' But Arceuthobium, besides all the advantages to be derived from this mode of distribution, had an additional aid from a projecting force.

"Did Arceuthobium at one time exist when or where there were no birds, and had it to depend on projection alone for its distributing power, and is the viscidity a later development? Did Phoradendron once possess the power, and has it abandoned it from having through the ages found out that it travels well enough without its exercise? Or is it rather, as the speaker himself inclined to believe, that nature loved to aim expressly at variety, and was continually exhibiting her power to accomplish the same end by a wonderful variety of means? But whatever might be thought of the various theories of development, and the laws of final causes which may have operated to produce changes, there could be but little doubt but parasitism was an acquired habit, and the endeavor to find out what these plants were, and how they behaved before they were parasites, was fast becoming one of the most interesting of biological studies.

"The seeds ejected from the endocarp in Arceuthobium fastened themselves to the branches of trees by a glutinous mass at one end. This end was opposite to the radicle, which, in germinating, would have to push out from above, and curve downwards towards the branch in order to attach itself. He had not seen them during the process of germination, but as the testaceous covering was held fast by the glutinous secretion, it is probable the cotyledons would be drawn out as the plumule took its upright position, leaving the testa as an empty case fastened to the branch. Presuming that this must be the case with other Loranthaceous plants, it was difficult to understand the process by which the East Indian species performed the locomotive feat recently noted by Dr. Watt, and which from its remarkable nature has had a wide publication. It was reported as the observation of Dr. Watt that a seed falling on and becoming attached to the coriaceous leaf of a Memecylon, would send out its radicle, which, curving down, formed a flattened disk by which it attached itself to the leaf. But, as if it knew that a leaf could not permanently support a perennial plant, the cotyledons were lifted and turned to the other side, when the end with the disk moved to another place, and in this way, the seed traveled to a more favorable spot. Without reflecting on the observation, Mr. Meehan believed it should be repeated in order to be sure of no mistake. In all plants in our country which fastened to an object through a disk at the end of a rootlet or tendril, as in Ampelopsis and *Bignonia capreolata*, the attachment was made while the disk was forming. A disk once formed, did not reattach itself to an object when removed from the original spot. In like manner the cotyledons, once removed from the endocarps, would have no viscidity with which to form a resisting power while the disk was unfastening itself from its undesirable location. There was, however, so much of singular behavior in the mistletoe family that further observations were very desirable."—*Proc. Acad. Nat. Sci. Phila.*

Differences in Radial Thickness in Tree Trunks.—Dr. Stearns in a recent paper read before the Am. Forestry Association, calls attention to certain differences in the diameters of tree trunks which are well worthy of more extended observation. He asks "whether the greatest diameter is persistently incidental to a certain aspect or quarter of the compass." Professor Whitney found the greatest diameter of the giant trees of California, (*Sequoia gigantea*) to be twenty four feet, one and one half inches; this was in a north and south direction. The least diameter was twenty three feet, in an east and west direction.

Furthermore, a remarkable difference was observed in the lengths of the several radii. The radial length from the heart of the tree to the circumference at its south point was thirteen feet, nine and one half inches (13 ft. 9½ in.), while the corresponding measurement north of the heart was but ten feet, four inches (10 ft. 4 in.). The radii making up the east and west diameter were of equal length, that is, eleven feet, six inches (11 ft. 6 in.).

Dr. Stearns suggests that the excess of growth of the south half of the trunk may be due to the greater heat and light which it received. The climate of the site of the tree under consideration, the Calaveras grove, is cool, hence the greater heat of the side exposed to the sun was advantageous to it. "In a comparatively arid region, with a high temperature and infrequent rainfall and a dry atmosphere, we may suppose that the southerly half of a tree might, through excess of light and heat, suffer from dessicating influences, and make a less growth than the northerly half, as the latter would have the advantage, if advantage it be, in such a climate, of less light and heat and more shade; while in a region less arid, with a much lower mean temperature, etc., the greater proportion of light and heat which the southerly half receives, would give that side of the tree an advantage over the northerly half." In corroboration of this hypothetical explanation of Dr. Stearns, we may record the statement of Professor Budd, of Iowa, that in trees grown upon the prairies the thickness of wood is always greater upon the north side of the trunk than upon the south side. We shall be glad to hear from our correspondents upon this point.

A CLIMBING POLYPODIUM has been detected by that excellent botanical collector, A. H. Curtiss, on Key Largo. The species is probably *Polypodium Swartzii* Baker, and its discovery is a most interesting one, giving another fern to Florida, and carrying our list of North American ferns up to 156.

Subscribers for Mr. Curtiss' plants will be glad to know that he has not only collected enough of the new fern to supply all of his sets, but that he has also collected fine specimens of *Asplenium serratum* as well.

Soon after an Ophioglossum, which proves to be *O. nudicaule* L. fil., collected by Dr. Parry, came to hand from California, adding another species to the flora of that State.—*G. E. Davenport.*

ZOÖLOGY.

THE OCCURRENCE OF MEPHITIS INTERRUPTA RAFINESQUE IN NORTH CAROLINA. — During the past summer I spent several weeks in the neighborhood of Roan mountain, N. C., an interesting region to any one having a taste for natural history matters. Here I found the *Pitys bryanti* Harper, the *Margaritana ravenelliana* Lea, the rare new Helices recently described by Mr. Binney, and last, but not least, here I killed and skinned a fine specimen of the rare *Mephitis interrupta* Rafinesque.

The synonymy of this species is fully set forth in Dr. Coues' Fur-bearing animals, which he heads *Mephitis* (*Spilogale*) *putorius* (L.).

Speaking of Rafinesque's claims to the species he says: "The *Mephitis interrupta* of Rafinesque may or may not have been "a pure figment of his imagination." It probably, however, had some basis, and even if his account does not wholly agree with specimens of *Spilogale putorius* examined, it will be remembered that even his elastic imagination would be put to the stretch to describe a spotted and striped skunk in terms too exaggerated to be met by the reality which this species offers. We may accept his name as undoubtedly belonging here, and in fact we should adopt it, as a more definite appellation than Zorilla, were it not anticipated by Linnæus as just shown."

Dr. Coues, in a recent letter to me, says, "the species undoubtedly belongs to Rafinesque."

It is a well-known fact that Rafinesque was, for a long time, Professor of Natural History in the old Transylvania University at Lexington, Kentucky. He made frequent excursions on foot through the wildest portions of the State, in pursuit of his favorite studies. As this little animal occurs so far north in the Appalachians as the northern line of North Carolina, it is within the range of Rafinesque's explorations without a doubt. He had doubtless seen it often, and if he may have mixed localities in regard to this animal, it is no more than all early students of our fauna did, and none to a greater extent than those who have been his most uncompromising critics.

This skunk is said by the inhabitants to be quite common at Roan, although this is the only one which I saw. The *M. mephitica* also occurs, and a semi-melanotic variety of the *Sciurus hudsonicus*. This beautiful little squirrel is less reddish than the northern variety, has a white belly and the lower half of the body, on each side, between the fore and hind legs, and shading off on the hips and shoulders, very dark—nearly black in well-marked specimens. It is considerably larger than the northern "pine squirrel," but has the same habit of choosing evergreen trees for its abode. The native people call it the "mountain boomer."—*A. G. Wetherby.*

Note on Gadinia excentrica Tiberi.—Twelve years ago I pointed out that this species was probably not a Gadinia, and did not belong to the Pulmonata, but until recently I had never seen a specimen. One just sent by Dr. J. Gwyn Jeffreys from the Mediterranean proves on examination to be a species of Addisonia (Rhiphidoglossa) closely allied to if not identical with the *A. paradoxa* Dall, recently described from the deep sea bed off the coast of New England. The close resemblance or identity of so many Mediterranean recent and Pliocene Italian forms with those living in the deep sea, is one of the most interesting features of geographical distribution.—*W. H. Dall.*

Molluscan Notes.—On August 26, 1880, I found in the Hudson river, near Catskill landing *Lioplax subcarinata* Say, quite abundant. This I think is a new locality for this species.

On Sept. 22, 1881, I found *Littorina littorea* Linn., on rocks at Lloyds Neck, Queens county, Long Island. I believe this to be the first taken on the Long Island side of the sound.—*Henry Prime.*

Habits of the Woodcock.—While out hunting Wilson's snipe, April 1, a specimen of American woodcock (*Philohela minor*), was flushed from a clump of persimmon trees on the border of a slash. Knowing that the bird has the habit of rising above a clump of bushes and then suddenly dropping behind it out of range, and also aware of its rapid movements, I fired as soon as it rose in view. When the smoke cleared away I observed my bird slowly rising with laborious flight and concluded it was wounded and expected to see it fall. (It is not uncommon for birds shot through the heart to rise quite high in the air and then suddenly drop dead.) When up about a rod high the bird turned and flew near me. My attention was called to something it seemed to be holding between its feet, and so heavy that its flight was slow and clumsy like that of a rapacious bird with heavy prey. By close observation I was convinced that the bird was transporting its young, as I could distinctly see the little fellow (about the size of a young chicken just hatched), located between its mother's legs and supported by her feet placed on its sides. I became so interested in watching this habit, entirely novel to me, that I forgot to fire the other barrel until the bird was out of range, and then I felt that a bird showing such love of offspring ought to go free. So slow was the flight that by taking a brisk trot I was able to gain on the bird, and tried to tire it out and make it drop its precious burden, but its pluck was greater than my wind. After chasing it forty rods or more it started across a cultivated field and kept wing until reaching the other side, when it disappeared in a clump of bushes over one hundred rods from the place it rose.

It seems rather early for woodcock to hatch, but in this region where the winters are open woodcock and Wilson's snipe both remain. I shot a specimen of the former this spring in February and fifteen of the latter about the middle of January.—*F. L. Harvey, Ark. Ind. Univ., Fayetteville, Ark.*

Feline Development.—It seems to me from the many articles I meet with in scientific journals, as well as in the general press, and from my own observations, too, that the cat family are constantly growing in the general estimation in the high qualities of sagacity and affection. In fact, I believe, they stand better than they did forty years ago—all the objurgations of Mrs. Swisshelm, the champion cat-hater, to the contrary notwithstanding. Here is our "Nig," for instance, manifesting a trait altogether new, as it seems to me—in this: he likes to ride as well as a coach dog. He cries almost every day to ride to town in the buggy, and is always ready to go out with the team when we are hauling in hay or grain or husking corn, provided he can ride. If one will hold him in his arms he also delights to ride on horseback. His pleasure is manifested in a remarkable degree whenever he is allowed the luxury of a ride, either in any kind of vehicle or on horseback, and his cries are altogether pitiful when he is told that he cannot go. This singular habit seems to have been a natural one with him, for he never had any special training in that direction. While cats are ordinarily frightened out of their wits by any attempt to give them such a ride, our "Nig" is never so happy as when he is thus indulged. He evidently reasons that if it is a good thing for people to "jump into a wagon and all take a ride," why don't the same rule apply to black cats? He would come pretty near accepting a railroad pass.—*Charles Aldrich, Webster city, Iowa, Jan. 31, 1882.*

Development of the Sturgeon and the Homologies of the Vertebrate Brain.—In a second paper by Salensky on the embryology of the sturgeon, according to the Journal of the Royal Microscopical Society, the author after describing the mode of development of the central nervous system, raises the question of the homology of this region with the nervous system of Vermes and Arthropoda. He points out that (1) the central nervous system of all vertebrates is formed from two thickenings of the ectoderm set parallel to the long axis of the body; that of all articulates has a similar origin. (2) In some cases, *e. g.* Echiurus, the articulates present a median groove comparable to that of vertebrates. (3) The formation of the medullary groove begins, in the case of both phyla, posteriorly, and is continued forwards. On the other hand the Vertebrata have the central nervous system dorsal in position, and the medullary groove becomes closed. As to the first of these, Salensky points out that the position of the mouth is the determining character in conjunction with that of the locomotor organs; these points he looks upon as having less morphological value than the development of the system, and its correlation with other organs during the course of development. The closure of the medullary groove is regarded as being merely the result of further modifications.

If we accept the general homology, we have next to determine how the parts correspond; the author cannot follow Dohrn and Hatschek in regarding the homology as being complete; he looks upon the brain of vertebrates as being a new formation, which is their exclusive property; it merely consists in an elongation and dilatation of the already existing nervous system, or in other words the medulla, which is the analogue of the ventral ganglionic chain of the Articulata.

Recent progress in the Study of Worms.—Several papers devoted to the higher worms, of a high order and with excellent illustrations, have lately appeared in Germany. The development of Polygordius and Saccocinus, two low chætopods has been described by Repiachoff. The Gephyrean worms have, however, received special attention. In an elaborate memoir on the Echiurida in the Nova Acta of Halle, by Professor Greef, the anatomy of the group is discussed with fullness, aided by colored drawings of transverse stained sections. The presence of a central canal in the nervous system is noted, and it is suggested that it is a remnant of the ectodermal invagination. A full account is also given of the curiously minute male of Bonellia. The author thinks that there is no close genetic affinity between the

Gephyrea and the Echinodermata, but that the former represents a distinct class allied to the Annelids and divisible into an armed (Echiurida) and unarmed (Sipunculidæ) group. In his elaborate account of the anatomy of *Sipunculus nudus*, Dr. Andreæ (*Zeits. Wissen. Zoologie*, XXXVI, 1881) expresses similar views as to the relations of the Gephyreæ.

On the other hand, Dr. Vejdovsky has studied very carefully Sternaspis, a form intermediate between the Gephyrea and Chætopods. His memoir appears in the Denkschriften of the Vienna Academy. He concludes that there are four natural orders of the class Annelides: 1. *Hirudinea*; 2. *Oligochæta*; *Polychæta*; and 4. *Gephyrea*. He derives the first two from the Discodrilida, and the other two from Sternaspis; the Discodrilida he considers form an offshoot from the Oligochæte stem, which descends into the Amedullata, which, with Sternaspis, have their common origin in the Turbellaria, which in turn are derived from the Cœlenterates. He also believes that the larvæ of the Chætopods and Gephyrea are formed on the same type, and that in Echiurus there is a true segmentation of the body.

Nervous System in Tape-worms.—The Cestodes, or tape-worms are usually described as having no nervous system. On investigation by transverse sections, Dr. A. Lang finds in the Tetrarhynchi a band-shaped cerebral mass with two longitudinal trunks which arise from the brain, and which give off lateral branches, the separate fibers of which enlarge here and there into very long and large ganglion cells. In Amphilina, an unjointed Cestode, the nervous system has a not inconsiderable resemblance to what obtains in the Trematoda.

Finally, says the Journal of the Royal Microscopical Society, Dr. Lang sums up the state of our knowledge as to the nervous system of the other Cestoda. *Tænia perfoliata* has a better developed nervous system than the rest of the Tæniadæ; the anastomosis or cerebrum contains nuclei and fibrils, gives off two lateral primary trunks, and completely resembles in structure the same parts in the Nemertinea. *Tænia solium*, with others, has three cords on either side. In the Bothriocephalida the water vessels are on the outer side of the longitudinal nerves, and here also the anastomosis is concave anteriorly; in the Ligulida the connecting commissure forms a pretty broad bridge, the lateral trunks lie outside the water vessels, and are approximated towards one another in the anterior region of the body.

Simroth's Nervous System and Locomotion of German land and fresh-water Mollusks.—This important article appears in the programme of the Realschule of the second order at Leipzig, and is an able discussion of the principal types of nervous system in these mollusks, with remarks on the physiology of locomotion. The plate is an excellent piece of work.

Zoology in France.—The late numbers of Lacaze-Duthier's Archives de Zoologie contain some notable essays. Perrier's studies on the earth worms, made use of by Darwin in his last work on the earthworm, is beautifully illustrated by chromo-lithographs, the French maintaining their reputation for exquisite illustrations and delicate anatomical dissections. Numbers of the Acinetæ are described and illustrated by E. Maupas, while the notes on the anatomy of the brain of the mole, by W. Vignal, is accompanied by excellent figures. A. Schneider describes and figures a number of new psorosperms, while Dr. Yung discusses the innervation of the heart and of the action of poisons on the lamellibranchiate mollusks. The last number issued (No. 4, 1881) contains elaborate studies on the Pycnogonids, with several plates, by Dr. Hoek.

Milne-Edwards' *Annales des Sciences Naturelles* contains a summary of Mr. Walcott's work on the trilobite, by the venerable H. Milne-Edwards, who concludes that the trilobites are Crustacea, while he regards Limulus and the Merostomata in general as Arachnids. He accepts Walcott's determination of the nature of the limbs of trilobites. The same number also contains Robin's elaborate memoir on bats, with a figure of an embryo bat, and besides other papers, a second installment of A. Milne-Edwards researches on the fauna of the southern regions, concerning the distribution of the albatross, etc.

Development of the paired Fins in Sharks and Skates.—The latest contribution to this subject is that of Professor Balfour, who states that in Scyllium these arise as slight longitudinal ridge-like thickenings of the ectoderm. Afterwards the fins become a ridge of mesoblast covered by epiblast (ectoderm); the embryonic muscle-plates grow into the bases of the fins, and form two layers, while in the intermediate indifferent mesoblast changes begin which give rise to the cartilaginous skeleton. There is thus formed in the fin a bar, which springs at right angles from the posterior side of the pectoral or pelvic girdle, and runs parallel to the long axis of the body. The free end of this bar begins to undergo segmentation into rays. We have then a longitudinal bar along the base of the fin, which gives off perpendicularly a series of rays which pass into the fin. The resemblance to the arrangement of the unpaired fins is consequently very striking, and support is given to the author's original doctrine of a once continuous lateral fin.

Mr. Stearns on Variation in American Planorbes.—Apropos of Mr. Hyatt's article in the June number on the evolution of Tertiary species of Planorbis, we have in the Proceedings of the Academy of Natural Sciences, Phila., 1881, a most interesting paper by Mr. Stearns: (1) as to whether the shells of Planorbis are dextral or sinistral, and (2) on certain aspects of variations in American

Planorbes. The larger so-called species of Planorbis are divided into two groups. *First,* those in which the whorls are rounded; that is to say if the tube or cone, as represented in the preceding part of the paper, was cut transversely, the section would show a rounded (not round) outline. Examples are the typical *P. corneus* L. of Europe, *P. guadaloupensis* Sby., *P. subcrenatus* Carp., and *P. tumidus* Pfr. of Nicaragua, a quite persistent form, not, however, quite as rounded as the others. *Second,* those in which the whorls are either planulate, angulated, carinated or sub-carinated, which includes most of the larger North American species: examples are *P. corpulentus* Say, *P. traskii* Lea, *P. occidentalis* Carp. and *P. bicarinatus* Say. In these the tube, if cut transversely, would present an outline more or less angulated. Forms like *P. trivolvis* connect the two groups, for while in some instances this species exhibits the rounded whorls of the first it imperceptibly differentiates from the above to obtuse angulation, and thence to the sub-connate forms of the second group. Further remarks in illustration, with references to variations in other species, follow.

Researches on the Comparative Structure of the Cortex Cerebri.—In the Philosophical Transactions of the Royal Society of London for 1880, Dr. W. B. Lewis details the results of a full investigation into the minute structure of the cerebral cortex in the pig, with notes upon the histology of the same structure in the sheep and cat, with a view of comparison between the brains of these animals and that of the highest members of the mammalian series. The general arrangement of the cells constituting the greater portion of the cortex of the brain of the pig, is very similar to that found in the highest Mammals, and the cortex of the sheep closely resembles that of the pig. Among the chief facts of interest elicited are the following: A five and six laminated cortex is found in all, the fundamental structure of the layers is similar, and divergence in type is induced through the varied character and distribution of the units of these layers. Variations in laminar type, whether in man or the lower animals, center about the mid-region of the cortex; and motor areas are characterized by a five-laminated cortex and nested cells. In the cat the cells of the third layer increase in size with their depth, and the ganglionic cells are very large and crowded around the crucial sulcus—this concentration is a feature of importance in the Carnivora, and distinguishes them from the pig and sheep, in which the ganglionic cells are widely spread and uniform; and from man and the apes, in which they are widely spread and varied in development. The ganglion cells of the sheep and pig differ wholly in type from those of the higher mammals, and approach closely in appearance the large pyramidal cells of the third layer in man and the ape.

CONCLUDING OBSERVATIONS ON THE LOCOMOTOR SYSTEM OF MEDUSÆ.—Mr. G. J. Romanes has, by his experiments upon Medusæ, done much to explain the nature and origin of nerve action. It is in the Medusæ that we have the first observed appearance, in the ascending scale of life, of both muscular and nervous elements, and fortunately the creatures exhibit much endurance under experimentation, and are, many of them, of considerable size. A startling result of Mr. Romanes' labors, is his conclusion that ganglionic action is not, by itself, adequate to explain rhythm. Rhythmic action is the rule in the lowest forms of animal life; the beautifully regular motions of some Algæ, Diatoms and Oscillatoriæ, of the Infusoria, etc., are certainly not due to ganglia—not the least vestige of a ganglion can be traced in the snail's heart; and it would be hard to decide in what respect the beating of the snail's heart differs, on the one hand, from that of the pulsatile vessels of the Infusoria, or, on the other, from that of the mammalian heart. This being the case, why, Mr. Romanes asks, should the rhythmic action of the latter be referred to the ganglia present in it? Does it not seem probable that those contractile tissues endowed with rhythmic action in the higher animals are those which have retained their primitive endowment of rhythmicality? The paralyzed nectocalyces of Medusæ yield a rhythmic response to stimulation, whether electrical, mechanical or chemical, but while the covered-eyed Medusæ respond most readily to faradaic stimulation, some of the naked-eyed Medusæ are acted on most powerfully by the constant current, as well as by mechanical and chemical stimulation. The effect of temperature upon the rate of contraction exhibited by tissues deprived of their ganglia (artificial rhythm) was exactly parallel with its effect upon the natural rhythm of the motions of the unmutilated tissues, and this leads up to the probability that the effects of temperature on the natural rhythm of the ganglio-muscular tissues of other animals are for the most part exerted on the contractile element instead of on the ganglionic.

The introduction of oxygen gas into the water containing the parts under the action of electrical stimulus, increased the rate of contraction, while carbonic acid gas diminished it. The removal of the periphery of the swimming-bell of Sarsia, with its accompanying ganglia, causes great elongation of the polypite. The same thing occurs in some other Medusæ, but to a less extent. Thus the polypite is normally in a state of tonic muscular contraction from the persistent ganglionic stimulation, while the bell, under the same stimulation, exhibits rhythmic action. This difference is believed to result from the greater irritability of the polypite, which is evident in whatever way a stimulus is applied. But as the artificial rhythm induced by stimuli is but a feeble substitute for the vigorous movements of the healthy animal, Mr. Romanes concludes that the ganglionic discharges are timed to coincide with the rhythmic action of the contractile tissues, due to alternate exhaustion and restoration of excitability, and thus nervous energy is economized. Thus, in creatures not possessed of ganglia, rhythmic action results alone from this alternate exhaustion and restoration of muscular excitability, causing the constant stimulation to alternately fall below and rise above the limits of adequacy.

Ova of Echidna hystrix.—Professor Owen has examined the ova of two specimens of *Echidna hystrix* as they occurred *in situ*. The ova increase in size prior to embryonal development, attaining a diameter of six millims., but evidence of the viviparity of the animal is found in the commencement of the fissure of the germ-mass. Previous observations have proved that the teatless mammary glands acquire large development during gestation, and that the lacteal aureola becomes lodged in a tegumentary depression or *quasi* pouch, capable of receiving the head and fore limbs of the young when this is not more than one inch ten lines in length.

Zoological Notes.—Professor Haeckel has returned from his expedition to Ceylon, and has sent over fifty cases of specimens to Jena. His researches on the Ceylon coral reefs were highly successful.——M. Thury has published a hypothesis on the origin of species in the Archives des Sciences Physiques et Naturelles, Feb. 15.——In a recent communication to the French Academy, M. Huet records the discovery of segmental organs in certain isopod Crustacea.——It appears, says *Nature*, that Mr. Arthur having lately examined trout introduced into New Zealand from eggs originally obtained from the Thames, England, found that the annual increase of weight had risen from 1½ to 2½ pounds, and an example had been seen weighing twenty pounds. The cœcal appendages, hitherto held as significant of species were found increased from thirty-three to fifty, as exemplified in British fish, to from forty-three to fifty-four in the New Zealand examples, showing that these organs are inconstant as to numbers. These fish, moreover, living in different streams in New Zealand, had also assumed local peculiarities of size and change of form.——The U. S. Fish Commission is issuing the first volume of its Bulletin; the pages received contain, among others, some excellent articles by Mr. J. A. Ryder, on the breeding habits and development of the four-spined stickleback, the Spanish mackerel, the shad and the sea-horse (*Hippocampus antiquorum*). He states that the bony fishes differ in their mode of development from other vertebrates and fish-like animals except the sturgeons, in having a persistent segmentation-cavity which extends under the head to form the heart. The true gastrula of Teleosts appears to originate as an invagination at the tail of the embryo, represented by Kupffer's canal, essentially the same as in Amphioxus, and is not homologous with the gastrula regarded as such by Haeckel. The paired fins originate from lateral folds, and the first skeletal elements of the breast fins in the cod are a pair of curved cartilaginous arcs or rods.

ENTOMOLOGY.[1]

Insects and Drouth.—The year 1880 is known to have been phenomenal in the excessive drouth which prevailed in spring and early summer in the New England States. In a yet unpublished account of the disastrous work of the Army-worm that year (contrary to the old theory that it can abound only in a wet summer) in Monmouth county, New Jersey, Rev. Samuel Lockwood, of Freehold, speaks as follows of the exceptional abundance of other species:

"As for that Colorado pest, it was out early and in vast numbers, and by June 1st the Striped beetle (*Lytta vittata* Fabr.) fell upon the potatoes in hordes so vast that some farmers, because of the activity and numbers of the insect, declared it more formidable than the Colorado scourge. And that queer beetle, *Macranoxia variolosa* Hentz, so rare that I had never yet heard of one in Monmouth county, appeared in the first week of June at Red Bank, in quantity. In the same week our clouded yellow butterfly (*Colias philodice* Godart) made a premature appearance in immense swarms. Another sight which affected me because of its novelty, was the occurrence in great numbers, in the openings of "The Pines," in the second week of May, of a low flying brown butterfly like a Hipparchia. Tempting as the scene was, I was too ill that day to get out of my carriage for a butterfly hunt. But enough has been stated to show that from every point 1880 was, for New Jersey, a phenomenal year."

Probable Sound Organs in Sphingid Pupæ.—In recently characterizing the pupa of *Sphinx catalpæ* Boisd., for our report as entomologist to the Department of Agriculture, we were struck with the occurrence on the anterior border of each of the larger, movable, abdominal joints (viz: abdominal joints 5, 6 and 7) of a peculiar, elongate concavity, a structure not mentioned by Westwood, Burmeister, Kirby, Spence, Girard, Clemens, Harris, Graber or any modern author whom we have been able to consult. There is an approach to it in the pupa of *Ceratomia amyntor*, and it occurs in that of *Sphinx harrisii*, in similar position and form as in *catalpæ*. In *Macrosila 5-maculata* it is somewhat above the spiracles, and that on the fifth abdominal joint has a second larger ridge running around it posteriorly. It does not occur in any of the species of the genera Sesia, Thyreus, Darapsa, Deilephila, Philampelus and Smerinthus in our collection. It has no internal connection with the respiratory or circulatory systems and its function is probably sound-producing by friction with the posterior margin of the preceding joint.

This organ may in fact throw some light on the method by which the noise is produced which the pupa of *Sphinx atropos* is

[1] This department is edited by Professor C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

known to be capable of. Unfortunately we have no pupæ of that species for examination. We shall be glad to learn from any of our lepidopterological readers if they are familiar with this structure in any other pupæ, or know of any record of it.—*C. V. Riley.*

Clover Insects.—In his paper upon the insects of the clover plant, read before the N. Y. State Agr. Society, Jan. 19, 1881, Professor J. A. Lintner enumerates but three species of Coleoptera as being destructive to the plant.

From personal observation I am now able to more than double the number, the revised list being as follows:

Hylastes trifolii Muller (larva in roots).
Languria mozardi Fabr. (larva in stem).
Graphorrhinus vadosus Say (imago on leaves).
Lachnosterna serricornis Lec. (imago on blossoms).
Macrobasis unicolor Kirby (imago on leaves).
Colaspis brunnea Fab. (imago on leaves).
Epicærus imbricatus Say (imago on blossoms).

The latter four species are my contribution to the list, all old offenders, and well known to the economic entomologist.

None of these have so far become to any extent destructive, the Colaspis approaching nearest thereto. But as yet clover culture is in its infancy in the West, hence if the acreage were largely multiplied, the results can now be only a matter of supposition.—*F. M. Webster.*

Is Cyrtoneura a Parasite or Scavenger?—Last spring we sent specimens of a Muscid for determination to Mr. R. H. Meade, Bradford, England, and he kindly wrote us as follows regarding this species which was bred from chrysalides of the Cotton-worm:

"The Dipterous insects which I received yesterday are one male and two females of *Cyrtoneura stabulans* Fallen. This fly is common throughout Europe, and also occurs in North America, according to Loew and Walker (see Osten Sacken's Cat. of Dipt. of N. A., edit. 2d, p. 163). The larvæ usually feed upon decaying vegetable substances, as fungi, etc., but Schiner (Fauna Austriaca, Dipt., Vol. 1, p. 597) says, according to Bremi and Hartig, they also live upon the larvæ of Lepidoptera and bees. It is a very interesting fact that they also eat the Cotton-worms. Your American specimens seem to be perfectly identical with my British ones, but are rather smaller. I may add that the genus Cyrtoneura Macq. belongs to the family of the true Muscidæ."[1]

There can be no doubt that the Cyrtoneuras we bred issued from pupæ of Aletia, but as the usual habits of the species are those of a scavenger, some doubt has arisen in our mind as to

[1] Vide also Mr. Meade's note on the same subject in the (London) *Entomologist*, June, 1882, pp. 140–141.

whether it is a true parasite. We recall to our readers another Dipterous insect, the *Phora aletiæ* Comstock, which has been called, by its describer, one of the most important parasites of the Cotton-worm, and which nevertheless turns out to be a mere scavenger. *Cyrtoneura stabulans* may, like this Phora, lay her eggs on the decaying pupæ of Aletia, which are so commonly met with at the time the worms have defoliated the fields and have also eaten the leaves which sheltered the chrysalides. These chrysalides when exposed to the light and heat of the sun are very liable to rot, and on examining the chrysalides hanging on the defoliated plants, by far the larger portion of them will be found to be rotten, many containing the larvæ of Phora, some the larva of this Cyrtoneura, while the largest portion contain only a badly smelling fluid. If further observations prove that this fly infests only such chrysalides and cannot be bred from the living Aletia larva, it cannot be considered a true parasite.—*C. V. Riley.*

HABITS OF POLYCAON CONFERTUS Lec.—There seems to be nothing recorded on the habits of the genus Polycaon beyond a short notice in Dr. Horn's Revision of the N. A. species of Bostrichidæ,[1] that *P. confertus* "occurs in California where it is said to depredate on grape vine." We lately received from Mr. Matthew Cooke, of Sacramento, Cal., some pear twigs in which the above-named beetle was boring in exactly the same manner as our common Apple-twig borer, *Amphicerus bicaudatus.* Mr. Cooke says that the Polycaon is quite injurious to apple and pear trees and also to the grape vine. Thus, from what we know of its natural history, we may safely infer that its habits do not differ essentially from those of *Amphicerus bicaudatus, i. e.*, the beetle bores for feeding purposes in living twigs of fruit trees and grape vines, never, however, ovipositing in such twigs, and both male and female being concerned in this destructive work. Both species live, in all probability, as larvæ in the dead and dry wood of forest trees.

DINODERUS PUSILLUS AS A MUSEUM PEST.—While speaking of the habits of Bostrichid beetles, we would mention that last year we made the acquaintance of the above-named species in the role of a museum pest, it being usually met with in various drugs and other stored and dry vegetable products. The beetles suddenly appeared in large numbers in one of our insect boxes which had not been used for many years, perforating the paper lining and evidently feeding on the cork with which the box was lined. How the beetles came in the box remains a mystery to us, for the box was made and lined nineteen years ago and the insect had not appeared previously.—*C. V. R.*

MYRMECOPHILOUS COLEOPTERA.—In connection with our remarks on *Coscinoptera americana* in the last number of the NAT-

[1] Proc. Am. Philos. Soc., Vol. XVII, p. 554.

URALIST, we would mention that while several species of the genus Cetonia (*C. ænea* and *C. aurata*) are known in Europe to live in the larva state among ants, and while it is also known that the species of Cremastochilus are true myrmecophilous insects, yet nothing has been recorded of the earlier stages of Euphoria, though some species are among our most common beetles. Mr. Laurence Bruner now communicates to us from West Point, Nebr., that he finds *Euphoria hirtipes* Horn—larvæ as well as beetles—quite commonly in the hills of the common red ant (which in all probability does not differ from the European *Formica rufa* Linn.). There is scarcely any doubt that other species of Euphoria will have the same habits. The only other myrmecophilous Scarabæid known from the U. S. is *Euparia castanea*, which is very commonly met with in the Southern States in the nests of *Solenopsis xyloni* McCook, the so-called stinging ant of the cotton fields.

Mr. Theo. Pergande made an interesting observation the past spring on *Hymenorus rufipes.* He found its pupæ in the hill of a large, black, sericeous ant (*Formica fusca* Linn.), and the pupæ of another species of Hymenorus, *H. obscurus* Say, in the nest of a large yellow ant under a stone, but which cannot be named at present. The great care and attention bestowed by the ants upon the pupæ of the beetles when the nests were disturbed, seem to show that the pupæ were not in the nests of the ants by accident. Further observations are necessary to establish the fact, but as myrmecophilous Tenebrionidæ are known, and as an undescribed species of Anthicus is undoubtedly an inquiline of the red ant in Colorado, we should not be surprised if these species of Hymenorus would prove to be myrmecophilous in their earlier states.

Mr. E. A. Schwarz, who has collected largely in ants' nests, and who has many unpublished facts, will, we hope, ere long give us a list of all N. A. Coleoptera known to live among ants. —*C. V. Riley.*

DISCONTINUANCE OF PUBLICATION.—We are advised by the publisher of the *Revue Coleopterologique* of the discontinuance of this periodical. When we noticed in these columns (p. 152) the appearance of the *Revue*, we hoped that it would cover the whole subject of coleopterology, thus furnishing to the specialist, at short intervals, that information which the *Zoological Record* and the *Zoologischer Jahresbericht* give only in very condensed form at long intervals. However, the magazine greatly disappointed us as it was evident that the managers were too much absorbed in lists of "new species," synonyms and the other dry bones of the science to create any general interest in its pages. The result just announced was, it seems to us, but natural.

ANTHROPOLOGY.[1]

Indian Languages of the Pacific States.—In the April number of the *Magazine of American History*, Mr. Albert S. Gatschet gives us a paper upon some of the Pacific coast tribes and upon the Pueblos. The classification of the tribes west of the Sierras is known to have been fraught with great difficulties. We are indebted to Mr. Hale, Stephen Powers and Mr. Bancroft for much help. The Bureau of Ethnology has afforded Mr. Gatschet the opportunity of extending greatly our information. The following is a brief abstract of the paper:

Mutsun family.—The Esselen, or Eslens, identical with the Huelels of La Soledad mission, and the Karkins of Carquinas straits, belong to the Mutsun family, as also did the dialects of the *rancherias* Saclan, San Juan Bautista and Juíchum. The idioms spoken by Powers' Miwok tribes are Mutsun. In fact, dialects of Mutsun extended from the Pacific coast across California to the Sierras.

Wintun family.—The Suisunes north of the San Francisco bay are Wintun, but at the mission San Juan Bautista, the colonies of Nopthrinthres and Lathru-unum were Yokuts.

Chimariko family.—East of Trinity river. Habitat and characteristics given. No divisions.

Washo family.—Nevada. Area and quality but no divisions mentioned.

Kalapuya family.—Willamet valley. Divisions: 1. Atfálati (Tuálati, Wápatu); 2. Yamhill; 3. Lukamayuk; 4. Kalapuya; 5. Ahautchuyuk, or Pudding river Indians; 6. Santiam (Ahálpam, Uplanders); 7. Ayaukeld (Yóukalla).

Yakona family.—Coast between Capes Foulweather and Perpetua. Two dialects, the Yakona and the Alseya.

Sayuskla family.—Habitat and qualities given. No divisions.

Kusa family.—Coos river and bay. No divisions.

Takilma family.—No divisions.

Pueblo Indians are divided into four families:

Rio Grande family.—1. Taos language, spoken at Taos and Picori; 2. Taño language, spoken at Isleta, Isleta del Paso and Sandia; 3. Téhua language, spoken at Tesuque, San Ildefonso, Nambe, San Juan or Ochi, Santa Clara, Pajoaque, Los Luceros, and at the Moqui village of Tehua; 4. Jemes language, on Jemes river, consolidated with Indians of Old Pecos; 5. The Piro language, spoken at Sinecu, a few miles below El Paso del Norte.

Kera family.—Spoken at San Domingo, east of the Rio Grande and west of that river on the San Juan and its tributaries. The Pueblos are: 1. The Kawaiko group on the San Juan river—Laquena, Acoma, Hasatch, Povuate and Moquino; 2. The Kera or

[1] **Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.**

Queres Pueblos on or near the Rio Grande, north-east of the former—Santa Aña, Cia, Silla, San Felipe, San Domingo and Cochiti.

Zuñi family.—At Zuñi Pueblos.

Moqui towns.—The language of one of the Moqui towns, Tehua, has given name to a linguistic family, the other towns Tsitsúmovi, Hualpi, Musházganevi, Shebuálavi, Shongápavi and Oraévi speak Shoshoni dialects. Mr. Gatschet is a very patient, scrupulous student, and his labors in disentangling the Indian languages of our continent, cannot receive too high a praise.

Geiger's Development of the Human Race.—From the press of Houghton, Mifflin & Co., of Boston, appears a work entitled "Contributions to the History of the Development of the Human Race," by Lazarus Geiger, translated by David Asher, and forming volume xx of the English and Foreign Philosophical Library. One not acquainted with the studies and works of Dr. Geiger would not guess what the volume is about. It should be named, the contribution which the study of language makes to our knowledge of the early history of man. From this point of departure the author seeks to unravel such mysteries as the evolution of technique, the color sense, the origin of writing, the discovery of fire, and the primitive home of the Indo-Europeans. It may be that the author generalizes too hastily here and there. For instance, the absence of allusions to fragrance in the Bible previous to the "Song of Songs," is supposed to teach that the sense of odor is not innate in man but has gradually had an evolution. In a much stronger sense the perception of colors has grown upon the human family, and this accounts for the lack of all mention of the color *blue* in the Rig Vida, the Zendavesta, the Bible, and the Homeric Poems. Indeed, Dr. Geiger lays down a law as to colors, that indifference with respect to the intermediate ones rises as we approach primeval ages, to an ever increasing degree, until at length only the outermost extremes, black and red, are left.

The freshness of thought and the suggestiveness of these lectures render them one of the most valuable contributions to our modern anthropological literature.

The Smithsonian Report for 1880.—The restriction of Congress as to the number of pages in this time-honored publication having been removed, the volume for 1880, though somewhat delayed, appears in an enlarged form, having 772 pages. The contributions to anthropology occupy the usual space in the volume, although many original papers were crowded out. In the report of the secretary mention is made of Mr. Frank Cushing's residence among the Zuñis, Col. Stevenson's collections among the Pueblos, Ober's researches in the West Indies, Dall and Bean's expedition to Alaska, Boehmer's index to the Smithsonian publications in ethnology and archæology, the contents of Vol. XXII, Contributions to knowledge, and the archæology of the West Indies. On page 56 Professor Baird makes the following announcement, which will be welcome to many of our older anthropologists: "Among the collections which will form part of the objects in the National Museum, a very interesting and instructive exhibit will consist of the Indian portraits and scenes painted by the late George Catlin. These pictures were presented to the institution in 1879 by Mrs. Harrison, of Philadelphia." On page 62 will be found an account of the relations of the Bureau of Ethnology to the Smithsonian Institution. The destination of Dr. Berendt's papers on Guatemala is given on page 69. The list of contributors given on pages 110–135 contains the names of many who have added to the anthropological collections. With the present number a more systematic scheme of summaries in different sciences is begun. The paper upon the progress of anthropology is by the editor of these notes in the NATURALIST, pages 391–448.

COLONEL STEVENSON'S COLLECTIONS FROM THE PUEBLOS.—The readers of the NATURALIST are not unfamiliar with the very extensive collections which Colonel James Stevenson, of the Bureau of Ethnology, has been making during the past three years in the Pueblo country. There is now passing through the government press an illustrated descriptive catalogue of these objects. Part I, nearly ready, contains the enumeration of 2858 specimens of pottery, implements of war and hunting, articles used in domestic manufacture, clothing and personal ornament, basketry, horse trappings, images, toys, stone tools, musical implements, those for gambling and religious ceremonies, fabrics, foods, paints, pigments, medicines, dye-stuffs, &c. By far the best part of the collection is the pottery, which Mr. Stevenson divides into six classes: 1. The red or uncolored; 2. The brown ware; 3. The black ware; 4. The cream white decorated in colors; 5. Red ware decorated; 6. The ancient pottery. There are 350 illustrations to the report, nine plates of colored lithographs by Julius Bien, the remaining figures being woodcuts. Mr. Stevenson's catalogue is much more than a mere printed list. The descriptive text contains the observations of a man singularly gifted in winning the confidence of the savages, who allowed him to witness all the operations of their quaint industries, and to collect the materials and implements for all stages of their barbaric art. The best informed technologist will find something to awaken fresh thought on every page of Col. Stevenson's narrative. The most important part of the material was gathered at Zuñi, but valuable specimens are also enumerated from Wolpi, Laguna, Acoma, Cochiti, Santo Domingo, Tesuque, Santa Clara, San Juan, Jenez, Old Pecos, the Cañon de Chelley, the Jicarillas and from miscellaneous sources. Part II, now in course of preparation, will enter more minutely into the distribution of industries and technical processes.

ANTHROPOLOGY IN GREAT BRITAIN.—We are in receipt of the May number of the *Journal* of the Anthropological Institute of Great Britain and Ireland, and of the fifteenth volume of the Transactions of the Victoria Institute. The former has an unusual amount of local matter, but the following papers will interest American readers:

On the animism of the Indians of British Guiana. By Everard F. im Thurn.

Notes on the Asiatic relations of Polynesian culture. By Edward B. Tylor.

On the stature of the inhabitants of Hungary. By Dr. John Beddoe.

Some vestiges of girl sacrifices, jar burial and contracted interments in India and the East. By M. J. Walhouse.

On the origin and primitive home of the Semites. By G. Bertin.

On some stone implements from British Guiana. By E. F. im Thurn.

President's annual address.

The Victoria Institute volume contains a paper by Dr. James C. Southall on Pliocene man in America, accompanied with remarks by J. W. Dawson, the Duke of Argyll, W. Boyd Dawkins, T. McK. Hughes and others.

ANTHROPOLOGICAL NOTES.—Professor Cyrus Thomas writes: "Applying to the inscription on the Tablet of the Cross the same method I have used to determine the order in which the characters of the Manuscript Troano are to be read, I discovered that the inscription is to be read in double columns from the top downwards. The demonstration of this I will give in my paper on the Manuscript Troano."——Col. F. F. Hilder, of St. Louis, is the author of pamphlet No. 6, published by the Missouri Historical Society, describing a remarkable vase containing devices indicative of sun-worship.——In the Bulletin of the Minnesota Academy of Natural Sciences, 1881, two papers of interest to our fraternity will be found: "Is the Dakota related to the Indo-European languages," by A. W. Williamson; "Classification of languages," by W. W. Folwell.——In the last volume of the Proceedings of the National Museum, pp. 455–458, will be found a list of all the anthropological publications of Dr. Charles Rau.——Under date of May 21, 1882, Mr. Henry L. Higginson presents his report as treasurer of the Archæological Institute of of America, showing a receipt of $12,560.95, and a balance of $2649.35. The following very important observation is made and should be seriously considered: "If the work is to be continued during the present year, it is apparent that the executive committee must be supplied with means in addition to what they will receive from the subscriptions of annual members."——Robert Clarke & Co., of Cincinnati, are the publishers of "Shea's Mississippi Series."

GEOLOGY AND PALÆONTOLOGY.

The Southern Limit of Ancient Glaciers in Pennsylvania.—At a late meeting of the Boston Society of Natural History, Professor G. F. Wright, of Oberlin, O., gave an account of the discoveries made last summer by him and Professor H. C. Lewis concerning the southern limits of ice-action (otherwise called the terminal moraine) in Pennsylvania during the glacial age. These investigations were made under the direction of Professor Lesley, who has charge of the elaborate geological survey now in progress in that State. Previous to last summer Mr. Clarence King had, first in 1876, through a paper of Mr. Wright's before this society, called attention to the terminal moraine at Wood's Holl. Subsequently Warren Upham, taking up this clue, had followed it through Cape Cod and Long Island, where the line joined on to that discovered by Professor Cook, of New Jersey, reaching the sea at Perth Amboy just below New York, and crossing the Delaware river at Belvidere, a little above Easton, Pa. From this point the line of the terminal moraine was seen laid down upon a map fifteen by ten feet, displayed for the first time to a scientific society, crossing Northampton county by a general north-western course to the center of Monroe county; thence westward, crossing the Lehigh fifteen miles above Mauch Chunk, and the Susquehanna twenty miles below Wilkesbarre; thence by a northwesterly course through Columbia county, rising to the summit of the Alleghanies in Lycoming county and crossing them diagonally through Tioga and Potter counties, where the general elevation of the country is upward of 2000 feet. From Potter county the moraine enters Cattaraugus county, N. Y., and continues to trend northward as far as Little valley, six miles north of Salamanca, where it makes a sharp turn to the southwest, running nearly parallel with the Alleghany river to Columbiana county, Ohio. The whole length of the line explored this last summer is about 400 miles. The signs of glacial action abruptly cease along this line, and it is marked by a special accumulation of unstratified material composed of clay, scratched stones and granite boulders which have been transported hundreds of miles. North of that line the signs of glaciation are everywhere apparent; south of it there are no scratched stones, no transported boulders, and no "till" or boulder-clay. Where streams cut through the line, however, boulders of granite and quartzite have been transported by water and deposited in terraces and deltas. The gravel at Trenton, New Jersey, in which Dr. C. C. Abbott has found palæolithic implements, is in a delta terrace thus formed when the river was fifty feet higher than now. Every stream to the westward which rises in the glaciated region and flows through the unglaciated region, has formed corresponding terraces and deltas, and is full of interest. The lecturer urged that thorough search for palæolithic implements should be made in all such formations. The majestic proportions of the great ice-movement are seen in the fact that it advanced as far south upon the mountains as in the valleys; for example, the valley between the Kittatinny and Pocono mountains, though twenty miles wide and one thousand feet deep, caused but a slight deflection of the ice-front to the south. The same is true where the moraine crosses the valley of the east branch of the Susquehanna. The grand deflection of the line to the northward is evidently due to variations in the forces which were pushing from behind. Now that an accurate knowledge of the southern limits of the continental glacier is being obtained, it will be possible to get a variety of approximate estimates of the quantity of erosion which has taken place since the great ice age, and so a more correct idea of its antiquity. Full accounts of this subject will appear in the report of the Pennsylvania geological survey. Arrangements are in progress for Mr. Wright to continue the exploration through Ohio the present summer.

New Phyllopod and Phyllocaridan Crustacea from the Devonian of New York.—A very interesting species of Estheria (*E. pulex*) is described by J. M. Clarke in the *American Journal of Science.* If this is a genuine Estheria (and it differs from other species in wanting a straight hinge margin) it is the oldest species of the genus yet found, though *E. membranacea* Jones, occurred in the Old Red of Caithness. In this country no species of Estheria has been found below the Trias.

The other forms described by Mr. Clarke are not true Phyllopods, but should be referred to the order *Phyllocarida*, being related to Discinocaris. They are forms of much interest. *Spathiocaris emersonii* Clarke, gen. et sp. nov., is from the Portage of Ontario county. The second form of this order, *Lisgocaris lutheri* Clarke, gen. et sp. nov., is from the base of the Hamilton, in the same horizon as *Estheria pulex.* The author refers it to the "Apus type of the Phyllopods," but are they not more properly allied to Nebalia, the rostrum having been lost or separated after death? Only the carapace of this genus and of *Spathiocaris* occured, the abdomen not having been discovered.

White's Contributions to Mesozoic and Tertiary Palæontology.—Dr. C. A. White describes in the Proceedings of the U. S. National Museum, several new mollusks from the Laramie and Green River groups, which is succeeded by a short paper on the molluscan fauna of the Truckee group, including a new form.

In the *American Journal of Science* he discusses certain conditions attending the geological descent of some North American types of fresh-water, gill-bearing mollusks. Dr. White claims that the rivers of North America having existed from early geological times, that some of them becoming confluent, have disseminated molluscan forms. Thus the Ohio and Upper Mississippi, the two most ancient portions of the present great system, were once separate rivers, emptying into a northern extension of the great gulf; and it is practically certain that neither of them received that portion of the molluscan fauna which now so strongly characterizes them, until after the confluence with them of the western portions of the present great river-system which brought that fauna from its ancient home in the western part of the continent." He concludes that "a large number of the types among the Mollusca of the Mississippi drainage system have come down wholly unchanged from a time at least as remote as the Laramie period.

WHITFIELD'S NEW SPECIES OF FOSSILS FROM OHIO.—This pamphlet contains descriptions of numerous new species of mollusks from the palæozoic rocks of Ohio, which are to be republished accompanied by illustrations, in the forthcoming volume of the palæontology of Ohio. Among the more interesting novelties is a new Eurypterus.

DAVIS ON THE LITTLE MOUNTAINS EAST OF THE CATSKILLS.—The first number of the third volume of "Appalachia," contains an account of the interesting and varied geology of the Little Mountains, a region attractive to tourists. The illustrations accompanying the article are clear and excellent of their kind.

GEOLOGICAL NOTES.—At a recent meeting of the London Geological Society, J. S. Gardner communicated a note upon the geology of Madeira. In the center of the island is a horse-shoe shaped valley, more than 2500 feet above the sea, with walls 3000 or more feet in height. This the writer regarded as the basal wreck of a volcanic mountain.——In the June number of the *Geological Magazine*, W. H. Hudleston continues his contributions to the palæontology of the Yorkshire oōlites; W. Keeping writes upon the glacial geology of Central Wales, and mentions that Aberystwith beach is rich in agates, onyx, felsites, and other stones that cannot have come originally from any part of Wales, but are probably washed by marine currents out of a boulder-clay now submerged in Cardigan bay; C. Davison contributes an article on the theory of vorticose earthquake shocks; and the Rev. A. Irving continues his notes on the classification of the European Permian and Trias. Mr. Davison considers that vorticose and twisting shocks are due to the facts that the earth's crust is not homogeneous and isotropic, that the seismic focus may be of any form and magnitude, and may even consist of detached portions; that the disturbances of different points of the seismic focus are not necessarily of equal intensity, and that the disturbances do not necessarily take place simultaneously throughout the whole extent of the seismic focus. ——At recent meetings of the Geological Society of London, J. W. Hulke, the president, described the pubis and ischium of *Ornithopsis eucamerotus*, a dinosaur allied to *Ceteosaurus*, *Cama-*

rasaurus and *Atlantosaurus;* H. G. Seeley noticed *Neusticosaurus pusillus (Simosaurus pusillus* Fraas) showing that the structure of its palate is generically different from that of any other plesiosaur; A. W. Waters gave a list of sixty-six chilostomatous Bryozoa from Mount Gambier, South Australia, including twenty-eight species now living, and fifteen not before described; G. W. Shrubsole described a new *Phylloporus* from the Permian limestones; and Professor J. D. Dana made a communication upon the geologic age of the Taconic rocks, maintaining their Silurian age.

MINERALOGY.[1]

THE MANUFACTURE OF ARTIFICIAL DIAMONDS.—Since the now famous experiment of Mr. Hannay in the manufacture of artificial diamonds, the subject has attracted great attention, and has led to a number of experiments in the same direction.

Dr. R. S. Marsden has recently succeeded in producing minute diamonds by a simple process depending upon the solubility of carbon in fused metals, and its subsequent crystallization upon cooling.

In a graphite crucible, lined within with a paste of gum and charcoal, layers of powdered charcoal (prepared by calcining sugar) are laid alternately with small lumps of pure silver, care being taken to keep the silver always surrounded by the charcoal. The closed crucible is then heated for ten hours at the temperature of melted steel, and then buried in hot sand so as to cool very gradually.

On opening the crucible the silver is found in a single lump near the bottom, and shows a crystalline structure. The lump is now dissolved in nitric acid, when the dissolved carbon remains as a grayish-black powder of a bright graphitic luster.

When examined under the microscope, this powder is seen to consist of three different substances: (1) graphite, forming the larger proportion; (2) an amorphous brown substance in flocks, being either amorphous carbon or a carbide of silver; (3) a number of small black octahedral crystals with curved edges. These last are unattacked by hydrofluoric acid or by any acids or alkalies, are hard enough to scratch quartz, and burn in a stream of oxygen gas. These, therefore, appear to be true diamonds, and it is probably merely a matter of experiment whether they can be produced of sufficient size to be of value.

PYRITES AS A SOURCE OF SULPHURIC ACID.—The use of pyrites as a source of sulphuric acid has long been known, but it is only within a few months that American pyrites has been used for that purpose. The distance of deposits of pyrites in this country from manufacturing centers has been the chief drawback. Two

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

mines of pyrites have lately been devoted to the manufacture of sulphuric acid. These are the Capelton mines of Canada and the Milan mines of New Hampshire. After the ore has been burned to drive off the sulphur, the cinders are returned to be treated for copper, the pyrites being cupreous. It is said that a pyrites ore, in order to be useful for the manufacture of sulphuric acid, must have a high percentage of sulphur, be near a market, be of medium coarseness, and not be too soft; it must not fuse easily, must contain no arsenic or antimony, must not decrepitate when heated, and must burn readily and down to a low percentage of sulphur: otherwise it will not pay.

A DIMORPHOUS FORM OF TIN.—Small crystals of tin are sometimes found in the slag from the smelting furnaces of tin works. As shown by Trechmann, in slag from Penzance, and by Foullon in slag from Mariaschein, the tin crystals may be of two kinds, either the ordinary tetragonal form, such as are deposited by galvanic action, or, more generally, an *orthorhombic* form, not previously observed.

The general appearance of the latter is that of a loose, irregular mass of thin plates of different sizes, sometimes a quarter of an inch square, which have a bright metallic luster and a grayish color. These plates are built up of a number of sub-crystals, which, having well defined edges, were capable of goniometrical measurement. They were found to have the axial ratio: $a : b : c = 0.387 : 1 : 1.035$.

BLASTING WITH LIME.—A new and ingenious method of blasting has lately been tried at a coal mine in Derbyshire, which, dispensing with the use of gunpowder, depends upon the action of water upon caustic lime. Cylindrical blocks of caustic lime, 2½ inches in diameter by 4½ in length, are prepared by the compression of burnt lime under a hydraulic press. The blocks, each of which has a longitudinal groove ½ inch in diameter, are taken in air-tight boxes to the mine and placed in holes some three feet deep, which have been bored in the coal. By means of an iron pipe which fits into the grooves in the blocks, water is now introduced to the bottom of each hole.

In the course of a few moments a sound like that of steam escaping under high pressure, is heard, which is immediately followed by the breaking down of the coal. There is no sudden explosion or danger from fire.

This method is of course inapplicable for the blasting of hard and compact rocks.

THE FORMATION OF SULPHUR IN THE SOIL OF PARIS.—In the course of an excavation for a sewer in the streets of Paris, the workmen encountered a mass of rubbish consisting of animal and vegetable refuse mixed with bones and with plaster. The bones were filled with crystalline acicular gypsum, and the plaster was impregnated with crystals of native sulphur. As shown by Daubrée, there is no doubt but that a chemical action has taken place between the organic matter and the plaster to produce these crystals of sulphur. A similar reaction may explain the formation of sulphur in stratified rocks.

Mineralogical Notes.—The amethysts of the Saxon Obergebirge are found frequently to have become soft and friable. They are often reduced to a fine powder, in which state they are known as *mealy quartz*.——An asbestos from Silesia, made up of short bundles of white interwoven fibers, has been found to contain more than three per cent. of soda.——*Gilbertite*, a mineral from the Saxo-Bohemian tin veins is, according to Frenzel, not a distinct species, but a transition product of the alteration of topaz into potash-mica. The topaz becoming white or greenish-gray, is then called gilbertite, while the latter afterwards becoming laminated and paler in color, finally becomes a potash-mica. Such changes of mineral species are of great interest. ——E. F. Smith and N. W. Thomas announce new localities for *corundum* and *wavellite* in Lehigh county, Penna. The former occurs in well defined and often large hexagonal crystals near Shimersville. One crystal was eight inches long and four and a-half inches wide. The locality has been leased for technical purposes. Wavellite was found in white, radiating nodules upon limonite, near Macunzie, in the same county. It has the composition Al_2O_3 36.66, P_2O_5 34.14, H_2O 28.32, Fl. *trace*, limonite 0.60 = 99.72.——At a recent meeting of the Microscopical Society of Belgium, M. Prinz read a paper upon the microscopic inclusions in sapphire, ruby and spinel. The paper is accompanied by a plate giving drawings of the remarkable liquid and solid enclosures, the crystals and the microlites which occur in these gems. The minute, hair-like crystals which produce the beautiful asterism of some rubies, are probably rutile.——*Cerite* has recently been shown to contain a new element, to which the provisional name of Beta-Didymium has been given. Ordinary didymium is supposed to be a mixture of at least three different elements, one being true didymium, another being a more basic element of lower atomic weight (Di–β) and the third a less basic element with higher atomic weight.

GEOGRAPHY AND TRAVELS.[1]

African Exploration.—Dr. Stecker has left Abyssinia for Kaffa in company with an embassy which has recently visited Abyssinia to offer the allegiance of the Sultan of Kaffa to King Johannes. He, therefore, has good reason to hope for a favorable reception in that country.

Some of the results of the six years' exploration of Shoa and

[1] Edited by Ellis H. Yarnall, Philadelphia.

Southern Abyssinia by the Italians, are mentioned in a recent address by Captain Cecchi before the Italian Geographical Society. The position of twenty places has been determined by careful astronomical observations and the correctness of D'Abaddie's work in Enarea and Kaffa has been established. The furthest point reached by Cecchi and Chiarini are the River Maira in lat. 7° 40′ N., long. 39° 30′ E., undoubtedly one of the head streams of Haines River, and the kingdom of Kullo to the south of Kaffa which Cecchi traversed as far as lat. 6° 30′ N.

Another Italian, Captain Casati, has succeeded in visiting a few villages of Akka to the south of Tangasi, the present capital of Monhutter.

The *Academy*, in speaking of the report of Herr Marno of his survey of the Lower Bahr el Ghazal as far as the mouth of the Bahr el Arab in lat. 9° 5′ N., observes that as a matter of course it differs very essentially from all preceding surveys, so-called. In fact, no satisfactory map of a river of the nature of that in question can be produced, unless the surveyor is in a position to determine the location of a number of points by careful astronomical observations. At present, and notwithstanding the extensive labors of Petherick, Schweinfurth, Dr. Junker and others, not a single longitude has been satisfactorily determined in the vast region lying to the westward of the Upper Nile, while the latitudes are few and far between.

The latest news from the missionaries at Rubaga, Uganda, is very satisfactory. The weakening of the aggressive power of Egypt on the north has done much to restore quiet to the country.

A number of the natives engaged on the construction of the road from Lake Nyassa to Lake Tanganyika have been killed and the work was temporarily suspended, but it was hoped that operations would be resumed in May.

Dr. Pogge and Lieutenant Wissmann on the 11th of August, 1881, were in Mieketta, eight marches north-north-east from Kimbundo. They were proceeding northward and aiming to reach Mukenge's town in the country of the Tuschilange in about lat. 5° S. This is said to be about a thirty-six days' journey along the left bank of the Chikapa River to its junction with the Kassi, and thence down that stream to near the mouth of the Lulua. The Tuschilange are said to be great traders, and Dr. Pogge hopes to meet with no opposition in exploring their country and visiting Lake Mukambo, which is reputed to be about five days journey to the east. This body of water is described as about forty miles in circumference.

Dr. Buchner, in a paper read before the Bremen Geographical Society, describes the territory of the Muata Yanvo as consisting in the main of wide upland savannas, intersected by valleys, portions of which are densely wooded. The fauna is remarkably poor. Neither lions nor elephants were seen by the explorer, and even antelopes were scarce, and never found in herds as in the south. The Muata Yanvo is avaricious, like all these African kings, but he is not cruel. Only three executions took place during Dr. Buchner's six months' residence, and these for criminal offences. At the residence of King Tambu, at Kabong, Dr. Buchner met with a very superior description of native weapons and woven fabrics, a fact which he thinks points to the existence of highly civilized tribes in the interior which have not hitherto come into contact with Europeans.—*Athenæum.*

The Royal Geographical Society's *Proceedings* states that the members of the Livingstone Inland Mission succeeded in reaching Stanley Pool in December last. They traveled on the south side of the Congo from Banza Manteka to a point opposite Bemba, and passed through forty miles of country not previously traversed by Europeans. They found it densely populated, villages or "towns" being passed every few miles.

The people were comparatively fearless and friendly, and food was fairly abundant, large gardens in a good state of cultivation surrounding most of the towns; the tracks of elephants and buffalos were continually seen during the journey, and sometimes the animals themselves at uncomfortably close quarters. At Bemba the party crossed to the north bank of the Congo and finished the journey to Stanley Pool on that side, reconnoitering the country with a view to the selection of suitable sites for future stations. They walked 169 miles in all, thirty-one of which were along Mr. Stanley's road, now nearly overgrown with grass. Bwa-Bwa-Njali and the other chiefs were at first friendly, but suddenly turned hostile and refused to let them cross to the south bank in order to carry out their plan of returning by that way. This action the missionaries seem to attribute to the operation of M. de Brazza's treaty, and they consequently retired to the Nkemke River, near which they secured land for a station from the chief of a populous district. Before proceeding with building operations, they went on to Bemba, and letters they there found waiting for them determined them first of all to explore the whole of the south bank from Bemba to Stanley Pool, in order to see which would be the best way to take up the steamer for the upper river. On this second journey of exploration the party started about the middle of January. On April 26th, reinforcements left Liverpool for the Congo, including a physician and a practical astronomer.

Dr. Danckelmann, a competent meteorologist, is about to join Mr. Stanley on the Congo.

Petermann's Mittheilungen publishes a recomputation of Stanley's hypsometrical observations, by Dr. Zöppritz, who assigns the Victoria Nyanza an altitude of 4058 feet.

Herr Flegel has started from Loko on the Benue for Adamawa.

Captain Burton and Commander Cameron have returned from the Gold Coast to England with large and valuable collections in all branches of natural history. Com. Cameron has also made extensive surveys.

Dr. Gumbel, director of the Bavarian Geological Survey, after an examination of specimens of ore from the Gold Coast, doubts whether there exists any country in the world which holds out so fair a hope of a continuous supply of gold as do the inland districts of the Gold Coast.

A correspondent of the London *Daily News* writes that the Italian travelers, Captain Bianchi and Signor Licata, are about to undertake an extensive journey in Africa. From the Bay of Biafra, in Guinea, they will traverse the hitherto unexplored high levels of the Cameroon Mountains in the direction of the Labi Lakes, and study the country in which rise the Congo, Niger, Gazelle Rivers, and Lake Tsad, to find the key of the hydrographic system of tropical Africa. From the lakes they will descend to Lake Luta, which was partly explored by Signor Gessi. They will then traverse the Uganda territory, going north-east towards the Gallas country, already known to Capt. Bianchi, and return to Italy *via* Abyssinia and the Red Sea, having thus crossed Africa from west to east. They believe it will take four years to complete this immense journey, which will have principally a scientific aim.

THE CIRCUMPOLAR STATIONS. — The steamer *Pola*, Captain Müller, left Pola on April 2d last with the staff and equipment of the Austrian Meteorological Expedition, consisting of fourteen persons. She expected to arrive at Jan Mayen early in May, and after leaving the party, with all the stores, will return home. The Austrians are to remain until August, 1883. Stores are supplied for two years, and three boats are provided for the escape of the expedition should the relief vessel not reach Jan Mayen next summer.

The German Committee held a meeting at Berlin on April 13th, and they are reported to have decided to erect one observing station in the northern arctic zone at Cumberland Sound, Davis Strait, and a second on one of the islands of South Georgia, 54° 30′ S. lat., 41° 30′ 15″ W. long., and some 1100 miles east of Cape Horn. The former expedition will be commanded by Dr. Giese and the latter by Dr. Schrader, of the Hamburg Observatory, and each will consist, besides, of six additional observers and three or four workmen. Both parties will leave Europe early in June. Dr. Schrader proceeding by mail steamer to Monte Video, and thence by a German man-of-war to their destination, but no definite arrangements have yet been made for the conveyance of Dr. Giese's expedition to Cumberland Sound.

The Swedes expect to open a station on Spitzbergen during the summer. It will probably be established at Mussel Bay, on the east side of Wyde Bay on the northern coast of West Spitzbergen, where Nordenskiöld and Palander wintered in 1872–3, and the expedition expects to use the building then erected on Polhem Island. There will be thirteen in the party.

The British have finally selected Fort Rae for their station.

MICROSCOPY.[1]

MICROSCOPIC DEXTERITY OF THE CAMEO CUTTERS.—One of the best examples of adroit manipulation under the simple microscope is the operation of cameo cutting as described in an article in *Our Home and Science Gossip*:

"A visit to a cameo cutter's workshop found him seated at a table covered with tools, varying from a triangular-pointed steel instrument to the most delicate pointed bits of steel wire fastened in handles. Very fine files and knitting needles, set in wooden grips and ground to infinitesimal points, figured in the lot. On a pad of leather, before the cameo cutter, was a block of wood just big enough to be grasped with his hand, and cemented to the middle of it was an oval object that looked like a piece of alabaster, just big enough to make a seal for the finger of a man who did not object to wearing large rings. Upon this the artist was just finishing a copy, with a pencil pointed to needle fineness, of a photograph in profile of a gentleman, which was leaned against a little photograph easel before him. Having finished the outline, he laid his pencil by, and taking up a fine wire tool he scratched the pencil mark around with it. Then he took a darning needle with a sharp point and scratched the line deeper. He worked with a magnifying glass at his eye, and stopped continually to inspect the progress of his work with critical minuteness. Then he went at it again, working slowly, scratching over the same line again and again, and always examining after each scratch. He changed his tools as he went on, and from the darning needle descended to a trifling little fragment of steel wire, not as thick as an ordinary sewing needle, set in a slender handle. With this he scratched and re-scratched, until the lines he had drawn with his pencil had quite vanished, and a thin, fine streak of a dark color had marked the outline of the head he had been tracing his way around. Next he took one of his burin-like tools and commenced again. This time he worked on the outside of the outline, cutting and scraping at the surface until the white turned gray, then brown, and finally vanished, leaving the face in relief, surrounded by a black ground—that is, the portrait remained intact in the white substance which formed the outer layer of the cameo, while it had been cut away around it to the lower or dark layer. The portrait or figure is then modulated upon its surface until it assumes the roundness of nature. The edges are left square to the dark ground. This is necessary, as, if they are

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

gradually rounded down, the outline becomes undefined toward its juncture with the relieving surface, owing to the white of the raised portion being partially transparent and permitting the dark to show through it when it is thinned down. Care is taken to finish this dark surface as much as possible with the cutting tools, and so separate the white from it as to leave it smooth and unscratched. A final polish is given it, however, with putty powder applied dry with a stiff brush, but the utmost care is necessary in this operation, as the slightest slip will ruin the work. This is the cameo cutter's work, the mountings being the jeweler's work. The cameos sell, unmounted, for about $25."

THE MICROSCOPE IN THE DETECTION OF FORGERY.—The Boston *Journal of Chemistry* for August, publishes some "interesting paragraphs" from a recent lecture in England, by Mr. Jno. Rogers. The quotations are an abstract, though not so credited, of remarks in Dr. R. H. Ward's lecture on the Practical Uses of the Microscope, delivered as president's address at the Buffalo meeting of the American Society of Microscopists, in August, 1879. Not only is the substance taken from that source, but numerous phrases and entire sentences are copied word for word. Dr. Ward's publication upon the subject was based upon more than twenty years of original work in a field then new and practically unoccupied, and, in appropriating his work, credit should have been given so fully and conspicuously, that it could not be overlooked or misunderstood.

KENT'S INFUSORIA.—The sixth part of Mr. W. Saville Kent's Manual of the Infusoria, just issued by David Bogue, of London, completes a work that will be a classic in microscopy. The book is the more remarkable as showing how much of excellent work can be accomplished in a limited time, the author having explained that when he undertook this study, ten years ago, he was but a beginner in practical microscopy. Finding the literature of his chosen subject to be fragmentary and scattered, and practically unavailable, he undertook to compile a manual that should bring to the knowledge of English-speaking microscopists the vast number of species of Infusoria now known to science. It soon became evident that the original plan of covering the broad field occupied by Ehrenberg and Pritchard, was far too comprehensive for the present state of knowledge. A more limited group was therefore adopted, represented by the flagellate, ciliate and tentaculiferous Protozoa; and these have been elaborated with great thoroughness, much original research being incorporated along with the record of previously described forms. Questions of affinity and derivation, of interest in general biology, have been well kept in view; and an additional plate with description of the apparatus specially adapted to the study of infusorial life, will be appreciated even by experienced students. The work comprises three large octavo volumes; it is lavishly illustrated, and derives additional value from an extensive glossary, bibliography and index.

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SCIENTIFIC NEWS.

— Professor H. W. Parker, of the Iowa College, Grinnell, Ia., has issued a circular which we are sure will appeal to the generosity of every naturalist and museum in the country, who, we hope, will send duplicates to restore the ill-fated collections of that college. It will be remembered that by the tornado of June 17th, the college buildings were demolished and with them the museum. Professor Parker, the curator, is now in the East collecting specimens and money to restore the collections, and it is hoped that there will be a generous response. The department has earned a claim to help. Without a fund, and mostly by the labors of the curator, the college had accumulated one of the best collections in the West.

— A committee, of which Professor Asa Gray is chairman and Alexander Agassiz is treasurer, has been requested by the English executive committee of the Darwin Memorial to join them in obtaining subscriptions from those in America who may wish to join in this tribute to the memory of Darwin. The form which the memorial is to take has not yet been decided; it will probably include an endowment for a scholarship to carry on biological research.

Subscriptions may be sent to Alexander Agassiz, Cambridge, Mass., who will acknowledge the same and forward them to the treasurer of the English executive committee of the Darwin Memorial.

— Mr. S. A. Forbes, of Normal, Ill., the founder of the Illinois State Laboratory of Natural History, and who has added so much to our knowledge of the food and habits of our birds and fishes, has been appointed State Entomologist in place of Professor Cyrus Thomas, resigned. The appointment is a most fitting one.

— The number of fellows of the Zoölogical Society, of London, is 3213. The total receipts for 1881 amounted to £25,810, while the number of visitors in 1881 were 648,604, and the number of animals were 2294.

— The Hon. George P. Marsh, well known to many of our readers as the author of "Man and Nature," and of a government report on the camel, died in Italy, July 24th. He was born in Vermont in 1801.

— Gen. G. K. Warren, U. S. A. Engineer Corps, who died at Newport, Aug. 8th, was not only a distinguished general, but, in connection with his work published several valuable memoirs on the physical geography of the United States, particularly of the Upper Mississippi. He also commanded several important Government exploring expeditions. He was a member of the National Academy of Sciences.

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SKETCH OF THE PROGRESS OF NORTH AMERICAN ICHTHYOLOGY IN THE YEARS 1880–1881.

BY W. N. LOCKINGTON.

THE amount of ichthyological work that has been done in the United States during the years 1880 and 1881 is exceptionally large. The greater portion of this work consists of descriptions of new species and additions to our knowledge of the geographical and bathymetrical range, habits, food and other data of economic value. A considerable portion of this work is the results of the U. S. Fish Commission conjoined with the census. Upon the Atlantic coast the steamer *Fish-hawk* has been engaged in dredging in the deeper waters, and among the resulting crowd of forms new to science, have been several fishes. Upon the Pacific coast, the special commissioners sent out, although unprovided with dredging apparatus, and dependent for their specimens entirely upon the supplies obtained by fishermen, and what they could themselves collect with the simple appliances at hand, have added vastly to the number of species known, and have conclusively proved that the Pacific shores are at least as rich in animal life as the Atlantic. Great additions to the fauna of our western coast may again be looked for whenever research in the deep waters is commenced. Unexpected additions to the fresh-water fish fauna have also been made in various parts of the country, and numerous species from Lower California and the more southern parts of the west coast of Mexico have been described.

Comparatively few have, during this period, worked in systematic, anatomical and embryological ichthyology. The tempting harvest of new forms still detains many of our naturalists in the easier walks of descriptive zoölogy, and the knowledge that the work of description is far from exhausted, has a deterrent effect upon monographers.

At least 124 species hitherto unknown to science have been added to the faunal lists of our Nearctic continent during the past two years, and the probabilities are that the actual numbers exceed this, for so rapidly is the work proceeded with, and so extensive is the field, that it is not unlikely that some species have been described in advance sheets of the proceedings of societies, which have as yet not issued their completed volume, and thus have escaped the notice of the writer.

The Proceedings of the U. S. National Museum for 1880, are almost entirely occupied with ichthyological papers. The principal contributors are Professor D. S. Jordan and his coadjutor, Mr. C. H. Gilbert, Professor G. B. Goode, W. N. Lockington and Professor O. P. Hay. The two former ichthyologists have no less than thirty-seven papers, in which forty-nine new species are described, all from the Pacific coast, U. S. The total number of fishes enumerated from that coast is 270, of which all but fifteen were obtained by the writers, who during 1880 represented the U. S. Fish Commission in California. Seventeen previously known species were added to the fauna of California, principally sharks, making a total of twenty-eight species common to the Atlantic and Pacific oceans. In the preparation of this list priority of publication has been strictly regarded, and we thus regretfully witness the substitution of Scomberomorus for Cybium, of Tylosurus for Belone, and of Stolephorus for Engraulis, while the familiar quinnat or Californian salmon is exchanged for the "tshawytcha" or "chouicha." The species of Sebastichthys or rock cod, are twenty-five, fifteen of which are new. Eight species are added to the flat fishes, three to the Embiotocidæ and six to the rays, while the Paralepidæ and their relations are increased from one to five. Several nominal species are eliminated from the Lophobranchs, Gasterosteidæ and Petromyzontidæ. Among the most interesting discoveries may be mentioned that of a true sole (*Aphoristia atricauda*), a "puffer" shark (*Catulus ventriosus* Garman), three Blennidæ of the genera Xiphister and Apodichthys, a cottoid devoid of ventral fins (*Ascelichthys rhodorus*) and *Nemichthys avocetta.*

In "Notes on a collection of Fishes from Utah lake," the same writers describe three new species of fishes.

The Proc. U. S. Nat. Mus. for 1881, contains descriptions of forty new species from Mazatlan, thirty from Panama and a few others from the Gulf coast, all by the same hard-working ichthyologists.

In the same volume Mr. C. L. Mackay reviews the genera and species of Centrarchidæ, and describes a new species of Lepomis.

W. N. Lockington (Proc. U. S. Nat. Mus., 1880) describes ten new species of fishes from various parts of the Pacific coast, the most noticeable of which are *Prionotus stephanophrys*, taken near San Francisco; *Myriolepis zonifer*, a singular Chiroid, and the curious soft-boned *Icosteus ænigmaticus*, for the reception of which and his own *Icichthys lockingtoni*, Professor Jordan subsequently instituted the family Icosteidæ. In the long low dorsal and anal, as well as in the extreme flexibility of the skeleton, these species agree, but while Icosteus is scaleless, with groups of spinules along the lateral line and spinules upon the fins, Icicthys is entirely scaly and without spinules.

The same writer (Proc. Phil. Acad. Nat. Sci.) describes some new species from the Gulf of California, and a Catostomus from the Gila.

Miss Rosa Smith describes a Cremnobates and a Gobiesox from Southern California.

Dr. T. H. Bean (Proc. U. S. Nat. Mus., 1880) describes a new hake from South Carolina, and in the same volume S. Garman gives a synopsis of the American Rhinobatidæ, and Professor Jordan notices a new Caranx from S. Carolina.

S. Th. Cattie, of Arnheim, Holland, also contributes some information respecting the structure of the organ of Syrski in the male eel, and the external characters of the sexes in that fish; and Professor O. P. Hay describes fifteen new species from the eastern part of the State of Mississippi, from affluents of the Mississippi and Tombigbee, and from the Chickasawha. Eight of these species (including the new genus Opsopœodus) are Cyprinidæ, the remaining seven Etheostomatidæ.

The U. S. Coast Survey Steamer *Yukon* proceeded, in 1880, along the coast of Alaska, calling at various points to make collections. The expedition was accompanied by Dr. W. H. Dall and Dr. Tarleton H. Bean, the latter of whom made a valuable collection of fishes, of which he gives a preliminary description in the Proc. U. S. Nat. Mus., 1881. The new species enumerated are thirteen in number, without counting one taken only at Plover bay, Siberia. The most singular of these new forms is the serpentiform *Ptilichthys goodei*, allied to the Mastacembelidæ. The dorsal consists in front of many isolated spines, with a posterior, many-rayed soft portion, the mandible terminates in a skinny appendage, and the tip of the tail is free. The same naturalist, together with Professor Goode, describes *Apogon pandionis*, a deep-water fish from the mouth of the Chesapeake.

During his stay upon the Pacific coast, Professor Jordan thoroughly investigated and cleared up the mystery in which the species of the genus Oncorhynchus (Pacific salmon) had been wrapped by a crowd of naturalists who at various times had described as distinct, forms which have now been proved to be due to age, sex or season. There are only five species, the quinnat, chouicha, or king salmon, the most important of all from an economic point of view; the blue-back, or red-fish, *O. nerka*, examples of which, found high in the rivers and in the lakes, have long figured as a distinct species from their brethren of the lower waters; the silver salmon, *O. kisutch;* the fall salmon, *O. keta*, and the dog salmon, *O. gorbuscha.*

Professor S. A. Forbes[1] describes a Chologaster from the southern part of Illinois, it agrees with *C. cornutus* in position of eye and plan of markings, and with *C. agassizii* in length of pectorals and structure of scales.

Mr. S. Garman,[2] whose special studies have added so much to our knowledge of the Selachians, has, during these two years, described two new species of Scyllium, one of Rhinobatus, one of Trigonorhina, two of Trygon and two of Raja, most of them from the Atlantic coast. Seven species of Trygon proper are now known to occur in America. Mr. Garman believes that the migrations of the Selachians, as also those of fishes, which the former follow in pursuit of their food, are much more limited in extent than has usually been supposed. Many species do no more than take short trips to deeper water and back again, and were methodical observations conducted for the purpose, it would be quite possible for our knowledge of the migrations of fishes to be extended so that the fisherman could follow his game as the hunter does his.

[1] AMER. NAT., March, 1881, p. 232.

[2] Bulletin Museum Comp. Zoology, Cambridge, 1880–1881.

The same zoölogist has also described eleven species of Cyprinodontidæ, Cyprinidæ and Catostomidæ from the various parts of North America.

On the Atlantic coast the labors of the Fish Commission have added several new species to our fauna. Professor G. B. Goode (Proc. U. S. Nat. Museum, Nov., 1880) describes seven new species of fishes that were the result of a single day's work of the *Fish-hawk* at the edge of the Gulf Stream in Southern New England. In this one day 120 species of invertebrates and fishes were added to the fauna of the region south of Cape Cod. The two new Pleuronectidæ are ranged under as many new genera, and the genus Hypsiconetes is instituted for a species which is apparently gadoid, but in some respects resembles the blennioids. The same naturalist contributes to the Bulletin of the U. S. Fish Commission, 1881, an account of the habits, range and economic values of the carangoid fishes, pompanoes, crevallés, amber fish, etc., of the Atlantic coast; and also a digest of the recent literature upon the life-history of the eel. There appears to be but little doubt that the organs of Syrski are the testes, but no one has as yet observed the spermatozoa in the common eel. Mr. Goode, however, has omitted any reference to a paper in this journal (Vol. XIII, May, 1879, p. 319) by Professor A. S. Packard, Jr., and J. S. Kingsley, who were the first to discover the male eel in America, three specimens having been obtained at Wood's Holl, while Mr. Kingsley claims to have seen the spermatozoa.

Dr. Theodore Gill, in his review of Dr. Günther's Introduction to the study of Fishes, severely criticises the latter's definition of a fish, and also the bibliography. The treatise is valuable from the thorough acquaintance with both external and internal characters which it displays.

Dr. Franz Steindachner (*Ichthyologische Beitrage* IX, Sitz. kais. Akad. Wiss., Wien, July, 1880), describes two species of Agonus from California, which have been shown to be identical with two species of Brachyopsis *(Agonus pars)* described a short time before by Lockington and Jordan respectively. The description is accompanied by figures. In No. XI of the same series (1881), Dr. Steindachner describes *Trichodon japonicus*, which ranges from Japan to Sitka.

Mr. Henry J. Rice (AMER. NAT., Jan., 1880) contributes a valuable article upon tbe habits, structure and development of *Am-*

phioxus lanceolatus, as observed by him in three adults taken at Fort Wool in twelve to fifteen fathoms of water, and in twenty young secured by surface dredging. The lancelet swims with a graceful, undulating motion, and can disappear from sight beneath the sand almost instantaneously. It swims indifferently upon back or belly, and when excited is able to dart about with extreme rapidity. The writer believes the ova to issue from the branchiopore, and states that it is questionable whether the anterior pigment-spot of the spinal cord is of any more value than any of the other pigment-spots of the nervous system.

The question, "Do flying fish fly?" is answered in the affirmative by C. O. Whitman, who declares that during a voyage from San Francisco to Yokohama, he several times distinctly saw the individual flaps of the large pectorals, while the ventrals were held in quiet expansion. The longest flight observed lasted forty seconds, and was certainly over eight hundred feet.

The principal, almost the only contributor to the embryological knowledge of fishes, has been the indefatigable J. A. Ryder, of the Fish Commission. In the course of his investigations during the past year, he has elucidated many points in the developmental history of the shad, cod, salmon, top-minnow, stickleback, sea-horse, garfish and other fishes. The range of his observations has, in fact, been sufficiently extensive to warrant him in arriving at certain general conclusions, some of which contravene those of previous observers. When it is remembered that the only material at the command of most biologists who have worked upon the eggs and embryos of fishes, has been preserved in spirits for more or less time, while Professor Ryder has all along been supplied with fresh material in large quantity through the Fish Commission, it will be evident that his conclusions are entitled to great weight. He finds that in the Teleostean fishes and in sturgeons, the segmentation-cavity is not obliterated, but gradually thins out and grows around the yelk between the epiblast and hypoblast, forming a paravitelline space which persists for at least two weeks after the embryo leaves the egg. Around the edge of the blastoderm a thickened rim or annulus is developed in both the types above mentioned, and limits the paravitelline cavity. The cleavage of the germ disk is regular, but the embryo agrees with that of the Selachians in developing at the edge of the disk, instead of in the center as is the case in birds and reptiles. A vesicle appears at the tail end of the embryo when the blastoderm has rather more than half surrounded the vitellus, and this vesicle is almost certainly the result of the invagination of the gastrula mouth or blastopore. From this vesicle, known as Kupffer's vesicle, a canal proceeds forwards and opens on the dorsal face of the embryo. The gastrula of teleostean fishes is thus the result of an invagination at the tail, essentially as in Amphioxus, and is not homologous with the gastrula of Haeckel.

The pectoral fins originate from lateral folds, and their first skeletal elements are a pair of cartilaginous rods which are not placed radially, but are concentric with the base of the fin. These folds vary in their position, but are placed so far back that their genetic relation to the gill-arches appears improbable. The position of the fin becomes more anterior with the growth of the embryo, and in the cod the base rotates through an angle of nearly 90° to gain its upright position. The shoulder girdle is of mesoblastic origin.

The median unpaired fins originate from a dorsal and ventral natatory fold, which may be continuous, discontinuous from the very first (Hippocampus), or discontinuous at an early stage. The vent of the young fish appears long before the mouth; the intestine develops from behind forward, and it is probable the intestine and medullary canal are primitively continuous by means of a neurenteric canal.

The investigations of Professor Ryder show wide differences in the order and manner of development of the various organs; differences of a nature to show that embryology alone is a most unsafe basis for classification.

In the four-spined stickleback the cerebral vesicles are extraordinarily large and the walls of the brain cavity very thin; the optic cups have a great space between the floor of the cup and the lens; the pectoral folds originate unusually near to the gill-arches, and when the young fish leaves the egg, are as much developed as in a mackerel four days old; and there is an asymmetrical vitelline system of blood-channels. The corpuscles appear to originate by budding off from knobbed cells of the hypoblast of the venous sinus.

The nest-constructing habits of the sticklebacks have long ago been noticed, but from the observations of Mr. Seal and Professor Ryder, it is now known that the male possesses a special spinning gland on the right side of the intestine, and that the stalks of water weeds and other objects of which the nest is constructed, are bound together by compound threads of six or eight fibers spun by him in a fitful way as the material is secreted.

The egg-membranes of floating fish ova, as those of *Cybium maculatum*, are extremely thin, and pierced only by the micropyle, not perforated by pore canals as is the case with ova, which like those of the stickleback, salmon and shad, sink to the bottom. The ova of *C. maculatum*, the Spanish mackerel, are hatched in twenty-four hours after fertilization, and the young are then in a very rudimentary state.

The gills of the so-called Lophobranchiates are not really tufted, but the two series of vascular branchial appendages to each arch in Hippocampus are homologous to the bifurcated vascular branchial appendages of a salmon or other fish. But these appendages are much reduced in number, and, as if to compensate for this, the area of the ultimate branchial lamellæ or pinnæ ranged upon them is extended, and these leaflets increase in size outwards, producing a tufted appearance. In all Lophobranchs the branchial arches are reduced, the opercle is a simple plate, the mouth is toothless, and the opercular membrane persistently roofs over the gill chambers of the embryos.

Experiments upon the retardation of the development of the ova of the shad, with the end of ascertaining the possibility of transporting them alive for long distances, were not successful on account of the development of fungus, but in four and a half days the ova at a temperature of 52° F., had not advanced farther than they would have done in water at 80° in twenty-four hours.

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METHODS OF MICROSCOPICAL RESEARCH IN THE ZOOLOGICAL STATION IN NAPLES.

BY C. O. WHITMAN.

(Continued from September number.)

II. Staining Methods.

It has gradually become a settled custom in the Zoölogical Station, to mount microscopical preparations in balsam wherever this can be successfully done; and to avoid, as much as possible, the use of aqueous media, both in mounting and staining. The disadvantages often arising from the use of these media in staining alcoholic preparations, such as the tearing asunder of fragile tissues caused by the violent osmosis; swelling, the effects of which cannot always be fully obliterated by again transferring to alcohol, and maceration, which is liable to result where objects are left for a considerable time in the staining liquid, may all be avoided by using alcoholic solutions. Objects once successfully hardened may be left in such solutions for any required time, and when sufficiently stained, be washed in alcohol of a corresponding strength, and then passed through the higher grades without being exposed to water from first to last. As a rule, alcoholic dyes work quickly, and give far more satisfactory results than can be obtained with other media. They penetrate objects more readily, and thus give a more uniform coloring where objects are immersed in toto. Even chitinous envelopes are seldom able to prevent the action of these fluids.

It is not, however, to be denied that non-alcoholic dyes may often do excellent work, and in certain cases, even better than can be otherwise obtained. In the case of the Turbellaria, Dr. Lang has found picro-carmine to be one of the best staining agents, and this has been my experience with Dicyemidæ. As Dr. Mayer has remarked, the swelling caused by aqueous staining fluids is not always an evil, but precisely what is required by some objects after particular methods of treatment.

From experiments recently made, Dr. Mayer has found that dyes containing a high percentage of alcohol, stain more diffusely than those of weaker grades, from which he infers that strong alcohol robs, to a certain extent, the tissues of their selective power, and renders them more or less equally receptive of coloring matter.

1. *Kleinenberg's Hæmatoxylin.*[1]—1. To a saturated solution of chloride of calcium[2] in 70 per cent. alcohol, add a little alum and filter.

2. One volume of No. 1 mixed with six to eight volumes of 70 per cent. alcohol.

3. At time of using pour into No. 2 as many drops of a con-

[1] May be used after all hardening fluids.

[2] Chloride of calcium, according to Kleinenberg, has no other use than to strengthen the osmotic action between the hæmatoxylin solution and the alcohol contained in the tissues. As chloride of calcium and alum give a precipitate of gypsum, it would probably be better to use *chloride of aluminum.*

centrated solution of crystallized hæmatoxylin in absolute alcohol as suffice to give the required depth of color.[1]

If the color appears too strong, the fluid may be diluted with solution No. 1.

Before immersing objects in this fluid, great care should be taken to free them from the least trace of acid by frequently changing the alcohol. If this is not done thoroughly, the acid left in the preparation will sooner or later cause the color to fade; and such results have led to the erroneous conclusion that hæmatoxylin will not give durable preparations. Dr. Mayer has found that the fading is entirely due to the presence of acid, and that with proper precautions the staining is permanent.

Small objects are best stained in a weak solution, which colors more slowly but with greater clearness than stronger solutions. After staining, Kleinenberg transfers objects to 90 per cent. alcohol. In case of over staining, the color may be partly removed by adding a little *oxalic acid* or *hydrochloric acid* (½ per cent. or less) to the alcohol containing the objects. The acidulated alcohol is allowed to work until the color is slightly reddened. On transferring to pure alcohol the color passes again into a permanent blue-violet.

2. *Mayer's cochineal tincture.*—1 gramme powdered cochineal soaked in 8–10 ccm. 70 per cent. alcohol for several days, then filtered.

The clear deep red fluid thus prepared may, like hæmatoxylin, be used in all cases where it is desirable to stain with an alcoholic solution, and will be found particularly useful for objects that are not easily penetrated by the ordinary aqueous solutions of carmine, such as the Arthropods.

It is necessary, before immersing larger objects in this fluid, to leave them a short time in 70 per cent. alcohol, otherwise there may be a precipitate. The time required for staining, will vary fro n a few minutes to even days, according to the nature and size of the object. With larger objects requiring considerable time,

[1] A good solution should be violet inclining a little to blue. The red tinge that arises after the fluid has stood for some time, indicates that it has become slightly acid, in which condition it is unfit for use. To restore its proper color, it is only necessary to open a bottle of ammonia over the mouth of the bottle holding the hæmatoxylin in such a manner that a very small quantity of the gas will mix with the fluid. If too much ammonia gas be added, a precipitate is produced which spoils the fluid.

it is important to use a large quantity of the fluid, otherwise the amount of coloring stuff in solution might not suffice to give the proper depth of color. Small and delicate objects, on the other hand, may be most successfully treated with a solution which has been diluted with 70 per cent. alcohol, or one which has been weakened by previous use. It is always necessary to free the tissues, after staining, from the surplus dye; and this may be done by washing in 70 per cent. alcohol, which must be changed until it shows no color. This process requires, for larger objects, considerable time and alcohol, but may be hastened by using the alcohol slightly warm.

The color ultimately assumed by objects treated with cochineal tincture varies much, and depends partly on the reaction of the tissues themselves, partly on the presence or absence of certain salts. It is certainly one of the best recommendations of this staining agent that, varying with the nature of the object and its mode of treatment both before and after staining, it gives such an extraordinary diversity of results. On account of the great variety of substances contained in the dried dye-stuff, it is evident that the composition of the tincture must vary according to the strength of the alcohol employed as a solvent. Solutions in 90 per. cent. or 100 per cent. alcohol have a light red color, and stain too diffusely to have any practical value. The weaker the alcohol the stronger the tincture, and the stronger the alcohol the more easily it penetrates objects; the grade of alcohol may therefore be selected with reference to two points, depth of color and readiness of penetration; 70 per cent. or 60 per cent. is recommended by Dr. Mayer as combining both these qualities in a very favorable degree. It is important to remember that whatever be the strength of the solution, a precipitate will always be produced if an alcohol of a different grade, whether higher or lower, be mixed with it. It is evident then that a tincture of any given strength contains substances that are insoluble in any other grade of alcohol, and this explains why superfluous coloring matter can only be removed from objects by the aid of alcohol of precisely the same degree as that of the tincture.

Over staining, which seldom occurs, may be easily corrected by the aid of acid alcohol ($\frac{1}{10}$ per cent. hydrochloric acid, or 1 per cent. acetic acid). Acid makes the tincture lighter, more yellowish-red, while the addition of ammonia and other caustic alkalies changes it to deep purple. Still more important is the fact that salts soluble in alcohol give a blue-gray, green-gray or blue-black precipitate. For example, if a piece of cloth that has been dyed in cochineal and washed, be treated with an alcoholic solution of a ferric or a calcic salt, it will assume a more or less deep blue color.

As the salts present in the living organism are seldom, if ever, fully removed by preservative fluids, but in some cases even increased, it will often happen that an object, though stained in the red fluid, comes out blue, precisely as when stained with hæmatoxylin. Such a result cannot, however, be obtained in the presence of acids, nor in the absence of inorganic salts; under these conditions the color is always red. It is not possible, therefore, to know what color an object will ultimately present.

Very often the different tissues of one and the same object present unlike colors. In the embryos of Lumbricus, Kleinenberg found the walls of the blood vessels red, their contents dark blue. Glandular tissues, or their contents, are frequently stained gray-green.

Objects treated with chromic or picric solutions, or with alcohol, usually stain without difficulty; but osmic acid preparations should be bleached before staining. Cochineal does not color so intensely as hæmatoxylin, and hence the latter often gives more satisfactory results in the case of large objects stained in toto.

As before pointed out, alcohol causes the salts contained in sea water to be precipitated, thus forming a crust on the exterior of the animal which interferes with the staining process. It is therefore necessary to treat marine animals that have been preserved in strong alcohol, with acid alcohol (1–10 parts hydrochloric acid to 1000 parts 70 per cent. alcohol), and then carefully wash in pure 70 per cent. alcohol before staining with cochineal.

3. Picro-carmine.—A very excellent picro-carmine is prepared by Dr. Mayer in the following manner:

To a mixture of powdered carmine (2 g.) with water (25 ccm.), while heating over a water bath, add sufficient ammonia to dissolve the carmine. The solution may then be left open for a few weeks (Mayer) in order that the ammonia may evaporate; or the evaporation may be accelerated by heating (Hoyer). So long as any ammonia remains, large bubbles will form while boiling, but as soon as the free ammonia has been expelled, the bubbles will be small and the color of the fluid begin to be a little lighter. It is then allowed to cool, and filtered. To the filtered solution is added a concentrated aqueous solution of picric acid (about four volumes of the acid to one of the carmine solution).[1]

In order to protect this fluid against changes attributed to Bacteria by Hoyer,[2] Dr. Mayer places a small crystal of *thymol* in the containing bottle; Professor Hoyer uses *chloral-hydrate* (1 per cent. or more) for the same purpose.

4. *Acetic Acid Carmine.*[3]—Pulverized carmine added to a small quantity of boiling acetic acid (45 per cent.) until no more will dissolve; filtered and diluted to about 1 per cent. for use.

Flemming used the concentrated solution.

5. *Grenacher's Carmine Solutions.*[4]—(1) *Alum Carmine.*—An aqueous solution of alum (1–5 per cent., or any degree of concentration) boiled with ½–1 per cent. powdered carmine for 10–20 minutes; allowed to cool, then filtered.

With the addition of a little carbolic acid the fluid will keep for years. It colors quickly, and nuclei more strongly than other parts. Objects washed in water after staining.

(2) *Acid Borax Carmine.—a.* An aqueous solution of *borax* (1–2 per cent.) and *carmine* (½–¾ per cent.) heated till the carmine is dissolved.

b. Acetic acid added by drops to solution *a*, while shaking, until the color is about the same as that of Beale's carmine.

c. Solution *b* left standing twenty-four hours, then turned off and filtered.

This solution, which is a modification of Schweigger–Seidel's acid carmine, is not recommended for coloring in toto. It colors sections in ½–3 minutes diffusely, and hence, after washing in water, they are placed for a few minutes in alcohol (50 or 70 per cent.) to which a drop of hydrochloric acid has been added; then transferred to pure alcohol.

[1] The addition of the acid should cease before a precipitate begins to form.

[2] Hoyer. "Beiträge z. histolog. Technik." In Biolog. Centralblatt, B. II, p. 17–19.

[3] Schneider. Zool. Anzeiger, No. 56, p. 254, 1880.

[4] Grenacher. "Einige Notizen z. Tinctionstechnik." Arch. f. Mik. Anat., Vol. XVI, p. 463, 1879.

None of these solutions to be used where calcareous parts are to be preserved.

(3) *Borax Carmine.*[1]—*a.* An aqueous solution of *borax* (4 per cent.) and *carmine*, heated till the carmine is dissolved.

b. Solution *a* mixed with 70 per cent. alcohol in equal parts, left standing twenty-four hours and filtered.

This fluid may be used for coloring objects in toto. After staining, the objects are to be washed in 35 per cent. alcohol, to which a little hydrochloric acid has been added (4–6 drops to 100 ccm.), and allowed to remain here until the color has been sufficiently removed. They are next passed through successively higher grades of alcohol for hardening.

(4) *Alcohol Carmine.*—A teaspoonful of carmine dissolved, by heating about ten minutes, in 50 ccm. of 60–80 per cent. alcohol, to which 3–4 drops of hydrochloric acid have been added, then filtered.

Objects colored in this fluid should not be washed in water, but in alcohol of a grade corresponding to that of the solution.

For diluting alcoholic solutions of carmine, alcohol of the same strength must always be used.

6. *Aniline Dyes.*—As a rule, aniline colors and the many others obtained recently from tar by chemical processes, can not be used for staining objects in toto, and are therefore not much employed in the Zoölogical Station. In very small objects and sections already cut, very excellent results can be obtained by the methods developed by Böttcher,[2] Hermann,[3] Flemming[4] and others; for here diffuse staining may generally be avoided by first overstaining and then withdrawing the color to any desired extent by means of alcohol. But to obtain satisfactory results, the sections must be thin enough to allow uniformity of action both to the coloring and the decoloring agent. It is evident that the process cannot be similarly controlled in larger objects, particularly where a dye is used, which, like most of those under consideration, is quickly extracted by alcohol, for in this case the color would be removed from the superficial layers more rapidly than from the deeper

[1] Dr. Mayer prepares, for some purposes, borax carmine of 50, 60 or 70 per cent. That of 70 per cent. contains little carmine, but is well adapted to staining delicate objects that would suffer if exposed to weaker solutions. Boiling alcohol (50 per cent. or 60 per cent.) dissolves about 1 per cent carmine and 1 per cent. borax.

[2] Bottcher. *Mul. Archiv.*, 1869, p. 373. Virchow's Archiv., Bd. XL, p. 302.

[3] Hermann. Communicated to the Naturforscherversammlung in Graz, 1875. Tagblatt, p. 105,

[4] Flemming. Archiv. f. Mikr. Anat., Bd. XIII, p. 702, Bd. XVI, p. 302, Bd. XVIII, p. 151, Bd. XIX, p. 317, and p. 742, B. XX, p. 1.

ones, so that a uniform precision of color would be impossible. In this respect,

a. Bismarck-brown forms an exception. The preparation of this dye, introduced by Weigert,[1] is extremely simple:

A saturated solution is made by dissolving the powder in boiling water or weak alcohol, or, according to Mayer, in 70 per cent. alcohol.[2] The solution should be used undiluted, and requires to be filtered from time to time. It colors very quickly objects hardened in alcohol or chromic acid.

b. Safranin.—1 part *safranin* dissolved in 100 parts of *absolute alcohol;* after a few days 200 parts of *distilled water* is added.

Dr. Pfitzner,[3] from whom the above formula is taken, recommends this solution as one of the best for staining nuclei. It is cheap, easily prepared, acts quickly and stains *only* the nuclei. It works best with chromic acid preparations, from which the acid has been removed as much as possible.

7. *Flemming's methods of treating Nuclei.*—The method employed by Böttcher and Hermann of *over staining* objects with aniline dyes, and then removing the color to any desired extent by the aid of alcohol, formed the starting point of the methods recently published by Flemming. The following is a summary of the more important conclusions reached by Flemming:[4]

A. For Nuclei in general.—1. Objects hardened in *chromic acid* (1-10 per cent. to ½ per cent.).

The time will vary according to the nature of the object.

2. Carefully washed in distilled water.

3. Stained directly, or further hardened in weak and then strong alcohol.

Safranin, Magdala red (rose de naphthaline) and *dahlia* (monophenylrosanilin) give the best staining. Safranin prepared as given above; magdala in the same way; dahlia best dissolved in water, or acetic acid.

Only very small objects, or thin sections, can be successfully stained, and these should be left in the fluid 12–24 hours.

4. Objects transferred to weak alcohol (70 per cent.) and shaken for a few moments; then placed in absolute alcohol for half a minute or longer—till no visible clouds of color appear. The process of decoloring is now completed and the objects must be

[1] Wiegert. Arch. f. Mik. Anat., Bd. XV, p. 258, 1878.

[2] According to Flemming, may also be dissolved in dilute acetic acid.

[3] Pfitzner. Morph. Jahrb., VI, pp. 478–80 and VII, p. 291.

[4] Flemming. Archiv. f. Mik. Anat., Vol. XIX, p. 321.

at once removed from the alcohol, otherwise the color will be too much weakened. If it be required to examine the objects before mounting, they may be removed to distilled water, in which the color of the nuclei will remain unchanged for a considerable time. They must then pass through alcohol again before mounting.

5. Clarified in clove oil and mounted in *dammar-lac.*[1]

Clove oil withdraws the color a little, and hence it must not be allowed to work too long. Creosote extracts the color still more rapidly than clove oil.

B. Eggs of Echinoderms.[2]—In his recent researches on karyokinesis, Flemming states (p. 5) that he obtained serviceable staining of nuclei in the following ways :

1. *Living eggs colored on the slide,* either with *safranin* or *aniline dyes*, followed by acetic acid (1 per cent.) which is allowed to flow under the cover and thus replace the staining medium, or with

Acetic acid carmine (after Schneider), used undiluted. The last mentioned staining agent causes swelling, but still gives the typical features of the karyokinetic figures.

2. Eggs first hardened in strong nitric acid (40–50 to aq. dest. 60–50), then washed in distilled water until the yellowish color, due to the presence of the acid, disappears. Colored with acetic acid carmine.

III. Methods of Dissecting.

For the dissection of single organs, fresh animals are generally placed in dilute alcohol, or a weak chromic solution. But the tissues are liable to suffer from maceration in these fluids, and hence, where it is important that the tissues should be well preserved, it is advisable to use picro-sulphuric acid, regardless of the injurious effects of the same on the dissecting instruments. The hardening capacity of the picro-sulphuric acid is extremely slight, but may be strengthened by the addition of chromic acid. Preparations thus obtained, and subsequently treated with alcohol, staining fluids, &c., should be transferred to creosote for further dissection, as the transparency induced by this medium will greatly facilitate the work.

IV. Imbedding.

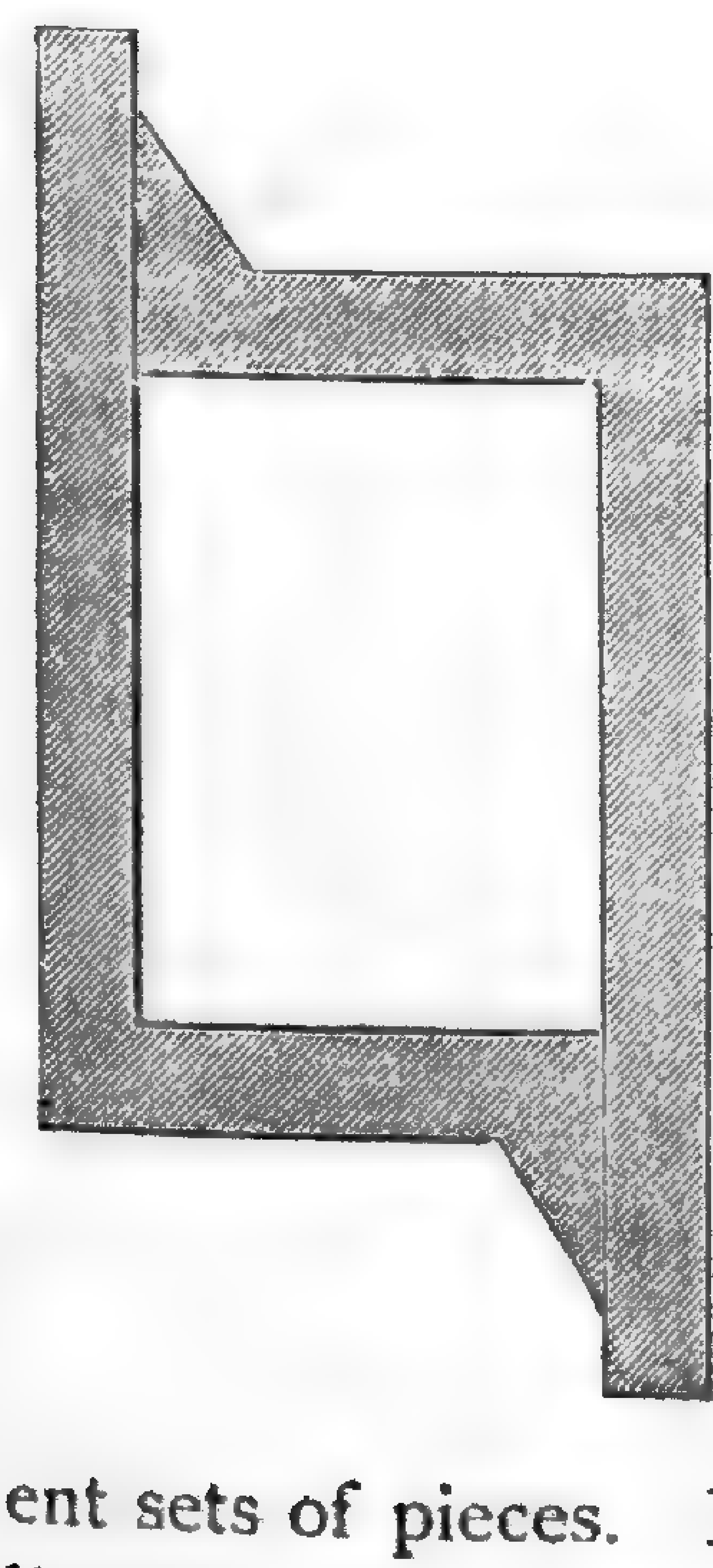
For section cutting, objects are usually imbedded in paraffine. By low temperature, as in winter, it is necessary to work with a softer paraffine than is required for summer. Instead of soften-

[1] Probably balsam dissolved in chloroform would answer the same purpose.

[2] Flemming. " Beitrage zur Kenntniss der Zelle und ihrer Lebenserscheinungen." Arch. Mik. Anat., Vol. xx, p. 1, 1881.

ing by an admixture of lard, as generally done, it is better to use a paraffine which becomes soft in summer, on account of its containing liquid hydrocarbons.

Preparatory to imbedding, the objects are removed from absolute alcohol[1] to creosote, clove oil or chloroform, and left until they become thoroughly saturated. The penetration of the clarifying fluid may, in some cases, be advantageously hastened by warming a little. They are next placed in soft paraffine, heated to about 50° C. over a water bath, and allowed to remain for an hour or so. The soft paraffine is then turned off and replaced by a mixture of hard and soft paraffine,[2] heated to about 50° C. After remaining for half an hour or less in the harder paraffine, kept at a steady temperature, they are ready for imbedding. For this purpose a small paper box may be used; or, much better, a box made of two pieces of type-metal, as used in Professor



Leuckart's laboratory. As will be seen from the accompanying diagram, each piece of metal has the form of a carpenter's square, with the end of the shorter arm triangularly enlarged outward. A convenient size will be found in pieces measuring 7 (long arm) by 3^{cm} (short arm), and 7^{mm} high. With such pieces a box may be constructed at any moment by simply placing them together on a round plate of glass, which has previously been wet with glycerine and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces. In such a box the paraffine may be kept in a liquid state by warming now and then over a spirit lamp, and small objects be placed in any desired position under the microscope.

It is well to imbed in a thin layer of paraffine, so that the object, after cooling, may be cut out in small cubical blocks, which

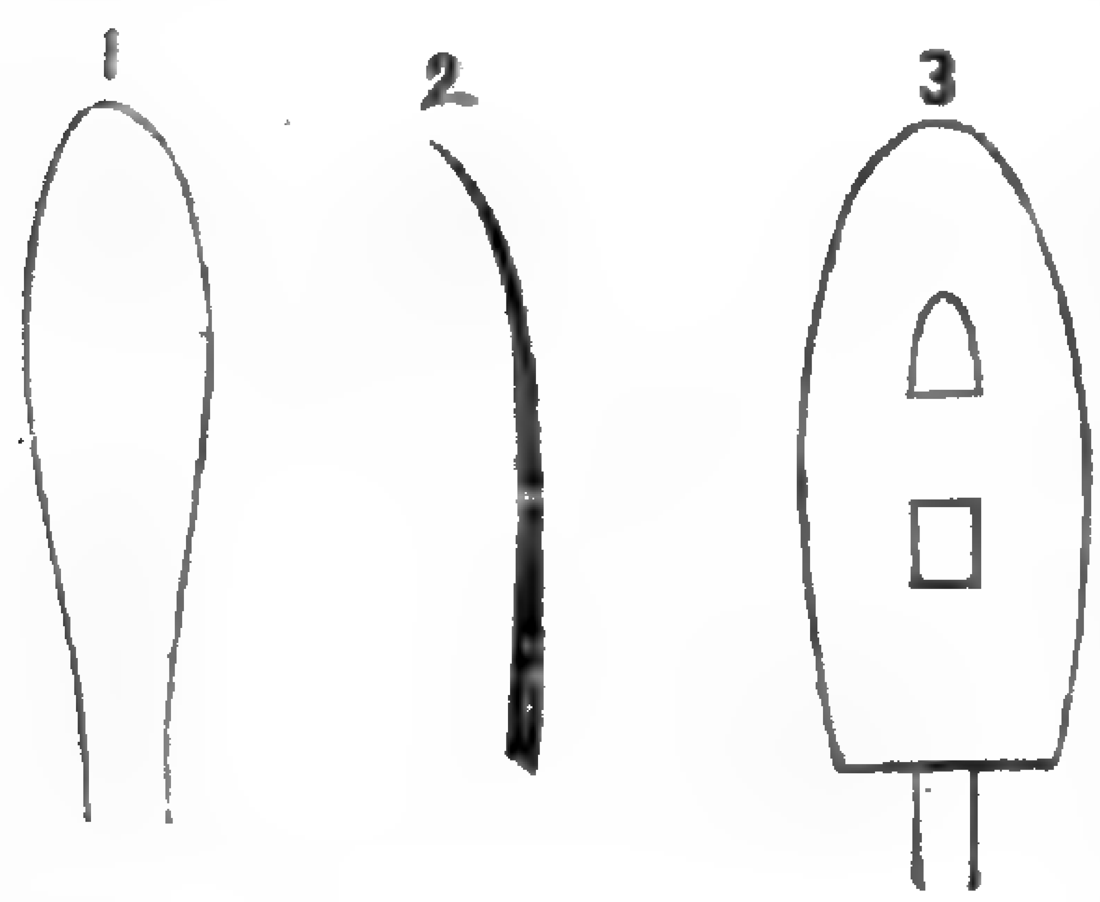
[1] In many cases a lower grade of alcohol will suffice.

[2] The ratio of combination must be determined by experiment, since it will depend on the quality of the paraffine and the temperature. Two parts of hard to one of soft, work very well for the winter temperature of Naples.

may be easily fixed, for cutting, to a larger block of hard paraffine.

V. Cutting.

Objects are cut dry with a microtome,[1] and the rolling of the sections may be prevented by holding a thin narrow spatula over the edge of the knife while cutting. The spatula may be made of brass, in the form of Fig. 1; of paper fastened to a flattened needle as indicated in Fig. 3. The spatula should be bent slightly (Fig. 2), and its convex face held over the paraffine without pressure. A small brush, slightly flattened, is used for the same purpose in Leipsic.



VI. Giesbrecht's Methods.

(1) *Transferring from Alcohol to a solvent of Paraffine.*[2]—To avoid shrinkage in transferring tender objects from alcohol to chloroform or an oil, pour a little absolute alcohol into a small glass tube, place the canular end of a pipette containing the solvent below the surface of the alcohol, and allow a few drops to flow from it to the bottom of the tube; into this tube let fall, by the aid of another pipette, or a small spatula, a few drops of absolute alcohol containing the objects to be imbedded. The objects will sink through the alcohol, which, being the lighter fluid, has taken a superjacent position, and rest on the upper surface of the fluid expelled from the first pipette. Most of the alcohol may now be removed by a pipette, and the objects left to sink gradually into the heavier fluid at the bottom of the tube. In this way the replacement of the alcohol contained in the objects by an oil, or some solvent of paraffine, is much retarded, and thus the danger from shrinkage reduced to a minimum.

Where chloroform is preferred to creosote or oil of cloves, a little ether (æther sulfuricus C_4H_5O) should be added, as many objects will not sink in pure chloroform.

To replace alcohol by a solvent of paraffine, and then by par-

[1] An improved form of Thoma's microtome is made by Rudolph Yung, Heidelberg, Hauptstrasse 15. The carrier is moved by a micrometer screw, and the holder can be adjusted in any desired position. A full description of the instrument with all the recent improvements will soon be given by Dr. Mayer.

[2] Giesbrecht. "Zur Schneide-Technik," in Zoolog. Anzeiger, 1881, No. 92.

affine itself, is an operation which may, in many cases, be readily accomplished by employing any one of the ordinary intermedia, such as oil of cloves, bergamot oil, creosote, turpentine, chloroform, &c. But with tender objects, particularly those with larger or smaller internal cavities, the process is often attended with great difficulties, and in such cases collapse and shriveling can only be avoided by giving the most careful attention to every step in the process.

Dr. Giesbrecht recommends, for difficult cases, chloroform,[1] as it is one of the best, and at the same time the most volatile solvent of paraffine.

(2) *Transferring from Chloroform to Paraffine.* — After the objects have become thoroughly saturated with chloroform, the containing tube is placed on a water bath and heated to about 50° C.—the melting point of paraffine; then a small piece of paraffine is added and allowed to dissolve, and this is repeated until bubbles cease to rise from the objects. To make sure that the chloroform has been fully expelled, the objects may next be transferred to pure paraffine and left for a few minutes before imbedding.[2]

(3) *Shellac as an aid in Mounting.*—The use of *shellac* for fixing sections on the slide, introduced by Dr. Giesbrecht,[3] is a very valuable addition to histological methods. By this method hundreds of small sections may be arranged in serial order, and all inclosed in balsam under the same cover without danger of disarrangement. The method is further extremely useful in mounting larger sections, particularly those composed of loose parts, or parts liable to swim apart.

[1] Bütschli (Biolog. Centralblatt, B. I, p. 591) has also recommended chloroform, entirely overlooking, as it would seem, Dr. Giesbrecht's prior publication.

[2] For the Hydrozoa, Professor Weismann prefers turpentine to chloroform, as where the latter has been used, the paraffine is liable to be more or less spongy in consequence of bubbles lodged in the tissues.

Turpentine renders objects brittle, and on this account chloroform will, in many cases give better results. The spongy state of the paraffine results from the fact that the chloroform has not been allowed to wholly escape.

In the case of the Actiniæ, Dr. Andres employs a mixture of turpentine, creosote and alcohol, using successively mixtures containing more turpentine and less alcohol, thus:

	Mixture No. 1.	No. 2.	No. 3.	No. 4.	
Turpentine	1	2½	4½	7½	parts.
Creosote	2	2½	2½	2½	"
Alcohol (absolute)	7	5	3	0	"

[3] Giesbrecht. "Methode zur Anfertigung von Serien-Praparaten," in Mittheilungen a. d. Zoolog. Station zu Neapel, 1881, p. 184.

The shellac is prepared and used in the following manner: One part of bleached shellac[1] mixed with ten parts absolute alcohol, and filtered. The object glass is first warmed to about 50° C.,[2] and then a thin film of the shellac is laid on by a glass rod drawn once over its surface. Before using, the slide is again warmed, and the shellac surface washed with oil of cloves for the purpose of softening it. The wash is made with a small brush drawn back and forth until the entire surface has been moderately but evenly wet with the oil. Sections are now cut and arranged for the first cover; this done, the slide is warmed over a spirit lamp so that the paraffine adhering to the sections melts and flows together, forming an even layer which cools almost instantly, and thus secures the position of the sections while those of the second cover are prepared. The sections for the last cover having been completed, the slide is warmed for ten minutes on a water bath, in order that the sections may sink into the shellac and become fixed, and the clove oil evaporate. After allowing the slide to cool the process is concluded by washing away the paraffine with turpentine, and inclosing in balsam dissolved in chloroform.[3]

[1] Dr. Mark informs me that he uses "the bleached shellac in the form in which it is prepared for artists as a '*fixative*' for charcoal pictures. It is perfectly transparent, and a film of it cannot be detected unless the surface is scratched." Dr. Mark attaches a small label to the corner of the slide, which serves for the number of the slide and the order of the sections, and at the same time marks the shellac side (otherwise not distinguishable).

[2] The same temperature is used throughout the operation.

[3] Since the above was written, my attention has been called to the following mode of fixing sections, first described by Dr. Gaule (Archiv. f. Anat. u. Phys., 1881, Phys. Abthlg., p. 156):

1. Sections cut dry and placed on the slide in the order and position in which they are to be mounted.

2. They are then smoothed out by the aid of a fine brush wet in 50–60 per cent. alcohol, until all wrinkles are removed and every part is in close contact with the slide.

3. Slide allowed to stand several hours (or over night) until the alcohol has completely evaporated, and the sections are left adhering quite firmly to the glass. The process may be hastened by gently warming to 45°–50° C.

4. The paraffine may be removed by any of the solvents in common use, but Dr. Gaule recommends Xylol. A few drops are allowed to flow over the sections, and after a few moments the paraffine is fully dissolved.

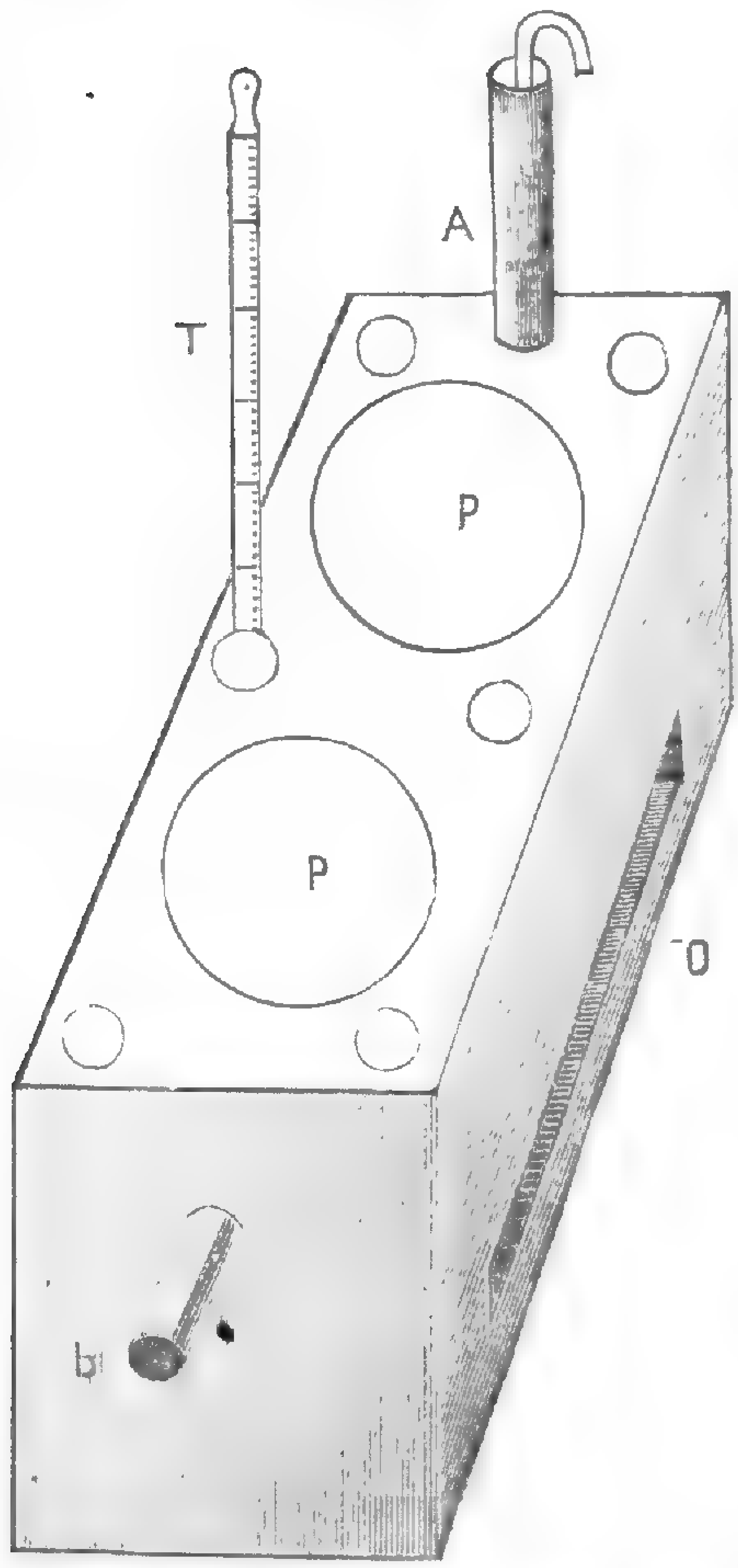
5. The balsam (a mixture of balsam and xylol in equal parts) is placed on the cover-glass, and this allowed to sink slowly, from one side, over the sections.

Dr. Gaule finds it convenient, especially with serial sections, to use large cover-glasses—often nearly as large as the slide itself. Thus a single slide may often contain a large number of sections closely arranged under one cover.

For large sections this method offers one important advantage over that of Dr. Giesbrecht; for by the former all wrinkles may be removed, while by the latter the sections must lie as they fall. In the case of smaller sections, not liable to get wrinkled during the placing, I prefer the shellac method.

Water Bath.

The diagram represents a convenient form of water bath, devised by Dr. Mayer.



It is a small brass box 18^{cm} long, 9^{cm} wide and 8^{cm} high. The tube *a*, through which the water is received, and the rod *b* serve as handles. The receiving tube is closed by a cork provided with a glass tube for the escape of steam, which is bent in the form of a siphon to protect against dust. One and a-half centimeters from the base of the box is an oven (*o*) $.7^{cm}$ high, and 12^{cm} long, which passes completely through the box, and serves for warming the slides when shellac is used. Above are seen two circular basin-like pits (*p*) 5.5^{cm} in diam., and 4^{cm} deep, for receiving the two tin paraffine holders. These are covered by circular plates of glass. There are also six tubular pits, one for a thermometer (*t*), the others for glass tubes.

This water bath will be found useful for other purposes than those of imbedding and mounting. It will of course be understood that the purpose in giving its exact dimensions is simply to furnish a guide where one is required. There are at least two important advantages offered by this water bath over those in general use, viz., the slides are protected from dust, and the paraffine is not exposed to the water.

———:o:———

ON THE HOMOLOGIES OF THE CRUSTACEAN LIMB.

BY A. S. PACKARD, JR.

THE following observations are reprinted from an essay on North American Phyllopod Crustacea, contributed to the forthcoming Twelfth Annual Report of the U. S. Geological and Geographical Survey of the Territories, F. V. Hayden in charge. I am indebted to Dr. Hayden's kindness for the use of the illustrations—Messrs. Sinclair & Son having, at their own expense, kindly struck off an edition of the accompanying plates from the drawings on stone made by them for the Survey.

The reader is supposed to have a general knowledge of Crustacea, especially the Phyllopods, a brief account of which may be found in the author's Zoölogy, where the genera here referred to are figured. As to the anatomy of these interesting Crusta-

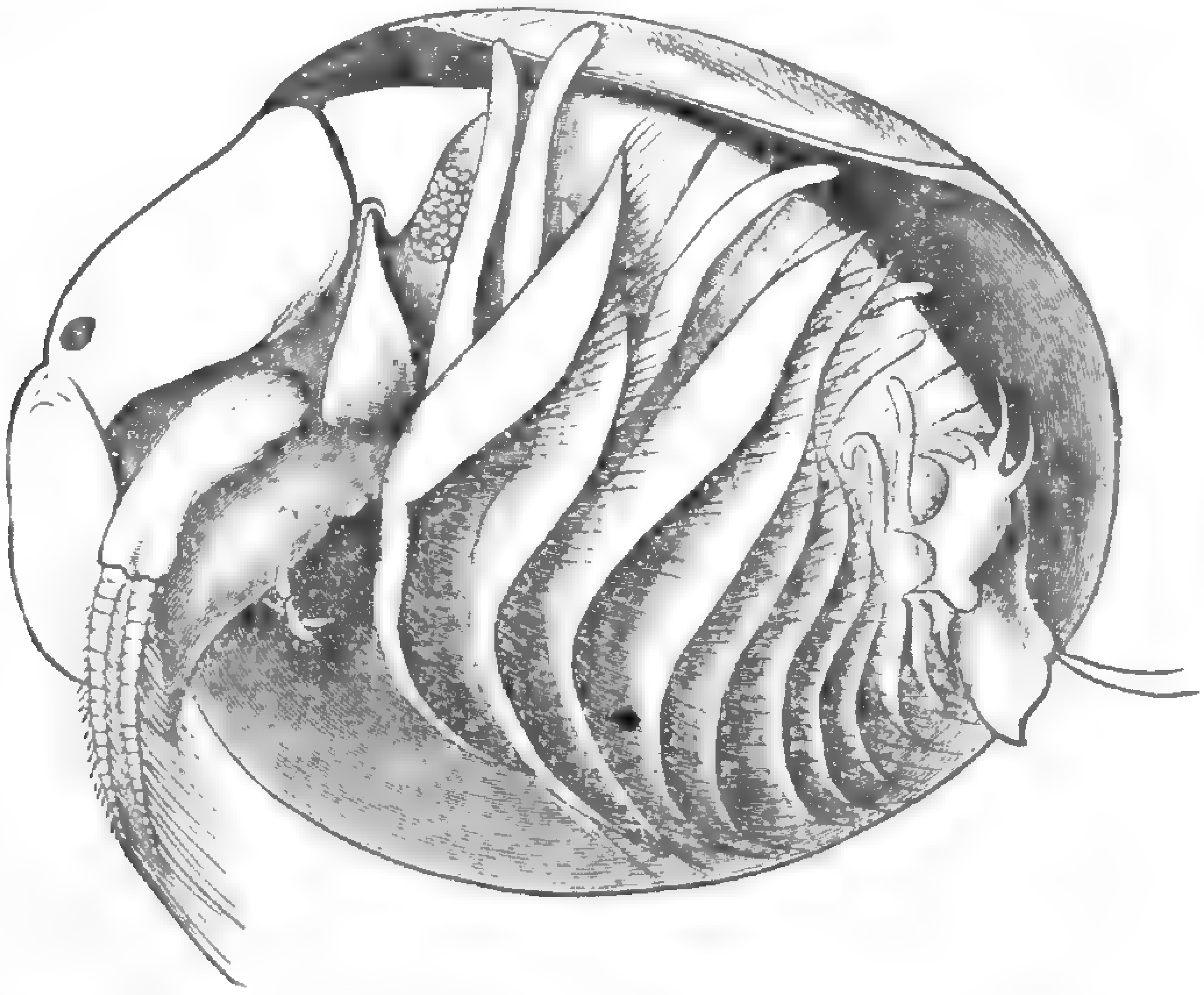


FIG. 1.—*Limnetis brevifrons,* enlarged. Burgess, del.

cea, a transverse section of the anterior part of the body of any genus of Phyllopods (see Pl. XII, Fig. 2, also Fig. 1 in text) will convey an excellent idea of the leading features in their organization, especially those by which they differ from the members of other Crustacean orders. The leading topographical features in the body, particularly of Arthropods, are the form of the elemental segments with their appendages, and the relations of the principal anatomical systems to the body-walls.

General relations of the systems of organs to the body-walls.—We will first look at a section of a typical Phyllopod, such as *Apus* (Fig. 2). The body-walls are rather thick and the muscles are well developed, particularly the dorsal extensor muscles, and the motor or extensor muscles of the limbs, which arise in part from the dorsal region, and in part from the sides and sternal region. The body cavity is rather small. The heart is large, either cylindrical as in Estheria, or flattened as in *Thamnocephalus.* The digestive tract is large, capacious, and the cavity of the head is mainly filled with the two liver masses; the brain being remarkably small, while the nervous cord, especially the second and succeeding ganglia, are remarkably small and weak, compared with other

Crustacea, either the malacostracous or the entomostracous orders; this peculiarity is well brought out in the transverse sections, where the diminutive size of the thoracic ganglia, particularly in *Limnetis* and *Estheria* is noteworthy. The apparent bulk of the body is largely due to the large size and nature of the leaf-like or foliaceous appendages, with their broad attachments; the latter peculiarity is characteristic of the Branchiopods in general and the Phyllopods especially, and is quite different from the definite, small coxal articulations of the legs of Malacostraca or Copepoda. The ovaries or testes, according to the sex, form a large lobulated mass extending along each side of the digestive canal, as far forward as the base of the head. Their relations in *Apus* are seen in Plate XXII, Fig. 2, and in *Thamnocephalus* in Plate XIV, Fig. 4 of our essay.

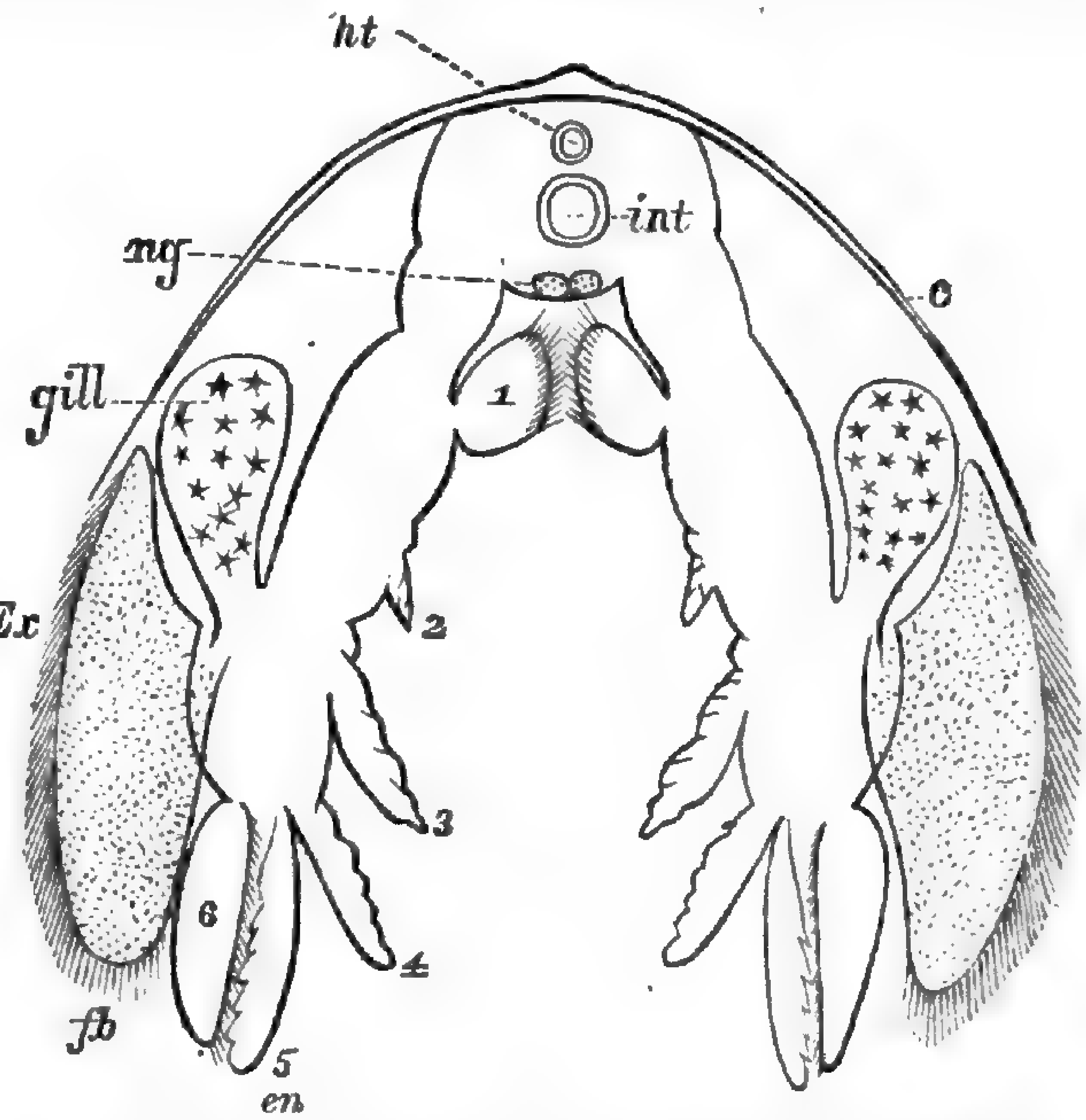


FIG. 2.—Section of Apus; *ht*, heart; *int*, intestine; *ng*, ganglion; *c*, carapace; 1–6, the six exites, 1 being the gnathobase; *gill* and *fb*, flagellum, representing the exites.

The segments of the body.—Phyllopoda are exceptional to other Crustacea in having an indefinite number of segments composing the body, and in having in one family (*Apodidæ*) more than one pair of appendages to an arthromere. While the normal number in the Decapoda is twenty-one, in the Phyllopods it varies from seventeen in Limnetis to forty-seven in Apus. The following table shows the number in different genera of American species:

	Antennal segments.	Mandibles.	Maxillæ.	Maxillipedes.	Limb segments.	Abdominal segments.	Telson.	Total.
Limnetis	2	1	1	....	12 (–14)	0	1	17–19
Estheria	2	1	2	....	23–27	0	1	29–33
Limnadia	2	1	2	....	1 22	0	1	28
Apus	*2	1	1	†1	27 (60 pairs limbs)	32 (14)	1	47
Artemia	3	1	2	0	11	8	1	25
Branchinecta	2	1	2	0	11	9	1	26
Branchipus	2	1	2	0	11	9	1	26

* Second antennæ sometimes wanting.
† The endite of *Apus* wanting in the American species.

In an *Apus lucasanus* forty-two millimeters in length there are sixty pairs of legs behind the maxillipedes. There are forty-two segments behind the maxillipedal segment, including the telson, and twenty-seven limb-bearing segments, or sixty pairs of legs to twenty-seven segments, the average being two and six-twenty-sevenths ($2\frac{6}{27}$) appendages to each leg-bearing segment. On the first eleven leg-bearing arthromeres, or the ten thoracic legs (bænomeres) together with the first abdominal arthromere, there is but a single pair of appendages to a segment, so that there are forty-nine pairs of abdominal appendages to sixteen arthromeres, or three and one-sixteenth pair of limbs, on the average, to each abdominal arthromere. The fourteenth, fifteenth and sixteenth pairs are situated on two arthomeres, and so on with the succeeding until the limbs become more numerous. On the two arthromeres before the last leg-bearing one, there are twelve pairs of appendages, or six to each arthromere.

This irrelative repetition of arthromeres is only paralleled in one other Branchiate group, the *Trilobita.* In this group the new segments are interpolated between the head and abdomen at successive molts, as shown by Barrande.

The grouping of the body segments into a cephalothorax and abdomen, comparable with those two regions in the Decapoda is but slightly, if at all, indicated in the Phyllopoda. In *Limnetis* there is no such distinction of regions, in Apus the cephalothorax merges insensibly into the abdomen, and it is not until we ascend to the *Branchiopodidæ* that we meet with a well-marked abdomen separated by tolerably clear indications from the thorax.

The Appendages in general.—The appendages of Crustacea may be divided into four groups: First, the sensory appendages, or antennæ, which are in the adult preoral; second, the organs of prehension of food and of mastication, *i. e.*, the mandibles and accessory jaws, or maxillæ and maxillipeds, which are postoral; third, organs of locomotion, whether natatorial or ambulatory, which are appended to the thoracic portion of the body; and fourth, the appendages of the abdomen, which are both natatorial and concerned in reproduction; of the latter are the two pairs of gonopoda[1] in the Decapoda, while the eleventh pair of appendages in Apus may perhaps be regarded as gonopods.

[1] I have (AMERICAN NATURALIST, XV, p. 881, 1881) applied the term *gonopoda* (Gr. γονή, generation; ποῦς, ποδος, foot) to the first and second abdominal limbs

The following table will give our idea as to the succession and nomenclature of the appendages in the three subclasses of Tracheata and the two subclasses of Branchiate Arthropods:

TABLE A.

Number of segments.	Hexapoda.	Arachnida.	Myriopoda.	Crustacea (neocarida decapoda).	Merostomata. (Limulus.)
1	Antennæ.	Mandible	Antennæ	First antennæ . .	First (preoral) leg.
2	Mandibles	Maxilla (chela) . .	"Maxilla"	Second antennæ .	Second (postoral) leg.
3	First maxillæ . . .	First leg	"Mandible" . . .	Mandibles	Third pair legs.
4	Second maxillæ (labium.)	Second leg	"Labium" . . .	First maxillæ . .	Fourth pair legs.
5	First thoracic legs (bænopods).	Third leg.	First pair of legs .	Second maxillæ .	Fifth pair legs.
6	Second thoracic legs (bænopods).	Fourth leg	Second pair of legs	First maxillipedes	Sixth pair legs.
7	Third thoracic legs (bænopods).	Embryonic, deciduous.	Third pair of legs	Second maxillipedes.	First abdominal legs.
8	First embryonic deciduous legs.*	. . do	Fourth pair of legs	Third maxillipedes	Second abdominal legs.
9	Second embryonic deciduous legs.	. . do	Fifth pair of legs .	First pair of legs . (bænopods).	Third abdominal legs.
10	Third embryonic deciduous legs.	. . do	Sixth pair of legs	Second pair of legs (bænopods).	Fourth abdominal legs.
11	Fourth embryonic deciduous legs.	First pair spinnerets.	Seventh pair of legs.	Third pair of legs (bænopods).	Fifth abdominal legs.
12	Fifth embryonic deciduous legs.	Second pair spinnerets.	Eighth pair of legs	Fourth pair of legs (bænopods).	Sixth pair abdominal legs.
13	Sixth embryonic deciduous legs.	Third pair spinnerets.	Ninth pair of legs.	Fifth pair of legs (bænopods).	
14	First pair of rhabdites.†	Telson of scorpion.	Tenth pair of legs.	First abdominal legs (uropods).	
15	Second pair of rhabdites.	. . . .	Eleventh pair of legs.	Second abdominal legs (uropods).	Telson (spine).
16	Third pair of rhabdites.	. . . .	Twelfth pair of legs.	Third abdominal legs (uropods).	
17	Cercopoda of some Orthoptera and Neuroptera, and anal legs of caterpillars.	. . . .	Thirteenth pair of legs.	Fourth abdominal legs (uropods).	
18	Eleventh abdominal segment in some Orthoptera and Pseudo-neuroptera.	. . . .	Fourteenth	Fifth abdominal legs (uropods).	
19	. . . .	. . . .	Fifteenth	Sixth abdominal legs (uropods).	
20	. . . .	. . . .	Sixteenth; 200th in Geophilus.‡	Telson	

* See Kowalevsky, Embry, Studien an Wurmern und Arthropoden, 1871, Plate XII, Fig 10. Embryo of *Sphinx populi*, in which the first ten abdominal segments have temporary rudimentary appendages, some of which persist in the caterpillar, serving as prop.legs.

† The ovipositor of insects, as we originally pointed out in 1868 (Proc. Boston Soc. Nat. Hist., XI, 393), is primarily composed of three pairs of appendages (called by Lacaze-Duthiers "rhabdites"), which arise in the same way as the legs; this view has been confirmed by Ganin, Kraepelin and Dewitz.

‡ The number of movable segments in the Geophilidæ, according to Newport, varies from about 35 to more than 200.

of the Decapoda, which are, as is well known, modified into accessory generative organs. The term is suggested as a convenient one to use in descriptive carcinology when speaking of either or both pairs of the basal abdominal limbs of the male Decapod. In the female they are not modified.

Camparison wth limbs of Cladocera.—We should naturally first compare the appendages of the Phyllopods with the members of their own order, and especially the *Cladocera;* and here, whether we consider the carapace-valves, the eyes single and compound, the two pairs of antennæ, or the telson, we find a very close connection in form between *Limnetis* and *Daphnia* or *Moina.* In the accompanying sketch (Fig. 3) from Gruber and Weismann's excellent paper on the Daphnidæ[1] (which we have slightly modified,

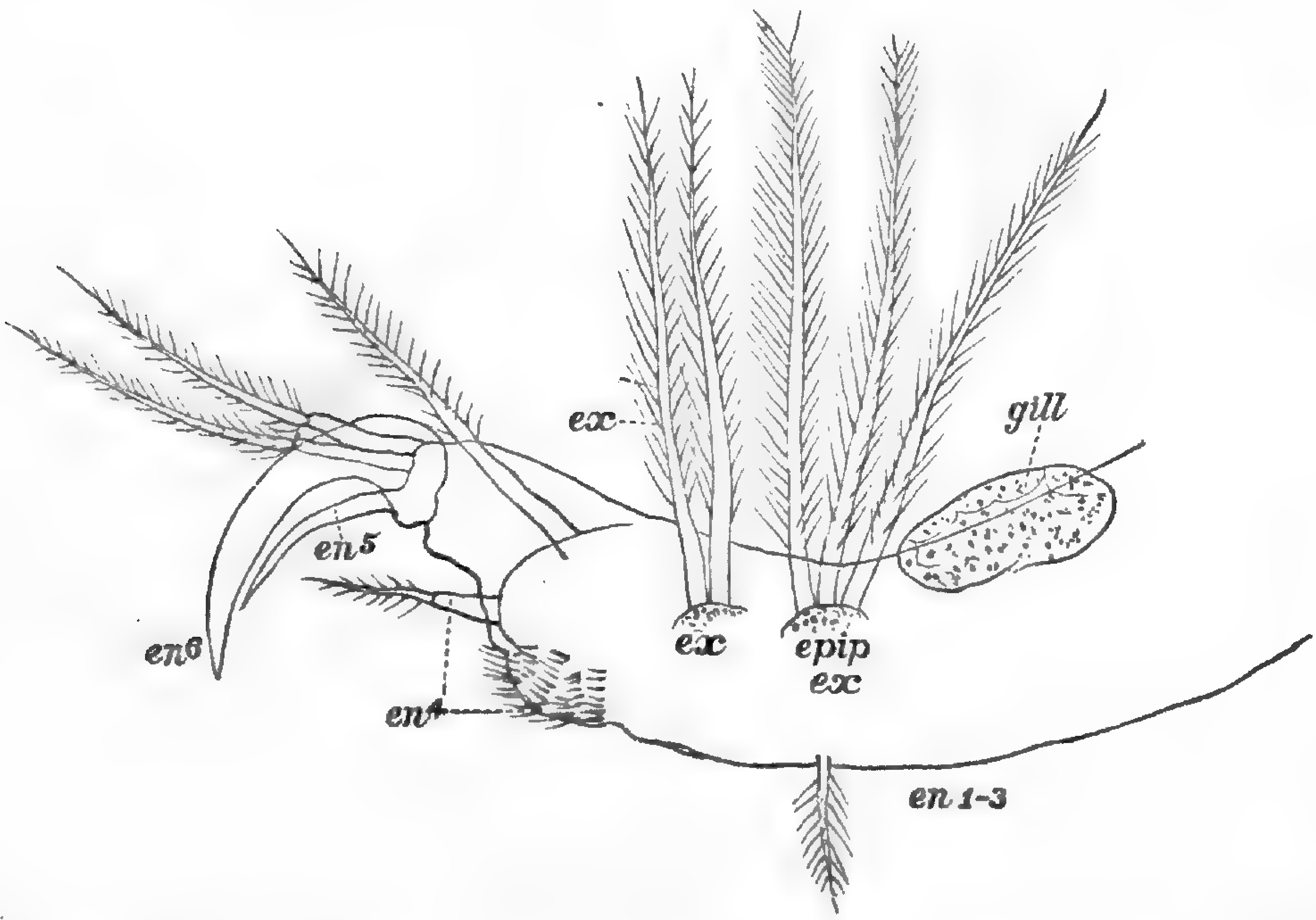


FIG. 3.—First leg of male of Moina (for comparison with that of male Limnetis): *ex*, exite; *epip*, epipodal portion of limb; *en*⁴–*en*⁶, endites, 4–6 compare with the endites forming the hand of the male Limnetis. The base of the endopodal region (*en* 1–3) not differentiated as in the Phyllopod limb.

introducing dots in the branchial portion) may be seen how nearly the first leg of the male of *Moina rectirostris* agrees with that of the male *Limnetis*, as seen in the sixth endite forming a claw like that of *Limnetis*, although the flabellum is not clearly differentiated from the endopodal portion of the limb. But when we look at the third pair of limbs of the female of the same Cladoceran (Fig. 4), we find an epipodal portion (flabellum, *ex*, and gill) differentiated from the endopodal portion of the limbs. The endopodal portion in the *Cladocera* is not differentiated, and forms a number of well-marked lobes or endites (Lankester), as in the Phyllopoda; this differentiation into six endopodal lobes being peculiar to the *Phyllopoda.*

The Cladocerous limb is intermediate in form and complication

[1] Ueber einiger neue oder unvollkommen gekannte Daphniden. 1877.

between the Phyllopodous and Ostracodous limbs, and the latter are evidently derived from the Copepods, so that there is a continuous ascending series from the Copepoda through the Ostracoda to the Cladocera, and thence to the Phyllopoda. Hence, as the young of the Copepoda are all Nauplii, and also those of the Phyllopoda, it follows that the ancestral form of all the Entomostracous Crustacea, as originally insisted on by Fritz Müller (Für Darwin) was a nauplius-like animal.

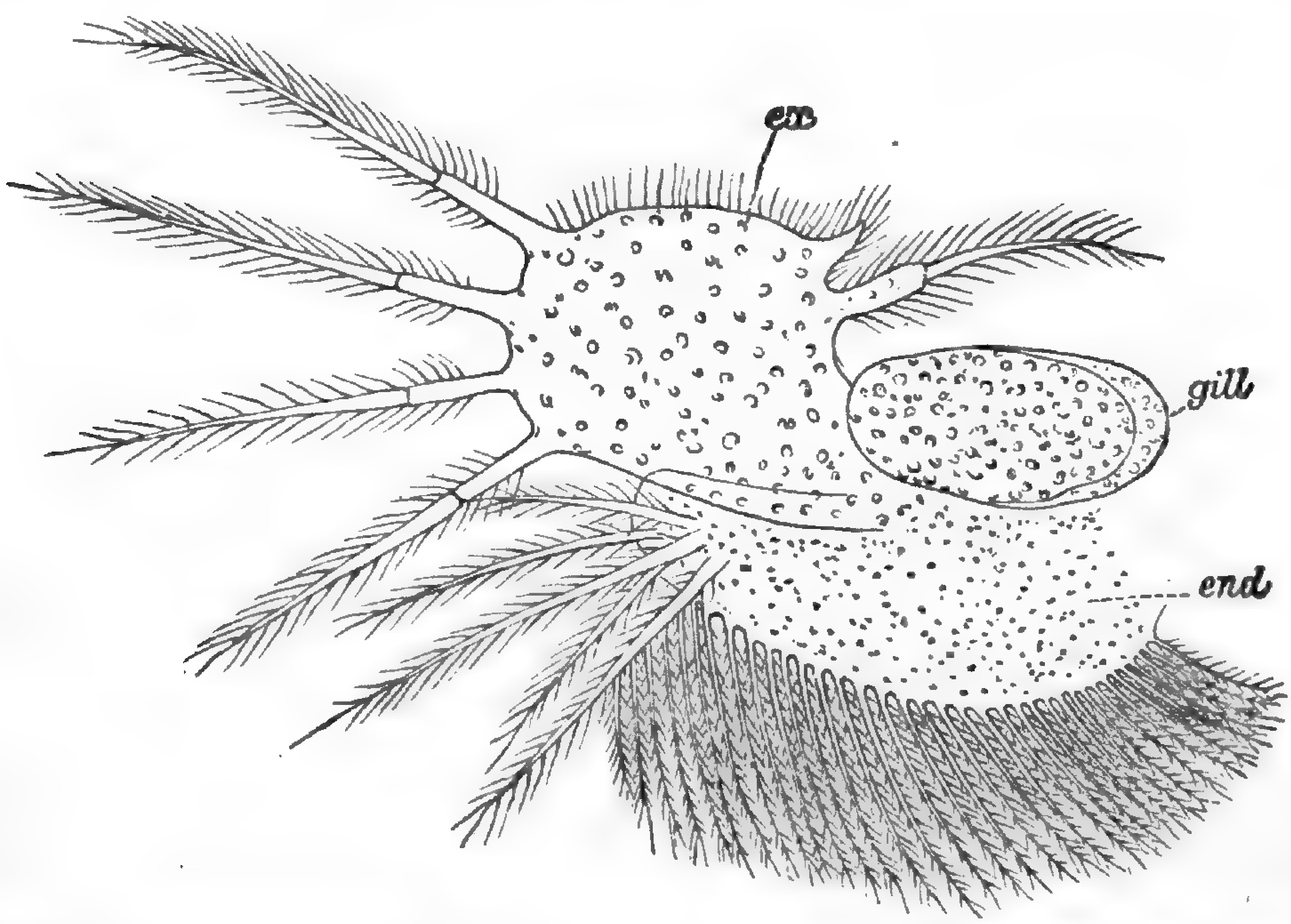


FIG. 4.—One of the third pair of limbs of Moina: *end*, the endopodal portion; *ex*, the exopodal (epipodal) portion of the limb.

Comparison with the Decapodous limbs.—Having studied the homologies of the Phyllopodous limbs among themselves, and also compared them with those of the Cladocera and Ostracoda, it remains now to compare the thoracic appendages of the Phyllopods with those of the adult *Decapoda*. At the outset, however, it seems nearly impossible to compare the swimming legs of the Phyllopods with the abdominal and thoracic appendages of Decapods. The thoracic Decapodous legs are axially jointed, consisting of an axis or protopodite, which is wanting in the Phyllopoda and all lower Crustacea, with no endital lobes as in Phyllopods, though the gill and flabellum of the Phyllopods are homologous with the gills and flabellum of the Decapod. There is no such relation or close resemblance as to lead us to infer that as regards the nature of the thoracic and abdominal feet the Decapods have descended from the Phyllopods. The Decapods have probably come down to us by a different branch of the Crustacean ancestral tree, and have arisen entirely independently of the Phyllopodous branch, by a line leading back directly to the ancestral Nauplius, the common ancestor of all the *Neocarida.*

Nor does it seem to us that this statement or hypothesis is weakened when we consider the resemblances between the thoracic feet of the Phyllopods and the maxillæ and maxillipedes of the Decapoda. When we compare the leg of a Phyllopod with the second maxilla[1] of the lobster (Fig. 6, B) or crayfish, we can detect a close homology, the chief difference being in the fact that the lobes of the endopodite are less numerous in the Decapod than in the Phyllopod. This close resemblance is based on the fact, which appears to have been overlooked by Claus and Lankester, *i. e.*, that as in the Phyllopodous limb, the maxillæ of the Decapods have no jointed axis, the limb consisting of epipodal and endopodal portions alone, the stem or axis being wanted. In the maxillipedes, where part of the endopodal region of the limbs becomes, as

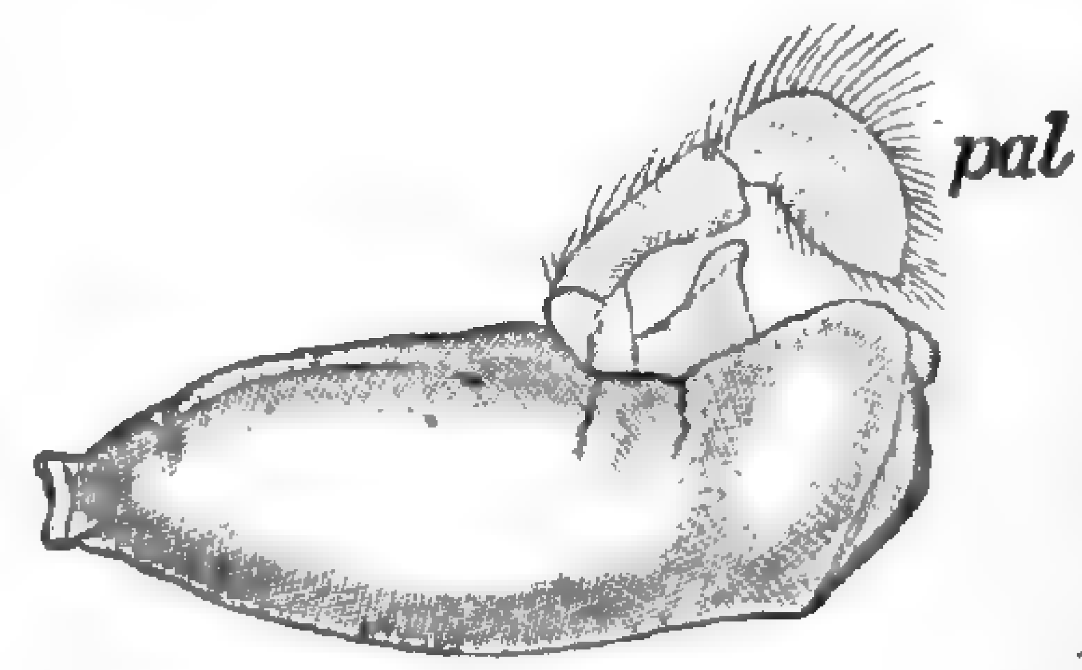


FIG. 5.—Mandible of the lobster, *Homarus americanus*: *pal*, palpus.

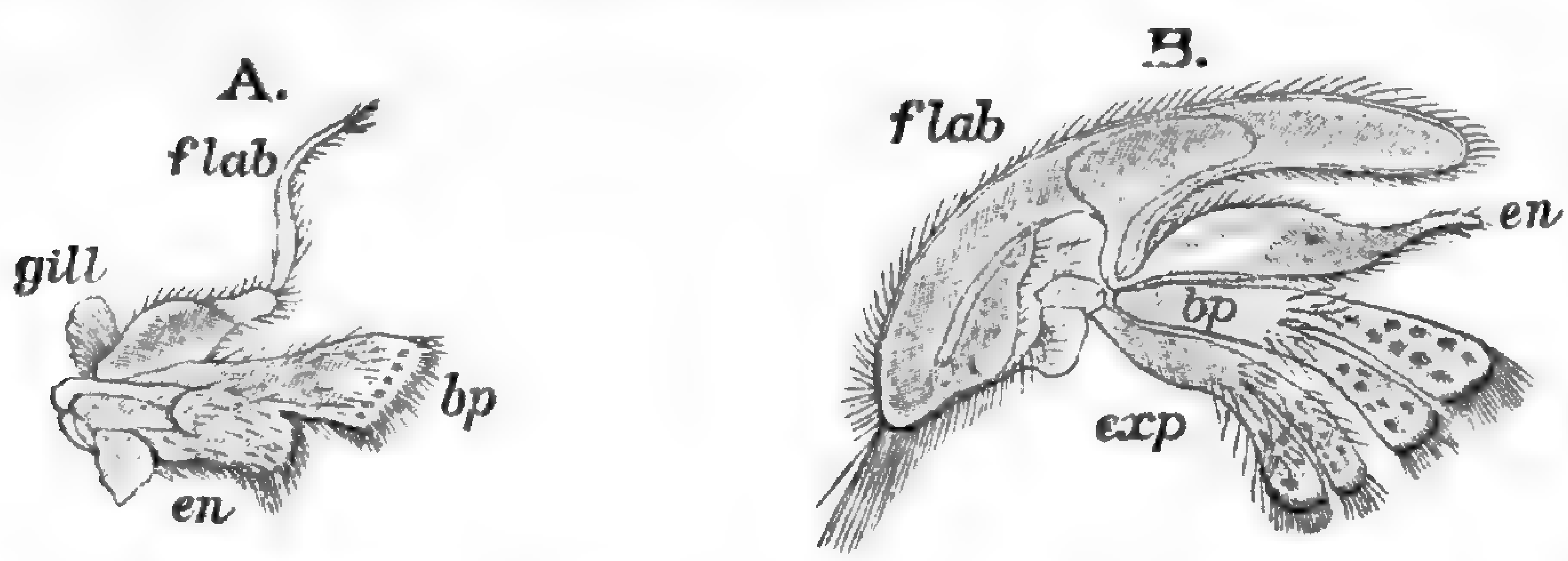


FIG. 6.—A, first maxilla of lobster; *en*, endopodite; *bp*, basipodite; *flab*, flabellum. B, second maxilla of lobster; *bp*, basipodite (epignathus); *cxp*, coxopodite. (This appendage, with its five endopodal lobes, approximates nearest to the Phyllopod limb.)

Lankester[2] claims, two multiarticulate endites, the fifth and sixth; or, as in the thoracic leg, becomes a single seven-jointed endite, the homologies cannot with certainty be traced. The lobster's thoracic leg consists of the jointed axis which is the homologue of perhaps the fifth endite of the Phyllopodous foot (Lankester),

[1] The resemblance to the second maxillæ of the young lobster in its first stage when freshly hatched, is still more striking. See Smith's Early stages of the American Lobster, Pl. XVI, Fig. 4.

[2] See his able article on the morphology or Apus, *Quart. Journ. Mic. Science*, 1881.

and the complicated gills and gill-fan (scaphognathite) correspond to the gill and flabellum of the Phyllopodous leg or flabellum.

In brief, the maxillæ of the Decapoda most closely resemble

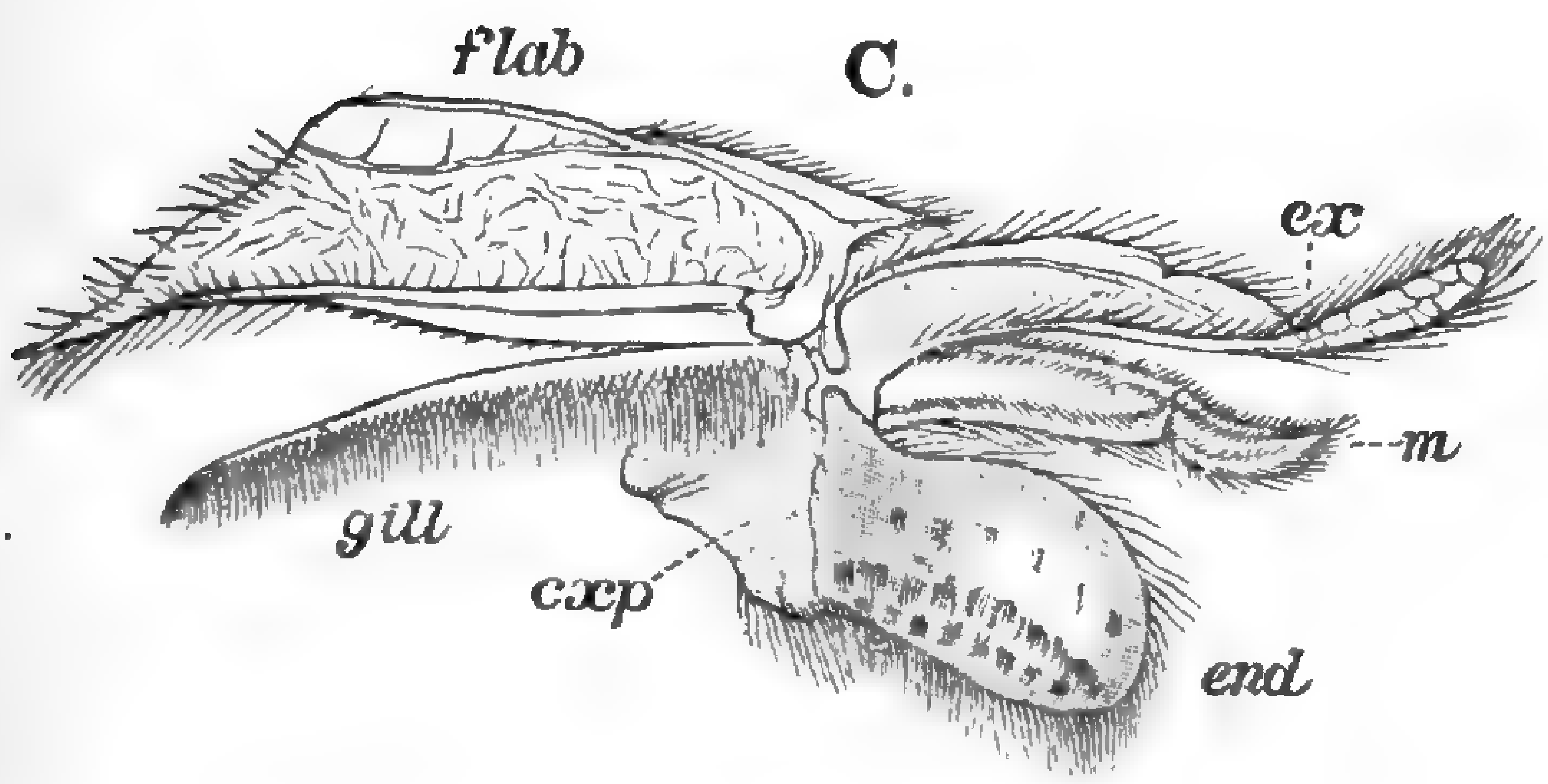


FIG. 7.—C, first maxillipede of lobster.

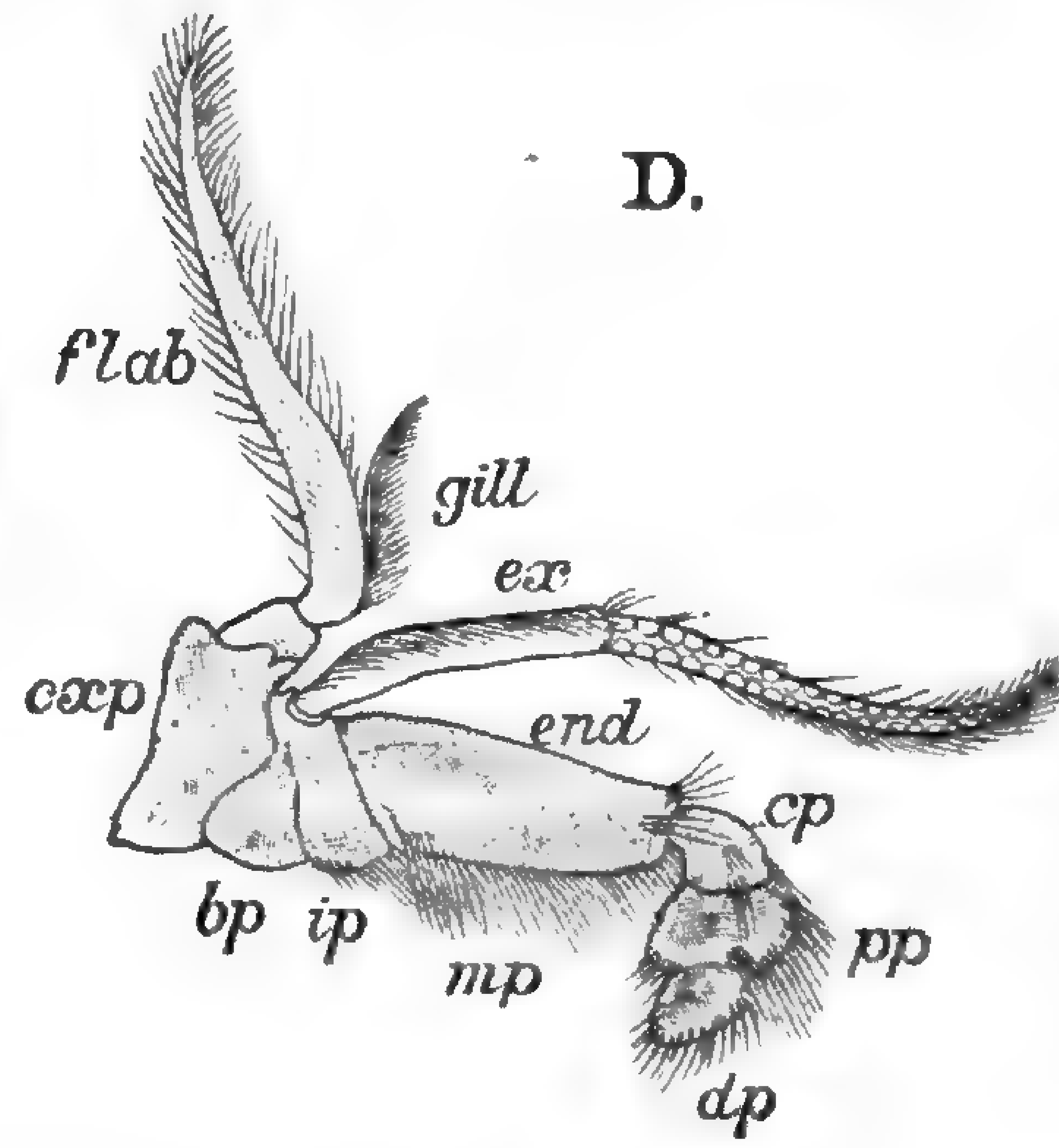


FIG. 8.—D, second maxillipede; *ex*, exopodite; *end*, endopodite; *flab*, epipodite or flabellum, or scaptogathnite.

the legs of Phyllopods. The maxillipedes, for example, those of the third pair, are much more differentiated than the limbs of the Phyllocarida or Phyllopoda. In the Decapoda the gill and flabellum are homologous with those of the groups just enumerated; while the endopodite and exopodite of the Decapoda represent

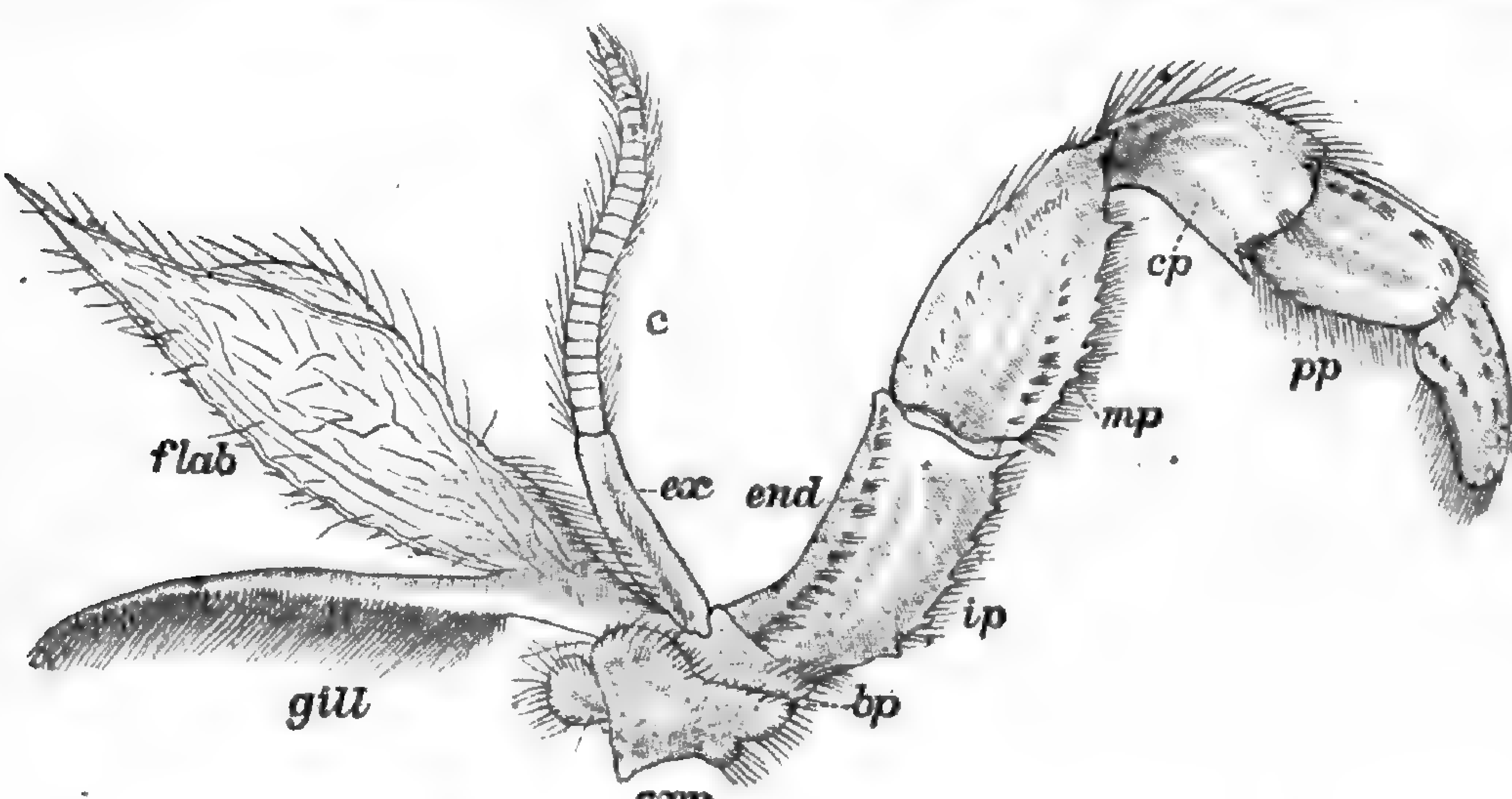


FIG. 9.—B, third maxillipede, *cxp*, coxopodite; *bp*, basipodite; *ip*, ischiopodite; *mp*, meropodite; *cp*, carpopodite; *pp*, propodite; *dp*, dactylopodite; *c*, multiarticulate extremity of exopodite or palpus; *flab*, epipodite.

the endopodal portion of the limb of the lower groups. There is in the Phyllopoda no division into a coxopodite and basipodite or stalk, from which two axially jointed divisions branch off, homologous with the exopodite and endopodite of the Decapoda. In the latter the maxillipede is highly differentiated; in the thoracic limbs of the Phyllocarida and Merostomata it is uniaxial and jointed, but in the Phyllopoda not truly jointed. In the simplest Decapod limb, that of the abdomen, we have a stem succeeded by two divisions, the exopodite and endopodite; in the thoracic feet we have but one of these branches, the endopodite, while in the maxillipedes, the most differentiated, we again have a stem and two branches (endopodite and exopodite), together with the gill and flabellum. Thus the entire leg of the Phyllopod (without the gill and flabellum) is homologous with the endopodite of the Decapod maxillipede, and the gill and flabellum with those of the Decapoda.

Comparison with the thoracic limbs of Nebalia (Phyllocarida).—Not to enter into detail, by a glance at Plate x and the figures in Plate XIV, it will be seen that the thoracic appendages of *Nebalia* consist of an inner axial-jointed portion (the endopodite), which may perhaps be regarded as homologous with the endopodite of the Decapod maxillipede, and also with the thoracic legs of the lobster. This also corresponds to the endopodal unjointed portion of the Phyllopod thoracic limb. In the exopodal or respiratory portion (*ex*) the upper part corresponds to the Phyllopod gill, and the double lower portion to the flabellum.

Comparison with the feet of Limulus (Merostomata).—The resemblance between the abdominal legs of Limulus and the thoracic ones of Nebalia is apparent on inspection of Pl. x, figs. 3 and 4. In Limulus the shell flares out widely and the appendages are united in the middle, although separate in embryonic life, so that this is a feature of secondary importance. The point of special interest is that the abdominal feet of Limulus may, as in the thoracic appendages of the *Phyllopoda* and of the *Phyllocarida*, or the maxillæ, maxillipedes, and thoracic feet of the Decapoda, be divided into an inner endopodal portion (whether ambulatory or natatory), and an outer or respiratory portion, as in *Nebalia* and Decapoda. The endopodite of Limulus (*en*) is axially-jointed, there being three well marked joints to this part of the limb. The branchiate portion of the limb (*ex*) is homologous with that of Nebalia, and the epipodital or branchiate portion of the Decapod thoracic limb. At the same time that of Limulus presents some remarkable peculiarities, *i. e.*, the exopodal (or epipodital)

PLATE X.

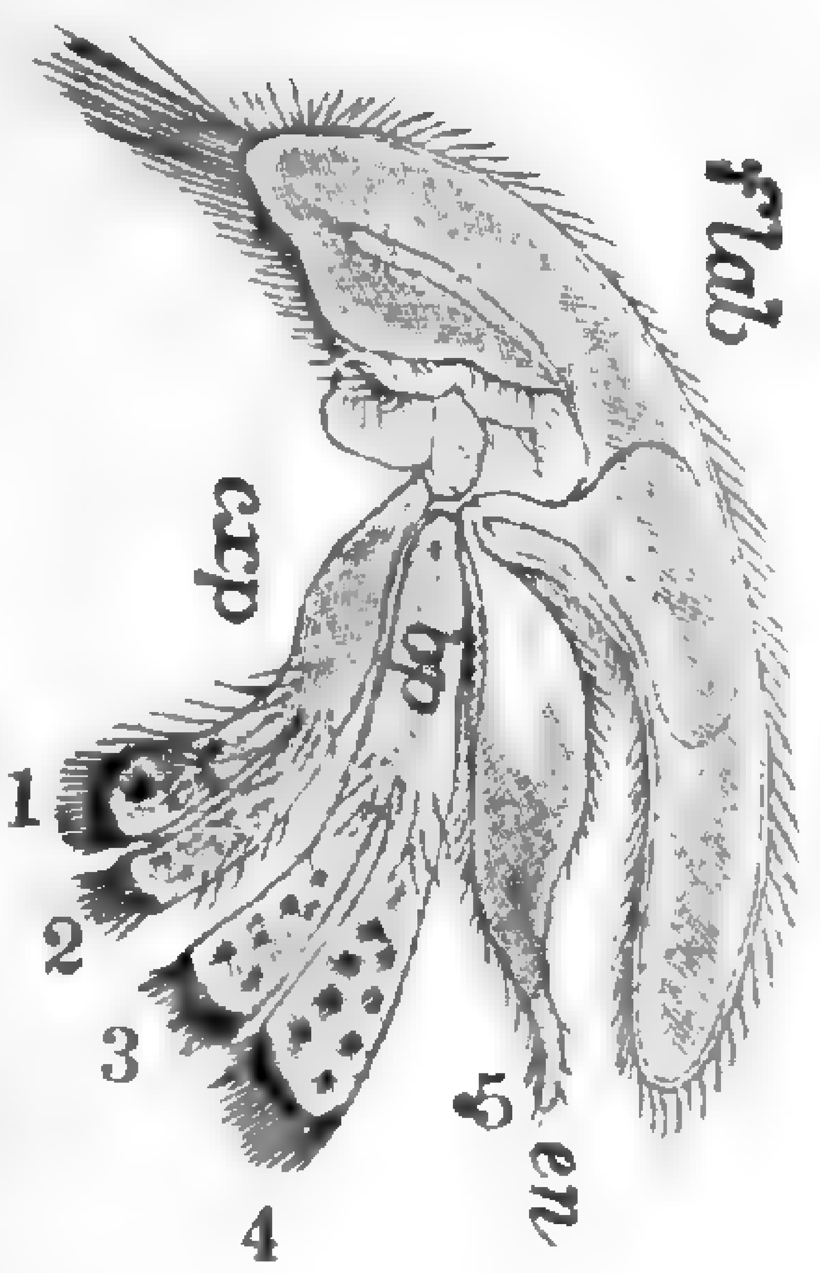


Fig. 1.

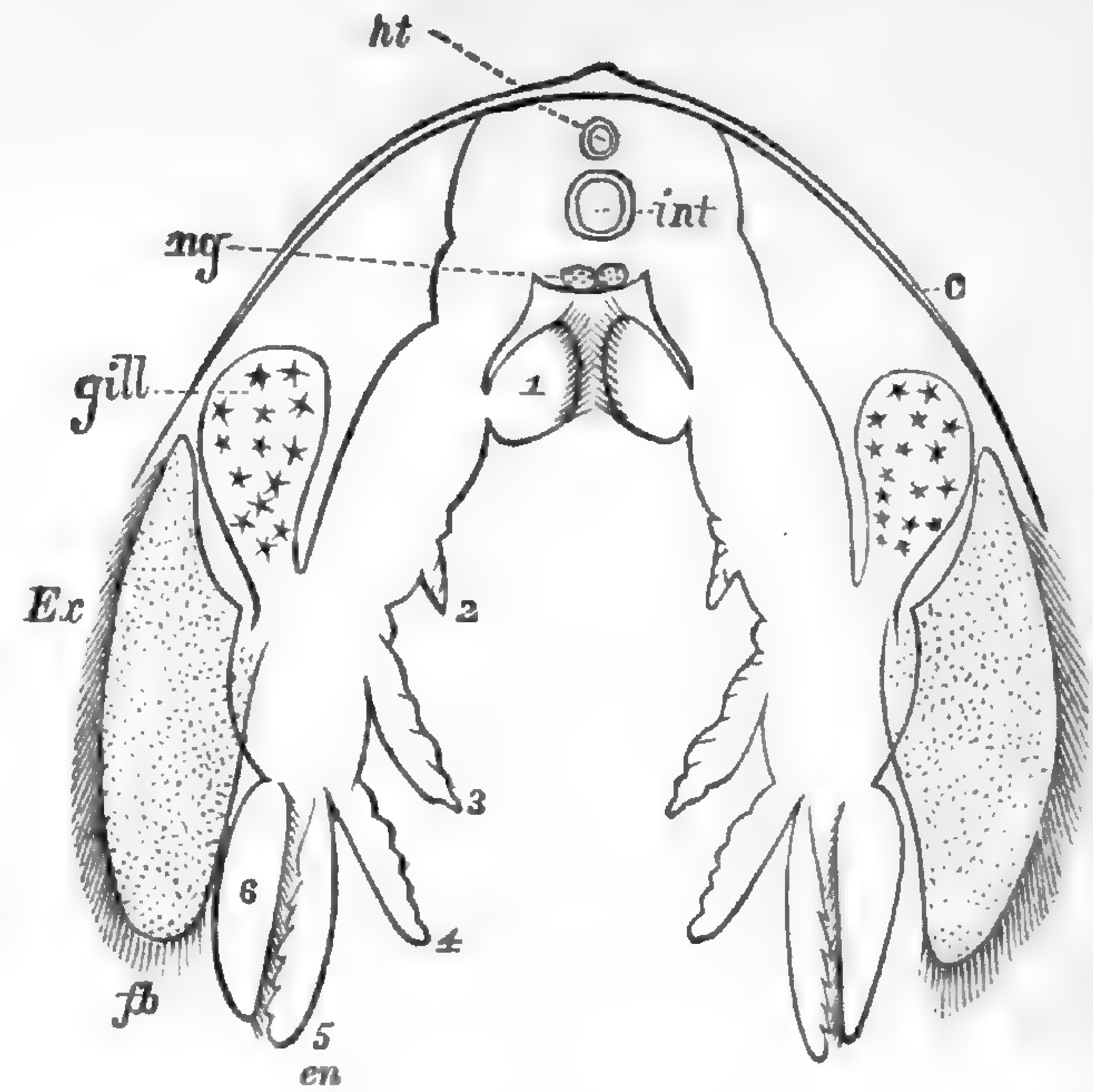


Fig. 2.

FIG. 1.—Maxilla of lobster with its five lobes (1–5) corresponding to the endites of the Phyllopod thoracic limb. FIG. 2.—Section through the thorax of Apus: *en*, 1–6, the six endites; *ex*, exopodal or respiratory portion of the limb; *c*, carapace.

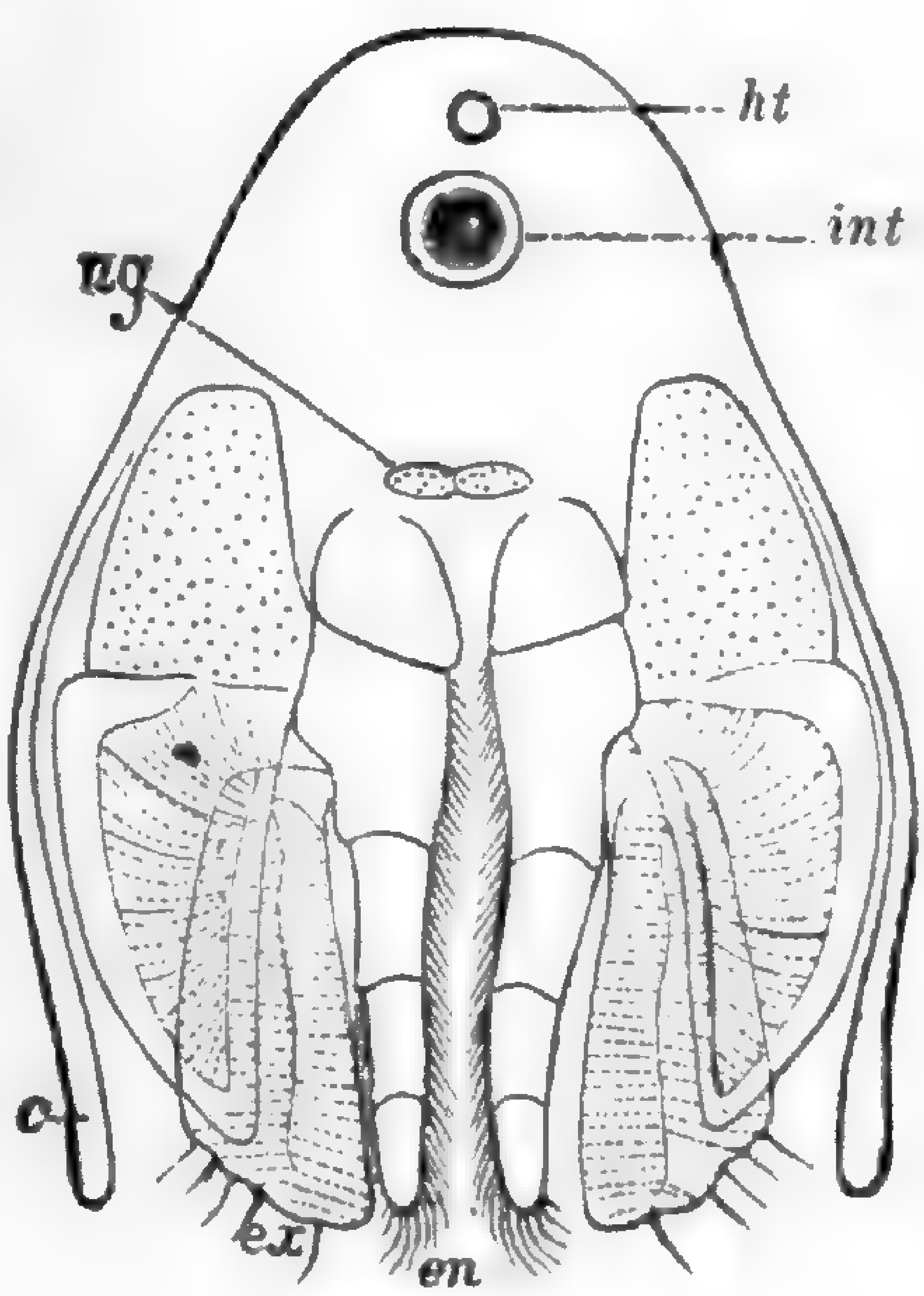


Fig. 3.

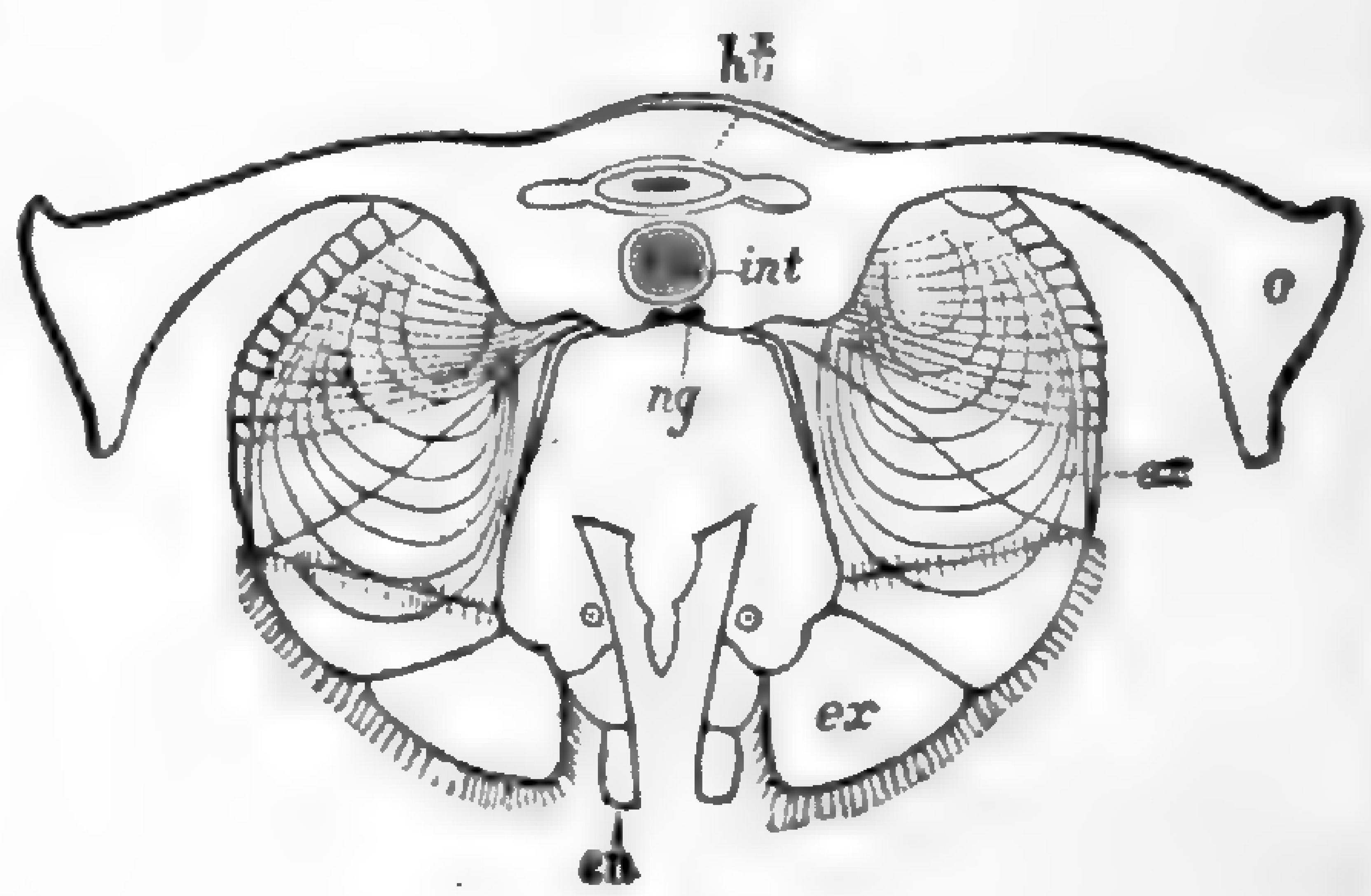


Fig. 4.

FIG. 3.—Partly diagrammatic section through the thorax of Nebalia; *en*, the axial-jointed endopodite; *ex*, exital portion or gill (above irregularly dotted) and flabellum below with rows of dots; *c*, carapace.

FIG. 13.—Actual section through the abdomen of Limulus: *c*, carapace; *ht*, heart; *int*, intestine; *ng*, ganglia (lettering being the same as Fig. 3); *en*, axial-jointed endopodite; *ex*, exital or respiratory portion bearing the gill-lamellæ; the outer division (*ex*) homologous with the exopodal portion of the Phyllopod and Phyllocaridan appendage.

HOMOLOGIES OF THE CRUSTACEAN LIMB.

portion is jointed; and the gill, instead of being a simple, fan-like extension, as in the Phyllopoda and Phyllocarida, is replaced by a number of flat, thin gill-plates, arranged parallel to each other, in an antero-posterior sense. When, however, we compare the gill, or rather the epipodital portion of the leg of Limulus, with that of the lobster, we have the various fundamental elements, *i. e.* an artery and a vein passing into the foot and in connection with a number of gill-plates. In the lobster we have along the base of the gill (Fig. 9), collective veins and an artery into which the blood passes after being aerated in a large number of cylindrical gill-filaments. Morphologically there is a fundamental resemblance between the two types of branchiæ; in Limulus there are gill-plates, in Decapods gill-filaments, each presenting in the aggregate a large respiratory surface. The gills of the Isopoda are in some degree intermediate between the Decapods and the Merostomata.

When we compare the anterior or cephalic appendages with the thoracic appendages of the lobster, there is a close resemblance in the axially-jointed endopodite (Fig. 10, *end*) of Limulus with its large terminal claw to the foot of the Decapod. The absence of the gill or branchiate (epipodital) portion in Limulus is correlated with the ambulatory nature of its anterior or cephalic appendages.

In the trilobites, however, as may be seen by Mr. Walcott's able restoration (Fig. 12), we have attached to the thoracic ambulatory feet a respiratory epipodital portion. In some respects, then, in the trilobites we have a style of structure intermediate between the Merostomata and the Decapoda.

In the trilobite we apparently have, besides a true-jointed locomotive endopodite (Fig. 12, *en*), an inner jointed appendage (*en'*), which may be homologized with the exopodite of the Decapod maxillipede (Fig. 9). From near its base arises the two singular spiral gills, which are unique. It is to be observed that the two jointed appendages and the stem of the gills arise from what appears to be a true coxopodite, and that this coxopodite is apparently homologous with that of Limulus (Fig. 10). It thus appears that a study of the general internal anatomy and of the appendages of the normal, recent Crustacea (*Neocarida*) throws light upon the structure of the archaic Crustacea (*Palæocarides*), and that the most archaic Neocarida, the Phyllocarida (Nebalia), as regards their thoracic limbs, do not remotely resemble the abdominal limbs of Limulus. In this connection we would draw attention to Fig. 11, which is designed to show the possible relations between Limulus and Calymene, or the Merostomata and the Trilobita. The essential difference is in the nature of the

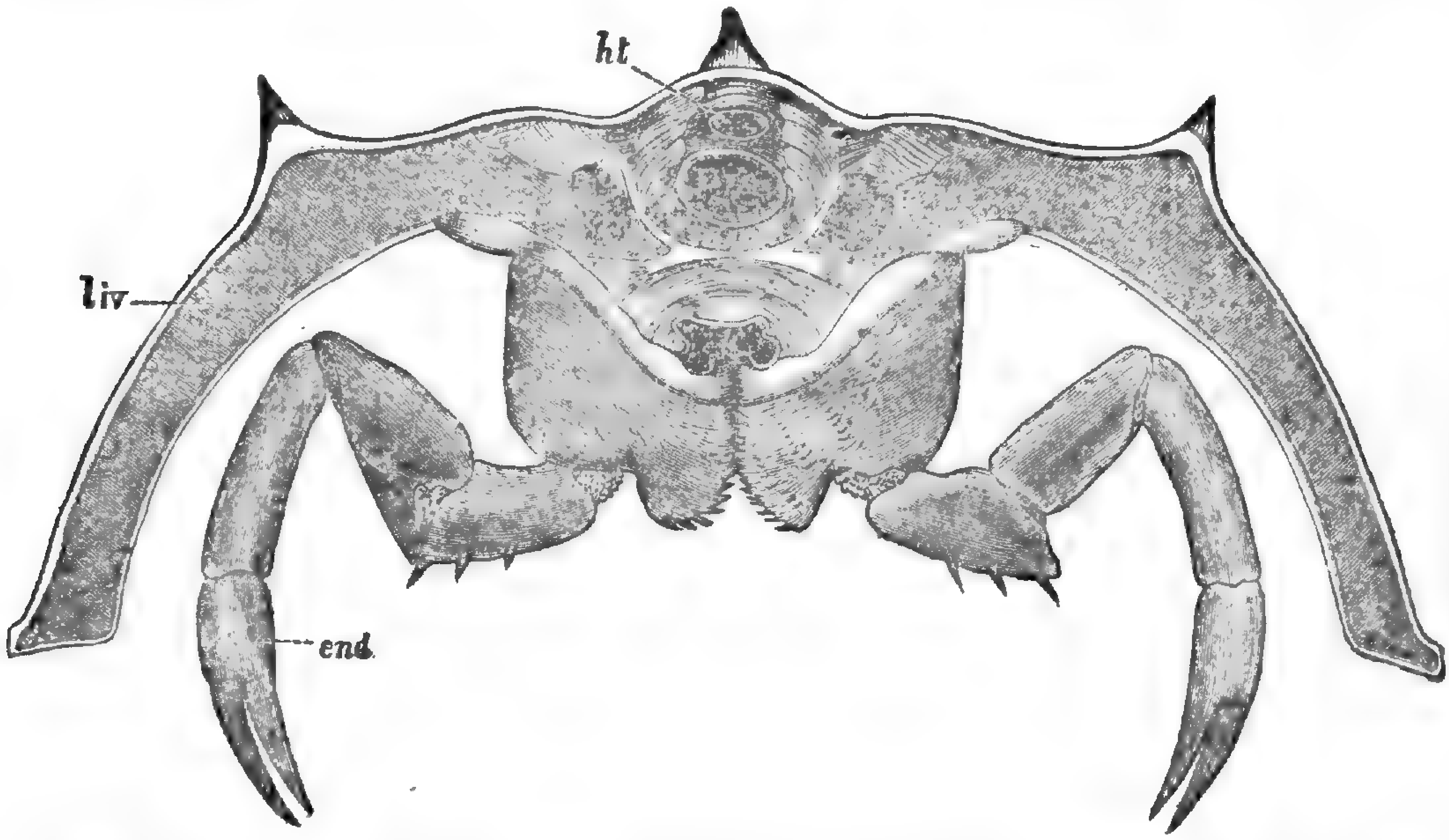


FIG. 10.—Actual section through the head of Limulus, showing the second pair of appendages and their relation to the shell or carapace: *ht*, heart; *liv*, liver; *end*, appendage homologous with the endopodite of Decapoda.

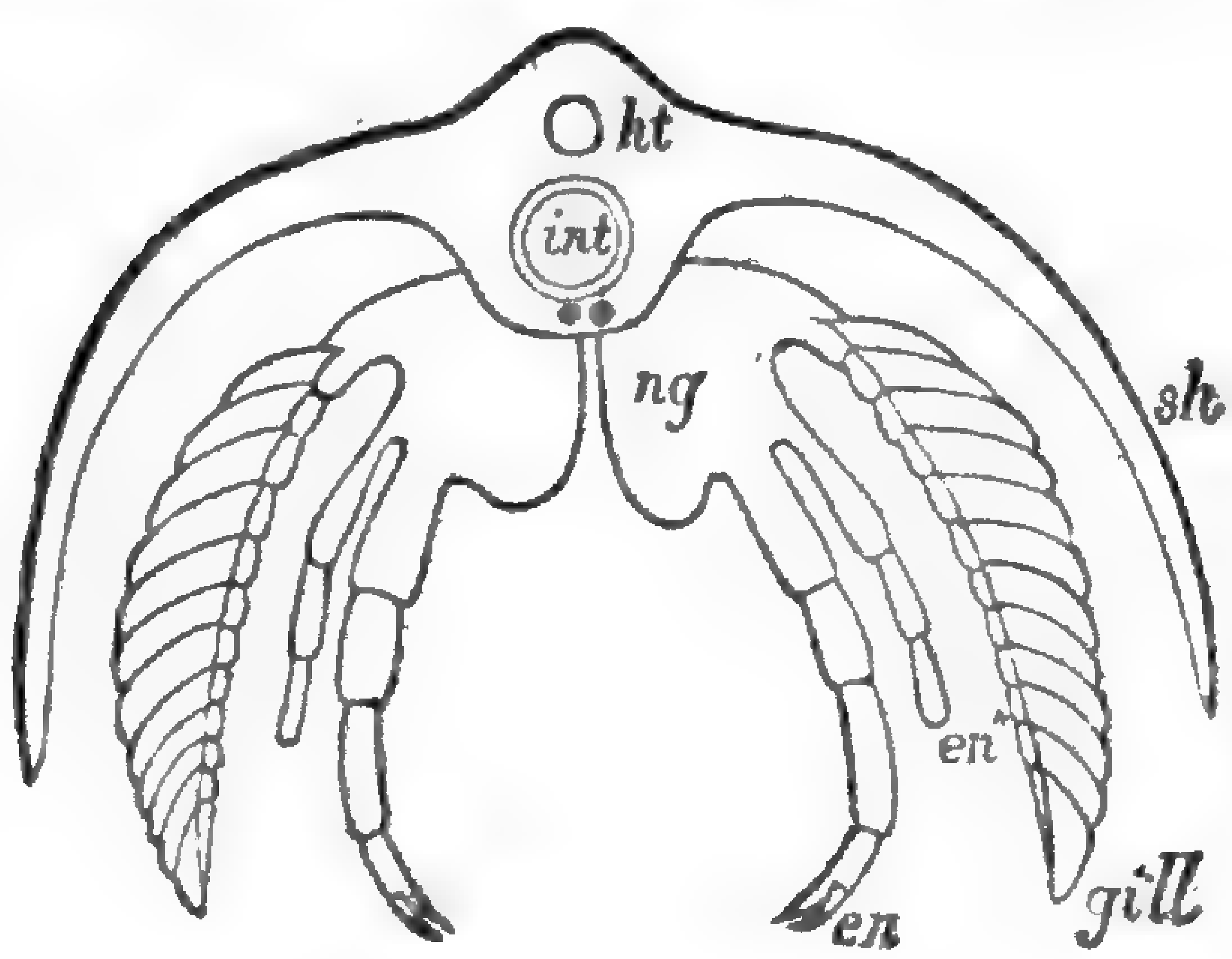


Fig. 11.

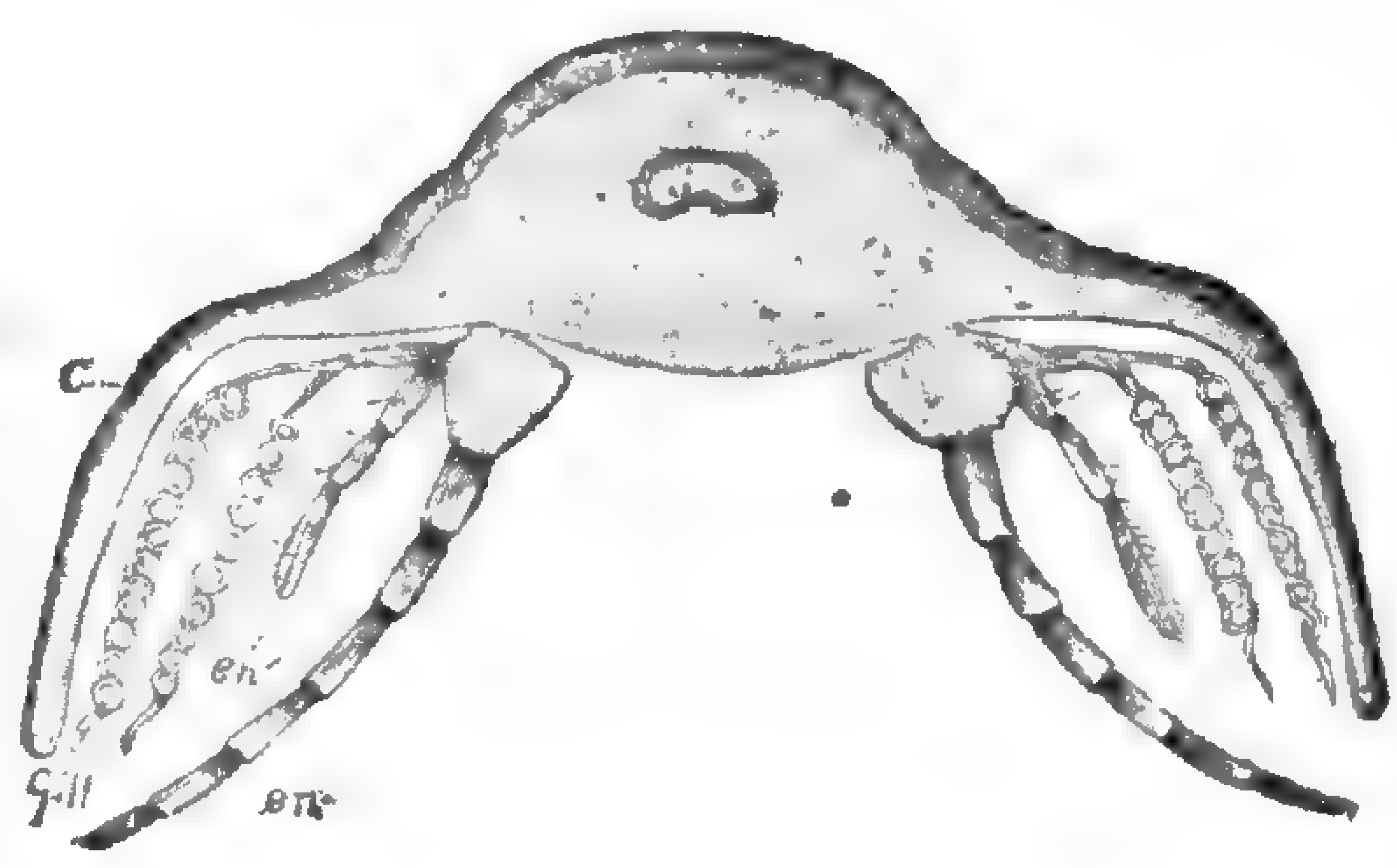


Fig. 12.

FIG. 11.—Diagrammatic section through body of a hypothetical form to show the possible homologies between the appendages of Limulus and a trilobite; the lettering as in Fig. 16.

Fig. 12.—Restored section of the thorax of a trilobite (Calymene), after Walcott: *c*, carapace; *en*, endopodite; *en'*, exopodite with the gills on the exopodal or respiratory part of the appendage.

limbs; the thoracic limbs of trilobite, while having a jointed endopodite as in Limulus, also having an exopodite and a forked spiral gill. Now, if we append to the coxopodite of Limulus an exopodite, and instead of having the gills arranged anteroposteriorly, like the leaves of a book, have them arranged on one side

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ANATOMY OF APUS.

(the outer) of a more or less cylindrical epipodite, as we have drawn them in Fig. 11, we shall hardly be doing greater violence to nature than we see to occur in any Decapod, where, as may be seen in Pl. x, the maxillæ of the lobster have no specialized exopodite, such as is so well marked in the maxillipedes, and the thoracic legs possess not even the rudiments. Change of function and radical changes of structure are most extreme in the Malacostracous Crustacea, from the Brachyura to the Isopoda and Amphipoda. If so startling in these comparatively recent forms, it is not to be wondered at that still greater and more fundamental modifications of the Crustacean type obtain in the archaic forms, the Palæocarides, of which Limulus is the sole survivor. To those who insist on the Arachnidan affinities of the Merostomata, we would suggest that the same shifting and change of function and structure is to be observed among the Tracheate Arthropoda, and that Limulus is not less a genuine Branchiate Arthropod for presenting some features analogous to the Arachnida.

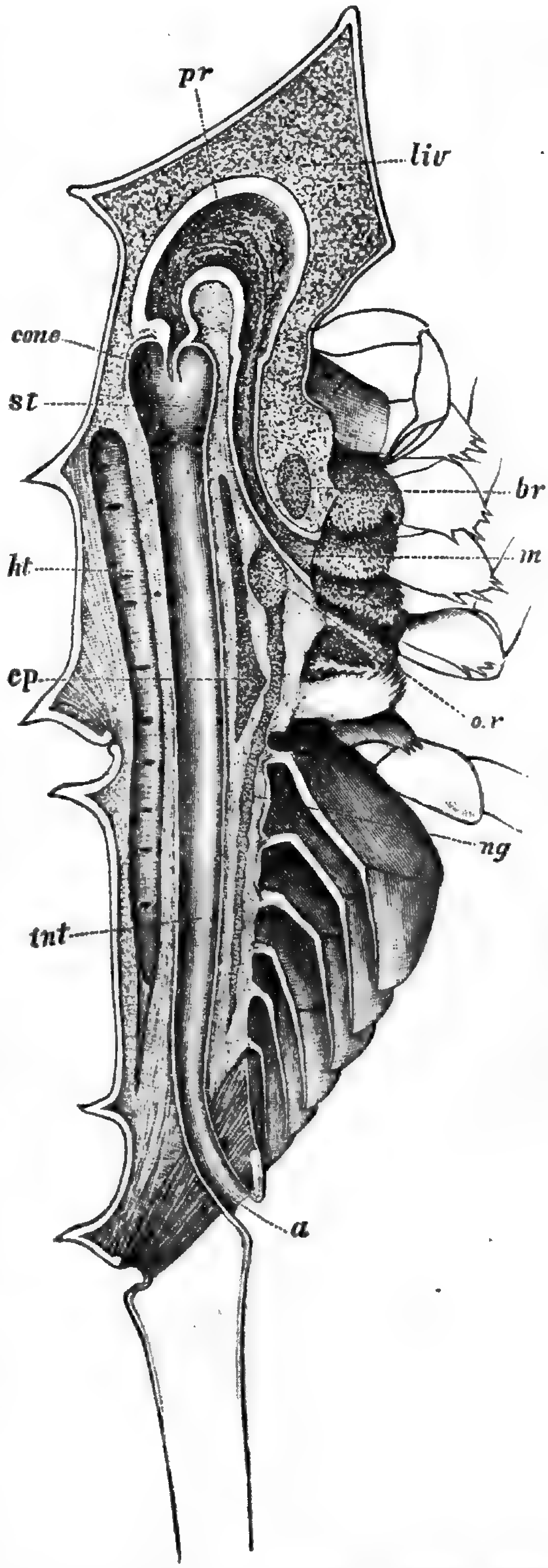


FIG. 13.—Section through a small *Limulus polyphemus* (much enlarged), to compare with a neocaridous Crustacean such as Apus: *liv*, liver; *pr*, proventriculus; *st*, stomach; *ht*, heart; *cp*, cartilaginous plate over the nervous system; *int*, intestine; *a*, anus; *br*, brain; *m*, mouth; *or*, œsophageal ring; *ng*, abdominal ganglia.

A study of the Phyllopoda and Phyllocarida must tend to confirm the view we have expressed as to the synthetic or generalized nature of Limulus. While we have in another place endeavored to show in the light of A. Milne-Edwards' anatomical studies on Limulus, that it is an abnormal Crustacean and far removed from the Branchiopoda; there are nevertheless some points in which it comes in contact with the Phyllopoda, and which have been noticed ever since the time when O. F. Muller comprised Apus in his genus "*Limulus*." If the reader will compare the accompanying longitudinal section of Limulus with our section of Apus in Pl. XI, some striking resemblances will be seen; externally the front edge of the carapace, *i. e.*, the frontal doublure, so well adapted for burrowing in the mud; the relations of the hypostoma or labrum, and the retention of the ocelli, as well as the mode of molting the shell, are external points of resemblance, while internally the front part of the head filled with the lobules of the liver, the oblique long narrow, œsophagus, the position of the stomach under the eye so far in front in the head, the simple archi-cerebrum, the general form of the heart, and the gnathobases near the mouth are additional points of resemblance.

EXPLANATION OF PLATE XI.

FIG. 1.—*Apus lucasanus* Pack. Seen from beneath. Enlarged 3½ times. *md*, mandibles.

" 2.—*Apus lucasanus* Pack. First antennæ.

" 2*a*.—*Apus lucasanus* Pack. End of the same magnified. The antennæ of both pairs drawn to the same scale.

" 3.—*Apus lucasanus* Pack. Maxilla, showing the (*a*) anterior and (*b*) posterior divisions of the free edge; *max*, the gill of the maxillipede.

" 3*a*.—*Apus lucasanus* Pack. Maxillipede, represented by the gill only.

" 4.—*Apus lucasanus* Pack. First leg giving (with some changes) Lankester's nomenclature of the parts; ax^1–ax^4, the pseudojoints; en^1–en^6, the six endites, with the gill and flabellum.

" 5.—*Apus lucasanus*. The oostegite, or part of the 11th pair of legs of the female containing the eggs; *os*, aperture of the sack; *fl*, modified flabellum; *x*, the greatly enlarged subapical lobe; *br*, the gill.

" 6.—*Limnetis brachyura* (Europe). ant^1, 1st antennæ; ant^2, 2d antennæ; *lab*, labrum; *sh. g*, shell gland; *int*, intestine; *ht*, heart; *add, ms*, adductor muscle; *oc*, ocellus; *md*, mandible; *liv*, liver.

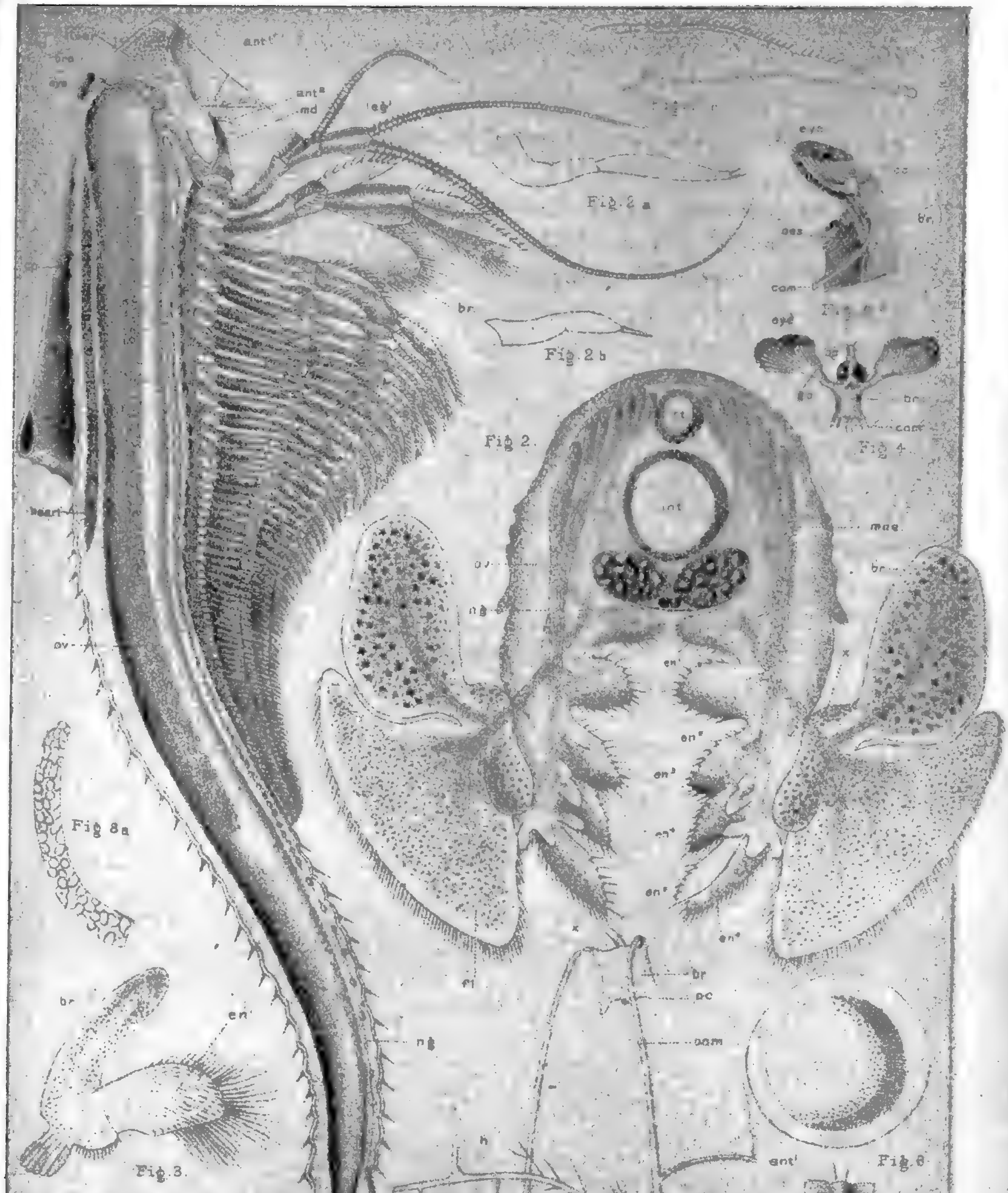
" 7.—*Limnetis brachyura*. Section through the body and shell (*sh*); *ht*, heart; *int*, intestine; *ov*, ovary; 1–6, the six endites.

" 8.—*Limnetis brachyura*. Brain (*br*) and nervous cord; *n.* ant^1, origin of the 1st antennal nerve; *n.* ant^2, 2d antennal nerve; *md. g*, mandibular ganglion; *mx. g*, maxillary ganglion; G^1, G^2, succeeding thoracic ganglia. Other letters as in Fig. 7.

" 9.—*Distomum apodis* Pack. AMER. NATURALIST, Vol. XVI, p. 142, Feb., 1882. Side view, greatly enlarged. A parasite in oostegite of *Apus lucasanus*.

" 9 *bis*. The same, ventral view.

Fig. 1 drawn from nature by J. S. Kingsley; Figs. 6–8 copied from Grube; the others drawn with the camera by the author.



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ANATOMY OF APUS.

EXPLANATION OF PLATE XII.

FIG. 1.—*Apus lucasanus* Pack. Section through the body, with the intestine removed. *md*, mandible; *ant*[1], *ant*[2], 1st and 2d antennæ; *leg*[1], first pair of legs; *br*, flabellum; *ov*, ovary; *ng*, ganglionic chain.

" 2.—Transverse section through the body at the 7th or 8th pair of feet, the shell removed, *mus*, dorso-ventral adductors of the feet, crossed by the adductors of the exites; *ht*, heart; *int*, intestine; *ov*, ovary; *n. g*, ventral ganglion; *en*[1]–*en*[5], endites; *br*, gill; *fl*, flabellum; *x*, subapical lobe.

" 2*a*.—1st antenna; 2*b*, 2d antenna; 2*c*, the extremity of 2d antenna, with four bead-like joints, showing the three imperfect joints, the third ending in a moniliform portion.

" 3.—Maxillipede with the gill (*br*) and single endite.

" 4, 4*a*.—Dorsal and lateral view of the brain of the European *Apus cancriformis*; *br*, brain; *com*, commissure to subœsophageal ganglion; *g. op*, optic ganglion; *oc*, ocellus; *œs*, œsophagus.

" 5.—Brain and part of ventral cord of *Apus cancriformis*; *oc*, nerve to ocelli; *ant*[1], *ant*[2], first and second antennal nerves; *G*[1], œsophageal; *G*[1], mandibular ganglion, sending off three mandibular nerves (*n md*); *d*, descending œsophageal nerve; *h*, unpaired or lower œsophageal ganglion; *œs*, nerve passing to the muscles of the œsophagus.

" 6.—Heart of *Apus cancriformis*.

" 7.—*Apus longicaudatus*, portion of embryonic membrane lying next to the chorion, and supposed to represent the amnion in Limulus; the nuclei in many of the cells have become absorbed.

" 8.—An egg of the same, showing the cellular nature of the amnion.

" 8*a*.—A portion of the same amnion seen sideways of the egg.

Fig. 1 drawn under the author's direction by J. S. Kingsley; Figs. 4, 4*a*, 5 and 6 copied from Zaddach; the remainder drawn with the camera by the author.

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IDOLS AND IDOL WORSHIP OF THE DELAWARE INDIANS.

BY CHARLES C. ABBOTT.

JOHN Brainerd, while a missionary among the Indians of New Jersey, recorded of one of these people, that "she had an aunt * * * * who kept an idol image, which, indeed partly belonged to her, and that she had a mind to go and fetch her aunt and the image, that it might be burnt; but when she went to the place she found nobody at home, and the image also was taken away." While this, indeed, is slender evidence of the occurrence of idol worship among the Delaware Indians, it is of interest in showing that images were not unknown, and that they possessed other significance and value than as mere ornaments. Any carving in wood or stone, merely used for personal decoration would not have become sinful in the mind of an Indian woman, through the preaching of the missionary; and a desire to destroy the object she reported as in her possession, must necessarily have arisen from the fact that it was regarded with superstitious reverence and invested with supernatural powers, in their belief.

Such "idols," however, unless usually made of material as perishable as wood, were of rare occurrence, if we may judge by the common experience of those who have been enthusiastic collectors of the ordinary stone implements of these people. Rude representations of the human face, it is true, have been quite frequently found; but the character of all these carvings is such as to suggest simply that they were intended merely as personal ornaments, and possessed no religious significance.

A recent discovery in New Jersey opens up the subject of the occurrence of "idols" among the Delaware Indians, and also furnishes another instance of the close relationship of the Ohio mound-builders and the Atlantic coast tribes. It has long been known to archæologists that elaborate carvings of the human head have been found, in mound regions, of such large size that their use as ornaments was impracticable, and their religious significance was therefore proportionately probable. Such a carving has been recently found in New Jersey, and is at present a unique specimen. For other reasons than this, however, it is of considerable interest. The brief but authentic history of this idol, if

Idol of the Delaware Indians.

we may so designate it, is this: It was found in clearing a previously uncultivated tract preparatory to building a dwelling house. The spot was covered with scrub pines, with an undergrowth of black huckleberry and, in the moister soil, of swamp blueberry. The drier soil, except some two inches of humus, was an exceedingly homogeneous yellow ferruginous sand; and the workman was impressed by the fact that his spade had struck a stone a few inches below the surface, as the spot was one so destitute of stone that the presence of one was deemed remarkable. His attention was also drawn to the fact that the stone seemed to be "set fast." He therefore drove his spade down by the side of the stone, and then throwing his weight on the handle, by this means started the object, which "came up with a click." Thus was the head broken from its base; and most unfortunately, no effort was made at the time to recover the missing portion. Many efforts have since been made, but as yet without success.

These particulars are of interest from one important fact. It is evident that the relic as obtained is only a small portion of a large object, the character of which can only be surmised. That the portion remaining in the ground is quite large, is shown by the resistance it offered to the considerable force exerted to displace it, and which resulted in the fracture of the specimen. This evidence of the considerable dimensions of the entire object is of interest archæologically, from the fact that the greater the size of any such carving the equally greater probability that the object possessed a religious significance in the estimation of its aboriginal owner.

It is not improbable that the missing portion of this interesting relic is simply a square base without any work having been put upon it other than polishing. This is inferred from the fact that essentially similar, but even more artistic carvings have been found in Western New York and in Ohio, having only such plain square bases. In the thirteenth report of the regents of the University of the State of New York, there is given a description, with illustrations of several carvings, which bear a marked resemblance to the New Jersey specimen. Some of them, indeed, evidence so great skill on the part of the sculptor, that doubts have been expressed as to their being the handiwork of the Indians. The finding of the New Jersey carving would seem to bear directly upon this question, for the skill shown in the production of the latter, is evidence that the more artistic New York examples of supposed aboriginal carving were not beyond the attainments of the Indian carver. It should be borne in mind also that the accuracy with which celts, axes and trinkets of various patterns were shaped from the hardest stones, is of itself sufficient to show that a faithful portrait in an easily worked material, was quite within their capabilities.

The "idol" so recently brought to light from barren New Jersey sands, possesses all those characteristics of feature and expression peculiar to the Indians of the Atlantic coast. The material is a compact argillaceous substance of a pale, olivaceous color. It is, in fact, an indurated clay-stone, and no doubt a nodule from the underlying cretaceous plastic clay cliffs on the shore of Raritan bay, near Keyport, New Jersey. These nodules abound in the clays just mentioned. The specimen shows, at the point of fracture, that this nodule is of unusual hardness, and has a clean conchoidal fracture. The slight depressions on the forehead are due to weathering, and the general condition of the surface indicates a considerable degree of antiquity. This fact, again, is of interest, as it adds to the series of facts already gathered concerning the handiwork of our coast tribes, which go to show that at the time of the Columbian discovery of the continent, the natives were not in as "advanced" a condition as they previously had been, and that the majority of the most artistic of their productions in stone, if indeed not all of them, were at that time veritable relics, and considered as such.

In the execution of the idol we have been considering, the artist has secured the peculiar Indian physiognomy, yet it has been from simple economy of labor given to certain salient points offered by the natural form of the nodule, the work being entirely limited to the front and upper part of the head. There is, strange to say, no labor given to the sides, the bunch-like prominences being left untouched, and the effect is produced of an irregularly winged aspect, somewhat Egyptian. This, of course, is purely accidental, and may be classed as one of those treacherous resemblances which have led to so much vain speculation as to the ethnic relationship of American and Egyptian civilizations.

The height of this fragmentary carving is five and one-half inches; the breadth, four and one-eighth. Curiously enough, these measurements are identical with those of two similar carvings found in Ohio, and nearly coincide with the measurements given of the specimens found in Western New York, to which reference has been made. Can, indeed, this uniformity of size be merely accidental? Does it not rather indicate that these similar objects, whether in the possession of mound-builders or coast tribes, had a like significance, and was it not in all probability religious in its character?

I am indebted to Professor Samuel Lockwood, of Freehold, New Jersey, for much of the information concerning the interesting object here described, and the details of its discovery. The specimen is in his cabinet.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Posthumous fame is doubtless of greater benefit to the community at large than to the person commemorated by it. The former are taught the possibilities of life by the examples of those who have achieved much, and are stimulated by it to exertion and to success. One of the most impressive forms of commemoration is the erection of statues in public places. The general public, especially those who do not read, are compelled to learn history when it is taught in the object lessons of the sculptor's and painter's arts. It has been the custom to erect statues to successful military men from time immemorial, and the United States has not been slow to follow the example of older countries. European nations, both ancient and modern, have also made statues of their philosophers, statesmen and artists, and although America has not yet immortalized many of her own sons in this way, she will probably do so ere long. We have statues of Humboldt, Shakespeare and other foreign worthies in our parks, but very few of our own masters have been so commemorated. We therefore look with pleasure on the movements to erect statues to Professor Henry, to Longfellow, and to Alexander L. Holley. England will erect a statue to Darwin and place it in South Kensington.

But an excellent method of attaining the same end is the establishment of scholarships bearing the name of the person whose memory it is important to preserve. It is greatly to be hoped that the subscription for the endowment of the Leidy chair of anatomy in the University of Pennsylvania, will be successful. This proposition is the more meritorious, since it is designed to benefit the present incumbent, Professor Joseph Leidy, during his life, as well as to commemorate his services to science.

The American committee selected to prepare a fitting memorial of Darwin in this country, are considering the advisability, as we understand, of creating a scholarship bearing his name, which shall support an American student of biology at some of the best schools of Europe. It is to be hoped that such a desirable proposition may be carried into effect.

The Bi-Centennial Association of Pennsylvania has issued a circular which sets forth a plan for the creation of a series of prizes for works in science and art, commemorative of the establishment of the Commonwealth by Penn two hundred years ago. The competitors must be natives or residents of Pennsylvania, and the sums awarded are $500 to $1000. The prizes will be mostly presented to the association by private persons, and will bear their names. A number of them have been subscribed. Such prizes, numerous in Europe, are rare here, and are a most effective method of stimulating the higher forms of intellectual effort.

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RECENT LITERATURE.

LUBBOCK'S ANTS, BEES AND WASPS.[1]—This volume is a reprint, with some omission of details, of Sir John Lubbock's papers which were read before the Linnæan Society of London. The volume is mainly devoted to ants, with a few pages referring to bees and wasps. The book is an important contribution to animal psychology, and is almost entirely a fresh record of facts observed by the author, who only refers to the observations of other naturalists for the purpose of introducing his own. Lubbock is a patient and most impartial observer, and is reticent as to ultimate questions, his method being purely inductive. However, at the outset Sir John feels disposed to place the ants next to man in intelligence, a position which may be disputed, as purely reasoning processes are perhaps at least as frequently observed in the mammals and birds, particularly the domesticated kinds, as in ants or bees.

We will now rapidly note the original discoveries of our author, such as prove to be additions to our stock of knowledge of insect mental traits. Lubbock is the first to show that in ants (*Myrmica ruginodis*), the queens have the instinct of bringing up larvæ and the power of founding communities; and not queens only, but, as has been shown by Denny, Lespès, Dewitz, and proved by Forel, the workers will lay eggs which produce males. Lubbock has further proved that the worker eggs only produce males. While it has formerly been supposed that ants live but one year, Lubbock kept two queens over seven years, and they "are probably more than eight years old." They seem in perfect health, and in 1881 laid fertile eggs, a fact which suggests physiological conclusions of great interest. He also has workers "more than six years old."

While English ants do not, as in warmer countries, lay up food for the winter, "they do more, for they keep during six months the eggs which will enable them to procure food during the following summer, a case of prudence unexampled in the animal kingdom."

[1] *Bees, Ants and Wasps.* A record of observations on the habits of the social Hymenoptera. By Sir JOHN LUBBOCK, Bart. New York, D. Appleton & Co.

As regards the slave-keeping propensity of ants and its effect upon the ant character, we have many fresh observations. During more than four years' observations of a nest of Polyergus, Lubbock's specimens "certainly never fed themselves, and when the community changed its nest, which they did several times, the mistresses were carried from the one to the other by the slaves." With Huber he does not doubt that specimens of Polyergus, if kept by themselves in a box, would soon die of starvation, even if supplied with food. "I have, however, kept isolated specimens for three months, by giving them a slave for an hour or two a day to clean and feed them; under these circumstances they remained in perfect health, while, but for the slaves, they would have perished in two or three days. Excepting the slave-making ants and some of the Myrmecophilous beetles above described, I know no case in nature of an animal having lost the instinct of feeding." In *Polyergus rufescens*, the so-called workers, though thus helpless and idle, are numerous, energetic and, in some respects, even brilliant. In another slave-making ant, Strongylognathus, the workers are much less numerous and so weak that it is an unsolved problem how they continue to make slaves. They make slaves of *Tetramorium cæspitum*, which they carry off as pupæ. The extreme in the series of slave-making ants is Anergates, which differs from all other ants "in having no workers at all." The male is wingless; they and the females are accompanied and tended by *Tetramorium cæspitum*. The Anergates are absolutely dependent upon their slaves, and cannot even feed themselves. Lubbock thinks male and female Anergates make their way into a nest of Tetramorium "and in some manner contrive to assassinate their queen." As regards the effect upon the character of the ants, we quote as follows from our author:

"At any rate, these four genera offer us every gradation from lawless violence to contemptible parasitism. *Formica sanguinea*, which may be assumed to have comparatively recently taken to slave-making, has not as yet been materially affected.

"Polyergus, on the contrary, already illustrates the lowering tendency of slavery. They have lost their knowledge of art, their natural affection for their young, and even their instinct of feeding! They are, however, bold and powerful marauders.

"In Strongylognathus the enervating influence of slavery has gone further, and told even on their bodily strength. They are no longer able to capture their slaves in fair and open warfare. Still they retain a semblance of authority, and when roused will fight bravely, though in vain.

"In Anergates, finally, we come to the last scene of this sad history. We may safely conclude that in distant times their ancestors lived, as so many ants do now, partly by hunting, partly on honey; that by degrees they became bold marauders, and gradually took to keeping slaves; that for a time they maintained their strength and agility, though losing by degrees their real independence, their arts and even many of their instincts; that gradually even their bodily force dwindled away under the enervating influence to which they subjected themselves, until they sank to their present degraded condition—weak in body and mind, few in numbers, and apparently nearly extinct, the miserable representatives of far superior ancestors, maintaining a precarious existence as contemptible parasites of their former slaves."

As to the passions of these creatures, Lubbock states that ants of the same nest never quarrel. "I have never seen the slightest evidence of ill-temper in any of my nests, all is harmony. Nor are instances of active assistance at all rare. Indeed, I have myself witnessed various cases showing care and tenderness on their part." As to their recognition of one another, it appears that it is not personal or individual, "their harmony is not due to the fact that each ant is individually acquainted with every other member of the community. At the same time the fact that they recognize their friends even when intoxicated, and that they know the young born in their own nest even when they have been brought out of the chrysalis by strangers, seems to indicate that the recognition is not effected by means of any sign or pass word." As to the power of communication, the results of a number of experiments taught our author that while they do not possess "any considerable power of descriptive communication," on the other hand, there can, he thinks, be no doubt but that they do possess some power of the kind. He concludes that his experiments "certainly seem to indicate the possession, by ants, of something approaching to language. It is impossible to doubt that the friends were brought out by the first ant; and as she returned empty handed to the nest, the others cannot have been induced to follow her merely by observing her proceedings. In face of such facts as these, it is impossible not to ask ourselves how far are ants mere exquisite automatons; how far are they conscious beings? When we see an ant hill, tenanted by thousands of industrious inhabitants, excavating chambers, forming tunnels, making roads, guarding their home, gathering food, feeding the young, tending their domestic animals—each one fulfilling its duties industriously, and without confusion—it is difficult altogether to deny to them the gift of reason; and the preceding observations tend to confirm the opinion that their mental powers differ from those of men not so much in kind as in degree."

While our author concludes that ants track one another by scent, he is inclined to adopt the mosaic theory of insect vision, and from experiments with the spectrum, concludes that "(1) ants have the power of distinguishing colors; (2) that they are very sensitive to violet; and it would also seem (3) that their sensations of color must be very different from those produced upon us." The sense of hearing appears to be lodged in the antennæ, certain stethoscope-like organs occurring there, though ants are deaf to ordinary sounds, still he thinks that ants perceive sounds which we cannot hear. On the other hand the sense of smell is highly developed, and how important this is in enabling them to find their way is shown in chapter IX, where are some curious statements both as to their apparent want of ingenuity, especially in constructing bridges and earthworks. Ants while guided by scent are also guided by sight, and are greatly influenced by the direction of the light.

In the chapter on bees he records experiments showing that honey bees "do not bring their friends to share any treasure they have discovered, so invariably as might be assumed from the statements of previous observers," and he has been a good deal surprised at the difficulty which bees experience in finding their way. His observations also teach him that "though bees habitually know and return to their own hive, still, if placed on the alighting-board of another, they often enter it without molestation." He was unable to discover any evidence of affection among bees, they appearing "thoroughly callous and utterly indifferent to one another." Contrary to the usual statements, he finds their devotion to the queen to be "of the most limited character," and the workers take no notice of their dead companions. Bees possess a keen power of smell, but like ants the sense of hearing is very dull; they possess, however, a color sense, preferring one color to another, blue being distinctly their favorite.

A brief final chapter is devoted to wasps, and Lubbock's experiments, "in opposition to the statements of Huber and Dujardin, serve to show that wasps and bees do not in all cases convey to one another information as to food which they may have discovered, though I do not doubt that they often do so." They are also not affected by sounds, and they are capable of distinguishing color, "though they do not seem so much guided by it as bees are."

The book has appendices giving details of experiments regarding the recognition by ants of friends after long separation, and on the power of communication of ants and bees, with notes on the industry of wasps, for Lubbock's investigations more than confirm the general belief as to the great industry of all these insects.

The work is a magazine of facts, materials for farther work on animal psychology. It should stimulate our youth of both sexes who are in any way interested in the study of nature, to observe patiently and thoroughly the habits of our insects. Any one of ordinary capacity can make similar observations, even those who are busy in other directions, for all of Sir John Lubbock's works have been prepared in moments snatched in the intervals of the life of a great banker and busy member of Parliament.

LÜTKEN'S ZOOLOGY.[1]—As respects fullness of detail, and especially the illustrations and press-work, this compact volume makes a most favorable impression. The author, Dr. Lütken, has long been known as one of the leading zoölogists of Denmark, and in fact of Europe. He has published copiously on fishes, Crustacea and especially Echinoderms, being one of the first living authorities on the latter group of animals. The Scandinavian naturalists are distinguished for the care and accuracy of their work, and these qualities are without doubt characteristic of the work before us.

The plan of this zoölogy is somewhat like that of Peters and Carus' and Claus' zoölogy, and is designed for the advanced, working zoölogist. It will prove valuable for reference to the American student, especially on account of the admirable wood-cuts, many of which are new, while all have been drawn and engraved with evidently great fidelity. It begins with the vertebrates and ends with the Infusoria. Over half of the volume is devoted to the vertebrates, and much attention is paid to the ganoids, a strong point with the author, whose restorations of extinct forms are new and valuable. The arthropods and worms are placed above the mollusks, and among the latter appear the tunicates. The Scandinavian naturalists are slow to adopt radical changes in classification, and although we should differ with the author in some taxonomic matters, we congratulate his countrymen at having such an admirable hand-book placed in their hands.

GROTE'S ILLUSTRATED ESSAY ON THE NOCTUIDÆ OF NORTH AMERICA.[2]—This essay relates to the structure and literature of our Noctuidæ, an extensive family of moths which has formed the subject of many papers by Mr. Grote, whose faithful pioneer work on this group has rendered American entomology a lasting service. The notes on Mr. Walker's types in the British Museum are the results of a second examination of that collection. The section entitled "Specimens of North American Noctuidæ" is illustrated with four excellent chromo-lithographs, drawn by A. H. Searle, in London. The book is thoroughly well printed and bound, and is an important addition to our lepidopterological literature.

RECENT BOOKS AND PAMPHLETS.—Mission G. Revoil aux Pays çomalis, Faune et Flore. Reptiles et Batrachiens. Par M. Leon Vaillant.

Note sur les Cyprinodon du Groupe du C. calaritanus. Par M. H. E. Sauvage. Pl. III. From M. Leon Vaillant.

Report of T. B. Ferguson, Commissioner of Fisheries of Maryland, January,

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[1] *Dyreriget.* En Haand-og Lærebog til Brug ved höjere Læreanstalter. (Lærebog i Zoologien Nr. 1.) Af Chr. FR. LÜTKEN. Fjerde Udgave. Kjöbenhavn, 1882. 8vo, pp. 699.

[2] *An illustrated essay on the Noctuidæ of North America;* with "A colony of Butterflies." By AUGUSTUS RADCLIFFE GROTE. London, John Van Voorst, 1882. 8vo, pp. 85. Price 10s. 6d.

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Address by W. H. Dall, vice-president Section F, before the Section of Biology, American Association for the Advancement of Science, Montreal meeting, Aug. 23, 1882. From the author.

Conference sur l'Unification des Travaux Géographiques. Par M. B. DeChancourtois. 1879. From the author.

Transcription des Noms Géographiques en lettres de l'Alphabet Latin. Par M. B. DeChancourtois. 1878. From the author.

De l'Unification des Travaux Géologiques en general, et particulièrement en ce qui concerne les Figures Conventionnels. Par M. B. de Chancourtois. From the author.

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GENERAL NOTES.

BOTANY.[1]

SOME NEW SPECIES OF SPHÆRIACEOUS FUNGI.—The four species here described were found on petioles of *Sabal serrulata*, at Green Cove Springs, Fla., during the winter of 1881–2, by Dr. Martin.

Diatrypella deusta E. and M.—Perithecia coriaceous, flask-shaped, about 3 mill. in diam., buried in the substance of the matrix, without any distinct stroma or circumscribing line, in elongated clusters of 6–12, the obtuse imperfectly quadrisulcate ostiola raising the epidermis into distinct ridges which appear blackened as if carbonized, and are often split longitudinally along their crest; asci lanceolate, $57–75 \times 5\frac{1}{2}—7$ μ. Sporidia cylindrical, curved, yellowish, $5\frac{1}{2}–7 \times 1\frac{1}{4}$ μ

Sphæria (Anthostomella) leucobasis E. and M.—Perithecia globose or subelliptical, about ⅓ mill. diam., buried in the matrix in definite groups, above which the epidermis is generally more or less blackened, the discolored patches mostly limited by a well-defined line which does not, however, penetrate deeply; ostiola obtuse, barely piercing the epidermis; asci cylindrical, 75–80 μ long; sporidia uniseriate, elliptical, brown, $11–13 \times 5\frac{1}{2}–7$ μ.

The substance of the petiole beneath the clusters of perithecia,

[1]Edited by PROF. C. E. BESSEY, Ames, Iowa.

is partially bleached so that a longitudinal section shows dull white blotches which indicate the presence of the fungus.

Sphæria sabalicola E. and M.—Gregarious or scattered, perithecia coriaceous with rather thick walls, about ⅓ mill. diam., covered by the epidermis which is raised into little obtusely conic projections around which the surface of the matrix is of a tawny color; asci clavate-cylindrical, 57 × 8 μ. Sporidia biseriate, oblong, 3-septate, brown, about 11 × 3½ μ.

Sphæria sabalensioides E. and M.—Perithecia scattered, minute, ¼ mill. diam., globose, covered, the short ostiolum barely piercing the epidermis and visible under the lens as a small black dot; asci 75–80 × 7½–9 μ. Paraphyses none; sporidia biseriate, elliptic-fusiform, appendiculate, yellowish, with a gelatinous envelop, 13–15 × 3½–3¾ μ. The short filiform appendages at each end of the sporidia are soon absorbed.

Sphæria sabalensis Cke., to which this is closely allied, has much longer sporidia (50 μ.).

To the above described species, which appear to be quite distinct from any of the species on Sabal published by Berkeley and Cooke, may be added:

Cercospora malvicola E. and M. (N. A. F. No. 821).—Amphigenous, minutely tufted on withered spots in the leaf; hyphæ gray, nodulose, sparingly branched, 90–114 μ. high; conidia terminal, narrow cylindrical or attenuated above, 5–7-septate, 75–95 μ long. Differs from *C. malvarum* Sacc., in its shorter hyphæ and conidia, duller color and orbicular spots.—*J. B. Ellis and Dr. Geo. Martin.*

New Fungi by J. B. Ellis.—*Cercospora cercidicola.*—On brown spots on living leaves of *Cercis canadensis.* Hyphæ fasciculate brown, 114 × 3½ μ., tips divaricate bearing the oblong-clavate, 3-septate (30–38 × 5–7 μ.) conidia,

Cercospora physalidis.—Amphigenous on white deciduous spots 1–2 mill. in diam. Hyphæ brown subnodulose, 45–55 × 5–5½ μ.; conidia clavate-cylindrical, faintly 5–8 septate 65–75 × 4 μ. On leaves of Physalis.

Cercospora euonymi. — Amphigenous on small white round spots, 1–2 mill. in diam., with a dark purple border. Hyphæ subnodulose brown, about 60 μ. high, conidia 50–65 × 7–8 μ. clavate-cylindrical 3–5-septate. On leaves of *Euonymus americana.*

Cercospora asclepiadis.—On *Asclepias cornuti.* Amphigenous, but mostly on the upper surface of the leaf, on suborbicular spots 1–3 mill. in diam., black at first but soon becoming white in the center, with a definite dark brown or nearly black raised border around which the leaf is stained purplish brown; hyphæ fasciculate subnodulose and sparingly toothed above, brown, 40–50 × 4 μ.; conidialinear clavate, about 5-septate, hyaline, 80–120 × 3½–4 μ.

Quite different from *C. clavata* Ger., which is also found on several species of Asclepias.

Cercospora toxicodendri.—Snow white on black spots 1–2 mill. diam. Hyphæ short, 25–30 × 5½ μ., pale brown; conidia slender clavate, faintly multiseptate above, contracted below into a slender base, 50–60 × 5–6 μ. On leaves of *Rhus toxicodendron*, Newfield, N. J.

Septoria sisymbrii.—On withered faded spots. Perithecia minute, erumpent, scattered or in groups of 3–4 open above as if the apex had been torn away; spores linear, 1–2 septate, 30–40 × 3–3½ μ., mostly curved, ends rather obtuse. The spores scarcely differ from those of *S. siliquastri* Pass., but the habit is different.

Septoria pruni.—Perithecia immersed in dark brown deciduous spots, 1–3 mill. diam. Spores cylindrical curved, obtuse, 4–6-septate, 30–50 × 2 μ. On leaves of *Prunus americana*.

The above species, except the one noted, were collected in the vicinity of Lexington, Ky., by Professor W. A. Kellerman.

The measurements are in millimeters (mill.) and micromillimeters μ., *i. e.*, thousandths of a millimeter.—*J. B. Ellis, Newfield, N. J.*

Pacific Coast Botany.—Our botanists of the western coast are showing a most commendable activity, worthy of imitation by those of the older portions of the country. Not content with the possession of the finest local flora of any country in their "Botany of California," they are pushing on with a vigor which will without much doubt enable them to complete the systematic disposition of all their native plants long before it can be done for any other part of the United States. The fungi of the coast have been carefully collected and catalogued by Harkness and Moore; Anderson has helped to make known the seaweeds of the coast, many of which have been distributed in Farlow, Anderson, and Eaton's "Algæ Am. Bor. Exsiccatæ." The lichens collected have been submitted to Professor Tuckerman for study, while the mosses and ferns were admirably worked in "Botany of California." All this implies persistent collecting, and good collecting at that. That the search for plants is carefully carried on may be shown by a reference to our two botanical journals, the *Torrey Bulletin*, and the *Botanical Gazette*, in which descriptions of new species crowd upon one another in rapid succession. The sets of plants now offered by the many collectors bring the coast flora within the reach of every one. We have recently examined plants of several of these sets—notably those of G. R. Vasey, the Parrish Bros., San Bernardino, Cal.; M. E. Jones, now of Salt Lake City; J. G. Lemmon, of Oakland, Cal., and find them to be most excellent. Among the plants sent out by Parrish Bros., are some very interesting Southern Californian species new to science, or but recently described. Likewise among Mr. Lemmon's ferns, are several new ones, and several other rare ones.

In Oregon, Professor G. H. Collier, of Eugene City, has just published a "List of the trees of Oregon," an eight page pamphlet, giving "the maximum observed height and diameter," of fifty-seven trees, with the local names and occasional remarks as to habitat or economic uses. Thomas Howell, of Arthur, Oregon, has also issued a "Catalogue of the Plants of Oregon" which, although defective in some particulars, is valuable as being based upon actual collections.

The last thing we have from our western botanists is Professor Rattan's third and much enlarged and improved edition of his "Popular California Flora." The introductory lessons contain many fresh notes and illustrations that are interesting, as for example, that on the germination of the big-root (*Megarrhiza*) on p. IX, and one on the germination of lupines on p. X. The Flora proper furnishes a handy manual for the study of the commoner and easier plants of Central California.

GRAY'S "CONTRIBUTIONS TO NORTH AMERICAN BOTANY."—In this we have: I. Studies of Aster and Solidago in the older herbaria, and, II. Characters of the new plants of certain recent collections, mainly in Arizona and adjacent regions. The first is of great interest to North American botanists, as it is the result of Dr. Gray's studies in the great herbaria of the old world, during his recent visit to England and the continent of Europe. The introductory paragraph is so suggestive that we reproduce it here entire.

"Aster and Solidago in North America, like Hieracium in Europe, are among the larger and doubtless the most intractable genera of the great order to which they belong. In these two genera, along with much uncertainty in the limitation of the species as they occur in nature, there is an added difficulty growing out of the fact that many of the earlier ones were founded upon cultivated plants, some of which had already been long in the gardens, where they have undergone such changes that it has not been easy, and in several cases not yet possible, to identify them with wild originals. Late flowering Compositæ, and Asters especially, are apt to alter their appearance under cultivation in European gardens. For some, the season of growth is not long enough to assure normal and complete development, and upon many the difference in climate and exposure seems to tell in unusual measure upon the ramification, inflorescence and involucral bracts, which afford principal and comparatively stable characters to the species as we find them in their native haunts. I am not very confident of the success of my prolonged endeavors to put these genera into proper order and to fix the nomenclature of the older species; and in certain groups absolute or practical definition of the species by written characters or descriptions is beyond my powers. But no one has ever seen so many of the type-specimens of the species as I have, nor given more time to the systematic study of these genera. * * *

"It is noticeable that the herbarium of Nees von Esenbeck for Aster is not referred to. *I cannot ascertain what has become of it.* But the types of several of his species, or specimens named by him, have been met with in other herbaria, especially in that of Lindley, and that of Schultz, Bip., the latter now a part of the large collection of Dr. Cosson. As to Asters, I do not here attempt anything beyond a report of the main results of the study of certain principal herbaria; and I leave the high northern and far western species out of the present view."

ZOÖLOGY.

Habits of Fresh-water Crustacea.—No one branch of biological study is now bringing forth more interesting and every way useful results than embryology. Throwing light as it does, not only on questions of classification and theoretical biology, but also on the application of such theories to practical life, this new science may be termed at once the root and most typical fruit of a revolutionized biology. No other science furnishes a better illustration of the value of minute, accurate study of the most common and apparently insignificant facts. Sets of isolated facts evolved by conscientious study of different men spring suddenly into line when once the clue is found, and the result may be a new law which renders all these facts eloquent.

To the systematist the merely external study of life histories is of greatest value as a check against redundancy in classification, and furnishes the only reliable method, among lower forms at least, of setting the bounds of species.

Many eminent monographers have been obliged to considerably augment the nomenclature of their specialty with names which, later, have proved to apply simply to larval or immature forms, on account of the impossibility of following the whole life history of each individual.

To confine ourselves to the class Crustacea, many instances of this sort could be recounted. The best known is perhaps that of the common Cyclops which in the earlier days of carcinology enjoyed as many as three names between its exclusion from the egg and maturity. The discovery of the earlier stages in the life of Cyclops opened a new vista in the whole subject, and now we recognize a "*Nauplius stage*" in the life-history of nearly every crustacean.

It has been more recently discovered that similar opportunities for error are afforded by the difficulty of distinguishing the ultimate stage in an animal's life. It has been shown that the functions of reproduction are anomalous in the lower animals. Especially is this true in Crustacea, in so much that their condition affords no sufficient evidence that the sexually mature animal is in its historically perfect form. The enthusiasm elicited by the discovery that certain amphibians, under some circumstances, reproduce during a larval stage, was almost unparalleled, but I believe it demonstrable that, not only species, but families of lower Crustacea are normally sexually mature in a stage preceding actual maturity.

We most naturally turn to the order Branchiopoda for a test, since the most remarkable cases on record of heterogeneous reproduction have recently been read in their history. We need only mention the parthenogenetic summer brood of Daphnia,[1] and the case of heterogenesis discovered by G. O. Sars in Leptodora,[2] in which Sars concludes that *L. hyalina* has both "dimorphous development and alternation of generations." Nor are we disappointed in looking among the Cladocera for examples of heterogenesis. During the winter semester of 1881–82, at Leipzig University, we had the opportunity of studying the development of *Daphnia magna* (=*schäfferi*), and among other interesting facts the following were elicited:

The development proceeds in very much the way described for Moina by Grobben.[3] The secondary or swimming antennæ have an evident palpus in the nauplius stage, however, which makes the parallel complete between Copepod and Branchipod Crustacea. The heart and circulatory system apparently is formed differently from the method given by Grobben. I may be permitted to say in this connection, that the circulatory system is much more complicated than hitherto described, and seems to originate about a mass of deutoplasm which surrounds the intestinal canal in the embryo, and which is a remainder of the food-yolk, "*Nährungsdotter*," of the egg. The embryo, in a comparatively early age, begins to differentiate the walls of the valves, which first appear as a fold over the maxillary region near the position occupied by the heart, and extends gradually backwards in a thick fold of turgid cells between which fluid flows. Quite remarkable is it that from the dorsal region a process extends, growing much more rapidly than the lateral portion till it reaches the membrane of the egg, when it curves downward and forwards till it reaches a position nearly half way from the extremity of the abdomen to the maxillæ. The method of growth of this tail-like appendage of the shell is obscure, but it seems to stand in close relation to the formation of the brood-

[1] See J. Lubbock; Phil. Trans., Vol. 147, p. 98.
Cfr. R. Leuckart: Archiv. f. Naturg., XXXI, and
v. Siebold: Wahre Parthenogenesis bei Schmetterlingen und Bienen.

[2] G. O. Sars: Om en dimorph Udvikling samt Generations vexel hos Leptodora, 1873.

[3] Die Entwicklungeschichte der *Moina rectirostris*, von Dr. Carl Grobben. Vienna, 1879.

cavity, and is the result of a secondary folding of the common shell envelop. At the close of the development in the egg, this "tail" lies between the valves of the shell, curved beneath like the tail of a frightened dog, although the frequent motions of the post-abdomen are not a little hindered thereby.

On its escape from the egg, the animal swims freely, and soon kicks this pliant appendage backward and upward till it assumes a direction parallel to the long axis of the body, and then very soon its unequal growth causes this tail to be somewhat elevated. The appendage probably serves as a support for the cast off skin in the molt, so that it cannot fall down upon the post-abdomen and then be broken off before that portion of the shell forming the inner covering of the brood cavity can be successfully molted—a danger especially incident to long forms with narrow brood cavities, and to young animals in which the shell is tender. (It may be for this reason that males, in which the part corresponding to the brood cavity is very narrow, and young females, have this spine, while adult females do not, for, as is well known, the males of all this section of the genus are spined through life.) Successive moltings increase the size of the animal, but the spine remains and increases correspondingly, giving the animal a very different appearance from the parent, which was not only of an entirely different form but totally without the spine.

Finally the young female produces eggs parthenogenetically, and is, therefore, according to our customary notions, an adult. We have here, therefore, a case of heterogenesis. Under circumstances where food is not sufficiently abundant, it seems certain that the above-mentioned state is the final one, and that the animal does not reach that condition which we name *Daphnia magna*, but remains in a stage which has received a different specific name.

The same process has since been observed in the case of *Daphnia pulex*, in Minnesota. Some of the so-called varieties are but age-forms. There is in each species what may be called a *post-imago* form, which is only assumed under favoring conditions. Without going into the synonymy of this genus, which will bear a revision in view of this and similar facts, we may safely say that in the Daphnidæ we find heterogenesis almost a rule, at least in the genus Daphnia.[1] We may add that every possible provision for the reproduction of these animals seems to be provided. (1) They are very prolific; (2) reproduce both sexually and parthenogenetically; (3) resist great extremes of temperature; (4) accommodate themselves to great alterations in the purity of the water; (5) the winter eggs are provided with a horny covering or *ephippium*, which permits them to be dried in a mass of mud or frozen in a cake of ice without destroying their vitality; (6)

[1] See Birge, Notes on Cladocera, Madison, Plate II, Fig. 6.

during mild winters both summer and winter eggs are produced, and the successive broods of young after producing agamic young, throw off an ephippium so that the pool is filled with eggs which are calculated to stand any vicissitude. Thus it happens that after a pond has been dried for a long time the first warm shower quickens in it swarming life. The above facts are more significant when we remember that the Cladocera are above all others among Crustacea, the most useful as purifying agencies. The greater number subsist entirely upon vegetable matter, and the only means they have of collecting it is by causing a current of water containing such minute particles as may exist in it to pass between the rotating jaws, though, perhaps, in some cases the labrum is sufficiently prehensile to grasp somewhat larger food. Certain it is, however, that these same minute animals form an indispensable agent in the economy of nature, purifying all our stagnant pools of the decaying vegetation floating therein. One who had given no attention to the number of these creatures would undoubtedly be surprised on carefully examining a given quantity of water from the nearest lake. Here are some figures.

In a quart of water taken by dipping from a lake near Minneapolis, the following were counted:

Ceriodaphnia	1400
Daphnia	9
Simocephalus	56
Cypris	50
Cyclops	28
Amphipods (chiefly young)	120
Infusoria	35
Mollusks	22
Diptera (larvæ)	100
Hemiptera	9

etc., all visible to the unassisted eye.—*C. L. Herrick.*

On the Habits of Cryptobranchus.[1]—Living examples of this Japanese salamander have rarely been brought to this country, and the following observations may be worth recording even if they merely confirm those of Hyrtl, Van der Hoeven and others, whose works I have not yet had an opportunity to consult.

This specimen is about seventy-five centimeters (2½ ft.) long, and was obtained for Cornell University through Professor H. A. Ward, who brought it by hand from Japan.

It is very sluggish, remaining quiet for hours in water, excepting for the respiratory movements presently to be described. Nevertheless it can display considerable activity, and upon one occasion escaped from a common wash-tub which was about thirty centimeters (1 ft.) deep. Out of water it appears uncomfortable, and crawls first in one direction and then in another,

[1] Read at the Montreal Meeting of Amer. Association for Advancement Science, August, 1882.

with frequent stoppages. It evidently seeks shelter from the sun, but gives no sign of discrimination between objects, walking against dogs and cats and people as readily as against wood and stone. The trunk is never lifted from the ground, and the compressed tail rests on one side, but the head and neck are sometimes raised.

The respiratory actions in deep water I have not accurately observed, but in shallow water, just covering it, the nostrils are raised above the surface at frequent intervals, a slight hissing sound is heard, and after the nostrils are again carried below the surface, a few bubbles of air escape therefrom and there are muscular movements about the neck. During an hour, in freshly changed water, these respiratory actions occurred at intervals varying from half a minute to twelve minutes, but usually the time was from two to four minutes.

No notice was taken of raw or cooked beef or fish, either floating at the surface, lying at the bottom or suspended just above the water.

But if bits of food are dropped close to the mouth or allowed to slide over the top of the head, or held at the lips, they are readily snapped up and swallowed, if not too large. After a time the head was moved slowly toward meat held about one centimeter from the lips, but I could not determine whether sight or smell were the sense concerned. Neither have I ascertained the function of the tubercles.

This specimen has now eaten the following articles: Beef heart, raw and boiled; blue-fish, raw and broiled; hard boiled white of egg, canned roast beef, raw lamb's heart, liver, diaphragm, thymus and lung, baked maccaroni. Evidently there is no difficulty in keeping the animal alive.

I hope to make careful observations of Cryptobranchus in comparison with Menopoma and Menobranchus.—*B. G. Wilder, Ithaca, N. Y.*[1]

Mammals of New Guinea.[2]—The Annals of the Museum of Natural History, Genoa, for 1880–81, contain a list of fifty-seven species of mammals collected in New Guinea by L. M. D'Albertis and A. A. Bruijn, illustrated with fourteen plates of new species.

The work of identification and description has been performed by Dr. Peters, director of the Berlin Museum, and G. Doria, director of that of Genoa.

In their introduction these gentlemen state that the Australian element in the New Guinea fauna is continually on the increase, as evidenced by the late discovery in that island of the genera *Tachyglossus*, *Dasyurus* and *Dromicia*. Thirty species of marsupials, forming almost the half of the known mammals of Papua, have been found, and, although almost all the species are peculiar,

[1] The habits of this species are described by Duméril and Bibron, Herpetologie Generale, IX, 1854, p. 165.

[2] Annali del Museo Civico di Storia Naturale di Genova, Vol. XVI, 1880–81.

they yet belong to Australian genera. Twenty-two species of marsupials are included in the list. Those described by our authors are *Phascogale dorsalis*, *P. pilicauda*, *Perameles rufescens*, *P. arvensis*, *P. longicauda*, *Phalangista angustivittis*, *P. Albertisii*, *P. pinnata*, *P. gymnotis*, and *Macropus papuanus*.

It is remarked that the genus *Phascogale* evidently takes the place in Papuasia of the insectivorous genus *Tupaia* of Malaysia. There is no pouch in this genus, and the females of the two new species differ in the number of their mammæ, of which *P. dorsalis* has four, *P. pilicauda* six. Six species of this genus are now known to inhabit the region.

Perameles rufescens is comparatively large, measuring 52 centimetres (1.′–9″) in total length. Five species of this genus are known to be Papuasian.

The genus *Phalangista*, as understood by our authors, includes *Dactylopsila*, *Pseudochirus*, *Distoechurus* (Peters), and *Cuscus*. Eight species are enumerated. *P. Albertisii* is a fine species, about 14 inches long, excluding the prehensile tail, which exceeds a foot in length; it is reddish-brown, shaded with black above, with an indistinctly-bounded black band along the back. *P. pennata* is of about the size of a dormouse, or smaller than a rat. In color this pretty little creature is yellowish-brown with two black bands passing from the forehead through each eye to the muzzle. The tail is naked above and below, but bears on its margins long hairs, causing the whole to resemble a feather. An adult female had a well developed pouch, containing a single young one; the mammæ were only two.

P. gymnotis is remarkable for its naked ears and short fur, and is less arboreal than its congeners. In size it exceeds *P. Albertisii*, as it is about a yard in total length. It is stated that *P. trivirgata* Gray, is found by Dr. Albertis to be entirely insectivorous instead of frugivorous, as was asserted by Wallace.

Only three examples of *Macropus papuanus* were taken, and unfortunately the skulls belonging to the two larger skins were lost, but the length of the sole of the hind feet was 10 inches, and D'Albertis asserts that it attains a stature but little inferior to that of *M. giganteus*. *Macropus Bruni* of Schlegel inhabits the islands Aru and Kei, while *Dorcopsis Mülleri* Schlegel, is found with *P. papuanus* on the eastern coast of New Guinea. The remaining kangaroos of the region are *Dorcopsis luctuosus* (D'Albertis) and two species of the tree-inhabiting genus *Dendrolagus*.

The discovery of the monotreme, *Tachyglossus Bruijnii*, described by Peters and Doria in 1876, is one of the most important in the field of geographical distribution, that had been made for several years. The French explorer, Leon Laglaize, has since procured some examples at a height of about 3500 feet above the sea-level, in the Karon mountains of New Guinea. The natives call it "Nokdiak" and chase it with dogs that follow it into its deep burrows. Professor Gervais, after a study of this animal, has founded for it the genus *Acanthoglossus* on account of the spines at the tip of the tongue. In 1877, *Tachyglossus (Echidna) Lawesii* was described by L. P. Ramsay, of Sydney, from an example taken by the Rev. Mr. Lawes at Port Moresby. *T. Bruijnii* of the north of New Guinea, is near *T. setosus* of Australia, while *T. Lawesii* is the representative of the Australian *T. hystrix.*

Nineteen species of Cheiroptera are enumerated, and two others are known. Among these *Emballonura Beccarii* and *Vesperugo papuanus* are new. Many of the bats are Malaysian, Australian or Polynesian.

The only insectivore of the Papuan group, *Crocidura luzoniensis* (Peters), was probably introduced from the Molluccas; and to introduction New Guinea probably owes its single wild ungulate, *Sus papuensis* (Lesson).

Among the thirteen rodents of the list the cosmopolitan *Mus rattus* and *Mus decumanus* find a place, followed by six others of the same genus, four of *Uromys* (Peters) and one of *Hydromys* (Geoffroy).

Results of the Voyage of the Magenta.—Prof. A. T. Tozzetti, of the Museum of Florence, has published a list of the Brachyura obtained by the Italian frigate *Magenta* in its circumnavigation of the world. The list includes sixty-three species.

The same naturalist contributes valuable notes upon the Mediterranean cephalopods. Thirty-one species of Dibranchiata are enumerated, with many additional particulars respecting their distribution and habits. The hectocotyle of *Parasira tuberculata* Tozzetti (=*Octopus violaceus* Risso) contains a single spermatophore in the form of a filament rolled upon itself. This takes the place of the many smaller spermatophores of ordinary cephalopods. *Octopus troscheli* is a new species differing from *O. vulgaris* in dimensions, proportion of arms and body, and disposition of the acetabula. Other new species are *Octopus incertus*, *Sepiola major* and *Rossia panceri*. *Ornitholepus australis* a small pedunculated cirriped living upon the ends of the abdominal feathers of a puffin, *Priofinus cinereus*, has also been lately described by Professor Tozzetti. Nearly a hundred of these birds were taken by the *Magenta* in the South Atlantic and Indian ocean, and all were infested with this parasite upon the barbs and barbules of the central abdominal feathers, while those taken in the Pacific were free from it. The strangeness of this parasitism is heightened by the fact, that *Priofinus* is one of the most ærial of birds, only resting upon the water at long intervals. None of the other Procellaridæ taken in the same regions harbored a cirriped, but all the species were well supplied with Anoplura of the genera *Lipurus* and *Docophoroides*.

THE INK-BAG OF THE CEPHALOPODA.—The researches of M. Paul Girod upon a great number of Cephalopods of the North sea and the Mediterranean, researches carried on in several successive sojourns at Roscoff and Banyuls, have elucidated many points in the anatomy, physiology and development of the ink-bag of those mollusks. The ink-bag is a long, black, pyriform sac opening at the summit of a papilla upon the posterior lip of the anus, and consists of a large reservoir, and of an ink-gland attached to the posterior face of the reservoir, and communicating with it by means of a small round orifice at its upper part. This description differs from that of preceding naturalists, whose statements are to the effect that the secretory apparatus consists of a reservoir whose walls are thrown into folds circumscribing spaces which pour the products of secretion directly into it. In the decapods the gland is free and projects into the ink-sac, but in the octopods the walls of the glands are united for much of their extent with the wall of the reservoir.

Ink-sac and gland are enclosed in a common envelope, consisting of an external tunic of conjunctive tissue; a middle tunic composed of a bed of smooth transverse muscular fibers crossed by a layer of horizontal fibers, and succeeded by a layer of pigment cells; and an internal tunic constituting the special membranes of the gland and reservoir. At the mouth of the sac is a terminal ampulla, bounded at each end by a thickening of the conjunctive tissue of the wall of the sac with a corresponding ring of muscular fibers from the transverse layer, thus forming a double sphincter.

The ink-sac is lined with pigmented pavement epithelium, except the terminal ampulla, which is lined with cylindrical epithelium similar to that of the epidermis of cephalopods.

The gland is composed of undulating lamellæ, leaving between them spaces of variable form. These lamellæ, flat near the orifice of the gland, become concave as they recede from it, and thus form concentric cups enveloping a central whitish mass (formative zone), and becoming of a more vivid black as they are more distant from the center. Analysis of the black secretion proves it to consist of 60 parts of water, 30.5 parts of organic insoluble matters, a little less than one part of soluble organic matters, and 8.6 parts of soluble and insoluble mineral substances. Among the soluble inorganic matters are carbonic acid and the sulphates and chlorides of sodium, potassium, magnesium and lime, while among the insoluble matters are carbonate of lime, magnesia and peroxide of iron. Iron and copper are both present in the blood of the Cephalopoda, the latter metal as a component of hemocyanine, which plays in these creatures the role of hemoglobine in vertebrates. In the soluble organic matters neither urine, uric acid, xanthine nor guanine can be detected, so that the gland is proved not to be a depuratory urinary organ.

The greatest portion of the black pigment consists of an insoluble organic matter to which Bizzio has given the name of *melaine*, and the composition of which greatly resembles that of the pigment of vertebrates.

At the thirteenth day of the development of a cephalopod the anal invagination forms. This increases and divides into the ink-bag and rectum. The cellules at the blind extremity of the growing ink-bag multiply and form a thickening which is the commencement of the ink-gland. The study of the tissues and development of the ink-bag proves that the epithelium of ink-sac and gland is a continuation of the epidermis, and that the wall of the bag is a cutaneous fold.

M. H. de Lacaze-Duthiers has discovered and described in the gasteropods a gland secreting a pigment and having the strictest relations with the rectum, opening into the anus and closely applied to the end of the digestive tube. This anal gland is in relation to another gland (*glande pupurigène*) supplied at once with venous blood, and with venous blood that has passed through the renal body. A gland with a vascular distribution identical with the latter gland of the gasteropods, and with similar nervous connections, has been discovered in the cephalopods between the ink-bag and the gills, and thus M. Girod is impelled to admit the homology of the anal gland of the gasteropods with the ink-bag of the cephalopods.

Zoological Notes.—The Smithsonian Report for 1880 contains much interesting information relative to work done in connection with the National Museum, and concludes with a record of scientific progress, containing among other reviews, that of Dr. Theo. Gill upon zoölogy and of O. T. Mason on anthropology.——Dr. J. G. Fischer (Bonn, 1882) publishes some notes on the collection of snakes in the Royal Museum at Dresden, and descriptions of four new species of lizards from Australia, three of them without fore feet, and two of them types of new genera.——Dr. E. L. Trouessart gives a synoptic revision of the genus Semnopithecus, in which he recognizes thirty-one species.——Recent issues of the Bulletin of the Fish Commission contain a republished article upon the food of the shad, by E. R. Mordecai, M.D. The writer claims the discovery that shad feed and fatten on marine fuci. Also observations upon the development of the silver gar (*Belone longirostris*), by J. A. Ryder; on the cod and halibut fisheries near the Shumagin islands, by Dr. Krause; and a most valuable and exhaustive essay upon Oceanic Protozoa, considered as food for higher organisms, by J. A. Ryder. The entomostracous Crustacea are the great feeders upon the Protozoa, and in their turn furnish food for fishes. The writer always found the remains of food in the intestines, and once in the stomach of shad that were in fresh water. The food consisted of Entomostraca, larger Crustacea and Algæ.——Among other matters the Proceedings of the U. S. National Museum contains a description of two new races of *Myadestes obscurus*, inhabiting respectively Southwestern Mexico and Guatemala, and the Tres Marias islands, by Leonhard Stegneger, and in the same Proceedings Mr. R. Ridgway describes two new Costa Rican birds, a new fly-catcher and a supposed new petrel from the Sandwich islands, a new owl from Porto Rico, and two new thrushes from this country, one from the Rocky mountains, the other breeding in New York.——The same Proceedings contain much ichthyological news, including a paper by Professor G. B. Goode on Benthodesmus, a new genus of deep-sea Trichiuridæ, allied to Lepidopus. The species was first described as *Lepidopus elongatus*, by F. E. Clarke, from examples taken in New Zealand, and has since been found on the Great Bank of Newfoundland. Messrs. Jordan and Gilbert publish a key to the species of Pomudasys (= Pristipoma) known to inhabit the Pacific coast of tropical America, eighteen in all, including *P. cæsius*, a new species, and describe thirty-eight new species of fishes from Mazatlan, and one from San Salvador. The genus Stolephorus (Engraulis) receives four additions, Tylosaurus (Belone) two, Gobiesox four, Muræna two, Ophichthys two, Lutjanus two. Among the features of the collection described was a specimen of a Malthe and one of Fierasfer, both new. Dr. T. H. Bean gives notes upon a collection of fishes, with descriptions of new species and of a new genus (Delolepis). In the same proceedings Dr. R. W. Shufeldt gives some valuable remarks upon the osteology of *Opheosaurus ventralis.*

ENTOMOLOGY.[1]

Buffalo Tree-hopper injurious to Potatoes.—Some years ago we gave a short account of the transformations of this insect (5th Report on the Insects of Missouri, pp. 119–125). The Buffalo tree-hopper (*Ceresa bubalus* Fabr.) oviposits in young twigs of apple, pear and other trees, subsisting in its later stages upon the sap of these trees. It is a very common and widely distributed insect, but does become injurious to a serious extent. We were greatly surprised, therefore, by the recent receipt of a number of specimens from Mr. W. M. Heilman, of Annville, Pa., accompanied by the following note dated July 19th: "I mail you to-day a box of insects injurious to potato plants, and plants showing their *modus operandi.* The insects are probably a species of tree-hopper, and it seems strange to me that they should work on potatoes. They commenced work on potatoes in a young orchard about four weeks ago, and I have not found that they work or do any injury after their last molt or when they become winged. They averaged about fifteen specimens to the

[1] This department is edited by Professor C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

plant. I find no insects but these on the plants, which, after being girdled by them, turn yellow and die. The insects are not near as numerous now as a few weeks ago."—*C. V. R.*

WOOD-BORING COLEOPTERA.—There are many Coleoptera of various families which live in the galleries made by other species in the hard wood of trees. Thus the galleries of Mallodon and other large Cerambycidæ, form the home of many other species after the original owner has left them. If these inquilines are much smaller than the maker of the gallery, there is, of course, no difficulty in recognizing them as inquilines that did not make the gallery themselves. If, however, they are nearly of the same size as the original burrower, it is difficult to decide whether or not the galleries they inhabit have been made by them. Thus Mr. Eichhoff, in his excellent work on European Scolytidæ, suspects that the genus Platypus uses the galleries made by other beetles. My own experience in the South, with the common *Platypus compositus* is as follows: When found in the thick bark of pine stumps, the larvæ doubtless bore themselves, as there is no other beetle found in their company which makes such smooth and straight galleries. If, however, they occur in hard wood, such as oak, hickory, hackberry, etc., the case appears to be different, and seems to confirm Mr. Eichhoff's statement, as I found them always associated with true boring insects, viz., *Colydium lineola* and *Sosylus costatus*. The galleries of these three species are undistinguishable, and it appears to me very probable that Platypus simply uses the old galleries made by the two Colydiid beetles just mentioned. The Histerid genus Teretrius is another instance of this sort where the inquiline can be readily mistaken for the maker of the gallery, but in this case the Teretrius is simply parasitic on Ptilinus and other boring insects. I also would call attention to the fact that Professor Riley discovered the larva of *Hemirhipus fascicularis* to be parasitic on *Cyllene picta*,[1] in whose galleries it was living. As the two species are of about the same size, the Hemirhipis might be readily taken for a true wood-borer.

Another observation bearing upon this subject I had recently occasion to make in a street in Washington, D. C. There was an old maple tree perforated on one side with numerous holes, made, I presume, by an Elaphidion or some other average-sized Cerambycid. The burrows had evidently long since been deserted by the original makers, but I saw protruding from four or five of them the heads of *Strongylium tenuicolle*. Upon investigation I found that the beetles had died in the vain effort to escape from the gallery, the entrance being much too small to let the body pass through. Now I know by experience that Strongylium is not a true boring insect, and lives only in the very soft wood of decaying trees, especially of oak. It appears to me probable, there-

[1] Vide 1st Report U. S. Entomological Commission, p. 304.

fore, that the parent Strongylium had laid eggs at the entrance of a gallery made by a species smaller than itself, and that this mistaken instinct resulted in the death of its progeny in the manner just described.—*E. A. Schwarz, Washington, D. C.*

BACTERIUM A PARASITE OF THE CHINCH BUG.—In the course of some experiments made last month upon the chinch bug, I was annoyed by the rapid disappearance of the bugs under observation, which were on some hills of corn transplanted to the laboratory. Unable to find any evident cause of the phenomenon, I crushed a number of those remaining alive, and examined the fluids from their bodies under the microscope. In every case these were found to be swarming with a species of Bacterium not easily distinguishable from *B. termo.* The observations were many times repeated with every precaution against accidental infection, but with the same results. Using water freshly distilled and re-distilled, passing slides, covers and the tools used through the flame of an alcohol lamp at every step of the operation, I still found the same Bacterium in thousands in every preparation, but much the most numerous, as a rule, in the oldest specimens.

Careful search in the juices of the corn upon which the insects were feeding, failed to discover anything of the kind there. If a bug were thoroughly washed in a drop of distilled water, no Bacteria occurred in the water, showing that they were not derived from the surface of the insect. When a number of the bugs were kept for a week in a bottle without food, the Bacteria were found to have greatly increased in numbers, and were especially abundant in those which were recently dead. When the legs and head were cut off in a way to avoid injury to the alimentary canal, and crushed by themselves upon a slide, no Bacteria were found; and if the thorax and abdomen were crushed on separate slides, that containing the latter showed, as a rule, the greater numbers.

Careful dissections of the chinch bug were next made, for the purpose of ascertaining whether the seeming parasites could be traced to the alimentary canal. In five cases I succeeded in isolating the digestive organs, transferring them to a slide, and crushing them with the covers in distilled water. In all these cases the Bacteria were very abundant, and could be seen issuing from the stomach in adherent masses, and also in motion separately in all parts of the field. In two cases where a comparison could be made between the contents of the anterior and posterior parts of the canal, they were found much the most numerous in that part of the canal posterior to the malpighian tubes. On the other hand, Bacteria were also found in the water in which the dissections had been made; but as it is probable that the intestine was more or less torn in preparing the object, these may have escaped from its cavity. None were found in the ganglia of the nervous system in the only case in which I examined these structures for them. From all this I conclude that they have their principal, perhaps exclusive, seat in the alimentary canal.

Similar experiments made upon chinch bugs taken from the field, gave similar results throughout; but nothing of the sort could be detected in the fluids of corn plant louse (*Aphis maidis*) feeding upon the same stalks, nor in any of a number of insects examined.

To-day (Aug. 17) I noticed that the chinch bugs in the field from which most of those experimented on were taken, were much less numerous than three weeks ago; and many dead bugs, both young and old, were found behind the sheaths of the corn. The mortality, from whatever cause proceeding, had evidently taken principal effect on the older individuals, as in this field not more than two per cent. of those living had reached the "pupa" state, and no winged specimens were seen, while in other fields, from half a mile to a mile distant, about nine-tenths were pupæ, and many adults occurred. I collected a number of bugs, both living and dead, from this situation, and found the Bacteria excessively abundant in all examined.

The objectives used in these studies were usually Beck's tenth-inch water immersion and a No. 7 Gundlach. For a more careful study of the Bacteria, and for a comparison with *Bacterium termo*, I used, in conjunction with Professor T. J. Burrill (whose studies of Bacteria are well known), a tenth-inch Spencer's homogeneous immersion and a fifteenth-inch Tolles' of recent make, likewise a homogeneous immersion lens.—*S. A. Forbes, State Lab. of Nat. Hist., Normal, Ill.*

On the Mouth of the Larva of Chrysopa.—Recently I had the opportunity of watching in a live box, under a low power of the microscope, the seizing and devouring of some plant-lice by the larva of an undetermined species of Chrysopa, and was interested in the manner in which it emptied the body of its victims. The jaws are large, hooked, pointed and tubular, with a small opening at or near the points. Approaching its prey the body of the Aphis is grasped by the hooked mandibles which at the same time pierce it. The Chrysopa larva remains stationary, and proceeds to pump its victim dry. At the base of each of the mandibles the integuments are dilated into a sac-like form capable of expansion and compression at will, a portion of the thorax is similarly constructed, and it is by the repeated dilating and compressing of these sacs that the fluid contents of the body of the Aphis are transferred through the tubular mandibles to the stomach of the Chrysopa larva.

When the abdomen of the Aphis has been emptied, the points of the mandibles of the Chrysopa larva are thrust in the thorax, and forward into the head in every direction, and in a few moments nothing remains of the once plump plant louse but a shrivelled skin. In the authors accessible, I can find no reference to these elastic bulb-like sacs at the base of the mandibles, nor to the peculiar structure of the thorax, which admits of its expansion and contraction as referred to.—*William Saunders, London, Ont., read before the A. A. A. S., at Montreal.*

MOTHS ATTRACTED BY FALLING WATER.—Mr. J. Starkie Gardner records in *Nature*, March 9, 1882, his observation made in Iceland, that the gleaming water-falls seem to be as attractive to moths as artificial light—moth after moth flying deliberately into the falling water. This fact can, of course, be observed best in a country like Northern Iceland where there is no night during the summer.

A NEW MUSEUM PEST.—Mrs. A. E. Bush, an esteemed correspondent of San José, Cal., complains lately in her letters of the ravages of a Dermestid in her insect collection, and from specimens, larvæ and imagos, lately sent to us, we find that the species in question, is the handsome *Perimegatoma variegatum* Horn. We do not find that this species was ever known before as a museum pest, and there is danger that it may become distributed in insect collections all over the country, just as have the other species of the same family, which are so well-known and dreaded by entomologists.

FLEAS FEEDING ON LEPIDOPTEROUS LARVÆ.—Mr. Chas. I. Boden records in the (London) *Entomologist* for March 1882, p. 71, that he observed fleas feeding upon Lepidopterous larvæ. The great abundance of fleas in our Southern States, in places remote from human habitations and where there are presumably few warm-blooded animals or none at all, may perhaps find explanation in this insect-feeding habit.

ANTHROPOLOGY.[1]

BRITISH ANTHROPOLOGY.—The York volume, 1881, of the British Association is at hand, and enables us to see what our brethren are doing. That portion of the work interesting to the readers of the NATURALIST will be the following:

The presidential address by Sir John Lubbock was a résumé of the progress of science during the fifty years of the association, and, as might be expected, contains valuable allusions to anthropology.

Professsor W. H. Flower chose as the theme of his opening speech before the department of anthropology, The low state of interest in anthropology in Britain compared with other countries.

The following papers are reported in abstracts:

The Viking's ship discovered in Sandefjord in Norway, 1880. By J. Harris Stone.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Earthworks at Flamborough and Yorkshire wolds. Maj.-Gen. Pitt-Rivers.
Composite Portraiture. By Francis Galton.
Ancient dwellings found on Yorkshire wolds. By I. R. Mortimer.
The origin and use of oval tool-stones. W. J. Knowles.
Flint implements in stratified gravel near Thebes. By Maj.-Gen. Pitt-Rivers.
Report of the Anthropometric Committee.
A collection of racial photographs. By J. Park Harrison.
Scandinavian and Pictish customs on the Anglo-Scottish border. By Dr. Phené.
The geographical distribution of mankind. By Miss A. W. Buckland.
The Papuans and Polynesians. By C. Staniland Wake.
Excavations at Ambresburg banks in Epping forest. By Maj.-Gen. Pitt-Rivers.
Relations of stone circles to outlying stones or tumuli or neighboring hills. By A. L. Lewis.
Saw cuts and drill holes in hard stones of primeval Egyptian period. By W. Flinders Petrie.
Relations of the Hebrew, &c., alphabets and the Khita inscription. By Hyde Clarke.
Colonization of Cyprus and Attica in relation to Babylonia. By Hyde Clarke.
Animism of the Indians of British Guiana. By Everard F. im Thurm.
Origin and primitive home of the Semites. By G. Bertin.
The utilization of memory. By George Harris.
The cultivation of the senses. By George Harris.
Traces of Man in the Crag. By H. Stopes.
Excavations in the caves of Cefu, N. Wales. By Professor T. Mck. Hughes and Mrs. Wm. Wynn.
A Roman bronze galeated bust. By Professor Hughes.
Celtic engravings on a slate tablet from Towyn. By J. Park Harrison.
Physical characters and proportions of the Zulus. By C. Roberts and George W. Bloxam.
Stone implements from Asia Minor. By Hyde Clarke.
Profile of the Danes and Germans. By J. Park Harrison.
Remarkable human skull found near York. By Edward Allen.

ANTHROPOLOGY IN FRANCE.—The Bulletins of the Société d'Anthropologie, though somewhat slow in making their appearance, are well edited. By an inspection of the titles given below it will be seen that the society still pursues with assiduity those biological investigations which have all along made it famous. The following papers in the volume of 1881, have more than a local interest:

Ardouin.—Craniologie des criminels, 709.
Statistique medicale du Japon, 717.
Bordier.—Recherches ethnographiques dans le Mackensie, 57.
Cartailhac.—Archéologie prehistorique en Portugal, 281.
Chervin.—Population de France en 1881, 790.
Chudzinski.—Trois encephales des Esquimaux, 312.
Splanchnologie d'un orang bicolere, 19, 172.
Un cas d'atavism, 626.
Anomalie du muscle abducteur du pouce, 748.
Corre.—Crânes de criminels, 638.

Dally.—Degenerescences humaines, 339.
Dareste.—Deviation chez un Agneau, 816.
Delaunay.—Pathologie generale, 803.
Duchesne.—Anomalies regressives, 329.
Foley.—Les Polynesiens, 264, 339, 545, 537.
Fontan.—Dents supplementaires chez les Neo-Caledoniens, 595.
Hayem.—Le Sang au point de vue anthropologique, 72.
Houel.—Hermaphrodites, 554.
Laborde.—Role fonctionnel des canaux semi-circulaires, 797, 819.
La Quesnerie.—Momies et autres objects du Perou, 550.
Le Bon.—Photographie des Fuegians du Jardin d'acclimation, 758.
Ledouble.—Sur les muscles, 111, 256, 654, 657.
Letourneau.—Les Akkas, 238.
Manouvrier.—Poids du crâne, 662.
Les Fuegians, 766.
Metchnikoff.—Des Origines japonaises, 724.
Mortillet.—L'ambre, 264.
Nadaillac.—L'Homme tertiaire en Italie, 260.
Parrot.—Crâne naviforme d'une idiote, 173.
Megaloglossie et idiotie, 752.
Quatrefages.—Nain microcephale, 752.
Royer, Mme.—Peuples Kymriques, 241.
Le Bien et la Loi Morale, 592.
Soldi.—L'Emploi du fer en Egypte, 34.
Tenkate.—Crânes malais, 37.
Thulie.—Instructions anthropologiques sur les Bochimans, 353.
Topinard.—Du Bord inferieur des naunes, 184.
Atrophie senile, 232.
Types indigenes de l'Algerie, 438.
Methode d'observation sur le vivant, 517.
Goniometre, 616.
Torok.—Crâne du jeune gorilla, 46.
Crânes Valaques. 175.
Ujfalvy.—Peuples de l'Inde, 598.
Vinson.—Calculs de têté, 124.
Vlasto.—Instruments en pierre de Brésil, 206.
Vogt.—Squelette humain associe aux glyptodontes, 693.
X.—Deformations artificielles et des mutilations, 632.
Zabarowski.—La memoire et ses maladies, L'Aphasie, 514.

Anthropological Nomenclature.—In every science there are three stages of investigation, which we may represent by the Greek words γράφη, λόγος, and νόμος. Upon these terms as a basis we may construct a system of nomenclature for our science, and the following is offered in a tentative way for the emendation and criticism of my professional brethren. As the origin of man is as yet a mere speculation, I have not included it in the three-fold division. The whole study of the natural history of man would stand as follows:

ANTHROPOGENY.

Observing and Descriptive Stage.	*Inductive and Classifying Stage.*	*Deductive and Predictive Stage.*
(γράφη.)	(λόγος.)	(νόμος.)
Anthropography	Anthropology	Anthroponomy
Archæography	Archæology	Archæonomy
Biography	Biology	Bionomy
{ Psychography	{ Psychology	{ Psychonomy
{ Phrenography	{ Phrenology	{ Phrenonomy
Ethnography	Ethnology	Ethnonomy
Glossography	Glossology	Glossonomy
Technography	Technology	Technonomy
Sociography	Sociology	Socionomy
{ Pneumatography	{ Pneumatology	{ Pneumatonomy
{ Daimonography	{ Daimonology	{ Daimononomy
{ Mythography	{ Mythology	{ Mythonomy
Hexiography	Hexiology	Hexionomy

THE SIOUAN OR DAKOTA STOCK --Major Powell, through the Bureau of Ethnology, is rewriting the linguistic stocks of North American Indians. Commencing with the labors of Gallatin, Hale, Gibbs and Trumbull, he has called in the aid of specialists like Dorsey, Gatschet, Hinman and Mason, to bring the subject even with our latest knowledge. The following is Mr. Dorsey's division of the Siouan stock:

Group I.—Dakota (Sioux) includes all the tribes of Dakota with the Asi′-ni-bwan, Stone Dakotas (Trumbull).

(Sioux is an abbreviation of Naudowessioux, a Canadian French corruption of a name given to the Dakotas by a hostile people. The real name of the Assiniboins seems to be Ie-ska-pi, they who speak white, intelligibly. They speak a dialect of Dakota, being an offshoot of the Ihauk-to-wa-na gens, and are called Hohe, rebels, by the Dakotas.)

Group. II.—Dhegiha. (A) Omaha-Dhegiha, includes Omahas and Ponkas,
(B) Kwapa-Dhegiha, includes Kwapas, Osages and Kansas. (Mr. Dorsey's first volume, Contributions to North American Ethnology, Vol. VI, relates to the Dhegiha language.)

Group III.—Tciwére. (A) Tciwére, or Otos and Missouris.
(B) Tcekíwere, or Iowas.

Group IV.—Hotcañ′gara, or Winnebagos.

Group V.—Númañkáki (Mandans). Formerly in two villages, speaking as many dialects. (A) Mitutahañkuc, and (B) Ruptari.

Group. VI.—Hidhatsa. (A) Hidhatsa = Minnitaris and Gros Ventres.
(B) Absároki = Kiqatsa or Crows.

Group VII.—Yesan (Tutelos) in Canada near Niagara falls.

THE NATIONAL MUSEUM.—Since it has been decided to make the new National Museum at Washington anthropocentric in its arrangement, anthropologists should watch with ever-increasing interest the unfolding of the scheme. To further this object circulars are issued, which any student may have for the asking, setting forth the progress of the work. Circular No. 17 has just appeared, but No. 13 is the one to which especial attention is asked. Did our space allow we should publish it in full, but enough is furnished to show the grand scheme which Professor Goode has in mind.

OUTLINE OF A SCHEME OF MUSEUM CLASSIFICATION.

Divisions.		Classes.
I.	Mankind (Biology, Ethnology, Biography)	1–3
II.	The Earth as Man's abode (Hexiology)	4–10
III.	Natural Resources (Force, Mineral, Vegetal, Animal)	11–15
IV.	Exploitative Arts and Industries	16–20
V.	Elaborative Industries	21–38
VI.	Ultimate products and their utilization	39–47
VII.	Social Relations of Mankind	48–54
VIII.	Intellectual Occupations of Mankind	55–64

Since Professor Goode invites criticism, the NATURALIST desires to further his wishes by urging upon anthropologists to procure circular 13 and to give him the benefit of their experience.

GEOLOGY AND PALÆONTOLOGY.

MAMMALIA IN THE LARAMIE FORMATION.—Mammalia, which have been so long looked for in vain in the Laramie beds, have at length been found. Mr. J. L. Wortman, who was sent to explore this formation the past season, was instructed to look especially for Mammalian remains. He now announces that he has found them in place and mingled with Dinosaurian remains in such a manner as to admit of no doubt of their contemporaneity. Two species have come to hand, of which the following only is determinable .

Meniscoëssus conquistus, gen. et sp. nov.—But one specimen of this animal was found, and that is represented by two molar teeth and a distal extremity of a humerus. Were it not for the associated molar tooth, I should think that the second tooth might be that of a herbivorous reptile. It is probably a fourth premolar of the general type of that of the *Plagiaulacidæ*.

Char. gen.—Fourth premolar with a compressed anteroposterior edge, which is studded with denticles; sides without ridges. Posterior molar rather small; crown with three longitudinal series of tubercles, of which many have crescentic sections.

This form is plainly not a distant relative of the *Plagiaulacidæ*, recently described in the NATURALIST, from the Puerco Eocene of New Mexico, and it may enter that family. Its molar has the same number of rows of cusps as in *Polymastodon* Cope. The tooth is, however, of especial interest from its resemblance to the molar of the genus *Stereognathus* Owen, from the Oölite of England, showing clearly that that genus, whose affinities have been hitherto unknown, must be referred to the neighborhood of the *Plagiaulax* of the same great Jurassic period. The humeral condyles have the remarkable characters of those of *Catopsalis*.

Char. specif. — The premolar is large as compared with the molar, but the disproportion is not so great as in *Ptilodus mediævus.* It has one side convex and the other plane, and each is bounded by a cingulum at the base. The sections of the denticles are ovals, transverse to the edge of the crown. The grooves which separate them are continued downward on the convex face, but not on the plane face. The enamel is minutely wrinkled. One end of the crown is lost, as it is also in the true molar. The latter has the crown expanded laterally, so that the longitudinal grooves are wide open, and not closed as in *Catopsalis.* The median ones are transverse crescents in section; those of one edge are half crescents, and those of the opposite edge are the least, and are transversely oval in section. In the fragment the number of lobes is 4–3–4; the last row of small cusps being complete, and turning into the median at both extremities. No cingula. Elevation of crown of P-m. IV, .007; width of do. at base, .006; width of molar, .006.

This species was about the size of the Australian bandicoot, and was probably a true marsupial.—*E. D. Cope.*

A NEW FORM OF TÆNIODONTA.—The Puerco beds of New Mexico continue to produce new types of Mammalia. The genus now to be described is probably a Tæniodont, and allied to *Calamodon*, but the absence of the canine teeth renders the determination incomplete. The incisors, while of the form of those of *Calamodon*, had a limited period of growth, and the root displays a contracted base. The enamel also extends but a short distance on the anterior face of the tooth. The probable first inferior incisors are quite small, but are generally like the second or large ones. The superior molars have but a single conic root, but in some of them a fissure of the external side marks the usual place of division. The crowns are narrow and transverse to the axis of the jaw. I call this genus *Hemiganus*, and the species *H. vultuosus.*

Char. specif.—Large incisors strongly curved, robust, wearing with a strong posterior shoulder. Shaft with the dentine finely and sharply ridged. Inferior apex compressed; front regularly rounded. Enamel? ridged or smooth. Superior molar with narrowed transverse crowns, and roots covered with a thin layer of cementum. There are one, perhaps two external cusps, but the crowns are all much worn. One crown, perhaps inferior, is subround with a notch, as in *Calamodon* sp. Enamel short, with equal base, smooth. Length of first incisor, .026; diameter of crown, anteroposterior, .008; transverse, .014. Length of second incisor, .094; diameters of crown, anteroposterior, .029; transverse, .019. Length superior molar, .0225; diameters crown, anteroposterior, .010; transverse, .017. Diameter inferior molar (second specimen), anteroposterior, .011; transverse, .011. Discovered by D. Baldwin in New Mexico. The species is a little larger than the *Psittacotherium multifragum.*—*E. D. Cope.*

THE PERIPTYCHIDÆ.—The structure of *Periptychus* has remained uncertain so far as regards the limbs and feet. As these parts have much significance, I point out some of their characters as seen in specimens recently received from the Puerco beds.

The brain is, as in *Phenacodus*, very small, with the olfactory lobes widely separated from the small hemispheres. The humerus has an epitrochlear foramen. The astragalus has no trochlear groove, and the neck is short. The head is convex, and presents a lateral face for contact with the side of the cuboid. Five digits on the posterior foot. The lateral ungues are rather narrow hoofs. Cervical vertebræ very short.

The absence of trochlea of the astragalus is a point of resemblance to *Meniscotherium*, and separates *Periptychus*[1] from the *Phenacodontidæ* as a family type, which I call the *Periptychidæ.* With it must no doubt be associated *Anisonchus* Cope, *Haploconus*, and the following new genus.

Hemithlæus kowalevskianus, gen. et sp. nov. *Char. gen.*—Dentition of the type of *Anisonchus*, but there is but one internal tubercle of the superior true molars, which is the apex of the V, the posterior cusp being absent, no intermediate tubercles. Last and penultimate premolars with internal cusp. Last inferior true molar with heel.

Char. specif.—The internal lobes of both third and fourth premolars are conic. The true molars are distinguished from the species of *Anisonchus* and *Haploconus* in that the posterior cingulum does not develop an internal cusp. Instead of this, the apex of the median V forms the internal angle of the crown, and an anterior and a posterior cingula of equal size rise to meet it. The inferior molars have anterior and posterior median cusps, and the internal anterior cusp is not compressed. Length of P-m. IV with true molars, .0185; diameters P-m. IV, anteroposterior, .005; transverse, .007; do. of M. II, anteroposterior, .0046; transverse, .007. The last true molar is smaller than the first or second. Two individuals from the Lowest Puerco. Larger than *A. sectorius.* Dedicated to the distinguished palæontologist, Dr. W. Kowalevsky, at present traveling in this country.

In the August number of the NATURALIST it was shown that there are species of *Haploconus* with the interior lobe of the fourth premolar conical. I now find a species of *Anisonchus* which presents the same peculiarity. I describe it as follows:

Anisonchus coniferus, sp. nov.—Three individuals of larger size than the *H. kowalevskianus.* This species differs materially from the last in the larger development of the cingular internal cusp of the superior true molars, so that the transverse diameter of the latter

[1] *Catathlæus* was established on the permanent dentition of *Periptychus.*

exceeds that of any of the species of this group. The apex of the median V is not very prominent. Third superior premolar with a rudiment of the anterior and posterior basal lobes; internal lobe not large, conic. Fourth not wider than first true molar, which equals the second and exceeds the third in size. An external cingulum on the true molars, none on the premolars. Probable inferior true molars with anterior and posterior median cusplets. Length of base of four last molars, .020; width of base of P-m. III .006; length of do., .005, do. of P-m. IV, .008; length of do., .007. Diameters of M. II, anteroposterior, .005; transverse, .0095. From the Lowest Puerco. D. Baldwin.—*E. D. Cope.*

SOME NEW FORMS FROM THE PUERCO EOCENE.—*Mioclænus protogonioides*, sp. nov. The largest species of the genus, represented by the superior true molars. It is an exaggerated form of the *M. subtrigonus.* The internal angle of the V, as well as the intermediate tubercles at the ends of its limbs, are distinct. Cingula extending entirely round the crown, the posterior with a small tubercle on the M. II as in *A. subtrigonus*; none on M. III, which is .75 the area of the M. II. Diameters M. II, anteroposterior, .008; transverse, .010. Diameters M. III, anteroposterior, .007, transverse, .009. From the Lowest Puerco of New Mexico, D. Baldwin.

Mioclænus opisthacus, sp. nov.— The species of this genus brought thus far from the Puerco formation have no internal cusp, but a ridge on the internal side of the heel of the inferior true molar teeth. The *M. brachystomus* of the Wasatch has such a cusp. The present species from the Puerco also possesses this cusp. It differs from the *M. brachystomus* in its much larger size and more robust premolars. The latter are, however, less robust than in *M. turgidus* and have an oval anteroposterior section. The fourth has a small heel, but no anterior basal lobe. The true molars are of subequal size and not smaller than the premolars. No anterior inner nor posterior median cusps. Length of last four molars, .025; do. of P-m. IV, .006; of last true molar, .0065. Depth of ramus at M. II, .0116. Three individuals.

Mioclænus baldwini, sp. nov.—The description of the last species applies to this one in many respects, including the posterior inner lobe of the inferior true molars, but the size is less, and the last inferior molar is materially smaller. There is also a well defined anterior internal cusp on the second true molar. The ramus becomes quite slender anteriorly. Length of last six molars, .035; do. of last four, .022; do. of P-m. IV, .0057; do. of M. I, .0053; do. of M. III, .0055. Dedicated to D. Baldwin, the discoverer of the Puerco fauna.

Protogonia plicifera, sp. nov.—This, the second species of the genus, differs from its congener, *P. subquadrata*, in that the internal cusp of the fourth superior premolar is connected with the anterior and posterior cingula by strong ridges, becoming thus the apex of a V. In the *P. subquadrata* it is a simple cone. Antero-external basal lobe distinct, intermediate lobe obsolete. The true molars are like those of the *P. subquadrata*, but all the molars are of smaller size. Length of P-m. IV, plus M II and M. III, .0215; diameters P-m. IV; anteroposterior, .006; transverse, .007; do. of M. II, .0095 and .008. D. Baldwin.

Dissacus carnifex, sp. nov.—This creodont differs from its only congener in its greater size, and in the presence of an anterior basal lobe on the third inferior premolar. This is wanting in *D. navajovius.* As compared with the latter the six inferior molars are as long as its seven, and the mandibular ramus is much deeper. Like it the P-m. IV and the true molars have an anterior basal tubercle: and the last two true molars have an internal supplementary cusp. After the *Sarcothraustes antiquus*, the largest flesh-eater of the Puerco. Length of last six molars, .075; of true molars, .038; of P-m. IV, .0125; of M. II, .0135; of M. III, .0130. Depth of ramus at M. II, .029. Upper Puerco, D. Baldwin.—*E. D. Cope.*

GEOLOGICAL NEWS.—The July number of the *American Journal of Science* contains a succinct account of the phenomena of metalliferous vein formation now in progress at Sulphur Bank, near Clear lake, Cal., including a description of the geology of the vicinity, by Professor Joseph Le Conte. To the same magazine Rev. A. A. Young contributes observations on the crystallized sands of the Potsdam sandstone of Wisconsin; and G. K. Gilbert writes upon the origin of jointed structure, combating the theory of Professor John Le Conte, who in the March number of the same magazine explains the jointed structure of the Quaternary clays of the Great Salt Lake desert by referring it to the same category with shrinkage cracks observed in recent Californian alluvial deposits. Shrinkage cracks form four to seven sided irregular masses, the included angles varying greatly, whereas the joints of indurated rocks are characterized by parallelism, and the lines of two systems of joints cross each other, which is not the case in shrinkage cracks. Mr. Gilbert then takes up the theory which classes joints with slaty cleavage, and attributes them to lateral compression. As it appears improbable that a broad sheet of fresh-water sediments, so fresh that the shore-trace of the formative lake has scarcely been impaired by the weather, should have been laterally compressed in two directions nearly at right angles to each other so as to form the two systems of joints which exist in it, and as, moreover, only a single system of joints exists in the Triassic and Jurassic sandstones of the Colorado plateaus, Mr. Gilbert dismisses this theory also as untenable, and regards the question as still an open one.——The

Report upon the Geology and Mining Industry of Leadville, Col., by S. F. Emmons, contains thorough details of the Palæozoic and eruptive Mesozoic rocks of the district, and of the ores, which principally occur underneath a porphyry sheet and chiefly in cavities penetrating the "Blue" limestone, the lowest member of the carboniferous.

MINERALOGY.[1]

CHROME TOURMALINE. — Cossa and Arzruni describe in the *Zeitschrift fur Krystallographie* a new variety of tourmaline, in which chromic oxide replaces a portion of the alumina. The tourmaline, of a deep green color, occurs in deposits of chromic iron in the Ural mountains. The crystals have a beautiful dichroism, appearing, when viewed by daylight, yellow brown, parallel to the optic axis, and blue-green at right angles to the axis. Viewed by lamplight the yellow-brown color changes to ruby-red, and the green color nearly disappears. The result is, that the crystals are green by daylight and intense red by lamplight—a phenomenon shared by alexandrite.

The chrome tourmaline has a specific gravity of 3.120. Before the blowpipe it melts somewhat easily to a grayish-white, opaque bead. With borax and salt of phosphorus it gives a fine green bead, and in the latter flux a skeleton of silica. It is only decomposed by acids after fusion. The analysis was as follows:

SiO_2	Bo_3	Al_2O_3	Cr_2O_3	FeO	MgO	CaO	NaO	H_2O	F	
36.79	9.51	30.51	10.86	2.91	4.47	.72	1.36	2.25	.65	= 100.08

It is to be classed in the third group of tourmalines of Rammelsberg's classification.

PARAFFINE IN LAVA.—O. Silvestri has found that the basaltic lava in the neighborhood of Etna, contains small geodes filled with solid crystallized paraffine. The paraffine is in large translucent plates of waxy appearance and yellowish-white color, with a melting point of 56°. It is soluble in ether and in boiling alcohol.

NEW LOCALITIES. — A. Schmidt describes small transparent crystals of *newberyite* from Mejellones, Chili. They occur in crevices in guano, and having bright lustrous faces, could be accurately measured in the reflecting goniometer. They are orthorhombic in tabular crystals, with a hardness somewhat more than 3, and a specific gravity of about 2.10. Newberyite had previously been found in Victoria, Australia.

Damour gives an analysis of *fuchsite* from the Urals, and Arzruni describes its physical properties.

Mendozite, a sodium alum, occurs in the province of Idzumo, Japan, in considerable quantity, as an efflorescence upon albite.

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

It is found in two forms, the one massive, finely fibrous, grayish-white and translucent; the other as friable opaque tears slightly colored by iron salts. It contains, as shown by Dr. Divers, twenty-four molecules of water, and is thus of the normal type.

A RELATION BETWEEN THE OPTICAL AND CHEMICAL PROPERTIES OF PYROXENE AND AMPHIBOLE.—F. J. Wiik has found a very interesting relation between the optical and chemical properties of the pyroxenes and amphiboles of Finland. The angle between the axes of greatest and least elasticity has a direct relation to the amount of ferrous oxide in pyroxene or the amount of alumina in amphibole, the angle becoming larger as the percentage of these substances increases.

Specimens from a large number of localities were examined with unvarying result. The following are examples:

Locality.	Optic angle.	Percentage of FeO.
PYROXENE.		
Wampula (yellowish malacolite)	37°	.99
Karis-Lojo (gray-green malacolite)	39°	2.68
Helsingfors (green pyroxene)	42° 30′	10.38
Pargas (black augite)	43° 30′	15.75
Lojo (black malacolite)	48°	27.50
AMPHIBOLE.		
Orijäroi (light-green actinolite)	17°	1.69
Orijäroi (dark-green actinolite)	18° 30′	5.10
Pargas (black hornblende)	24° 30′	11.92; 13.75
Korpo (light-green hornblende)	27° 30′	20.10; 20.73

NEW MINERALS.—Two new minerals from Wermland, Sweden, are described by Igelström:

Manganbrucite.—This is a massive, uncleavable substance of a yellow or brownish-red color, which occurs in small grains imbedded in the manganese ore of the Jakobsberg mines. It is associated with a number of manganese minerals. It contains

MgO	MnO	H_2O		
57.81	14.16	28.00	=	99.97

If a pure substance, and found to be of constant composition, it may be classed as a massive manganesian variety of brucite.

Talktriplite.—This is also a massive substance of yellow or yellowish-red color occurring in grains the size of a pin head at Horrsjöberg. It is transparent, has a hardness of about 5, and contains phosphoric acid, iron, manganese, lime and magnesia, with some fluorine. As it was not separated from its matrix, no analysis of the pure substance was made. It is supposed to be a triplite containing lime and magnesia, but further examination seems to be necessary before classing it among accepted species. It occurs with lazulite, svanbergite and other phosphates.

DIABANTITE-VERMICULITE.—Professor B. K. Emerson describes a *diabantite-vermiculite* from a dyke of diabase near Turner's

Falls, Connecticut. The foliated chlorite known as diabantite frequently decomposes and then contains amygdules filled with a bronze-yellow substance which exfoliates largely before the blowpipe. The diabantite itself is regarded as an original product of the decomposition of the trap while still hot, while the so-called diabantite-vermiculite is of much more recent origin, being due to atmospheric alteration.

Salt water in Sulphur Crystals.—Many of the flat crystals of sulphur from Catania, Sicily, contain enclosures of a colorless transparent liquid, in which gaseous bubbles may frequently be seen. Microscopic tubular cavities also traverse the flat laminæ of the crystalline masses of sulphur. Sylvestri finds the enclosed liquid to be a weak aqueous solution of sodium chloride and sulphate, with traces of potassium, calcium, barium and strontium chlorides. The total saline matter amounted to slightly over one per cent.

The Dispersion of Chromate of Soda.—M. Wyrouboff has shown that crystals of chromate of soda having four per cent. of water have very remarkable optical properties. When examined with converging polarized light a plate of this salt shows a curious system of curves very differently arranged on either side of the bissectrix. In the last number of the Bulletin of the Mineralogical Society of France, colored plates are given illustrating the irregular figures produced by polarized light. The irregularity of the curves is due to inclined dispersion combined with considerable difference in the position of the planes of the axes for different colors. It is a very striking example of inclined dispersion, no other substance being known to possess it to such a degree.

Aluminium as a Blowpipe Support.—The use of a plate of aluminium as a support for the assay in blowpipe operations, as advocated by Col. W. A. Ross, appears to possess a number of advantages over the usual block of charcoal.

The *black* sublimates formed by arsenic, antimony, lead, etc., invisible upon charcoal, can be distinguished upon the new support. Any sublimates formed can be scraped off in a pure condition for further examination, whereas upon charcoal there is always an admixture of ash. The danger of loss of the sublimate or assay, either by cracking of the charcoal, by blowing away, by admixture with white ash, or by re-sublimation on the incandescent charcoal, is greatly lessened by the use of aluminium as a support, and more minute quantities of a substance may thus be detected.

In practice, it is often necessary to place a small slip of charcoal between the assay and the aluminium plate, in order to obtain a sublimate.

The superior heat conduction of aluminium prevents it from combining with fusible metals, as is the case with platinum. For the same reason aluminium foil is stated to be better fitted than platinum foil for the fusion of alkaline carbonates, the detection of manganese, etc.

Ersbyite.—This feldspar, hitherto regarded as an anomalous variety of doubtful existence, has recently been shown by F. J. Wiik, to be a potash microcline. The large percentage of lime given in former analyses is proved to be due to an admixture of calcite. After purification in weak acid, the following composition was found:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O
66.18	19.52	.36	13.03	.91

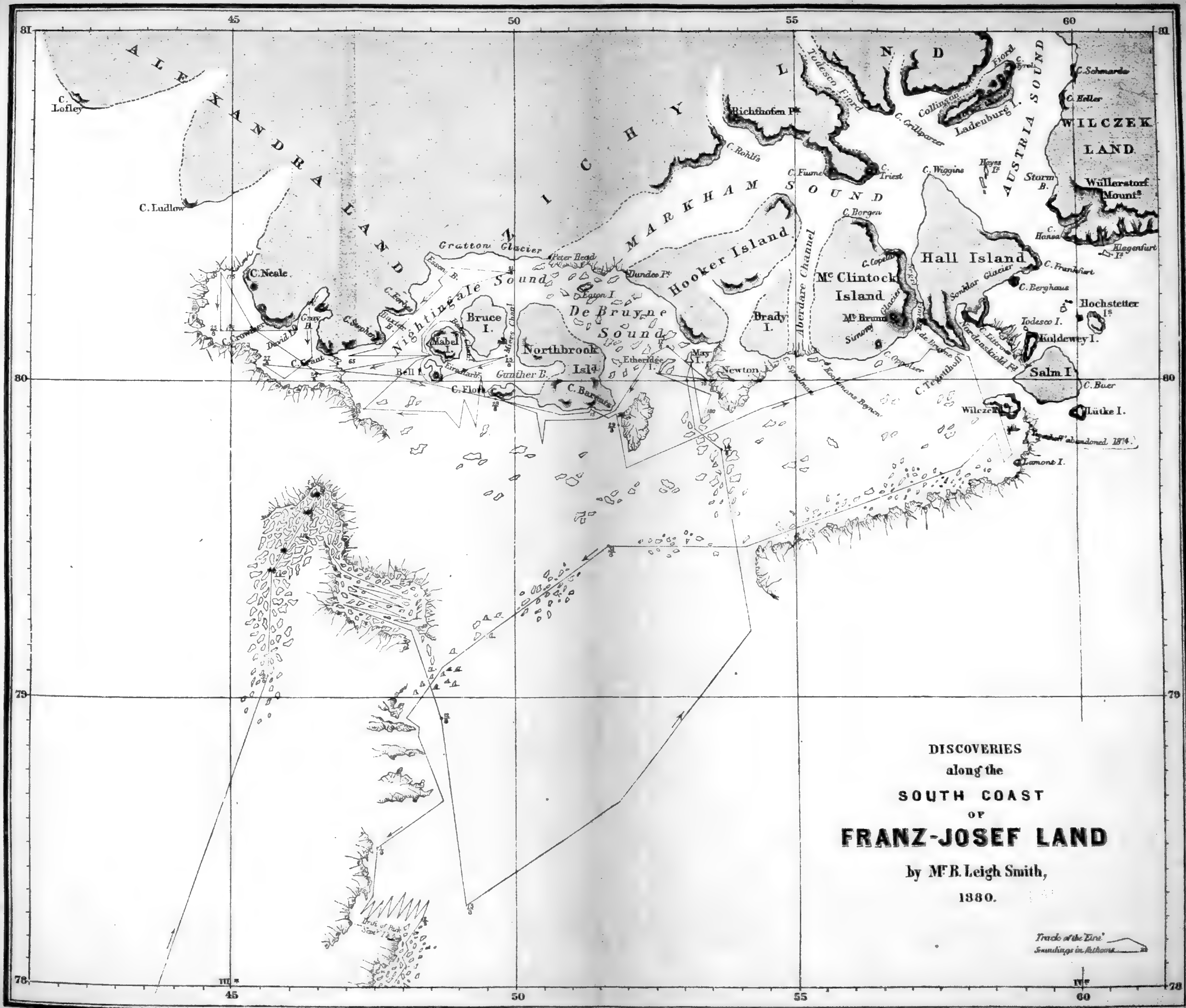
The feldspar occurs in colorless crystals at Pargas, Finland, and is intimately associated with another feldspar, now shown to be andesite. The optical properties are identical with microcline, and the name ersbyite must be dropped from the list of species.

Mineralogical Notes.—N. H. Darton is giving, in the *Scientific American Supplement*, a popular account of the mineral localities and the minerals to be found in and around New York city. The articles are written in a familiar style, and will be of great assistance to beginners in mineralogy living near New York city. Professional mineralogists also will be glad to know the exact localities of the specimens in their cabinets, and will be interested in the full description of their method of occurrence.——The Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences of Philadelphia are offered for sale at fifteen cents.——Crystallographers will be interested in the abnormal *diamond* crystals recently described and figured by Purgold of Dresden. One of these has eight projecting triangular points—the result of repeated twinning.——The second part of Professor Tschermak's "Lehrbuch der Mineralogie" (Vienna) has recently been issued. It is a valuable work, embodying the latest results of mineralogical research.——Selenium and tellurium have been found in the sulphur of Japan.

GEOGRAPHY AND TRAVELS.[1]

The Rescue of the Crew of the Eira.—The steam whaler *Hope*, Captain Sir Allen Young, which sailed from the Scotch port of Peterhead about June 20th, to search for and relieve the crew of the *Eira*, has been most successful in its mission, having returned with all the members of the missing expedition on board. The *Eira* left Peterhead on the 14th of June, 1881. The ice that season reached very far south, and no opening could be found to enable her to get north until the middle of July. Franz-Josef's Land was reached on July 23, and the *Eira* steamed along the coast to within fifteen miles of Cape Ludlow. The ice was closely packed to the north, so it was decided to return to Gray

[1] Edited by Ellis H. Yarnall, Philadelphia.


DISCOVERIES
along the
SOUTH COAST
OF
FRANZ-JOSEF LAND
by Mr. B. Leigh Smith,
1880.
ALEXANDRA LAND
ZICHY LAND
WILCZEK LAND
C. Lofley
C. Ludlow
C. Neale
Gratton Glacier
Peter Head
Nightingale Sound
De Bruyne Sound
MARKHAM SOUND
AUSTRIA SOUND
Hooker Island
Aberdare Channel
Mc Clintock Island
Hall Island
Bruce I.
Mabel I.
Northbrook Isld
Brady I.
Gunther B.
C. Flora
C. Barents
Bell I.
Etheridge I.
May I.
Newton
Eaton I.
Dundee Pt.
Richthofen Pt.
C. Rohlfs
C. Fiume
C. Triest
C. Wiggins
C. Grillparzer
Todesco Fiord
Collinson Fiord
Ladenburg I.
C. Schmarda
C. Heller
Storm B.
Wullerstorf Mount.
C. Hansa
Klagenfurt Is.
C. Frankfurt
C. Berghaus
Hochstetter Is.
Todesco I.
Koldewey I.
Salm I.
C. Buer
Lütke I.
Wilczek I.
Lamont I.
C. Tegetthoff
C. Borgen
C. Copeland
Sonklar Glacier
Nordenskiold Fd.
Track of the "Eira"
Soundings in fathoms
45
50
55
60
81
80
79
78

Bay and wait till a more favorable opportunity should present itself to proceed. On August 7 the *Eira* was made fast to the land floe near Bell Island, and a store house was erected of materials taken out of the *Eira*. On August 15 the *Eira* left Bell Island and being unable to pass to the eastwards of Barents Hook, she was made fast to the land floe off Cape Flora. The next few days were spent in collecting plants and fossils, which unfortunately were lost with the vessel. On August 21 the *Eira* was heavily nipped by the ice, and about 10 A. M. a leak was discovered. The *Eira* sank in two hours time, before many stores were saved. A house was built on Cape Flora of stones and turf, and covered with sails, and the winter was spent there. The party depended chiefly for food on the bears and walrus. Thirty-six bears and twenty-nine walrus were killed and eaten. Large numbers of walrus appearing in June, they were enabled to lay in provisions for two months and started in four boats on June 21, 1882, for Novaya Zemlya. Eighty miles of water was encountered before reaching ice. Then the troubles began, and six weeks of constant toil followed until the open water was again found, and within twenty-four hours of leaving the ice the four boats, with their crews of twenty-five in all, were safely landed upon the beach at Matyushin Strait on the evening of August 2, where they were found the next day, first by the Dutch expedition in the *Willem Barentz*, and then by the *Hope*. The *Hope* arrived at Peterhead on August 20, within a few hours of the anniversary of the day when the *Eira* was lost.

There seems now no reason to doubt that at some period of every summer, Franz-Josef Land is accessible without great difficulty, and it undoubtedly presents, at present, the most inviting and encouraging field for Arctic exploration for the purpose of reaching the most northern latitudes.

ARCTIC EXPLORATION.—Lieutenant Hovgaard, formerly of the Nordenskiöld Expedition, will sail early in June, from Copenhagen, in the steamer *Dympna* for Cape Chelyuskin, afterwards endeavoring to reach Franz-Josef Land.

Remains of Northmen have been found on the east coast of Greenland in lat. 60° 31′ N. The building discovered is forty paces long by ten wide, and its foundations consist partly of stones of cyclopean dimensions. There are similar ruins, the natives report, in lat. 60° N.

Immense ice-floes filled the sea between Spitzbergen and Iceland in June. In Iceland large districts are said to be suffering from famine, as the vessels are unable to land the provisions on the customary arrival of which they depended. The severity of the weather is preventing the growth of the crops, and large numbers of sheep and ponies are dying.

Baron Nordenskiöld has published the first volume of the "Scientific Results of the *Vega* Expedition." It covers 800 pages with maps and tables. There are papers on the aurora, the health of the expedition, the color sense of the Chukchis, on the botanical collections, meteorological observations, the Invertebrata of the Arctic Seas, etc.

Nature states that the French Government is making preparations to send out an Antarctic Expedition to Cape Horn. The expedition will be fitted out for a period of eighteen months, and 2,500,000 francs have been voted for it.

Recent explorations in the Argentine portion of the Terra del Fuego show an abundant occurrence of gold.

Deep Sea Explorations. — The president of the English Geologists Association in his recent address before that Society, has given a valuable account of deep sea explorations from Capt. Dayman's survey of the North Atlantic sea bed in 1857, to the expedition of the *Challenger*.

The French Commission will continue their deep sea explorations on board the *Travailleur* during this season. The investigations will include the ocean bed along the coast of Spain, Portugal and Morocco.

Ascent of Mount Cook.—The Rev. W. S. Green and his two Swiss guides, succeeded in ascending Mount Cook, the highest known Australasian peak, on the 2d of March last, after two unsuccessful attempts. Great danger was incurred from continual avalanches, and the summit was not reached until 6.20 P. M. As the clouds obscured the view and the hour was so late only ten minutes were spent on the summit and no observations appear to have been taken so that the actual height of Mount Cook is still unknown. It is given in the government map as 12,349 feet. In the account given in the *Proceedings* of the Royal Geographical Society it is said: "The scenery about the upper part of the Tasman Glacier and its branches, is described as supremely grand, equaling and even excelling the most famous scenery in the European Alps. The peaks rise higher above the level of the snow fields, and these are more extensive, and under the brighter and clearer atmosphere of New Zealand, present a more dazzling beauty. The spurs of Mount Cook, below the snow line, were covered with plants which reminded the travelers of the Alpine vegetation of Switzerland. Among these was a Gnaphalium closely resembling *G. leontopodium*, the well-known 'Edelweiss.'"

Afghanistan.—During the recent occupation of Afghanistan by the English, an area of 39,500 square miles has been surveyed in more or less detail, in various parts, and a further area of about 7000 square miles has been explored by native agency. An important result of these surveys is to show that the position of Kabul, Ghazni and Kandahar, as indicated previously on the maps, are correct in latitude but erroneous in longitude by ten to fourteen miles, and that they all require to be shifted to the east, bringing them so much nearer to the British frontier. A large number of the heights are found to be considerably in excess.

MICROSCOPY.[1]

BIBLIOGRAPHY OF THE MICROSCOPE.—Mr. Julien Deby, of London, late vice-president of the Belgian Microscopical Society, has commenced the publication, under this title, of a most useful work. Part III, relating to the Diatomacea, has appeared, Mr. Frederick Kitton having assisted in its preparation. Parts I and II, relating to the microscope proper, the Protozoa, the Desmidiæ, etc., will shortly follow. In preparing for his own convenience this catalogue of the books and papers in his microscopical library, Mr. Deby has with much labor prepared a catalogue which, with its added desiderata, constitutes a very complete microscopical bibliography. The work includes reference to papers in journals and transactions; and also contains a chronological index to all the publications referred to. It is handsomely printed for the author, and the necessarily limited edition has been generously distributed by him in the hope of making it useful to microscopical friends—a hope which will be abundantly realized.

APPARENT SIZE OF MAGNIFIED OBJECTS.—Professor Wm. H. Brewer read a paper upon this subject at the recent meeting of the A. A. A. S. The well known diversity of opinion as to the apparent size of an object under the microscope was illustrated by reports of experiments upon over 400 observers of all classes, ages, occupations and qualifications. The object was a common louse magnified, as estimated by scientific microscopists, to the size of 4.66 inches. By far the greater number of observers underestimated this value; two estimates were only one inch, while seven were over a foot, and one (by an expert draughtsman) was at least five feet. Among new students the first impression was usually somewhat larger than the real value, and this was adhered to for some time.

DOUBLE-STAINING OF NUCLEATED BLOOD CORPUSCLES.—Dr. Allea Y. Moore gives, in *The Microscope*, a valuable explanation of the method of differential staining by which his fine slides of blood corpuscles are produced. The blood is spread upon the slide by the usual method, drawing a drop across one slide by means of the edge of another slide. When the film of corpuscles, thus evenly spread, is thoroughly dry, the slide is flooded for three (3) minutes with a solution of rosin five grains, in distilled water and alcohol, four drachms each. The slide is then washed by passing it gently through clean water, and before drying is flooded for two (2) minutes with a solution of methyl analine green five grains, in distilled water one ounce. It is then

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

washed again, as before, and set aside to dry, and finally mounted in Canada balsam warmed just sufficiently to spread properly. Corpuscles prepared in this way will be found to be stained red, while the nuclei and leucocytes will be a bluish-green, and will show with great sharpness and brilliancy under the microscope.

MOUNTING WITH BLACK BACKGROUND.—On principle, I very much dislike to see objects mounted with an irremovable *black background*. When it is desirable to view objects as opaque, there are so many other ways of doing this, *e. g.*, the diaphragm, or the dark well of the opticians, or a piece of dead-black paper, cloth or velvet placed behind the slide; it can then still be viewed as a transparent object also. Otherwise it is the mounter saying to the observer: "You shall see my slide as *I* will, and in no other way."—*Tuffen West in Journal of the Postal Microscopical Society.*

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SCIENTIFIC NEWS.

— A specimen of the Gila monster, a large lizard, *Heloderma horridum*, has been recently added to the Zoölogical Garden at London, according to *Land and Water.* This lizard is reported to be poisonous. We remember visiting one which lived loose for a number of months in the front window of an apothecary's shop in Salt Lake City, which showed slight, if any, evidence of ferocity, its keepers not being aware of its reported poisonous qualities. Dr. Irwin, U. S. A., experimented with the *H. suspectum* in Arizona, fifteen years ago, and concluded that it was harmless. The London individual was tested with a frog, which died after a few voracious bites, and then a guinea pig, which was convulsed and died in three minutes after one bite in the leg; but this might happen if this large lizard was not poisonous, and there is room for more careful experiments as to its venomous qualities.

— Mr. Herbert Spencer, the leading philósopher of England, if not of the world, has been in this country for some weeks, the guest of Dr. Youmans, the editor of the *Popular Science Monthly*. Mr. Spencer, it is understood, will not lecture while in the United States, as he is traveling for his health. While few will probably have the pleasure of meeting this great thinker and organizer of new lines of thought which have already revolutionized social as well as physical science, it is a great pleasure to have him among us, and we feel sure that every one will earnestly hope for his full restoration to health and former capacity for work.

— Professor R. Ellsworth Call has met with good success in his collecting tour in the Gulf States, having obtained a large number of the *Strepomatidæ*, a group of shells which he intends to monograph. He designs not merely to systematize the group, but to give their anatomy, development if possible, distribution, habits, &c., &c. He has already eight-tenths of all the nominal species, and hopes for the loan of rarities and even common species from conchologists at home and abroad.

— The Darwin memorial fund amounts to £2500, and the memorial will take the form of a marble statue, to be placed in the large hall of the new Natural History Museum at South Kensington.

— Our readers will deeply regret the untimely death of Professor F. M. Balfour, who was killed in July at the age of 31, by a fall on a glacier on Mont Blanc. His career had been a remarkably brilliant one, his work was critical and yet profound, and he had done perhaps more than any one else to advance embryological science in England. His "Comparative Embryology" will be a lasting monument to his genius as an investigator and scholar.

— William Stanley Jevons, professor of political economy in University College, London, was drowned while bathing at Bexhill, near Hastings, England, Aug. 15. His greatest work, "The Principles of Science," gave him a wide reputation; it fully recognized the place of the doctrine of evolution in the philosophy of science. His text book on logic is widely used in American colleges.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Montreal, Aug. 23–30, 1882.—The attendance on this session was nearly a thousand, being almost as many as met at Boston two years ago; the citizens of Montreal gave a most generous and warm reception to the association. The address of the retiring president, Professor Brush, was on mineralogy, its present state and early history in America. The association will meet in 1883 at Minneapolis, Minn., under the presidency of Professor C. A. Young, Principal Dawson having been president of the Montreal meeting.

Professor Wm. B. Carpenter, of England, was present, and delivered an evening lecture on the temperature of the deep sea, and Mr. T. Graham Bell lectured on visible speech. Besides Dr. Carpenter, Professors Szabo from Buda Pesth, W. Kowalevsky of Moscow, and Haughton of Dublin, were present, and assisted at the meeting. On the evening of the 24th the Peter Redpath Museum of McGill University was formally opened. The excursions were a pleasurable feature of the meeting.

Following is a list of the papers read in geology:

SECTION E—GEOLOGY AND GEOGRAPHY.

On the relations of Dictyophyton, Phragmodictyum and similar forms with Hyphontænia. James Hall.

Note upon the genus Plumulites. James Hall.

A source of the bituminous matter in the Ohio Black Shale (Huron Shale of Newberry). Ed. Orton.

Contribution to Seismology. Richard Owen.
The topography and geology of the Great Salt Lake valley. William Bross.
Pre-glacial channel of Eagle river, Lake Superior. Charles Whittlesey.
Recent discoveries of fossil fishes in the Devonian rocks of Canada. J. F. Whiteaves.
The Eozoic rocks of Central and Southern Europe. T. Sterry Hunt.
The Serpentines of Italy. T. Sterry Hunt.
Note on the occurrence of *Siphonotreta scotica* in the Utica formation near Ottawa, Ont. J. F. Whiteaves.
Arctic explorations in North America. John Rae.
Recent Investigations and palæontological discoveries in the Wappinger limestone of Dutchess and neighboring counties, New York. Wm. B. Dwight.
A *Mastodon americanus* in a beaver dam near Freehold. N. J. Samuel Lockwood.
Silicified stumps of South Park, Col. Robert B. Warder.
On the classification and origin of joint structure. W. O. Crosby.
On the Winooski marble of Vermont, with exhibition of specimens. G. H. Perkins.
The comparative stratigraphy of the crystalline rocks of North Carolina and Canada. Alexis A. Julien.
The genesis of the crystalline iron ores of North Carolina and Northern Michigan. Alexis A. Julien.
Palæozoic floras of Eastern North America and more especially in Canada. J. W. Dawson.
Deep-sea soundings and temperatures in the Gulf Stream off the Atlantic coast, taken under the direction of the U. S. Coast Survey. J. R. Bartlett.
Terraces and beaches about Lake Ontario. Jos. W. Spencer.
Occurrence of Graptolites in the Niagara formation of Canada. Jos. W. Spencer.
On the change of relative level of the ocean and uplands on the eastern coast of North America. Geo. H. Cook.
On a Post-tertiary deposit containing impressions of leaves in Cumberland county, N. J. M. L. Britton.
The origin of joint cracks. H. F. Walling.
The great terminal moraine across Pennsylvania. H. Carvill Lewis.
The Danite beds of North Carolina. Alexis A. Julien.
The Felsite tufa of Colorado. Alexis A. Julien.
Note on the exterior markings of bark of *Lepidodendron chemungense.* E. W. Claypole.
On *Amphicœlia cedarvillensis* from the Niagara group of Cedarville, Ohio. E. W. Claypole.
Note on the fauna of the Catskill red sandstone. E. W. Claypole.
A rocking stone in New York city. Chas. H. Graham.
Occurrence of magnetic ore deposits in Victoria county, Ontario. W. Hamilton Merritt.
The undulations of the rock-masses across Central New York State. Henry S. Williams.
Fresh-water lignitic series of beds in the Cretaceous formation of France. D. W. Kowalevsky.
On the surface limit of the thickness of the Continental glacier in New Jersey and adjacent States, with notes on glacial phenomena in the Catskills. John C. Smock.
Suggestions as to the history of the Lower Coal measures of Ohio. Edward Orton.
The glacial flood of the Connecticut River valley. C. H. Hitchcock.
Some mooted points in American geology. J. S. Newberry.
Genesis of North American flora. J. S. Newberry.
Currents of air and ocean in connection with climate, regions of summer rains and summer droughts. J. Beaufort Hurlbert.
Subterranean map-making, with new maps of Mammoth and Luray caves. Horace C. Hovey.
Law of fracture or fissuring, applied to inorganic and organic matter. Richard Owen.
The caves of Staffa and their relation to the ancient civilization of Iona. F. Cope Whitehouse.
On the association of crystals of quartz and calcite in parallel position. R. B. Hare.

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THE ANCIENT MAN OF CALAVERAS.

BY W. O. AYRES.

IN the minds of almost all, the existence of prehistoric man in California is associated mainly with the famous "Calaveras skull," and inasmuch as doubt has been cast on the authenticity of that relic, the whole subject has been badly neglected, and even by men of science has been unreasonably set aside. We will speak of that skull presently, but it is only one of the many evidences to be considered, and we will at first put it out of view. We shall find that if it had never come to light at all, the proofs that man existed when, or rather before, the auriferous gravel was deposited, are so complete that he who doubts them would as readily doubt that Napoleon Bonaparte died on the Island of St. Helena.

The auriferous gravel of the books is the pay-dirt of the miners, and that we may know what the existence of man at the time of its deposit means, we must endeavor to ascertain how long ago that deposit occurred. If we say to a geologist that the gravel is of Pliocene age, he carries back his thoughts over an interval of which the years reckoned by thousands are never counted, though he knows the thousand must be very many. But for those to whom Pliocene and Post-pliocene sound like barbarous terms it may be possible to adduce a form of proof which appeals to the eye, and which brings with it therefore, a force which all can appreciate.

It is well to state at the outset that the pay-dirt is manifestly all of one formation and of one geological age, wherever we find it. Some of it is lying opened and exposed; we will let that pass. Some of it is covered by volcanic rock, and of course is itself older than the rock; that is, the lava flowed out and covered the gravel after the gravel was in its present form and position. That is sure, for after the gravel was thus imbedded, it has most certainly never been disturbed until within these last few years the miners have dug into it in search of gold. To the gravel then below the lava, we will turn our attention.

Looking out from Carson hill, in Calaveras county, you see across the Stanislas in Tuolumne, a long mountain ridge. It extends down into the plain, where it ends very abruptly, while its upper limit is out of sight away among the main heights of the Sierra Nevada. It looks like a huge railroad embankment, and suggests to you that idea, but men do not make railroad dykes forty miles long and 1500 to 3000 feet high. That which gives it its smooth even upper surface is basalt, that is, ancient lava; the lower part is of looser materials. The thickness of the basalt varies at different points, being here and there hundreds of feet thicker than it is at other places a mile or two either above or below. This is Table mountain, a name which has been famous in the history of California, as we shall see.

The question occurs to us: How came Table mountain to exist? That basalt, when it was erupted, was fluid like other lava. How could it be piled up so thick and so abrupt (for its sides are often perpendicular) on that high mountain ridge, and remain there? Why did it not spread itself out laterally and cover the plain? But one answer to these questions can be given: *There was no plain.*

When that eruption took place, and the crater or fissure opened, far up near the summit of the Sierra Nevada, it naturally flowed into the bed of the first stream which crossed its track. This it filled and followed down until, when the eruption ended, the old river bed, away down to the plain, was blocked up by tne solid volcanic rock, and the waters which should have been there, were finding their way by some other track.

As time passed on, the side of the mountain range was yielding to atmospheric influences. The flowing water was carrying off the softer material on each side of the hard basalt, which had filled and obliterated the old river-bed; the Tuolumne river on the south and the Stanislas on the north, with their tributaries, were formed, and scooped out their present valleys, and thus Table mountain, which had been deposited in the bed of an old mountain torrent, with high ridges confining it, became itself a ridge, standing like a wall above all which adjoined it. But beneath the basalt lay the stones and gravel and sand and clay which made the bed of the ancient torrent, as they do of the modern streams. And like the modern streams, their predecessor, in age but not in locality, was rich in gold, and thanks to this gold, we know something of the Ancient Man of Calaveras and Tuolumne. We know him because he has left his mark among the stones and gravel.

In what are called the "early days" in '49 and '50, the southern mines were specially noted and productive. Don Pedro's bar and Hawkin's bar on the Tuolumne were crowded with miners, and all the region about Sonora, and Columbia, and Shaw's flat, was swarming like a hive. The gold which was obtained had been brought down in company with the gravel from the mountain heights far above, by the rush of water, ages before. Wherever an old channel could be found in which the flow of water had been confined to narrow limits and to whirling eddies, there the gold had been deposited more abundantly, and rich strikes were made. While exploring these surface deposits, an old river-bed was struck at Shaw's flat, in 1854, which showed features quite distinct from the "diggings" adjacent, and in following out this discovery it became manifest that Table mountain, as already stated, was simply a mass of lava filling an ancient torrent cañon, and that the gravel thus buried was in various places most wonderfully rich. This was the beginning of Table mountain mining.

The whole matter had very much the character of a lottery, for the expense of running a tunnel under the mountain was very great, and the result entirely uncertain, commonly rich to even a fabulous degree, or on the contrary a total failure. The failures were many and the losses destructive to the fortunes of the men interested, but the wild excitement of golden possibilities lured multitudes along, and for years and years in succession Table mountain was bored and tunneled most completely. It is not for us now to speak of the triumph or the heart-ache which went with the work; we know well that

> "No minstrel ever sung or told
> A song so sweet as chink of gold,"

and nowhere, even in that land of enchantment, was the wild and fatal fascination of the search more fully felt than at Table mountain. But that goes by us. Out of these tunnels came the tokens of the past, and we see shadowy visions of the ancient man looming up.

But we will first try to measure off the interval since the Table mountain lava flowed; not that we can specify it in figures, but we may learn enough to reverence its extent. We will consider but one feature. This is the magnitude of the work which has been done by streams of water since the period of volcanic eruption of which mention has been made.

The western slope of the Sierra Nevada is furrowed with enormous gorges reaching from the summit ridges to the plains of the Sacramento and the San Joaquim. Any one of them may be taken as a type of all the others. At their upper part they are, of course, shallow and narrow; a few hundred feet deep and a quarter to half a mile wide, more or less, but steadily increasing in both dimensions. Before they reach their debouchure they are ten to twenty miles wide and two to four thousand feet deep. Standing far up among the higher ranges and following with the eye the stupendous furrow through its windings, fifteen, thirty, forty miles, till all is lost in the blueness of depth and of distance, one often tries to roll back the tide of time and get some glimpse of the days when that plowshare began its work. But the blueness of the chasm is only a faint index of the dimness which comes across the mental vision. It is idle to suggest to one thus standing and looking down the cañon of the Yuba, or the American, or the Tuolumne, that water can have done that work (and water certainly has done it) within an interval which, reckoning years by thousands, must not have written against it *very, very many.* We will not specify how many, but the number surely is great.

And all this scooping out of cañons, this furrowing the western Sierra slope into its configuration of the present era, has been done since the Table mountain lava flowed. Of that there can be no question. The evidence is too plain to admit a doubt.

If now we find the remains of man, or works which none but man could have made, among the gravel-beds beneath Table mountain, or in any other place amid the undisturbed pay-dirt, we cannot fail to know that human hands and human brains had done their work before the immense cañons of the Sierra Nevada commenced their formation in the little furrows near the summit down which the waters trickled.

We can take the proofs only in brief, and we will take none but those which are absolutely established and authentic.

Dr. Perez Snell, of Sonora, had in his collection (this collection has unfortunately perished by fire) a human jaw which was brought out in a carload of "pay-dirt" from a shaft stretching far in beneath the Table mountain, and with it were several stone implements. Dr. Snell did not himself see this bone in the car as it was drawn to the surface, and in the minds of some a doubt might thus be thrown on its authenticity. The specimen was given to him by a miner. If it were an isolated instance this would be possibly worth considering, but it is only one of many, and at the same time it is only fair to state that there could not well have been found a miner in all that region who would have thought it worth his while to attempt a deception, nor even one who had any doubt in his own mind as to the point we are considering. They saw the products of man's work come out with the gravel too often to pay commonly any attention to them. The only wonder is that he even took the trouble to pick out the bone at all. There can be no question that for one such that has been preserved, dozens and perhaps hundreds have gone down in the current of water in the sluice washing.

In 1857 Col. Hubbs, who was afterward State Superintendent of Instruction, found in a load of "dirt" as it came out from his claim under Table mountain, portions of a human skull. He was on the ground himself, and saw the fragments as they were taken out of the sluice. They had come from a distance of 180 feet beneath the lava. One of the pieces is now in the collection of the Boston Society of Natural History; the other in that of the Philadelphia Academy.

Mr. O. W. Stevens certifies that in 1853 he found in a shaft under Table mountain, "about two hundred feet in," a relic that resembled a large stone bead, of white marble, about an inch and a half long and an inch and a fourth in diameter, with a hole through it a fourth of an inch across.

Dr. Snell had in his collection a stone muller or pestle which he took with his own hands from a car load of "dirt" as it came out from under Table mountain.

Mr. Llewellyn Price certifies that in 1862 he dug up a stone mortar under Table mountain at a depth of about 200 feet from the surface and about 1800 feet in from the mouth of the tunnel.

But why need we specify any further single instances. The witnesses already given were all credible and worthy men, they could have had no possible collusion, they had no motive for deception, and the circumstances were such that they could not well be deceived as to what they stated. If any candid person will not be convinced by the evidence they give, he would be equally incredulous were a hundred more to testify to the same truths.

And the hundred more could be summoned were it worth the

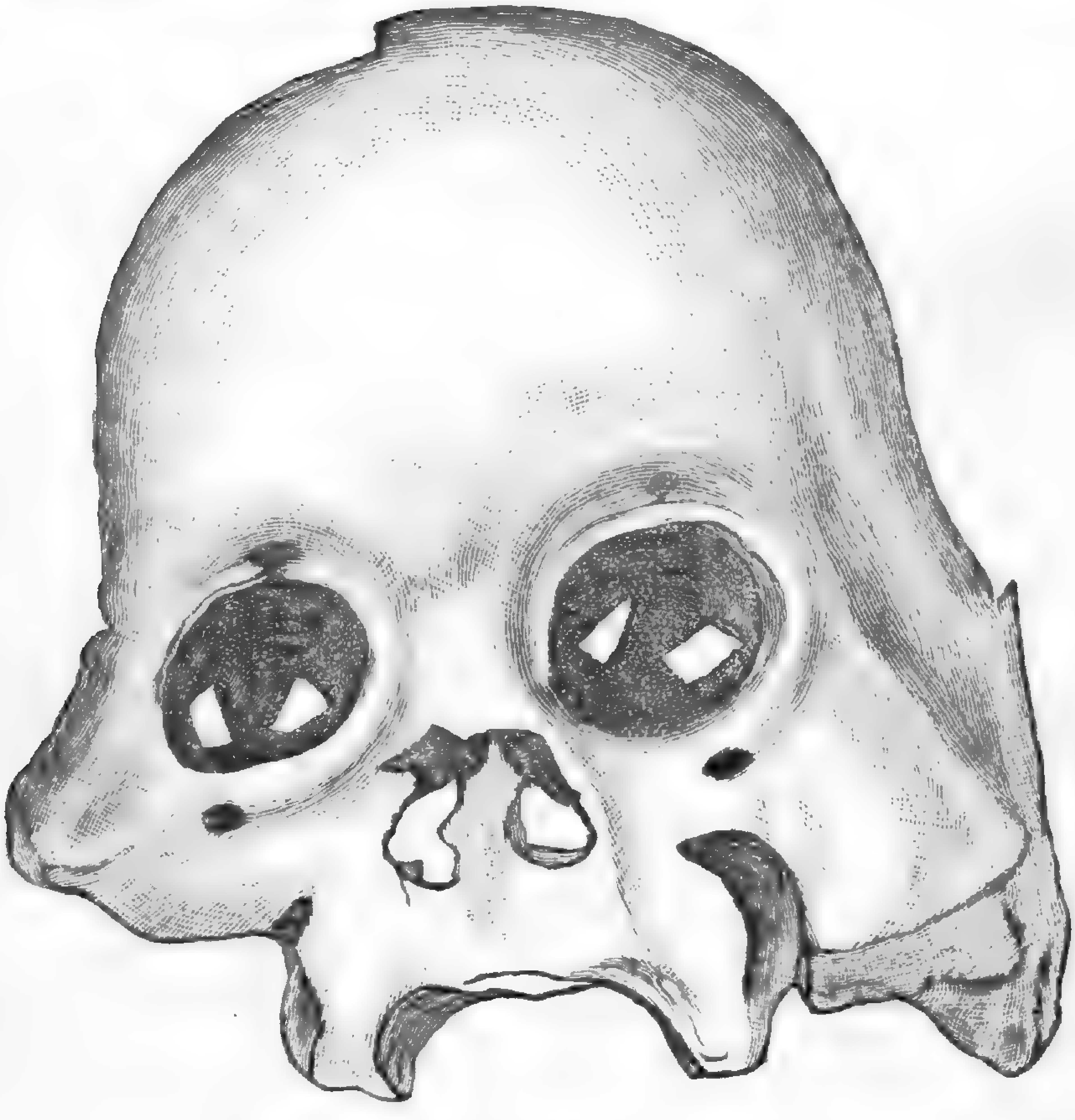

FIG. 1.—Calaveras Skull, Front View.

while, for the instances in which the products of human workmanship have been washed out of the "gravel" in searching for gold are altogether too numerous for record. Very many of them are now in the Museum of the University of California, and very many more were disregarded and lost, for so common did they become during the days of surface mining, that at length the miners paid no attention to them, and they simply went in with the refuse of the workings.

They were almost universally implements of stone, such as mortars, pestles, rude vases or platters, that is, articles which could be used for grinding food, &c., but all rough in workmanship and evidently fabricated by people low in the scale of civilization. But such as they are, they show with what appears to be conclusive proof, that they were made before Table mountain lava was erupted, and perhaps long before, for they were also surely made before the auriferous gravels were deposited.

One item comes naturally to our consideration here in the line of confirmation. The auriferous gravels contain abundant remains of plants and animals. Mastodons and elephants appear

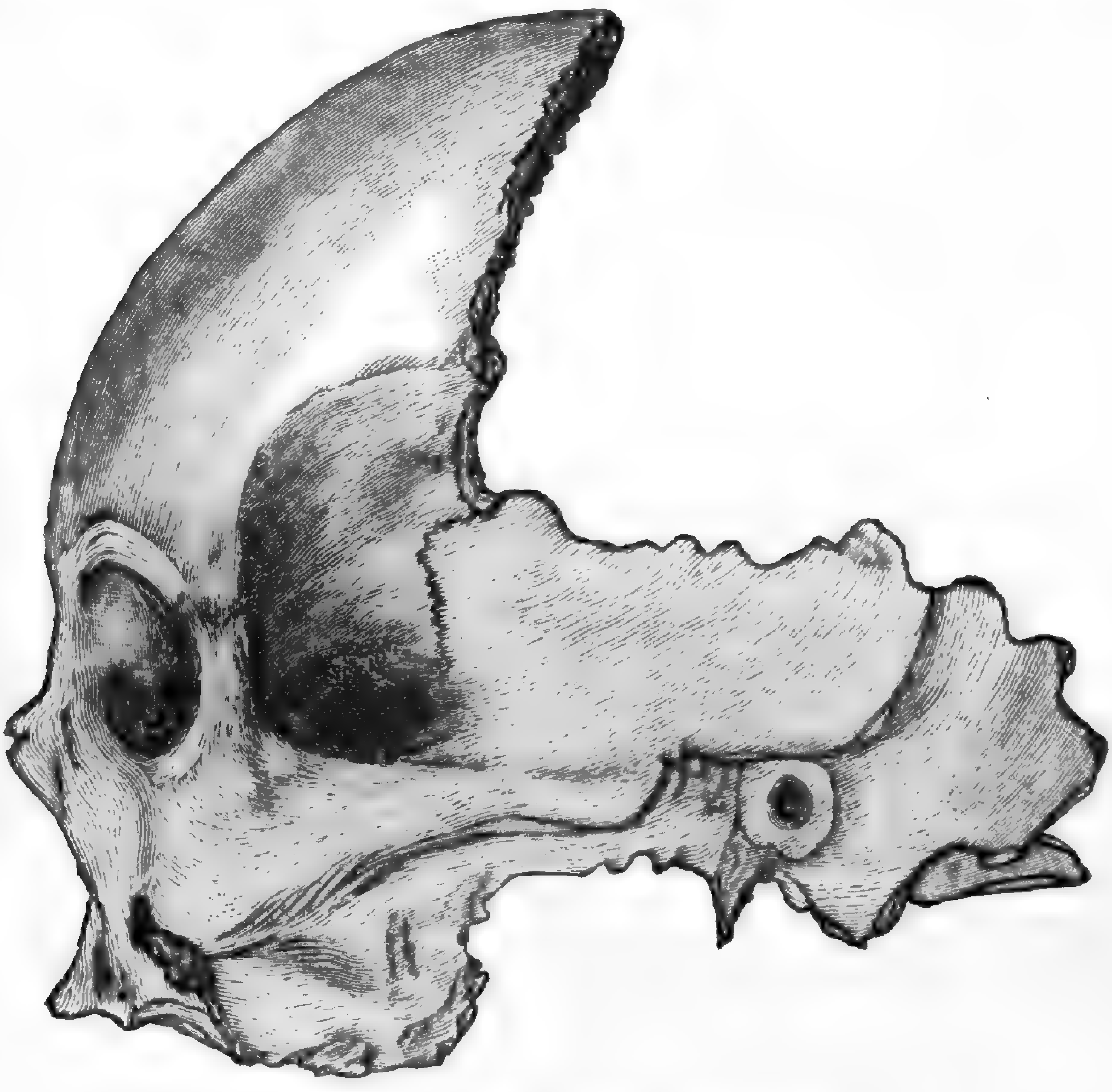

FIG. 2.—Calaveras Skull, Profile View.

to have specially abounded; in no other part of the world have their bones and teeth been found in greater numbers. With them were found species of rhinoceros, Elotherium, horse, ox, camel, &c., &c. But all of these were of types long since passed away, and the same can be said of the leaves and fossilized wood. Dr. Newberry's report characterizes them as being entirely unlike anything now growing in California, and as belonging to the Tertiary age, the later Pliocene. Now we know that the fauna and flora of a country cannot be *completely* changed except through the intervention of a very great space in time, or the agency of a sudden cataclysm and reconstruction.

And shall we now compare them in age with the others which are absolutely prehistoric, and which have disturbed the scientific world by their venerable antiquity. Fierce have been the conflicts waged over the Neanderthal skull, the Engis skull, the men of Cro-Magnon and the various other relics gathered from the gravels and bone-breccias of Europe. But their record is dwarfed to comparative insignificance when laid by the side of that to which we have been looking. The days of Table mountain had passed off into the dark realm of the forgotten past, ages before the drift of the valley of the Somme was deposited or the man of the Neanderthal lived. Those European relics have by none been counted older than the Post-pliocene; these of the Sierra Nevada go back to the Pliocene, and as the "new world" of modern style was the very oldest in showing itself above the waste of waters, so perhaps it was also the first to feel the step of man. It is possible that the discoveries of Ribiero in Portugal, and of the English Geological Survey in India may be found to carry us as far back as the times we have been discussing, but they have thus far been strangely ignored.

What manner of man then was this Ancient Man of Calaveras? Let him speak for himself. All notice of the skull described by Professor Whitney has been purposely omitted till this moment, because it is by far the most important "find" yet made, and it is worthy of being considered by itself and in the present connection. The chief point in estimating its value, is its genuineness. It has been the subject of much criticism, and in the minds of very many, its mention barely recalls Bret Harte's ridiculous doggerel,

> "My name it was Brown, and my crust it was busted
> Falling down a shaft in Calaveras county,"

and the request to send the pieces back to old Mazzoura, has relegated the whole matter to the domain of joke. In the belief that Professor Whitney was the victim of a *sell*, the question is often asked whether there is any evidence that the skull was actually taken from the shaft to which its discovery is credited.

Now with all due submission to previous judgment (or misjudgment), I maintain that that question is of only secondary importance. The skull speaks for itself, and notwithstanding that its lower jaw is gone, it talks good English, whatever its vernacular may have been in the days of the flesh.

That it came to Professor Whitney from the hands of Mr. Mattison (or as I always heard him called, Matthewson), of Angels Camp, is certain. Where did Mr. Matthewson get that skull? I do not know, nor is the precise spot of much consequence. He says he took it from his shaft near what was then called the Forks of the Road, above Angels. Suppose he did, or suppose he foolishly tried to humbug the geologist, what does it matter? He got the skull *somewhere*, and wherever it might have been first found, it surely was imbedded in the auriferous gravel, and it had become so imbedded at the time the gravel was originally deposited.

You say, that is a bold assertion; how do you know it? I will tell you; I know it, because *the skull told me so.* I saw it and examined it carefully at the time when it first reached Professor Whitney's hands. It was not only incrusted with sand and gravel, but its cavities were crowded with the same material; and that material was of a peculiar sort, a sort which I had had occasion to know thoroughly. It was the the common "cement" or "dirt" of the miners; that known in books as the auriferous gravel. This is an article "*sui generis*;" it is not easily imitated. No skill possessed by Mr. Matthewson or any one else could have been sufficient to give the skull the characters which it had as I saw it. It is most certainly no fabrication.

But it has been said that it is a modern skull which had become incrusted after a few years of interment. This assertion, however, is never made by any one knowing the region. The gravel has not the slightest tendency toward an action of that sort. The skull would either decay and waste away, or it would remain unchanged; and added to this comes in the fact that the hollows of the skull were crowded with the solidified and cemented sand, in such a way as they could have been only by its being driven into them in a semi-fluid mass, a condition which the gravels have never had since they were first laid down.

No, no! Let the skull tell its own story, and believe what it says, because it brings its own proof. Whatever age belongs to the gravel deposit under Table mountain belongs to the Calaveras skull, entirely irrespective of the question of honesty or dishonesty in the alleged finder. Wherever he found it, I believe its age to be beyond cavil.

Its degree of fossilization has not been here insisted upon, because that change is more rapid in some localities than in others, but it is an interesting fact that this Calaveras skull is more thoroughly fossilized, a greater proportion of its phosphate of lime has become carbonate than in either of the European specimens which are reckoned of the greatest age.

We seem then fairly entitled to consider the Ancient Man of Calaveras the oldest representative of our race to which we can as yet refer; and being such, is he of a bestial type? Look for yourself. Figures have been published by Professor Whitney in his work. What is there bestial as shown by them? A single skull cannot, of course, speak for a whole race, but so far as this specimen can testify, what man is now, man was then. It manifests no sign of inferiority to the American race as now existing. Barbarous in habit he doubtless may have been. All the relics of workmanship thus far discovered of those coeval with him, indicate a low grade of civilization, and yet one not necessarily much, if at all, lower than that of most of the Indian tribes which formerly occupied the entire breadth of the continent. And in intellectual power, judging from his cerebral development, he might assuredly have claimed a fair average rank.

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THE GRAY RABBIT (LEPUS SYLVATICUS).

BY SAMUEL LOCKWOOD.

A BIT of odd, yet attractive innocence is the wild rabbit of Europe. I cannot say as much for its descendant, that piebald and lop-eared pet of my boyhood. All endearment died out at sight of the pampered old buck killing his own offspring from sheer wantonness; then came implacable dislike on seeing the doe eating one of her little babies. The domesticated rabbit gains nothing intellectually over its wild ancestor, but becomes emotionally unnatural, if not pathologically unsound. The tamed gray squirrel will lose the sexual instinct to the extent that it becomes degenerated into or absorbed by a morbid appetite so engrossing that the male will suck at one place on the tail of his mate, until he has nearly severed that member. Something not unlike is seen in the stallion of high strain, when biting the neck of the mare in the fervency of his passion. At the best, under domestication, the rabbit, like the guinea pig, *Cavia cobaia*, with its rabbit-like head and face, gets simply coddled into a stupid harmlessness. In its wild state dwelling in communities, with a living to get, and many foes to shun, the wild rabbit has sharpened wits and many entertaining ways. I have seen them in their warrens abroad, and a rollicking abandon is their early morning frolic. Then all of a sudden comes a still, serious watchfulness, a oneness of circumspection, the whole camp mounting guard, for sitting on his hinder parts, every individual is on the alert. It is light and shade, Milesian merriment topping off with a bit of a row. Let one get its temper up, and it will stamp the ground in pettish, and it may be angry demonstration. All which has in it a spice of high-class nature; for I have seen chimpanzee do the same thing—yes, and coming higher, have painful recollections how a little motherless lad used to quail under a similar plantigrade terrorism, inflicted by Madam Anthropos. So this animal pantomime of "stamping out" is very human.

Though not without cunning, if a ferret invade its domicile, it is all up with bunny, sure. But a terrier dog has been known to squeeze itself into the burrow, and coney, returning to find his home invaded, has with great energy closed up the entrance, thus burying alive the disturber of his peace.

But all this is writing about real rabbits, which is not what we started to do. Perhaps the following occurrence may set our subject in a proper light: A friend had procured an Irish farm-hand at the immigrant depot, at Castle Garden, New York. He brought him to Keyport, New Jersey, by steamboat, then took him in his own vehicle to the farm, some five miles away. William was intelligent and made sensible remarks on the new scenes through which he was riding. Our farmer friend, an inveterate wag, said: "Yes, a fine country, William. But wait till I show you some of our native animals. You have not yet seen an American rabbit." On reaching the first field of the farm a large Spanish stud appeared. Seeing his owner, Sancho approached the fence by the roadside, and brayed a sonorous welcome.

Farmer: "There, William, what do you think of that for an American rabbit?"

William: "An' is that an American rabbit? Sure an' if I'd seen the baste at home I would have pronounced him a jackass! But this *is* a fine country!"

It was not long before the man did make the acquaintance of our gray rabbit, one which had been caught without harm in a trap. Attempting to toy with it, he received on his hand a smart blow from both hind feet of the affrighted little prisoner, which inflicted quite a scratch, on which he exclaimed: "Sure, Master, 'an is this why you called that ass an American rabbit? Troth, and the little baste does kick like a mule. But I should never take it for a rabbit. At home we would call it a young hare." Probably it would have bothered this sensible man, had he been told that there was in America a hare known as the "great jack-ass rabbit."

Still, William was right every time. The gray rabbit is a hare; and our opening paragraph is applicable only to the true European rabbit, *Lepus cuniculus.* The word rabbit then simply denotes a species of the genus *Lepus,* of which the word *hare* is the generic expression in the English and some of the continental languages. Though possessing several species of hare, America does not include the true rabbit. Passing by certain real distinctions of form, let us notice some striking differences of habit. The cony is a true burrower, and lives in communities. The hare is solitary and, as a rule, does not burrow, though sometimes found occupying an abandoned burrow of some other animal, like the so-called burrowing-owl, *Athene cunicularia,* which occupies the deserted burrows of the prairie dog, *Cynomys ludovicianus.* Then the rabbit, like the guinea pig, brings forth its little ones full-haired and open-eyed; but the young hare comes into being nearly naked and quite blind, altogether a very helpless thing. However, the popular voice has fairly got the start of science in this matter, and as the "gray rabbit" it will be always known. The truth is the systematists got things so badly mixed that not until recently did this very common animal have a scientific name of its own. Peter Kalm, the Swedish botanist, for whom Linne named our beautiful Kalmia, published at Stockholm his Travels in North America, 3 vols., 1753–61. Here is the earliest book allusion to the little hare, and it is referred to as inhabiting New Jersey. But the first carefully-worked-out diagnosis of the species, was made by John David Schoepf, who in 1783 wrote an accurate scientific description of it in New York, which he published the year following in Germany. What is strange and unfortunate, he did not give it a systematic name, but simply called it, "Der Nord-Americanische Haase;" and some of the systematists jumped at the conclusion that by "North American Hare," the savant meant *Lepus americanus.* It was some sixty years afterwards when Professor Baird translated Schoepf's description, and said in connection: "It is not a little remarkable, that this, one of the best known animals of North America, should not have received a distinct scientific name until 1837, when Dr. Bachman gave it the name *Lepus sylvaticus*," the wood hare. Other scientists had worked on the case, but, in fatal confusion, had mistaken the individual. Schreber, in 1792, named it *L. nana*, the dwarf hare, a good name, but his description applied to another hare. So it fell out that the only canonic christening the little fellow got, was received of Rev. John Bachman, a collaborator of Audubon. In what follows, the words hare and rabbit will be used interchangeably.

A curious appearance is sometimes noticeable upon the snow after it has lain a few days. The foot-tracks and hard fecal pellets of the rabbit are seen, and close by certain reddish-brown stains, like spots of oxydized blood. These, in mistake, I once explained as probably hæmorrhoids produced by constipation due to the dry fibrous food to which a severe winter reduces the animal, when succulent food cannot be got. This is not the true cause. Something similar is seen in winter when the bees of an apiary, after being snowed-in, are "dug out." The snow around the hives is immediately thickly spotted with small brownish orange stains, Bee keepers call it "bee dysentery." It is simply due to the cleanly habits of the insect. It will not defile the hive, so practices a severe continence until it can get out. In the hard winter of 1880, the hungry rabbits ventured into the gardens of Freehold, N. J., and in a number of places the snow was stained with these bloody spots. It is certainly interesting to know that all this comes of the almost fastidious cleanliness of the animal. Should it find no better shelter in the cold weather, it must occupy its "form," or "bed," that is, its squatting place, into which it pushes its back parts, then flattens itself like a toad in its hole. Thus squatted, such is the resemblance of color to the ground, that the hunter has strode close to the animal's nose and missed it. This form may be a depression in the side of the bank, or under a log, or in a tussock of grass, or in some low, bushy, close-leaved plant. Suppose a snow-storm, and the animal gets "snowed under," there is heat enough to make a little chamber, and generally a thin breathing spot, or hole, above, caused by the thawing of the warm breath, which unhappily often betrays its hiding place to dog and man. If undisturbed, the animal is so impatient of cold as to stay in its form several days without food. So cleanly is the poor thing, that it will suffer acutely rather than pollute its home; hence the practice of a painful continence until forced by sheer distress to seek relief in a discharge of the suppressed urine. By this time the retained renal secretions have become thickened, and when discharged are of a reddish-brown hue.

The hare of Europe, it is commonly said, never gets fat, unlike other wild animals, even their rabbits, and this no matter how good may be its feeding grounds. Our wood hare does sometimes get quite fat, although it never makes "kidney fat." But confined to its form, as just described, the condition of the animal becomes extremely bad. From long fasting the flesh gets to be very lean, while the retention of the urine infects the entire tissues with urea, making its odor so rank as to receive the epithet "skunky."

The domestic rabbit can be made enormously fat. An epicure not many miles away, often luxuriated on a buck of large size, splendid condition and exquisite flavor. The truth told, it was an eunuch Cuniculus, fat, fair and portly, which graced our gourmand's board. But before leaving the adipose part of this subject, a bit of ignorance must be mentioned, which ought to be unique. Last autumn my neighbor's man captured a fine, gray rabbit. He had skinned the game, and was profuse in praise of its condition; but having opened it, the poor man stood aghast in horror, and was suddenly taken sick, for he beheld in the coney an immense tape-worm! And this horror fell upon the whole family, for they all "saw it with their own eyes." So, not to waste the thing, it was thrown into the stye out of sight. Here was a pearl cast before swine, for the simple fact was, that attached by the edge of a thin membrane to the viscera, along nearly its entire length, was a ribbon of adipose tissue, which was scolloped by little beads of fat. These scollopings were mistaken for "tape-worm joints." In truth, this white, wavy fillet of round, waxen beads was really a very pretty object. Besides, who would look for a Tænia on the outside of the alimentary canal? However, these innocents believed they were right, and "guessed," dear souls, that "the naturalist wasn't nice enough about his victuals."

Our gray rabbit is often badly tormented with wormals, or worm-holes, in the skin, like the worbles of cattle. These are really subcutaneous bots, due to the presence, under the pelt, of the larvæ of *Cuterebra cuniculi* Clark. Packard speaks of this species of fly infesting rabbits in the South, but they have long been too common in New Jersey. Over the pit occupied by each grub or maggot, is a clean-cut hole through the skin, which serves the larva for a breathing place. They are the most noticeable in the early fall, when the animal is in its best condition; for as the grub or larva feeds on the juices of its host, the mother-fly does not deposit her eggs upon the "ill-favored and lean-fleshed." I am told, however, of a boy who caught a rabbit in the winter, and took it to a friend of mine to skin, and it was too badly infested to be usable. Professor C. V. Riley writes me thus: "I have received the larva of *Cuterebra cuniculi* as early as July 19th. The larvæ were at that time full grown, and pupated four days later. I have also found them, both large and small, as late as September, so there is probably but little uniformity in their development, and it is not particularly strange that they should be found in the larval state in the winter." The hunters say: "The grub leaves after frost." The places specially infested on the animal, are the back and neck, and forward parts of the shoulders. So bad is this at times that a suppuration occurs under the pelt, and an attempt to flay the animal starts the pus flowing, and the loathsome cadaver is cast away. Nor is this flow of maturation to be taken for the effect of wounding the larva by the knife. The skillful dresser of such small game scarcely uses the knife in skinning, except at the head and toes, drawing the pelt off like a stocking.

But the hare family is often the subject of an epidemic. In his grand monograph on the Leporidæ, says J. A. Allen: "In the case of our little wood hare (*L. sylvaticus*), I have repeatedly met with their dead bodies in the woods and thickets, bearing no marks of a violent death, and have noted the scarcity of these animals during the years immediately following." The Indians declare that the hares as a food supply are sometimes seriously reduced by disease. Mr. Allen cites Dr. J. G. Cooper in AMERICAN NATURALIST, who although as against the Indian averment, and disposed to attribute much of this mortality to the deep snows making them easy prey, says of a certain species: "Their numbers seem never to have increased much, north of the Columbia and Snake rivers since the epidemic (small pox) destroyed them some years since; but south of these rivers they became common." O, shade of Jenner! *Lepus variolus!* What says the epicure to this variety?

The gray rabbit has one form or bed to which it adheres with a cat-like attachment, the runway to which may sometimes be easily traced. If the gunner stations himself near this the game retreating homeward becomes an easy prey. A hunter told me when praising his hound, that by its bark he has distinguished the doubling at half a mile distant, and shot the rabbit at its return; but that an old rabbit, if you miss him, will avoid his "bed," and give you trouble to get him. An old rabbit usually has a series of forms at distances of thirty or forty yards from its favorite one. These supplemental forms it uses for comfort's sake, and for strategic purposes. It dislikes to face the wind, and when in repose keeps its back to windward. With the change of wind, it will change its form. A change may be made upon suspicion of danger; or it may be circumvented when away from its favorite form. Though if the danger be imminent, it usually has some hole in the ground or place under or behind a log, or in a brush-heap, into which it at once retreats. If not taken too suddenly, there is a good deal of intelligence in its methods of flight, as well as in its temporary change of domicile. They do not connect their forms by their tracks, but take prodigious leaps, clearing at a bound from fifteen to twenty feet, and the zig-zags and doublings are well suited to deceive. A curious fact about their tracks might delude the unwary into the belief that they were double, and directed backwards. The hare is virtually a plantigrade, and its leaping is done with its hind legs, much like that of the kangaroo. Upon the soft snow or on the soft ground the spoor, or trail, of a rabbit in full jump comprises two dissimilar pairs of imprints; a pair of small toe-tracks inside, and a pair of large full foot-tracks outside. The series is the impression of successive leaps, which are made in the following way: The two little front feet or hands are put pretty close together, while the hind feet are set somewhat widely apart. The fore feet are then raised from the ground, and the body by the same act is thrown back so as to bring the entire weight upon the firmly planted hind feet, in which, and in the thighs, and on the back the muscles are powerful, hence comes the tremendous spring. In alighting, the forward feet nearly close together, touch the ground first; then come down the hinder feet, striking outside and forward of the front feet. Thus is made a double track, the large and wide one outside and forward of the small one, like the kangaroo's track, with this singular difference, the latter makes his double tracks walking, for when leaping the fore feet do not touch the ground. These peculiarities of rabbit tracks were noticed by that delightful naturalist, Robert Kennicott, in 1857, who adds: "In making the longest leaps the fore feet strike in a line, one behind the other, and at some distance in the rear of the hind ones, as if they had been again raised before the latter had touched the surface." It is noticeable that when in quest of food on the snow, their tracks are made of leaps about four feet long.

The strategic tact and knowingness of the wild rabbit was well understood by the plantation negroes, who held the little fellow in an affection not less than that of the Feejee for fat missionary. The upper side of the rabbit's tail is brown, but it has a persistence in showing the under side, which is like a toilet puff, cottony white. The tail being ordinarily carried erect, looks like a tuft of pure clean cotton, or a fresh opened cotton ball, hence its familiar name among the negroes—"little cotton tail." Uncle Remus, though partial, always gets fraternal when on this subject, and makes the cunning "brer rabbit" circumvent the slyness of "brer fox."

(To be continued.)

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THE CRUSTACEAN NEBALIA AND ITS FOSSIL ALLIES, REPRESENTING THE ORDER PHYLLOCARIDA.

BY A. S. PACKARD, JR.

I.—THE STRUCTURE AND DEVELOPMENT OF NEBALIA.

A GOOD deal of interest is attached to this little Crustacean, on account of its composite nature and its evident relationship to some curious fossils which are usually placed among the Phyllopods. The following exposition of the structure of *Nebalia bipes*, which is sometimes dredged on our coast, and the remarks on its fossil allies may prove to be of interest to our readers. The article is taken, by permission, from the advanced sheets of the Twelfth Annual Report of the U. S. Geological Survey of the Territories, F. V. Hayden, in charge.[1]

The species of Nebalia inhabit the sea at moderate depths. We have dredged *N. bipes* on the coast of Labrador in from four to eight fathoms, and on the coast of Puget sound we collected a similar species, just below low-water mark, among fucoids. The following is taken from Baird's British Entomostraca: "Otho Fabricius tells us that it carries its eggs under the thorax during the whole winter; that they *begin to hatch* in the month of April, and that the young are *born* in May. They are very lively, he adds, and adhere to the mother, who appears then to be half dead. The adult swims in a prone state, using its hinder feet to propel it through the water. They are not very active. Montagu informs us that when moving in the water the superior antennæ are in constant motion as well as the abdominal feet, but that the inferior antennæ are usually motionless and brought under the body. They are found, according to Leach, on the south-western and western coasts of England, under stones that lie in the mud, amongst the hollows of the rocks; and Mr. McAndrew dredged it from a considerable depth amongst the Shetland isles."

In *Nebalia bipes* the body is rather slender and somewhat compressed, the anterior half protected by a carapace, beyond the lower edge of which the broad thin phyllopodiform feet do not project.

The carapace.—The head and anterior half of the body, including the thorax and four anterior abdominal segments, are covered by the carapace, which on the lower edge extends below the ends of the thoracic feet, covers the basal joints of the antennæ, and entirely covers the mouth parts. The sides are compressed, and are drawn together over the body by a large but rather weak adductor muscle (Pl. XIV, Fig. 6), situated a little in front of the middle of the thorax. There is no large highly specialized adductor muscle connecting the two sides of the carapace, nor any well-marked round muscular impression in the carapace, such as is characteristic in the Limnadiadæ; nor is there any hinge, a still more characteristic feature in the bivalved Phyllopods. On the contrary, as seen in Pl. XIII, Fig. 3, repre-

[1] I am indebted to Messrs. Sinclair & Son for kindly striking off an edition of the plates from the stones, after the Government edition was printed. To Dr. F. V. Hayden I am indebted for the use of the illustrations.

senting the carapace removed from the body and flattened out, there are no signs of a median hinge-joint.

The nature of the rostrum is one of the diagnostic features of this order. In Nebalia the rostrum is long and narrow, oval, seen from above, terminating in an obtuse point quite far in advance of the head. It is loosely attached to the sinus in the front of the carapace, and thus forms a long, narrow, tongue-like flap, with a free movement up and down. It is thus seen to be rather a movable appendage of the carapace than a solid, immovable continuation of it, as in the Decapoda. Upon removing the carapace and flattening it out, it is seen to be readily comparable with the carapace of Ceratiocaris.

The eyes.—The eyes are mounted upon a stalk, and thus Nebalia may be said to be essentially stalk-eyed. In this respect it is similar to the eye of the Branchipodidæ on the one hand, or to the eye of the Decapoda on the other.

The antennæ.—The two pairs of antennæ are large, well developed, and of nearly equal size in the female, but in the male the second pair extend backward beyond the bases of the caudal appendages. In the 1st pair the stem (scape or protopodite) is seen to be composed of five joints, the 1st, 2d and 4th the longest, the 3d and 5th short. From the scape arises the flagellum or endopodite, which has sixteen well-marked joints, each joint provided externally with numerous setæ; and besides, there arises from the 5th joint of the scape or stem a scale-like unjointed appendage, which may be regarded as an exopodite; if so, then the 1st instead of the 2d antennæ in the Phyllocarida bear a scale-like exopodite; the 2d antennæ in Decapoda bearing the exopodite.

The 2d antennæ have a two-jointed stem or scape (protopodite), and a single, long, many-jointed flagellum or endopodite, the basal joint a large one; no exopodite being present even in a rudimentary form.

The 1st and 2d antennæ are thus seen to be quite unlike those of the Malacostraca, and to resemble those of the Copepods, in that the anterior pair are rather the stouter of the two; but in those Copepods with very long antennæ it should be remembered that they are the 1st and not the 2d pair, as in the male Nebalia. It will thus be seen that while the antennæ of the Phyllocarida are entirely unlike those of the Phyllopoda, they are neither closely homologous with those of the Decapoda (Mysis or Cuma) or the Copepoda.

The 2d antennæ of the male is said by Claus to be very long, and to resemble those of male Cumaceæ, but upon a comparison of the stem of the antennæ, it is in Cuma quite different in the relative length of the three joints. So also, while, as Claus observes, they are like the antennæ of the Amphipoda, this resemblance is quite general; on the whole, however, the antennæ of both pair bear a general resemblance to the Malacostracous type; also, on the other hand, they may also be compared with the more primitive Copepodous type.

The mandibles (Pl. XIII, Fig. 4; Fig. 2, *md*).—These are remarkable from the small size and weak development of the biting edge or mandible itself compared with the palpus. The oval or biting end of the protopodite is small, and armed with comparatively few and weak setæ, which shows that the living Phyllocarida probably feed on decaying animal and vegetable food, which is easily brushed into the mouth by their slight stiff bristles. The palpus, however, is enormously developed, extending out quite to, if not a little beyond, the edge of the carapace (Fig. 1). It is three-jointed; the 2d a little longer than the basal, and swollen at the base, while the 3d is somewhat longer but slenderer, and edged with a fringe of close-set, rather stiff setæ. Though so immensely developed as to the palpus, and entirely unlike the mandible of the Phyllopoda, in which only the protopodite is developed, it may be compared with the mandibles of the Decapoda, especially of Mysis and other Schizopods,[1] in which a very long three-jointed palpus is developed. But the very long and large mandibular palpus and very weak protopodite may be set down as a diagnostic feature of the living Phyllocarida, though the mandibles of the fossil species appear to have been much larger.

The 1st Maxilla (Pl. XIII, Fig. 2 mx^1; Fig. 5 mx^1, 5 *a*).—These are likewise singular and diagnostic features of this order, as represented by their structure in the Nebaliadæ. They consist of a small lobe (Fig. 5 *a*, cx^1) with about eight stout setæ, and a larger lobe (cx^2) with the outer edge fringed with long coarse setæ, one of which is a large ciliated seta; from this arises, after bending on itself at its base, an extremely long and slender multiarticulate

[1] Compare G. O. Sars' Monographie over Mysider, 1870, Pl. I, Fig. 8. Claus states that the large palpus is very similar to that of many Amphipoda, but apparently overlooks the still closer resemblance to that of Mysis.

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process (or endopodite?) which, in the female, is directed upward and backward (Fig. 5 *a, en*), reaching to the tergum of the basal abdominal segment, and ending in two very long, slender setæ, while a few other similar setæ arise, one from each joint.[1] In the male of *N. geoffroyi*, according to Claus, the long setose process is directed forwards and downwards.

The 2d maxilla (Pl. XIII, Figs. 2, 5 mx^2).—These are entirely unlike those of the first pair, and unlike the Decapodous or Phyllopod type. They consist of a basal portion composed of four thin, delicate, unequal lobes (Fig. 5, [1, 2, 3, 4]), edged with long setæ, with two setæ twice as long as the others arising from the 4th lobe; from this four-lobed basal joint or coxopodite, arise two appendages, the anterior (exopodite, *ex*) small, one-jointed; the posterior (endopodite, *en*) two-jointed, the end of the second joint carrying above five long, spreading, stout, slender setæ This two-jointed appendage Claus considers as representing the stock of a palpus.

This pair of maxillæ are quite unlike those of Decapods (Mysis, etc.), as well as those of the Phyllopods, and appear to be another diagnostic feature of the order.

The absence of any maxillipedes, or of any rudiments of them, either in the adult or in the embryo, is a negative character of a good deal of importance when we regard the affinities of the group to the Decapods, or the zoëa-form of the same order, where two (Macrura) and three (Brachyura) pairs of maxillipedes are present, there being three pairs in the adult Decapod.

The eight pairs of Phyllipodiform thoracic feet (Plate XIV, Fig. 3).—The maxillæ are directly succeeded by eight pairs of leaf-like thoracic feet, the maxillipedes not being present. The feet all repeat each other in form, and a description of the 3d or 4th pair will answer for the 1st as well as the last. The leg (Fig. 3, 3d or 4th pair) consists of a broad, thin, six-jointed appendage, the endopodite (*en*), which is fringed with very long, delicate setæ, those arising from the terminal joint being ciliated; while a second series of fine stiff setæ arise obliquely from the edge. To the second joint of the endopodite are appended a distal or lower very broad thin gill, not quite twice as long as broad, and which reaches to the end of the endopodite, while situated more externally is a double, broad, large lobe which corresponds to the exite

[1] Claus draws attention to the position of this foot as compared with the 2d maxillæ (putzfuss) of the Ostracoda.

or flabellum of the Phyllopod foot, this flabellum being as long as the entire endopodite, but not quite so broad as the gill. The distal portion of the flabellum is more pointed than the proximal, and, as will be seen by referring to the figure, is more actively engaged in the process of respiration. The figure shows by the dotted lines of parenchymatous matter the course taken by the blood in passing through the gill and accessory gill or flabellum, and that it must also be partly aerated by the jointed endopodite; the entire appendage, therefore, as in those of the Branchipodidæ, is concerned in respiration. It will thus be seen that the limb is lamellated, but differs essentially from the Phyllopodous limb in that the endopodite is simple, the axis multiarticulate, but sending off no endopodal lobes from the axites, such as form the characteristic feature of the Phyllopodous foot. From overlooking this important and radical difference from the Phyllopodous foot, the earlier observers were led to place Nebalia among the Phyllopods.

In comparing the thin, lamellar, thoracic foot of Nebalia with the thoracic foot of any Decapod, from Cuma to Mysis, and up through the Macrura to the crabs, it will be found impossible to homologize the parts closely, though a general homology is indicated, the endopodite of the Nebalia and the gills corresponding in a general sense to those of the Decapods, and it is this lack of a homology more than any other which forbids us from regarding the Nebalidæ as entitled to take rank under the order of Decapoda, or with any of the Malacostraca. But when we compare the thoracic legs of the adult Nebalia with the maxillipedes of the zoëa of the Decapods, then we can detect a slight and interesting resemblance, but the resemblance and homology is not so close as between the thoracic legs of the Phyllopods and the maxillæ of the early zoëa.

On comparing the broad lamellate thoracic feet of the adult Nebalia with the rudimentary thoracic feet of the later stages of the zoëa, the resemblance is but slight. Just before the zoëa passes into the adult condition the five pairs of thoracic feet of the adult bend out as two-lobed processes; but the resemblance to the leaf-like foot of Nebalia is too remote to be of any taxonomic value; and this remote resemblance shows that Nebalia does not belong to the Decapod type.

The six pairs of abdominal feet (Plate XIV, Figs. 4, 5).—Turning to the abdominal feet, we find that they are simple, without gills, and entirely different from the leaf-like thoracic appendages, and we have in this differentiation of true abdominal from the thoracic feet a Malacostracan character, one quite unlike the differentiation or blending of the two regions in the Phyllopods.

The abdomen is nine-jointed, the segments cylindrical and edged with obtuse spines (Pl. XIII, Fig. 8) much as in Copepoda.

In their general form the abdominal legs appear to resemble the simple biramous legs of the Copepoda, but still more closely those of the Amphipoda, in which, as Claus observes, there is a similar retinaculum. (See also Milne-Edwards's Crustacea, Pl. 30, Fig. 3^{a}.)

The 5th and 6th segments of the abdomen bear much smaller, more rudimentary legs. The 1st pair (Pl. XIV, Fig. 5) are seen to be two-jointed, the 2d joint long and slender, bearing near the end stout raptorial setæ, and on the inner edge slender setæ. The 6th pair are still more rudimentary, one-jointed, and with but few setæ, which are stiff and coarse. These resemble the simple unbranched 5th and last pair of abdominal feet in Copepoda (Calanus ♀).

The long, slender terminal segment bears two very long, narrow cercopods (Pl. XIII, Fig. 7) ending in one large and several small setæ, but there is no telson; the cercopods are simple, the integument entirely smooth, with no striæ or any other markings, and they are edged externally with short, and internally with long ciliated setæ. In the absence of a telson Nebalia differs from Cuma or any other Decapod, and in this respect, and the simple cercopods, shows a close resemblance to the terminal segment with its two setiferous cercopods of the Copepoda.

Internal anatomy.—Claus remarks in his "Untersuchungen zur Erforschung der genealogischen Grundlage des Crustacean-Systems" (1876), that in all the internal systems of organs, Nebalia is considerably removed from the Phyllopoda, and shows an immediate relationship to the Malacostraca, sometimes approaching near the Amphipoda, sometimes near the Mysidæ. The nervous system consists of a large two-lobed brain and of a ventral cord extending through all the limb-bearing segments, there being, as shown in Metschnikoff's Fig. 25 of the embryo, seventeen ganglia, corresponding to the seventeen limb-bearing segments of the body behind the head. A transverse section of a ventral ganglion of *N. bipes* (Pl. XIII, Fig. 9, or Fig. 1, in text, *ng*) shows a form of ganglion quite unlike that of the Estheria and other Phyllopods, in which the ganglia are separate, connected by rather long transverse commissures, whereas in Nebalia the pair of ganglia are consolidated and of the form of the Decapod ganglion, as also pointed out by Claus, who says that there is a very close resemblance in the form of the nervous centers to the ventral ganglionic chain of the Mysidæ.

We have endeavored to obtain good sections of the brain of *Nebalia bipes*, and Fig. 1 in the text will serve to illustrate tolerably well the form and intimate structure of the supra-œsophageal ganglion. The brain is very small, and the section represented was the third from the front of the head. The ovaries (*ov*) pass into the head, the end of each ovary overlying the brain. The brain itself is composed of two lobes closely united, and seen in section the brain is as deep as broad, with a constriction passing around the outside in the middle. The histological structure is very simple, with nothing approaching the complex nature of the Decapodous brain.

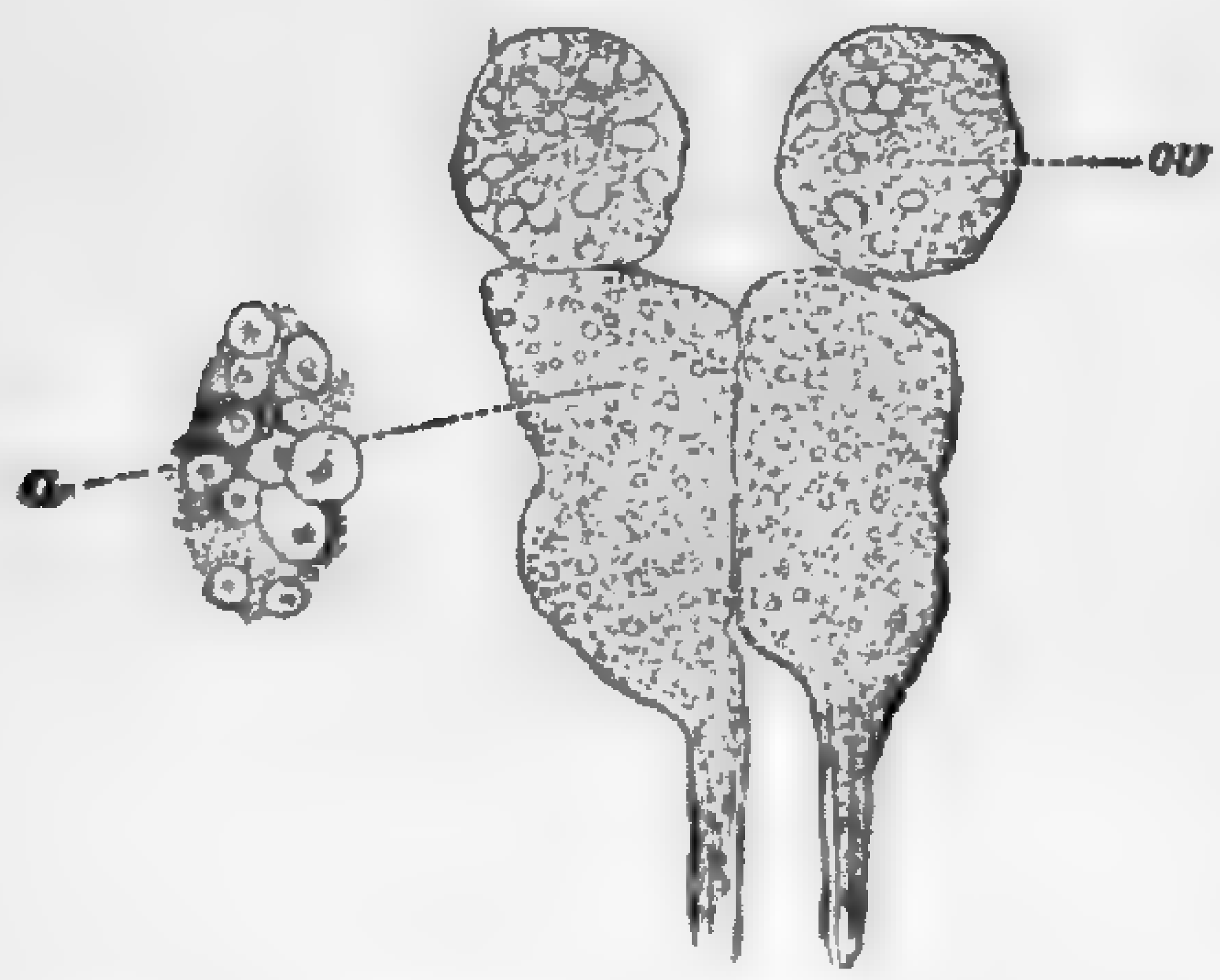

FIG. 1.—Section of the brain of *Nebalia bipes*; *ov*, ovary; *a*, portion of brain still more enlarged to show the ganglion cells. Author del.

In the digestive canal, says Claus, we have a quite specific peculiarity, together with approximations sometimes to the Amphipoda and Isopoda, and sometimes to the Mysidæ and Podophthalmata. The short up-curved œsophagus leads into a stomach with a complicated chitinous armature, in which an anterior and a posterior division can be distinguished.

Our sections of the body of *Nebalia bipes* show that in their general features the digestive canal and appendages are much as Claus describes for the Mediterranean species. We were unable to get good sections of the proventriculus or *kaumagen*.[1] Plate XIV, Fig. 6, evidently passes through the stomach in front of the heart, which is much larger than the intestine (Fig. 2, *i*, in text). Fig. 2 (in text) is a section (No. 9) through the anterior part of the thorax, in the region of the adductor muscle (*add. m*); the heart (*ht*) is quite remote from the small intestine, which is smaller than the two anterior cœca. In Fig. 3 (in text) of section

[1] Our Sections were kindly made by Mr. Norman N. Mason of Providence, R. I.

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14, through the same specimen at the end of the thorax, the

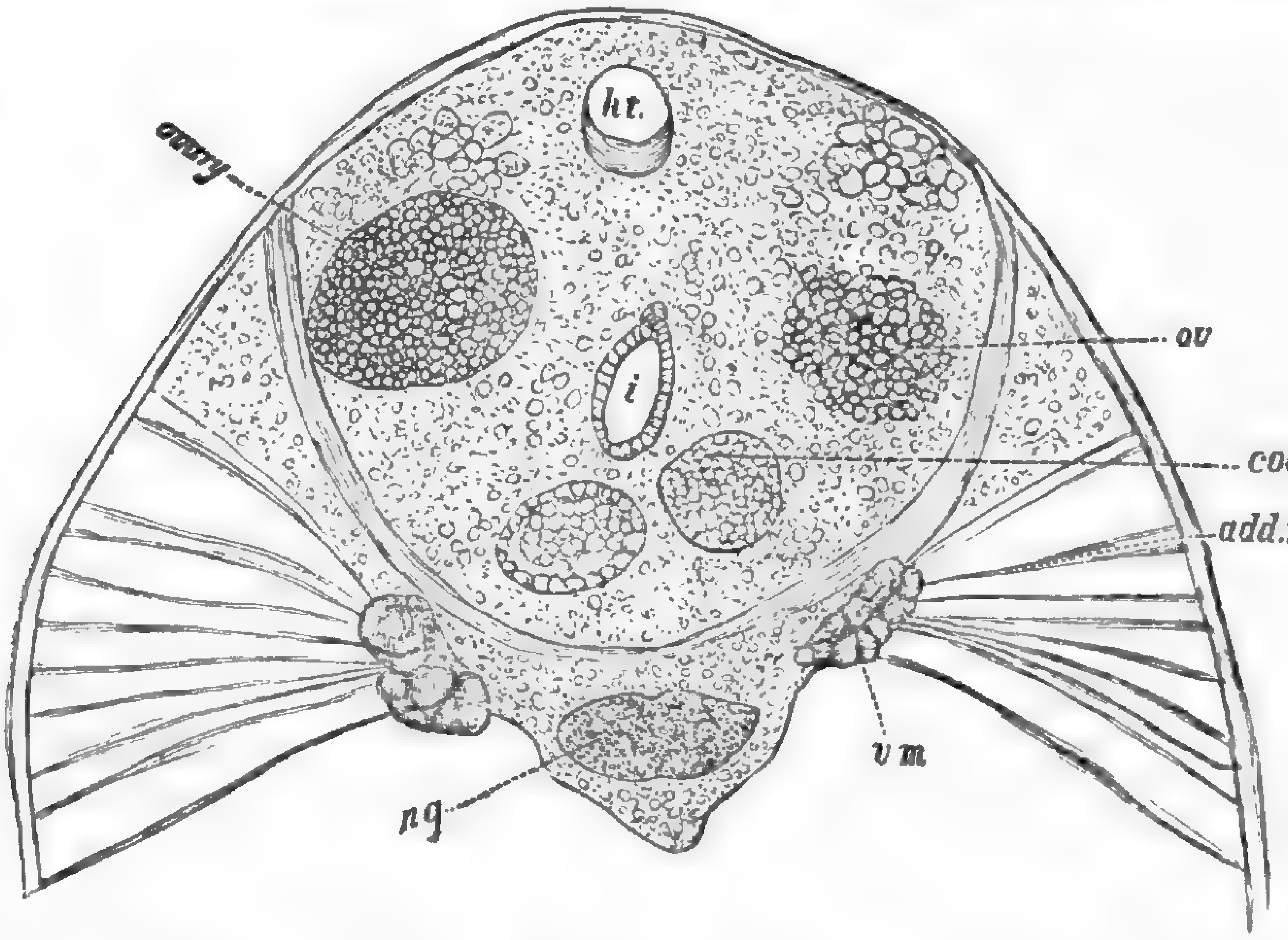

FIG. 2.—Section through the front end of the thorax of *Nebalia bipes*. *ht*, heart; *i*, intestine; *ng*, ganglion; *vm*, ventral muscle. Author, del.

heart (*ht*) is of its maximum size, and now we see sections of six cœcal tubes, the series of four lower ones being the four posterior tubes described by Claus as passing back into the abdomen. In this section the dorsal muscles (*dm*) of the posterior part of the body appear, and the ventral muscles (*vm*) are larger than in section 9, while the ovarian tubes (*ov*) are smaller.

The heart of Nebalia is a long straight tube a little thicker just in front of the middle, beginning over the maxillæ just in front of the 1st thoracic segment (tergite) and extending to the middle of the 4th abdominal segment.

Claus includes Nebalia among the Malacos-

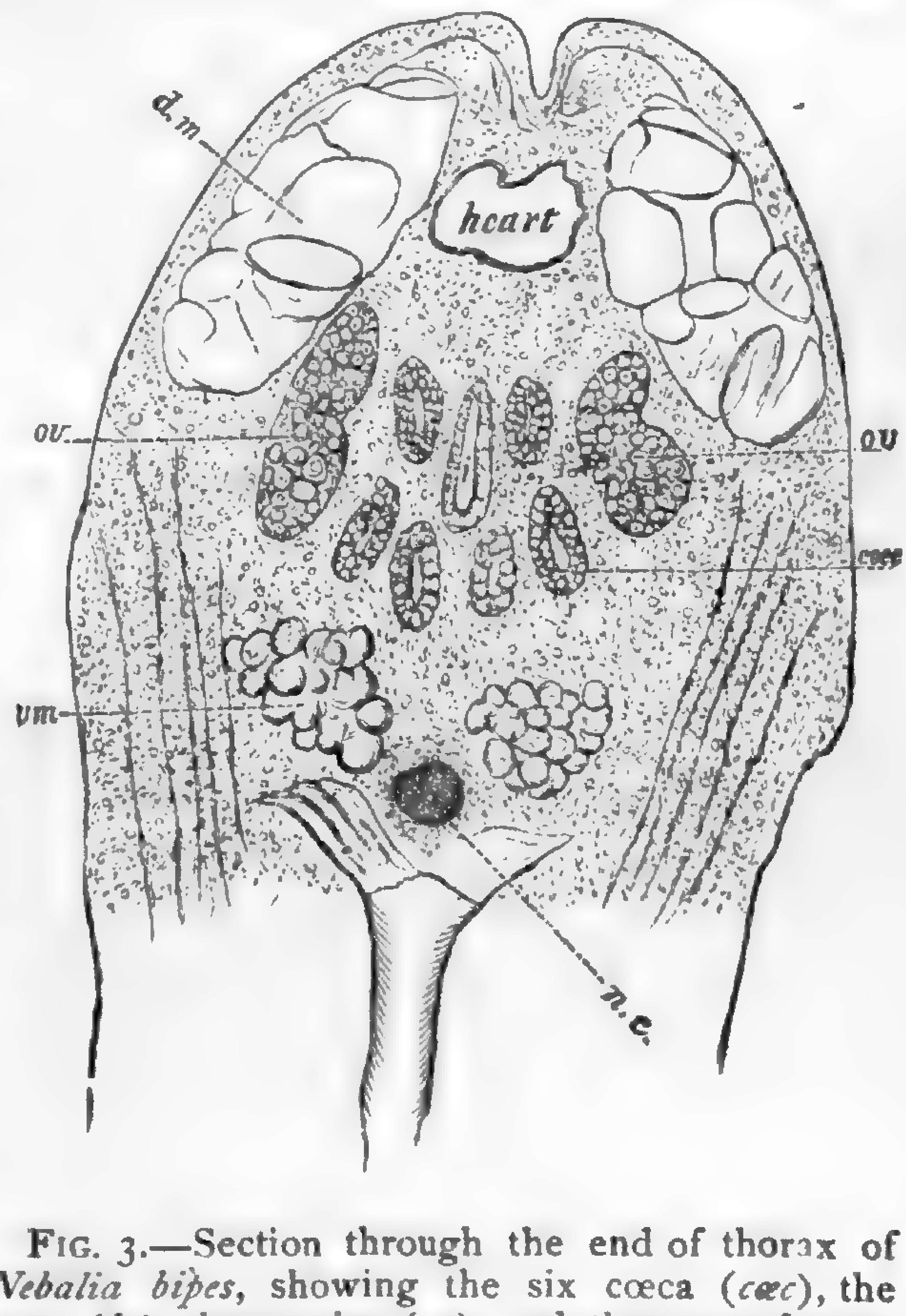

FIG. 3.—Section through the end of thorax of *Nebalia bipes*, showing the six cœca (*cæc*), the heart (*ht*), the ovaries (*ov*), and the sets of muscles; *dm*, dorsal muscles; *vm*, ventral muscles; *nc*, nervous cord; *ov*, ovary; *i*, intestines. Author del.

traca, but when we consider the composite nature of the internal organs as described by him, we wonder that he failed to appreciate the independent, synthetic nature of the Phyllocaridan type which, when we take into account the external as well as internal organization, forbids our regarding Nebalia as a true Malacostracan, though the type of a group standing outside of, but nearer to the Malacostraca than are the Phyllopods.

The development of Nebalia.—Our knowledge of the development of Nebalia is due to the distinguished Russian embryologist, who in 1868 published an elaborate account of the developmental history of *Nebalia geoffroyi.* Unfortunately the pamphlet is in Russian, and only brief abstracts of it have appeared in German. But as ample and well-drawn figures illustrate the work, we can state the salient points in the ontogeny of this interesting Crustacean. The yolk does not undergo total division, but by the subdivision of a large polar cell the yolk becomes surrounded by a layer of blastodermic cells. Soon after the rudiments of the two pairs of antennæ and of the mandibles bud out, the abdomen also being differentiated from the rest of the body (Pl. xv, Fig. 1). This is regarded as representing the free nauplius condition of other Crustacea. At a succeeding stage (Fig. 2) the two pairs of maxillæ and two pairs of thoracic feet bud out; and in a stage immediately succeeding (Fig. 3) the palpus of the mandibles elongates, the maxillæ are two-branched, and seven (or eight) pairs of thoracic feet are indicated. In a succeeding stage (Fig. 4) Nebalian characters assert themselves; such are the carapace and large rostrum, the biramous anterior pair of antennæ, the unbranched 2d pair, the long mandibular palpus, the absence of any rudiments of maxillipedes, and the eight pairs of thoracic feet (bænopoda) and three pairs of abdominal feet (uropoda), all of which are now well developed. At this stage it may be seen that, as in spiders, the 1st pair of thoracic feet may represent the 2d maxillæ of insects transferred from the head to the thorax; so in Nebalia, the three first of the eight pairs of thoracic feet may correspond to the three pairs of maxillipedes of Decapods, which in early life, before the thorax is differentiated from the head, may have remained afterwards as a part of the thorax. An intermediate step is the retention in the Mysidæ of the last pair of maxillipedes or the 1st pair of thoracic feet, so that these Crustacea have six pairs of feet. Moreover, Nebalia at this time, in the absence of differentiation of the thorax from the abdomen, and of thoracic and abdominal feet, the two sets being similar in form and development to each other, may also represent the Phyllopod stage. In the next stage, at the time Nebalia leaves the brood sac of the mother, it is but one step removed, so to speak, from the adult form.

Metschnikoff's observations were made on *Nebalia geoffroyi* of the Mediterranean sea. We have in our sections of *Nebalia bipes* observed stages of development in the young similar to the stages represented by Metschnikoff's Fig. 13 or 14, and have found in the bottom of the vial in which the specimens were sent, several young which had fallen out of the brood sac of the parent. Upon comparing these with Metschnikoff's Fig. 19, or Fig. 5, Pl. xv, they are of the same form; the rostrum being large, the procephalic lobes large, the eyes small, the stalks not yet developed, while the maxillary palpus stretches back to the 1st abdominal feet; the thoracic feet are covered by the large carapace, and a 4th pair of abdominal feet have developed, while the caudal appendages are as in the adult. In all these features we see only a general resemblance to the Schizopods of any value, the similar earliest phases of development proving of no special importance.

Comparison between the early stages of Nebalia and the Decapod (Schizopod) Mysis.—It would appear that if Nebalia were a Decapod, that in its larval stage it should present a close homology with Schizopods at a similar stage of existence. In Euphausia the young leaves the egg and becomes a free-swimming nauplius, and then a protozoëa, and at length a zoëa larva before assuming the adult condition. It is evident that since Nebalia passes its early stages in the incubatory pouch of the mother, that it should be rather compared with the young, when about ready to leave the mother, of some Mysis-like form.

Happily, Professor G. O. Sars has afforded us the material for such a comparison. The early stages of Mysis, as worked out by Van Beneden and Claparède, and of Nebalia, are much alike; the formation of the blastoderm is much the same. The nauplius stage in the egg is nearly identical in both, but beyond this the parallelism ceases to be an exact one; Nebalia turns off and follows quite a different developmental path from Mysis or any Decapod. If we compare the young of Nebalia, taken from the brood-sac, with that of Mysis, as figured by Claparède (Plate

XVII, Fig. 6), or a more advanced stage, particularly that of *Pseudomma roseum,* as figured by Sars,[1] we shall find that many of the differential characters which, in the adult, separate the Phyllocarida from the Decapoda, are to be found i the young. In Mysis and allies at the same stage as Metschnikoff's Fig. 18 of Nebalia (our Plate XV, Fig. 4), the 2d antennæ are simple instead of being bifid as in Nebalia; there are no maxillipedes, and the maxillæ are, as in the adult, immediately succeeded by the eight pairs of thoracic feet; moreover, there are no abdominal feet in Mysis or Pseudomma, while three pairs are present in the young Nebalia. But with the exception of the lack of abdominal feet in the Mysidæ at this stage, it may be thought upon the whole, as has already been stated by Balfour, that "the development of Nebalia is abbreviated, but from Metschnikoff's figures may be seen to resemble closely that of Mysis. * * * There is in the egg a nauplius stage with three [pairs of] appendages, and subsequently a stage with the zoëa appendages." It seems to us that the comparison[2] here made is, as regards any resemblance to a zoëa, loose and inexact, whether applied to the Mysidæ or to the Phyllocarida. The stage of the Mysidæ succeeding the nauplius is characterized by the presence of the rudiments of eight pairs of appendages, the two pairs of maxillæ, and the six pairs of thoracic feet of the Schizopodous type, while the zoëa has no thoracic feet at all, so that it would appear that the Schizopods do not pass through a genuine zoëa state like that of the higher Decapods. Nor on the other hand is the Nebalia stage represented by Metschnikoff's Fig. 18 (our Fig. 4) a zoëa stage, for the embryo has the rudiments of eight pairs of thoracic feet, and besides those of three pairs of abdominal feet, while there is a well-marked carapace and rostrum, as well as procephalic lobes with eyes, all these parts not being developed in the embryo Mysidæ.

But whatever may be said of the resemblances between Nebalia and the Mysidæ at an early period after the nauplius stage has been discarded, when we compare the later stage represented by Metschnikoff's Fig. 19 (our Fig. 5, Plate XV) with the latest larval stage of Pseudomma (see Sars's Fig. 23, our Plate XV, Fig. 6),

[1] G. O. Sars, Monog. over Mysider, Heft. 1, Taf. IV, Fig. 23.

[2] Claus (Genealog. Gundlage des Crust. Systems, p. 31), as we find since writing the above, does not accept Metschnikoff's comparison of the young Nebalia with the zoëa, although he does not give the reasons for his dissent.

PLATE XV.

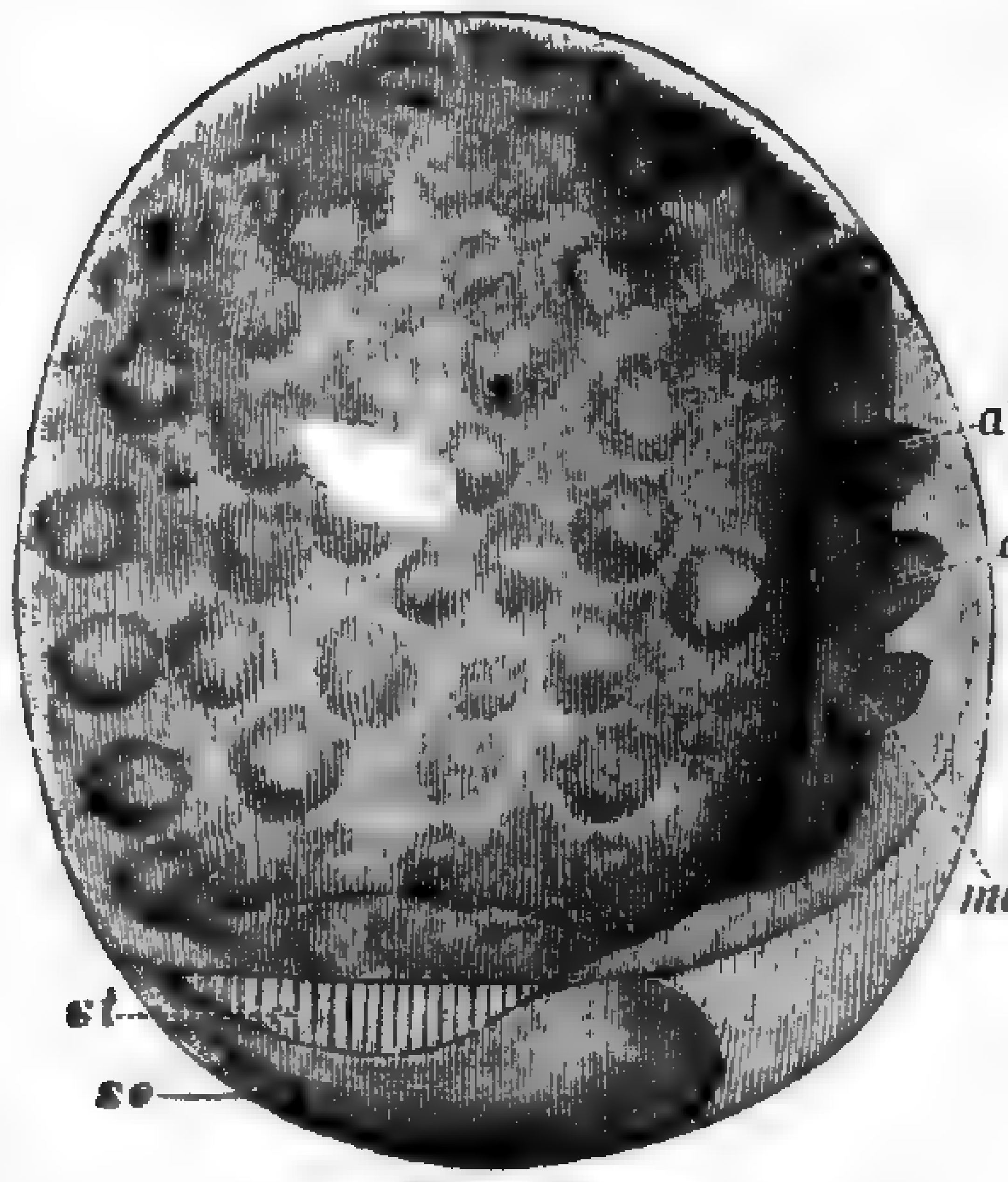

Fig. 1.

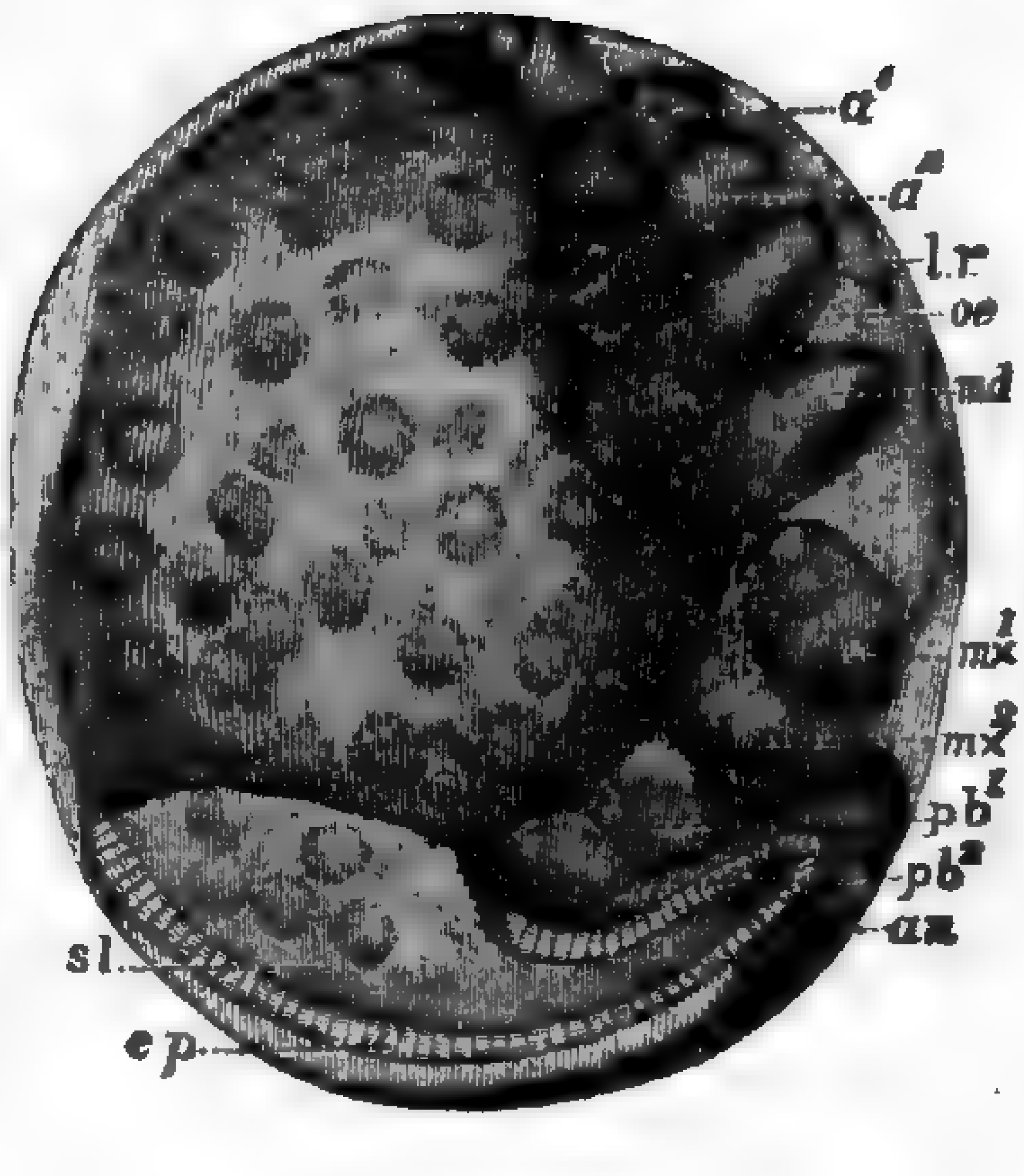

Fig. 2.

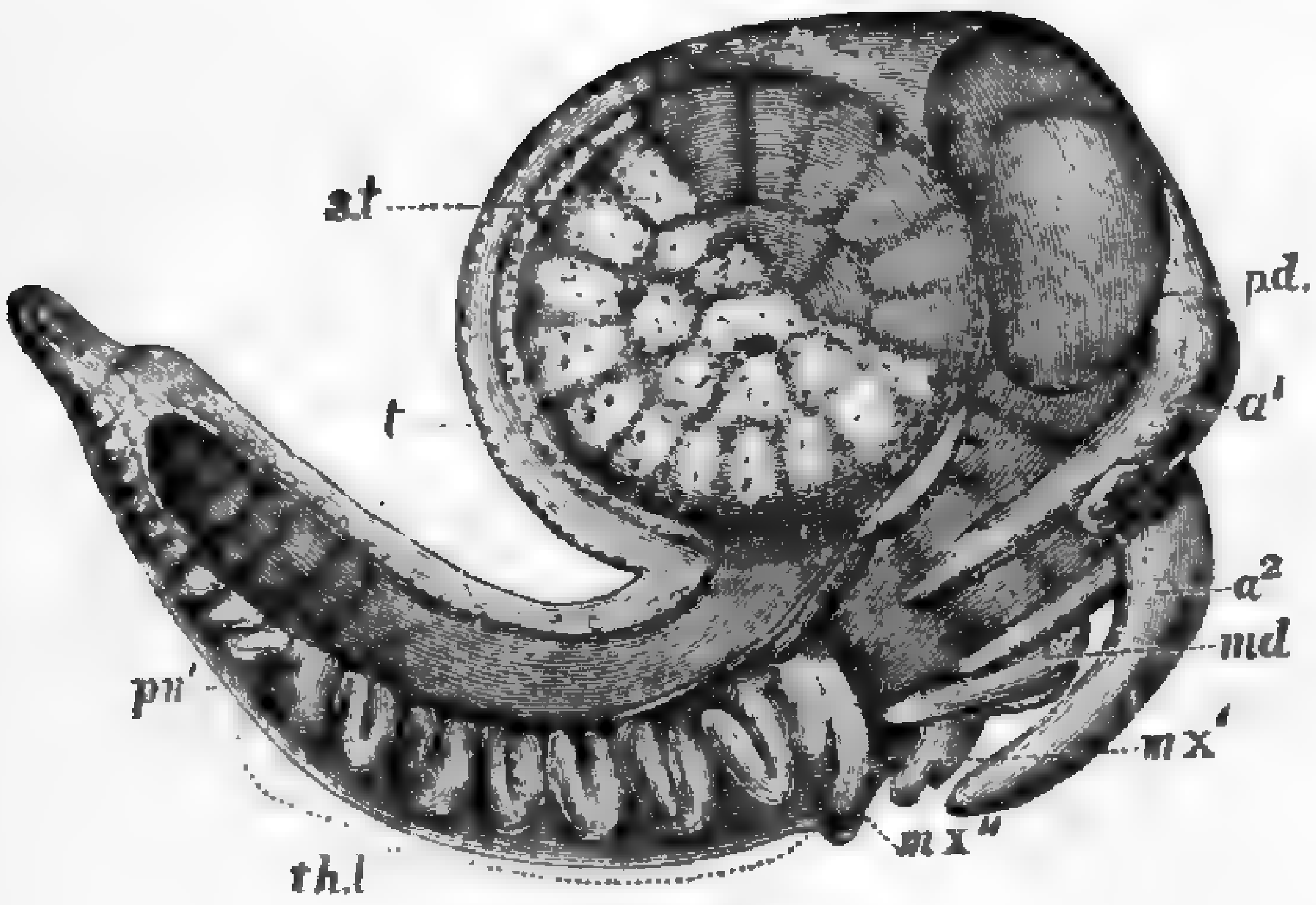

Fig. 3

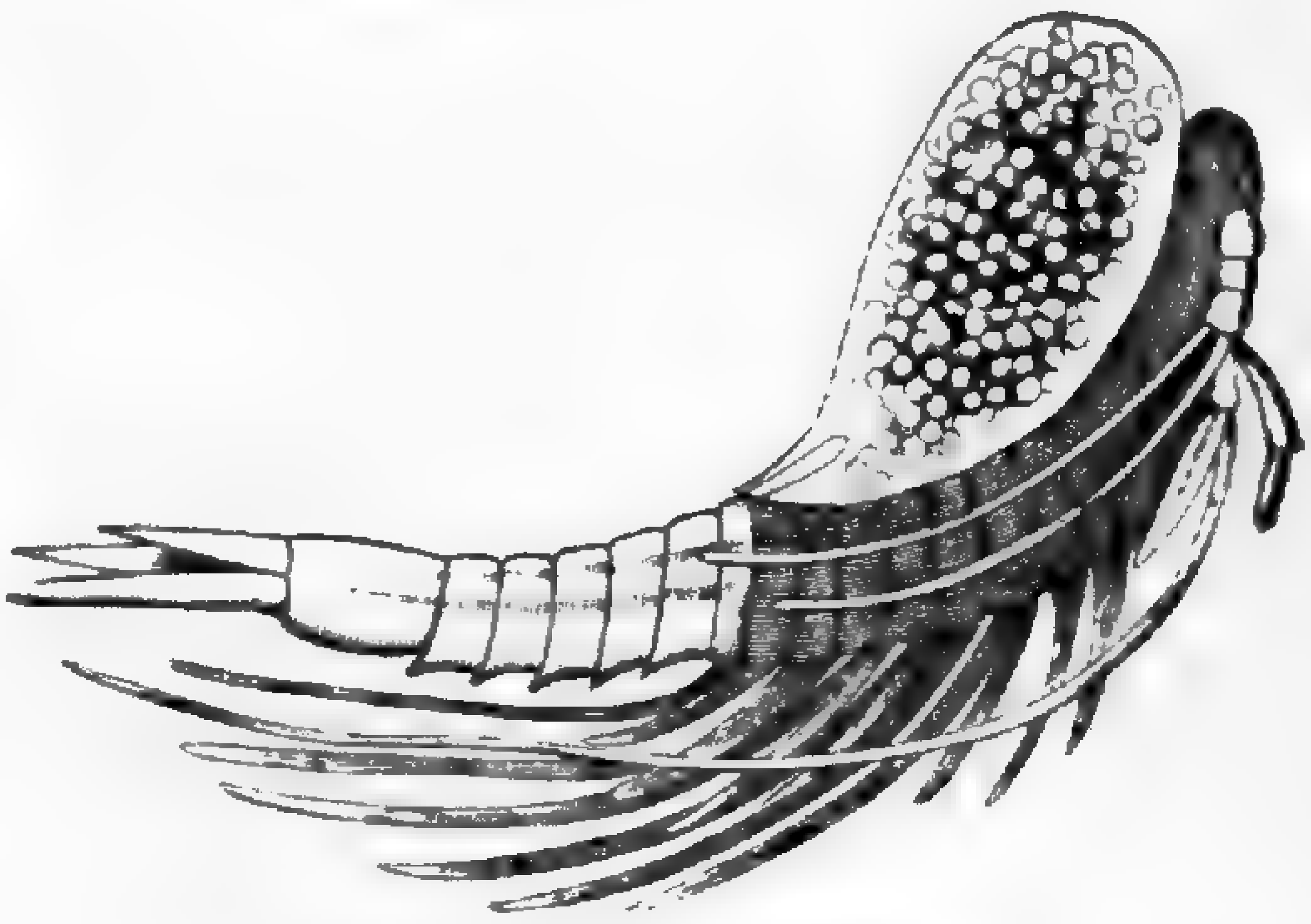

Fig. 6.

Fig. 5.

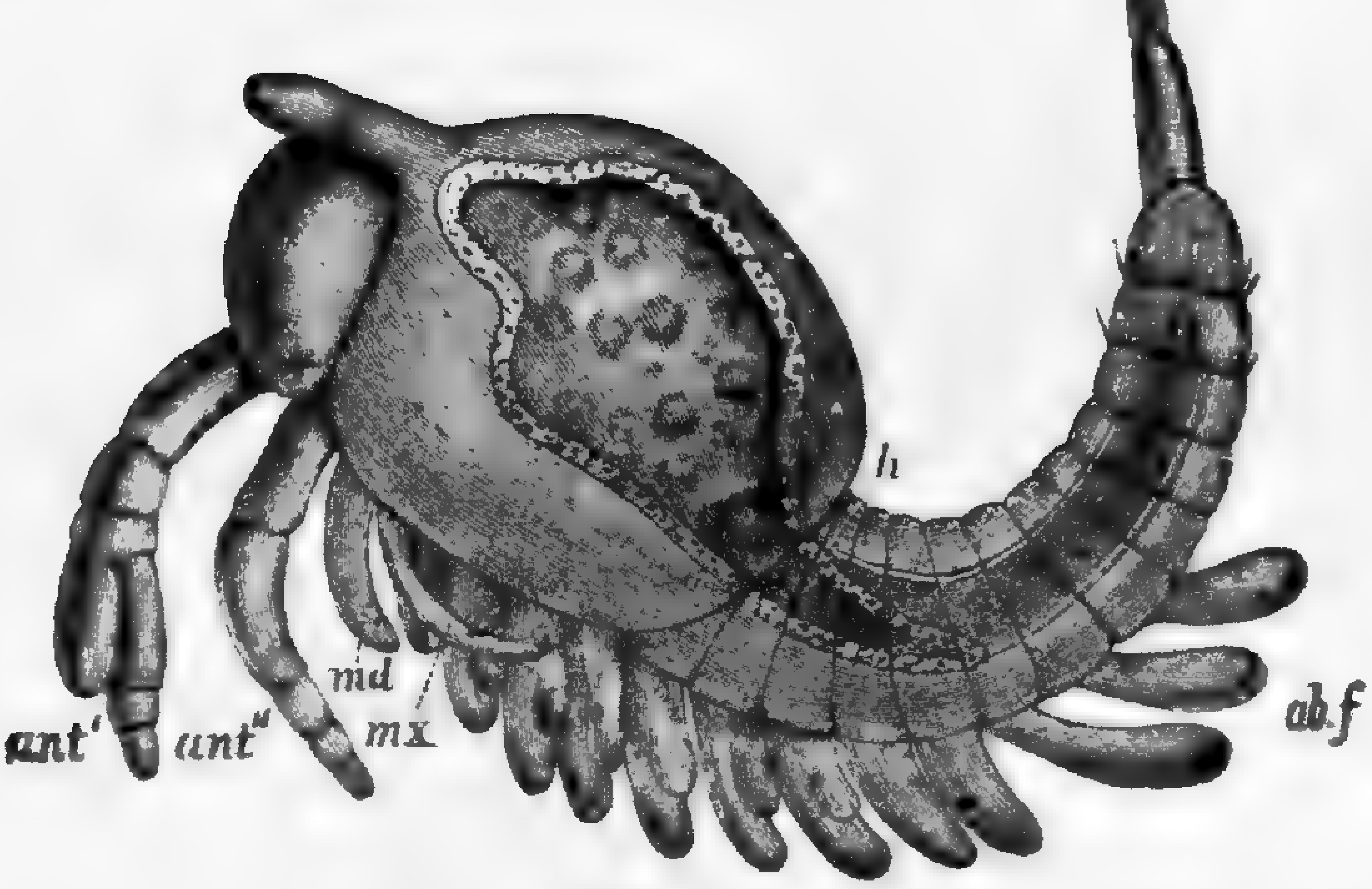

Fig. 4.

THE EMBRYOLOGY OF NEBALIA.

then we see that the diagnostic ordinal characters of the Phyllocarida have declared themselves. There are to be seen in Nebalia the large movable rostrum, the compressed pseudobivalvular carapace, the lack of maxillipedes, the eight pseudophyllopod thoracic feet, and four pairs of abdominal feet, out of the six of the adult. On the other hand, in Mysis of the same stage, the two pairs of maxillipedes are well developed, and the six pairs of remarkably long thoracic feet (the first pair modified maxillipedes) are present. There is little to indicate that the Schizopods have descended from a Nebalia-like form, but rather from some accelerated zoëa form; while, as we attempt in this essay to show, the Phyllocarida have had no Decapod blood in them, so to speak, but have descended by a separate line from Copepod-like ancestors, and culminated and even began to disappear before any Malacostraca, at least in any numbers, appeared.

EXPLANATION OF PLATE XIII.

FIG. 1.—*Nebalia bipes* Kroyer; female, much enlarged.
" 2.—*Nebalia bipes* Kroyer, female, head; *ros*, rostrum; *car*, carapace; ant^1, 1st antenna, (1–5) five basal joints; *ex*, exopodite; *en*, endopodite; ant^2, 2d antenna, with 1–3 three basal joints; pes^1, part of first pair of feet; *md*, mandible; mx^1, first maxilla; mx^2, second maxilla; *st*, stomach.
" 3.—The carapace flattened out to show relations of rostrum.
" 4.—Mandible, *md*, cutting edge; *p*, palpus.
" 5.—The two maxillæ; 1–4, the four lobes of the coxopodite.
" 5*a*.—1st maxilla; cx^1, cx^2, coxopodites; *en*, endopodite.
" 6.—(Omitted.)
" 7.—Cercopoda or caudal stylets.
" 8.—Portion of dentate edge of an abdominal segment.
" 9.—Section through a ventral ganglion.

EXPLANATION OF PLATE XIV.

FIG. 1.—*Nebalia bipes* Kr. ♀; 1st antenna; lettering as in Pl. XIII; *k*, lobe from 4th joint.
" 2.—2d antenna.
" 3.—One of the 3d or 4th pair of thoracic feet; *fl*, flabellum; *ex*, exopodite; *en*, endopodite.
" 4.—One of 2d pair of abdominal legs; *ret*, retinaculum; *en*, endopodite; *ex*, exopodite.
" 5.—One of the fifth pair of abdominal feet.
" 6.—Section through the body just behind the first pair of thoracic feet, through the stomach (*st*), and the two anterior cœca (*cæc*); *add. mus*, adductor muscle; *sh*, shell.
" 7.—Section through one of the cœca.

EXPLANATION OF PLATE XV.

FIG. 1.—Nauplius stage of *Nebalia geoffroyi.*
" 2.—Farther advanced embryo.
" 3.—Still older stage, with the thoracic feet.
" 4.—Advanced embryo.
" 5.—Embryo ready to hatch.
" 6.—Embryo of Pseudomma about ready to hatch. (After Sars.)

Figs. 1–5 copied from Metschnikoff.

AMERICAN WORK ON RECENT MOLLUSCA IN 1881.

BY WILLIAM H. DALL.

SINCE the appearance of our last record (1880), death has claimed Mr. Chas. M. Wheatley, of Phœnixville, Pennsylvania, who was formerly noted for his interest in fresh-water shells, and for whom several American species have been named. He did little original work in this field, but in geology and palæontology, especially the exploration of certain bone-bearing caves, his contributions to science have been gratefully recognized.

The recorder would renew his request to authors to furnish him, as promptly as practicable, with separate copies of their publications on recent mollusks,[1] in order that the completion of this record may be made as early in the succeeding year as possible, and he would also suggest to writers not resident in America that any papers bearing on American mollusca or especially interesting for any reason to American malacologists, will, if copies are furnished, be duly noted in the record.

The year shows a creditable amount of work done, and is especially notable for the investigations into the mollusks of the deep sea (of which Pleurotomaria is not the least interesting); the contributions to our knowledge of the Cephalopoda of our eastern coast; and the researches into the egg and early stages of *Limax campestris* and the generalizations resulting therefrom.

An account of recent progress in zoölogy for the years 1879 and 1880, by Dr. Theo. Gill, appears in the Smithsonian Report for 1880, separate advance copies being issued in 1881. It contains a résumé of the more remarkable advances in our knowledge of mollusks during the period mentioned. We are informed that similar reports may be hoped for annually hereafter in the Smithsonian Report on various subjects and by several hands.

General works.—Mr. Tryon's Manual of Conchology has completed its third volume in 1881 covering the Tritonidæ, Fusidæ and Buccinidæ. When, in 1879, this work was announced, it was stated that it was proposed "to compile a conchological manual which while more comprehensive than any similar work hitherto published, shall be so condensed in text and illustration that it may be issued at a much more moderate price. It will include in systematic order the diagnoses of all the genera and

[1] Which may be sent care of the Smithsonian Institution, Washington, D. C.

higher divisions of the mollusca, both recent and fossil, and the descriptions and figures of all the recent species," etc., etc. We have hitherto refrained from comment upon the manner in which the performance compares with the promises above quoted from the second page of the cover. This, both from our wholly friendly feeling towards the industrious author, and from the hope that as the work advanced, the quality of it (once off unfamiliar ground like the Cephalopods) might improve. The fourth volume has now begun to appear, and it seems to us that it is time to vindicate malacology in this country from the reproach of quietly accepting such a work as this as a praiseworthy or representative product of American science.

The work is an utter failure if we judge it by its own prospectus. In the plain edition the figures are largely unidentifiable. In the (very badly) colored edition they are somewhat more recognizable, though we had not realized that so many blue and crimson gasteropods existed as are there depicted. The expense so far for a bound copy would be about $65, a sum sufficient to obtain quite a little library in itself, and at this rate the claim of a "moderate price" is quite unjustified. There is not a figure in the entire work, so far, by which it would be possible to discriminate between critical species, several of the figures are wrongly numbered, the "descriptions" are inadequate to a painful degree, and contain, in many cases, no diagnostic characters. Were diagnoses of "all the genera" of recent and fossil mollusks really furnished; even if merely copied from the originals without confirmation, the work would still be valuable, but that this is not the case in the families treated, can be determined by any reader.

In general, an uncharitable critic might be disposed to say that the author, when he found a species of which he could not copy a figure, "lumped" it with that which he "guessed" was nearest like it, or if he could not identify it with anything in the collection at Philadelphia, he catalogued it with the "spurious" species. We do not assert that Mr. Tryon has done anything of this kind, but we do assert that the results of his work, in whatever way he arrived at them, are little better than they would have been in the above hypothetical case.

Little care or research seems to have been devoted either to hunting up the locality where species not in the monographs were described or in figuring unfigured species which were easily within the author's reach. Indeed, we have noticed, so far, but one original figure in the whole work, though there may be more. Of a species described in the Proceedings (1865, p. 64) of his own society, the Philadelphia Academy of Natural Sciences, and of which the type is accessible to all students in the National Museum at Washington, but a few hours away from his home, Mr. Tryon says, "no diagnosis of this species has been published, it is merely mentioned in Carpenter's 2d Report, and figured in Küster from a drawing furnished by W. H. Dall." This "drawing" was one of the plates of Alaska mollusks distributed by the writer in 1879, but of which the text is still in MS. owing to uncontrollable circumstances.

The merits of the work are those pertaining to any catalogue which brings together scattered material, and would have been greater had not an illjudged attempt been made to combine species not autoptically known to the author, and of the distinctness of which he could not therefore speak with authority. It certainly will not be, to a student requiring a real "manual" of the subject, comparable in value to works like Bronn and Keferstein's Malacozoa, for instance, and others of which the combined cost would be less than that of the few parts of Mr. Tryon's work already issued.

It is somewhat refreshing to turn from the preceding work to another, which though not American in authorship or publication, is nevertheless of so much importance to American, as well as other students of malacology as to render its mention here not inappropriate. I refer to Dr. Paul Fischer's Manuel de Conchyliologie (Paris, F. Savy, 1881–2, fasc. 1–4. To contain six or seven fasciculi of seven signatures each, 400 cuts in the text and 24 plates with 600 figures), of which (to May, 1882) four parts have appeared. The subscription (payable in advance) for the whole work, is twenty-four francs. The typographical execution is of excellent quality, the illustrations in the text clear, and many of them new; the form, medium octavo, is convenient; and of the execution so far, more need not be said than that it is promptly up to date in matters of research, and in every way worthy of its distinguished author.

"Common Sea Shells of California," by Josiah Keep, A.M., Alameda, Cal. This little work prepared and published by its author, a teacher in the Alameda High School, contains sixty-four pages of text and sixteen plates, figuring ninety-five species of Californian shells, which are described in a conversational way in the text. Little is said of systematic classification, and wisely so. As it is, the book is well suited to assist the young to a knowledge of the names and more obvious characters of the shells they are likely to find on the shore, and to interest them in the general subject. The figures are very characteristic and in many cases unusually good.

The draughtsman with some instruction would evidently do better work than is common. But we trust that, should Mr. Keep issue a larger work, as it has been hinted he would do, and his present draughtsman should assist, the latter will examine some standard works (like Adams' Genera, for instance) and observe that the axis of the spire should be kept at right angles to the line of sight, by which the foreshortening and distortion which spoil some of his figures of Gastropods (*e. g.* Pl. VI, Figs. 4, 6, 7; Pl. VII, Figs. 1, 2) will be entirely avoided. This criticism excepted, we cordially welcome the little book, which can be obtained of the author himself for the price of one dollar, by those who wish to encourage such enterprise.

Anatomy, Physiology and Development.—The most important work in this department which has appeared during the past year is that on the "Maturation, fecundation and segmentation of *Limax campestris* Binney," by E. L. Mark (Bull. Mus. Comp. Zoöl., VI, No. 12, 8vo, pp. 173–625, Pl. I–V, Oct., 1881). This paper, according to a note by the author, was prepared early in 1879, though its publication has been long delayed, and has already been noticed in the NATURALIST. Its length and character forbid any attempt at analyzing it in detail here. This is the less to be regretted, since those who are in a position to profit by the observations and deductions therein set forth, will by no means fail to inform themselves from the original, while any attempt to condense for others the deductions from such investigations, could hardly result in an adequate representation of the author's position. The work, in execution and presentation, is creditable to American science and to the author, and will form, we hope, merely a beginning of his achievements in this direction.

A reference was made in the record for 1880 (p. 709) to Professor Alpheus Hyatt's lecture on the "Transformation of Planorbis at Steinheim." In the Proceedings of the Am. Assoc. Adv. Science (vol. XXIX, Boston meeting) published June, 1881, is a combination of an abstract of the lecture, together with "remarks upon the effects of gravity upon the forms of shells and animals (pp. 1–24, Pl. I–II, separate copies). In this extremely suggestive paper, Professor Hyatt, after discussing the particular case of the Steinheim Planorbis, strives to "bring into comprehensible shape the following conceptions." The conceptions are chiefly to the effect that the unsymmetrical spirality of most gasteropod shells is due to the effects of gravity transmitted by heredity. That many locally constant characteristics are due solely to the physical influences of the environment. That natural selection does not explain these relations, but only serves to fix the results and bring them within the reach of heredity, when they may be inherited according to the law of heredity with acceleration. That gravity appears to be one of the causes of the differences in effort, function and anatomy observed between various parts of animal forms when laterally or vertically considered. That the bilateral or *geomalic* (the tendency to equalize the form in direction of a horizontal plane) growth of organs or organisms appear to be directly or indirectly responses to the demands of gravity. Lastly, that the origin of the limbs in pairs, while mere buds, perhaps, may be the results of attempt at maintaining equipoise by geomalic growth in obedience to the laws of gravity.

That this effect of gravity is marked in animals which become permanently and immovably fixed, like the oyster (and only after they become attached) Professor Hyatt shows to be the case in many instances, and that he has suggested an hitherto overlooked *vera causa* there seems to be no doubt; though its effect in modifying, for instance, the cone of molluscan shells, seems less likely than that the inevitable divergencies from a true cone produced by the physical necessities of the environment, in perhaps a majority of cases, were seized on by natural selection on account of the advantages gained by economy in material, in space occupied, strength resulting and protection insured to delicate internal organs by the spirality of the shell. Supposing all conchifers to be born with a straight conical shell, it is self-evident that unless the creatures were pelagic or very sedentary, that fractures and unequal developments of the margin of the cone would be the case in a majority of individuals. That in fact the conical form would be a decided disadvantage to any creature which had to travel for its living. That every divergence from a true cone would be an advantage and would lead to hereditary retention or repetition of the divergence, and that spirality (as we know) must necessarily result from any deviation from the straight cone whether due to a mere accidental fracture or any other cause. Knowing this and knowing that in most active mollusks gravity could not act in the same way and direction for five minutes at a time, owing to their changes of position, it does not seem that there is any need of it to account for the development of the spiral in the shells of free gasteropod mollusks.

But whatever view may be taken of single details, Professor Hyatt's paper possesses, like most of his writings, the invaluable quality of arousing discussion, exciting interest and of suggesting new lines of thought; and of such essays we cannot have too many.

Although first printed in the *Quarterly Journal of Microscopical Science* (London, 1881) and the result of studies by a native of Japan, K. Mitsukuri's paper "On the structure and significance of some aberrant forms of lamellibranchiate gills" (Studies from the Biological Laboratory, Johns Hopkins University, II, No. 2, pp. 257–270, Pl. XIX, Mar., 1882) may be considered as in one sense American work, since it was done at the laboratory of an American university and under the instruction and direction of Professor W. K. Brooks. The author here considers the structure of the gills of Nucula and Yoldia and their relation to the gills of other acephalous mollusks. He arrives at the general conclusion that the Lamellibranchiate gill was perhaps originally a simple ridge on the side of the body, but to increase the surface of contact with the water, folds may have arisen on two sides of this ridge. If this be true, Nucula and Yoldia have advanced so far as the gills are concerned, but very little beyond the primitive condition. In course of time, however, as some forms of Acephala became less capable of extensive locomotion, these folds were perhaps prolonged to form tentacular filaments, from which were finally evolved complex gill structures like those of Mytilus, Unio and Ostrea, which took on other functions than respiration, such as assisting in the food supply by means of the currents generated by their cilia. Between the simple gills of Nucula and the complex ones of Unio, there are many intermediate stages with modifications in different directions.

In considering these views it should be borne in mind that the gills (especially in Gasteropods) are almost purely epithelial structures, and therefore especially liable to modification; in most cases they hardly exist in the embryonic stages. As regards the correlation of inactivity with a high type of gill structure, it is perhaps doubtful how far this will bear inspection. Yoldia is extremely active, but is almost like the sedentary Nucula in its gills: Unio which has, according to Mitsukuri, highly specialized gills, is, probably, in many cases nearly as active as Yoldia. Cardium and Pecten are remarkable for their activity, and have highly developed gills, as also have Scintilla and Lepton, which move about almost like Gasteropods.

Whatever be the fate of incidental speculations of the author, the paper is most suggestive and interesting, and may be taken as an intimation of what is in store for malacology when the embryologist and anatomists shall join forces and carry their investigations from the young stages to the fully developed adult form with greater continuity than appears to be the rule at present.

Report of the Commissioners of Fisheries of Maryland, Jan., 1880 (8vo, pp. LXXVIII, 1 l. unp., 269, 8; and 16 plates and sections), Annapolis, State printers, 1880.

Report of T. B. Ferguson, a commissioner of fisheries [for the western shore] of Maryland, Jan., 1881, 8vo, Hagerstown, Bell & Co., 1881 (pp. CXIV, 152, 6; and 18 plates besides cuts in the text).

The contents of the first report were alluded to by the recorder in his summary for 1881, but not having been procurable by him until a late date, exact references to its contents are now added. The appendix contains the account of the "Development of the American Oyster," by Dr. W. K. Brooks, which occupies pp. 1–102, with ten plates; "Extracts from the Report of Master Francis Winslow, U.S.N., made to C. P. Patterson, superintendent coast and geodetic survey, of investigations of the oyster beds in Tangier and Pocamoke sounds and parts of Chesapeake bay, 1878–9," comprising pp. 103–219, with four sections, and lastly, a compend of the "Oyster laws," which, it is alleged by disinterested parties, are never enforced except against non-residents, and hence are practically a dead letter.

The second report is made by Major Ferguson, on the Fisheries-work which came under his own supervision, the State law allotting one commissioner each to the eastern and western shores. The report itself relates chiefly to vertebrate fisheries, but the appendix is devoted entirely to invertebrates and further "Oyster laws" are included in the compendium which closes the volume.

The appendix consists of (1) an Account of experiments in oyster culture, by John A. Ryder; (2) an Account of an experiment in artificially fertilizing the ova of the European oyster, by Master Francis Winslow, U.S.N. (referred to in this record for 1880); (3) a Bibliography of literature (38 entries) relating to oyster culture; and (4) Notes on some of the early stages of development of the clam or mananose (*Mya arenaria* L.) by John A. Ryder.

The first paper contains an account of the anatomy of the oyster, with illustrative diagrams. Several points are developed more fully than has been done by previous writers; the author's attention is, however, chiefly directed toward the digestive, reproductive and respiratory tracts, and the account does not claim to be by any means complete. The pedal (?) muscles are not noted, an omission characteristic of most papers on the oyster. It is concluded that the oyster is diœcious. The "fat" of the oyster is not fat at all, but though containing some oil globules, is a deposit of delicate protoplasm, easily digestible and nutritious, which is almost wanting in breeding oysters, which are, therefore, far less desirable as food. The food of the Chesapeake oyster is discussed, and an instance is mentioned where a Pinnotheres with eggs was found established in the shell of an oyster upon which again were attached numbers of Vibriones and Zoöthamnium colonies, whose increase, in all probability, formed part of the food supply of the mollusk, so that host and messmate were mutually benefited. The fauna of the oyster beds is enumerated, with many notes on the various species mentioned. There are but few mollusks, including the "soft-shell clam" (Mya); a species of Modiola; *Xylotrya fimbriata* which rapidly destroys the woodwork of hatching boxes, etc; *Solecurtus gibbus; Crepidula glauca; Litorina irrorata; Urosalpinx cinereus*, the "drill" or oyster borer; and some small gasteropods (probably in part Astyris and Cerithiopsis), including some nudibranchiates. The artificial fertilization of the ova is then treated of and is undoubtedly practicable, but the further preservation of the embryo oysters has so far failed entirely on account of their minute size, and in spite of the sanguine hopes expressed by Messrs. Ryder and Brooks, there does not appear to us to be any reasonable prospect of success in the project except at an expense which would in practice prove prohibitory. Mr. Ryder also gives figures of young oysters of known age, which illustrated the greater energy and extent of growth in the American (*O. virginiana*) as compared with the European (*O. edulis*) oyster.

The second paper was noticed in this record for 1880, and in view of possible doubts as to the species of oyster observed upon, it is desirable that the experiment should be repeated with undoubted *O. edulis.* It is really surprising that, with their facilities, the European naturalists have hitherto failed to give us a comprehensive monograph of one of the commonest and perhaps the best known mollusk in the world.

The name "clam" in America is commonly applied to any bivalves not "mussels" or "cockles." In New England the clam is *Mya arenaria*, in New York it is *Venus mercenaria.* In the former region the Venus is known as the "hard" or "round" clam; in the latter the Mya is called "soft shell" or "longneck" clam. The name "mananose" is a southern appellation for the Mya, perhaps of Indian origin. Mr. Ryder's observations on the early stages of Mya are full of interest. This mollusk spawns in September and October during a period of about forty days. It is diœcious. The changes in the egg succeed each other with considerable rapidity, and as in the development of the oyster there are marked periods of active change of form which alternate with periods of repose. Bilateral symmetry is marked. The eggs are about $\frac{1}{500}$ inch in diameter. Their segmentation, as far as followed, resembled that of Anodonta, and the gastrula stage is formed in the same way as in the oyster.

A portion of a letter from Mr. Henry Hemphill, of California, relating to variations due to station, in the genus Acmæa appears in Proc. Acad. Nat. Sci. Phil., 1881, pp. 87–8, in which the identity of the so-called *Nacella instabilis* Gld., with *Acmæa pelta* Esch., is claimed. The recorder showed long since that the "Nacellæ" of Carpenter's lists were all referable to Acmæa except one, which is an Anisomyon belonging to the Siphonariidæ. If an examination of the soft parts confirms Mr. Hemphill's views, it will be a very striking illustration of the influence of food and station on external characters.

"Observations on Planorbis" (Proc. Acad. Nat. Sci. Phil., 1881, pp. 92–110), by Dr. R. E. C. Stearns, discusses several interesting questions, such as "Are the shells of Planorbis dextral or sinistral?" He finds most of the species examined sinistral, others dextral and occasionally the same species may be coiled either way. Certain aspects of variation in American Planorbes are considered and pregnant suggestions made. The paper is well illustrated.

An abstract of a paper by Professor E. S. Morse, on changes in the proportions of Mya and Lunatia since the Indian shell-mound period (if such an expression may be permitted when the mounds were probably added to continuously up to the historic period), appears on p. 323, Am. Journ. Sci., XXII, Oct., 1881, and an erratum to the same on p. 415. Professor Morse, as in Japanese shell-heaps, believes he has found good evidence of a change in the proportions of these shells in the differences between the average measurements of a large number of specimens from the shell-heaps on the one hand, and from the present shore on the other. While there seems no reason why such a change may not have taken place, it is still evident that the satisfactory demonstration of the proposition is beset with no little difficulty. The original paper was read before the Cincinnati meeting of the American Association for the Advancement of Science, in August, 1881.

S. P. Robins has an article on "Natural selection and the ink bag of dibranchiate Cephalopods," in the *Canadian Naturalist* (IX, No. 9, pp. 414–420, Dec. 29, 1880), containing some speculations on this subject.

Minot has, in the *Journal of Otology* for 1881, an article in which the available information on the otoliths of mollusks is brought together, but the recorder has not seen a copy of it.

Abyssal mollusks, faunal and descriptive papers.—The mollusks of the deep sea have recently attracted considerable attention. Owing to their peculiar relations to the faunæ of other shores, the deep-sea animals have some right to be considered under a separate head. Those of the Gulf of Mexico and the Caribbean sea, dredged by the *Blake*, form the subject of a "Preliminary report on the Mollusca," by W. H. Dall (Bull. Mus. Comp. Zoöl., IX, No. 2, pp. 33–144, July to December, 1881). To secure priority, advance sheets of each signature were sent to all those most interested, and the work has benefited in several cases by the criticism and information thus elicited before its completion. The following new genera or subgenera are proposed: Ancistrosyrinx, Bathymophila, Callogaza, Fluxina, Microgaza, Neilonella and Turcicula. The family Pleurotomariidæ is defined from observations on the soft parts. About 150 new species are described, many of which are liable to turn up or have turned up in far distant regions. The genus Macrodon Lycett, hitherto known as a fossil, furnishes a minute representative to the list. The most numerous additions are in the Solenoconcha, Pleurotomidæ, Trochidæ, Marginellidæ and the genera Triforis, Neæra, Leda and various opisthobranchiate groups. Among the latter, *Atys? bathymophila* (l. c. p. 98) has since proved to belong to the (fossil) genus Sabalia. The synonymy of the genus Puncturella; of Pleurotomaria (which is shown to be quotable as of Sowerby, not, as usually, of Defrance); of Crepidula and of Gouldia, is worked out. The latter is shown to be tenable as well as the specific names given by Professor C. B. Adams, in spite of a contrary opinion which had been expressed by Mr. E. A. Smith, of the British Museum, who had in his excellent review of the genus, omitted to observe that the portions of D'Orbigny's Mollusques de Cubá, in which his species of Gouldia (Adams) were published, dates from later than 1846 (probably 1853); unlike the earlier part, of which advance sheets were issued in 1841–2. The little Crassatellas, with which American conchologists are more familiar under the name of Gouldia (like "*Gouldia*" *mactracea*) than they are with the more tropical type of the genus (*G. cerina* Ad.), are hardly separated by any definite characters from the typical Crassatella, though they were called Eriphyla by Gabb.

It may be well to call attention to the necessity for circumspection in describing these deep-water forms on which naturalists are working in several countries, to point out that at least two of the writer's species of Neæra, *N. limatula* and *lamellifera*, have been redescribed subsequently as *N. contracta* and *N. semistrigosa*, by Dr. Jeffreys, who, however, atones for his synonymy by some excellent figures. *Modiola lutea* (Jeffr. MS.) Fischer (Journ. de Conchyl., Jan., 1882), is without doubt identical with *Modiola polita* V. and S. The wide range of many of these deep-sea forms and their existence in a fossil state in Italian and Sicilian

Tertiaries, render the work of identification and determination of new forms peculiarly difficult, and the writer himself may doubtless have erred, unintentionally, in taking for new what may, hereafter, be found already described. For all corrections or emendations he will be very grateful. A considerable number still remain to be worked up, of which several will doubtless prove new. There were no new brachiopods in the Agassiz-Sigsbee collection, but in the Agassiz-Bartlett dredgings of the following year there seem to be several, of which a fine Terebratula, larger and more elongated than *T. vitrea*, with a strong, squarely flexed anterior margin, relatively small appressed apex, and a loop shaped much like that of *T. sphenoidea* Ph., is proposed to be called *T. bartlettii*, in honor of Commander Bartlett, U.S.N., its discoverer in the deep waters of the Antilles. All the new species will be illustrated in the final report now in preparation.

"Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England" (No. 2), by E. A. Verrill (*Am. Jour. Sci.*, XXII, Oct., 1881, pp. 292–303). In this paper, a continuation of others heretofore mentioned, Professor Verrill gives the details in regard to a number of stations at which deep-sea dredgings were made by the *Fishhawk* in 1880 and 1881, a list of fishes obtained and notes on the more interesting mollusca. In a note Moroteuthis, n. g., is proposed with *Lestoteuthis (?) robusta* (Dall) V., from the North Pacific, as type. The following new species are described: *Issa ramosa* Verrill and Emerton, *Pholadomya arata* Verrill and Smith, *Mytilimeria flexuosa* Verrill and Smith, *Diplodonta turgida* V. and S., and *Dolium bairdii* V. and S. The latter was also obtained by the Blake expedition in deep water off the Antilles, and is closely allied to a small deep-water Mediterranean species, *D. crosseanum* Monterosato.

"Report on the Cephalopods [of the *Blake* expedition], (etc.)," by A. E. Verrill, (Bull. Mus. Comp. Zoöl., VIII, pp. 99–116, 8 pl., March, 1881.) This paper includes figures and descriptions of eight species of cephalopods supposed to be already known, together with *Mastigoteuthis agassizii* V. g. et sp. n., and *Eledone verrucosa*, sp. n. The figures are admirable, the text is revised in the second part of Professor Verrill's "Cephalopods of the N. E. coast of America," elsewhere noticed, which should be consulted for some changes in the nomenclature here used.

Intimately related to the material forming the subject of the foregoing papers, is that treated of in a paper "On certain Limpets and Chitons from the the deep waters off the eastern coast of the United States" (Proc. U. S. Nat. Mus., 1881, pp. 400–414), by W. H. Dall. Certain very ordinary-looking little limpets from deep water were kindly submitted to the author by Professor Verrill, together with specimens of his *Lepetella tubicola.* The examination showed that these forms were of the highest interest, and belonged to two orders, Rhiphidoglossa and Docoglossa, most of the species appearing to be blind. Of the former group there were three species belonging to two genera, both nearer to each other than to any described genus of the order, but differing so much as to necessitate their separation into distinct families which are described as follows: Family Cocculinidæ Dall, containing the genus Cocculina Dall, with the two new species, *C. rathbuni* and *C. beanii.* The dentition closely resembles that of Parmophorus and Helicina, and indicates a relation of this family to the following one, such as in the Pulmonata is sustained by the Cyclostomacea to the Cyclotacea as defined by Troschel. The internal and external anatomy present a curious mingling of features supposed to be characteristic of the Docoglossa and Rhiphidoglossa. The second family, Addisoniidæ Dall, includes the genus Addisonia with the new species *A. paradoxa.* This has a remarkable shell resembling Pilidium Midd. (Capulacmæa Sars). It, or closely allied species, has been described from the Mediterranean, under the name of *Gadinia excentrica* Tiberi, but it has no relations with Gadinia. The soft parts are crowded to one side to make room for a curiously exaggerated gill or rather series of branchial leaflets. The dentition is different from anything hitherto recorded in the Rhiphidoglossa, showing Docoglossal features, while the remainder of the anatomy is less like the true limpets than that of Cocculina. Among the Docoglossa the characters of Lepetella Verrill are determined. It presents certain peculiarities and, for the group, a very abnormal dentition, which have led the writer to separate it in a distinct subfamily, Lepetellinæ from Lepeta, etc. *Pectinodonta arcuata*, n. g. et sp., is proposed for a curious form allied to Scutellina, blind and with a dentition composed of one large pectinate lateral on each side of the median line. The writer suggests that the peculiarities of the Docoglossal dentition may perhaps best be accounted for by conceding to the group a normal dentition of $\frac{1}{3\,(3.3)\,3}$ which by consolidation or suppression of teeth would cover all the forms yet investigated.

The species of Chitonidæ found in deep water on the American coast are enumerated, and the paper[1] concludes with a scheme of classification of the Docoglossa brought up to date from that proposed by the writer twelve years previously.

(To be continued.)

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PROGRESS OF INVERTEBRATE PALÆONTOLOGY IN THE UNITED STATES FOR THE YEAR 1881.

BY C. A. WHITE.

WE have not to record the death of any worker in invertebrate palæontology during the past year, and the names of those who have published the results of their investigations during 1881, are mostly well known through their previous labors. The following account of work published during the past year is not really the measure of the amount that has been done; for some of those who are most deeply engaged in the work, have published very little within that time. Those gentlemen have kindly kept me informed of the progress of the work they have in hand, and mention is made of some of these in the following paragraphs:

Mr. S. W. Ford has continued his studies of the primordial fauna, and has published a very interesting paper on the "Embryonic forms of Trilobites from the Primordial rocks of Troy, N. Y., in the *American Journal of Science*, Vol. XXII, pp. 250–259, with 13 woodcuts. Also "Remarks on the genus Obolella," in Vol. XXI, of the same journal, pp. 131–134, with 5 woodcuts.

Professor James Hall informs me that "no reports of the New York State Museum having been printed for the past three years," he has a large amount of work awaiting publication. As these works may be expected to appear soon, only brief reference need be made to them now.

[1] This paper did not appear until April, 1882, but on account of its relations to other material here treated of, the recorder has taken the liberty of calling attention to it. Those interested in deep-sea mollusks should also consult a paper in the *Journal de Conchyliologie*, by Dr Paul Fischer, entitled "Diagnoses d'espèces nouvelles de Mollusques recueillis dans le cours des expeditions scientifiques de l'aviso le Travailleur (1880–81)," l. c. pp. 49–53, Jan., 1882.

The museum report for 1880 is to contain some further work of Professor Hall's on the Bryozoans and Lamellibranchiates. The report for 1881 will contain the completion of the Lamellibranchiates and a continuation of the Bryozoans and corals, a discussion of Uphantænia and Dictyophyton, &c., &c. The report for 1882 will contain the completion of the work on Bryozoans and corals. The appendix to Vol. V, Part II, of the Palæontology of New York, with 16 plates, is near completion.

Professor Angelo Heilprin has continued his original investigations in connection with his professional duties at the Philadelphia Academy of Natural Sciences. The following is a list of the articles published by him during the past year, all of which have appeared in the Proceedings of the academy for 1881: "Notes on the Tertiary geology of the Southern United States," pp. 151–159: "A revision of the cis-Mississippi Tertiary Pectens of the United States;" "Remarks on the Molluscan genera Hippagus, Verticordia and Pecchiolia;" "Note on the approximate position of the Eocene deposits of Maryland," and "A revision of the Tertiary species of Arca of the Eastern and Southern United States." Professor Heilprin has other works in progress besides the arrangement and classification of the collection of the academy.

Professor Alpheus Hyatt has published the work mentioned in my last review, on the "Genesis of the Tertiary species of Planorbis at Steinheim," in the Anniversary Memoirs of the Boston Society of Natural History, 114 pages and 9 plates.

A synopsis of this work, together with other matter, was published in the Proceedings of the American Association for the Advancement of Science, Vol. XXIX, pp. 527–550, with two plates, under the title, "Transformations of Planorbis at Steinheim, with remarks on the effects of gravity upon the forms of shells and animals." During the summer of 1881 Professor Hyatt, together with a party of his assistants and students, visited Anticosti and other places in a yacht, for scientific study. Concerning his palæontological studies, he says: "I found specimens of Beatricia showing the terminal part to be an open cup. I also found natural sections exhibiting what seem to be vertical septa similar to those of Cystiophyllum." His memoir on the Ammonites is now ready for the press.

In June of last year Mr. U. P. James published a paper in No.

5 of *The Palæontologist*, pp. 33–44, which contains descriptions of a number of species of fossils by Mr. James, under the general title of "Contributions to Palæontology: Fossils of the Lower Silurian formation, Ohio, Indiana and Kentucky."

During the past year Mr. S. A. Miller has published the following articles in the Journal of the Cincinnati Society of Natural History: "Description of some new and remarkable Crinoids and other fossils from the Hudson River group, and notice of *Strotocrinus bloomfieldensis*," Vol. IV, pp. 69–77, illustrated on plate 1; "New species of fossils and remarks upon others from the Niagara group of Illinois," Vol. IV, pp. 166–176, illustrated on plate 4; "Descriptions of new species of fossils," Vol. IV, pp. 259–262, illustrated on plate 6; "Description of new species of fossils from the Hudson River group, and remarks upon others," Vol. IV, pp. 316–319, illustrated on plate 8. In the second of these articles Mr. Miller describes the new genus Zenocrinus, and in the last the new molluscan genus Pyanomya. He also continues his "Remarks on the Cenozoic age or Tertiary period," in No. 4 of Vol. III, and Nos. 1, 2 and 3 of Vol. IV of the same journal.

Mr. Samuel H. Scudder is still actively engaged upon work pertaining to fossil insects. Five installments of his "Bibliography of Fossil Insects" have appeared since the first two, mentioned in my last review. These seven parts comprise something over thirty pages. His memoir on the "Devonian Insects of New Brunswick has appeared in the Anniversary Memoirs of the Boston Society of Natural History, 41 pages quarto. His article on the "Structure and Affinities of Euphoberia," appeared in the *American Journal of Science*, Vol. XXI, pp. 182–186; and that on the "Tertiary Lake Basin at Florissant, Colorado," in the Bulletin of the United States Geological Survey of the Territories, Vol. VI, pp. 279–300, and also a map. The following have also appeared from his pen during the past year: "A notice of Goss' papers on fossil insects," in *Psyche*, Vol. III, p. 138; "On two new British Carboniferous insects, with remarks on those already known," *Geological Magazine*, Vol. VIII, pp. 293–300, with one figure; "Remarks on a remarkable Carboniferous Millipede," Proceedings of the Boston Society of Natural History, Vol. XXI, p. 122; "On *Lithosialis bohemica*," *ib.* p. 167; "Relation of Devonian insects to late and existing types," *American Journal of Science*, Vol. XXI, pp. 111–117.

Mr. Scudder has also nearly completed works on fossil spiders and the Archipolypoda.

Part II of the "Revision of the Palæocrinoidea," by Messrs. Charles Wachsmuth and Frank Springer has appeared in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1871, pp. 1–237, and three plates. This important and exhaustive work embraces the family Sphæroidocrinidæ, with the subfamilies Platycrinidæ, Rhodocrinidæ and Actinocrinidæ. It is greatly to be desired that nothing will occur to prevent the consummation of the plan of these gentlemen to complete this work for the whole order.

Mr. C. D. Walcott has published his memoir, which was announced in my last review, on "The Trilobite; new and old evidence relating to its organization," in the Bulletin of the Museum of Comparative Zoölogy at Cambridge, Vol. VIII, pp. 191–224, with six plates. This paper contains, among other matter, a résumé of all the evidence concerning the character of the ventral appendages of Trilobites, with illustrations of those organs. He has also published a brief article in the *American Journal of Science*, Vol. XXII, pp. 394, 395; "On the nature of Cyathophycus," in which he expresses the opinion that the genus mentioned is a member of the same group to which Dictyophyton belongs, and which Professor Whitfield has shown to have close affinities with Euplectella, or the so-called glass-sponges. He is now engaged on some palæontological work for one of the divisions of the U. S. Geological Survey.

Professor A. G. Wetherby has published the following papers in the Journal of the Cincinnati Society of Natural History: "Description of Crinoids from the Upper Carboniferous of Pulaski county, Kentucky," Vol. III, pp. 324–330, illustrated on plate 9; "Description of new fossils from the Lower Silurian and Subcarboniferous rocks of Ohio and Kentucky," Vol. IV, pp. 77–85, illustrated on plate 2; "Description of new species of fossils from the Lower Silurian and Subcarboniferous rocks of Kentucky," Vol. IV, pp. 177–179, illustrated on plate 5.

In my review for 1880 I inadvertently omitted to mention Professor R. P. Whitfield's "Notice of new forms of fossil Crustaceans from the Upper Devonian rocks of Ohio, with descriptions of new genera and species," which appeared in the *American Journal of Science*, Vol. XIX, pp. 33–42. The new genera are

Echinocaris and Palæopalæmon. During the past year he has published the six following articles: "Observations on the structure of Dictyophyton, and its affinities with certain sponges," *American Journal of Science*, Vol. XXII, pp. 132. This is accompanied with a note by Dr. J. W. Dawson. "On the structure of a specimen of Uphantænia," pp. 132, 133; "A new genus [Anthracopupa] and species of air-breathing mollusk from the Coal-measures of Ohio, and observations on Dawsonella," *American Journal of Science*, Vol. XXI, pp. 125–128, with six wood-cuts; "Description of a new species of Crinoid from the Burlington limestone, at Burlington, Iowa," Bulletin No. 1 of the American Museum of Natural History, pp. 7–9, plates 1–2; "Remarks on Dictyophyton and descriptions of new species of allied forms from the Keokuk beds at Crawfordville, Indiana," Bulletin No. 1 American Museum of Natural History, pp. 10–20, plates 3 and 4. This article contains also a reprint of Dr. Dawson's observations on Uphantænia already mentioned. Professor Whitfield is the first to announce the opinion that these and kindred bodies are closely related to the so-called glass-sponges. "Observations on the purposes of the embryonic sheaths of Endoceras and their bearing on the origin of the siphon in the Orthoce'rata," Bulletin No. 1 American Museum of Natural History, pp. 20–28, and three wood-cuts. Besides his stated work at the American Museum, he is engaged upon the palæontology of New Jersey.

Professor Henry S. Williams has published in the Annals of the New York Academy of Natural Science, Vol. II, No. 6, his complete paper on the "Life-history of *Spirifer lævis*," of which an abstract was formerly published in the *American Journal of Science*.

Professor A. S. Packard, Jr., has published, in the Bulletin of Hayden's U. S. Geological Survey,[1] a description, with figures, of a new species of fossil crayfish, under the name of *Cambarus primævus*. The specimens were from the lower Tertiary fish beds of Bear river, Wyoming Terr.

In the *American Journal of Science*, Vol. XXII, pp. 134–136, Mr. W. W. Dodge has an article announcing the discovery of Lower Silurian fossils in Penobscot county, Northern Maine.

During the past year I have published the two following works: "On certain Cretaceous fossils from Arkansas and Colorado," Proceedings of the U. S. National Museum, Vol. IV, pp. 156–139, and one plate; "Fossils of the Indiana rocks," Annual report for 1880 of the Indiana Geological Survey, pp. 103–154, and eleven plates. I have also several other works now in the printer's hand.

[1] See AMER. NAT., Vol. XV, p. 832.

THE NUMBER OF BONES AT PRESENT KNOWN IN THE PECTORAL AND PELVIC LIMBS OF BIRDS.

BY R. W. SHUFELDT.

IN many birds, as the Ætomorphæ, Psittacomorphæ, Coracomorphæ of Huxley, we find at the back and upper part of the glenoid cavity, a sesamoid long known to ornithotomists as the os humero-scapulare; this bone can in no way be claimed as belonging to the category of bones that enter the pectoral limb, as it increases the articular surface of the glenoid cavity, and in so doing properly belongs to the scapular apparatus, being accessory to the shoulder girdle.

In the arm we have then but one bone, the humerus, in the forearm, or antibrachium, we find two, the radius and ulna, and in the angle formed by the articulation of the latter two with the humerus, or the elbow, we detect in many birds (Turdidæ and others), lodged at its posterior aspect, quite a sizable sesamoid, crescentic in form, which seems to serve the purpose of protecting the joint. It reminds one not a little of a floating olecranon. Two of these sesamoids occur at the same locality among Guillemots and Penguins (Owen).

Among raptorial birds and in some few other families, we find articulating with one or both of the long bones of the antibrachium, at the distal end or ends as the case may be, another sesamoid, the os prominens.

The vast majority of adult birds, and indeed the writer does not recall a single exception at this moment, possess *two* free carpal bones, the scapho-lunar and cuneiform. To these we have to add to our enumeration, several bones that are found in the wrist of some, but not all immature birds; these eventually, we know, all become anchylosed about the proximal extremities of the metacarpals. First in this list we have os magnum, the largest, that subsequently amalgamates with index metacarpal; next in order we discover the unciform (Morse), a diminutive segment found in some birds, that finally unites with the last metacarpal, and to these four the writer, two or three years ago, added a fifth and called it the pisiform. For several reasons, however, I have been induced to change the name of this segment, and have done so in a memoir elsewhere, now in press, and called it the pentosteon, it being the fifth carpal segment discovered up to date. The name is one that cannot be productive of harm nor confusion after its true homology has been decided upon. In manus we have quite a number of bones, but we must recollect that the list here given does not occur in all birds. Immature birds, at various ages, present us with three free metacarpals; these are pretty generally, at present, taken to be the first or pollex metacarpal, second or index, and third or middle. All three of these bones anchylose together, and with certain carpals, as mentioned above, to form in the adult the bone usually known as the metacarpal, a far better name for which would be the carpo-metacarpal.

Now pollex metacarpal may support one phalanx, or one phalanx and a claw, which may be covered with the common integument, or pierce it and be sheathed with horn. Index metacarpal may possess as many as *three* phalanges, the last or distal one exhibiting the same conditions as the distal joint of pollex; finally middle metacarpal supports a single phalanx.

To recapitulate then, we have those adult birds that possess the fewest number of bones in the pectoral limb, presenting us with a humerus, an ulna and radius, two free carpals, a metacarpal and four phalanges, *ten* in all, but the complete list of the bones of the avian pectoral limb, up to the present time, are just double this number, though we do not know a single bird that can boast of having them all, either adult or young.

The following is the complete list:

	Brachium or arm	= 1 =	humerus.
	Sesamoid of the elbow	= 2 =	
	Antibrachium or forearm	= 2 =	radius and ulna.
Carpus.	The carpal sesamoid	= 1 =	os prominens.
	Two free carpals	= 2 =	scapho-lunar and cuneiform.
	Other bones of the carpus	= 3 =	os magnum, unciform and pentosteon.
Manus.	Metacarpal	= 3 =	first, second and third.
	Phalanges	= 6 =	2 for pollex, 3 for index and 1 for [middle.
	Total	20	

Very many more bones are found in the pelvic extremity of birds than we have just enumerated for the anterior limb, but as already remarked, probably no single bird, either adult or young, possesses them all.

The limb now under consideration is divided into thigh, leg, tarsus, metatarsus and toes.

To the thigh is allotted one bone, the femur, while on the other hand the leg or the next division below, has two principal long bones, a heavy one constituting the main support, the tibia, and a lighter companion, the fibula, on its outer side. Up to the present date I know of but two free bones that occur about the knee-joint; the first of these is the patella, and this may co-exist with the cnemial ridge of tibia, as in Colymbus (Owen). The other is a free sesamoid found in some birds, in a notch at the head of the fibula (Speotyto). In at least one bird the head of the tibia, or rather its *proximal* extremity, may be formed by an epiphysis so large as to include in the young the extensive pro and ecto-cnemial ridges (*Cinclus mexicanus*). The fibula is never so far produced as to articulate with the tarsus or its elementary representatives. Young birds of several genera offer us for examination at the distal end of the tibia, three distinct ossifications that eventually amalgamate with that bone and with each other. These have been described by Morse and afterwards by myself in the osteology of the Tetraonidæ, as the fibulare (outer one), the tibiale (the inner one) and the intermedium (above). In many birds , *i. e.*, Centrocercus, we find a large sesamoid in the tendons at the back of the joint formed by the tibia and tarso-metatarsus. Three bones unite to form the bone of the so-called tarsus of birds ; they are the second, third and fourth metatarsals, and in immature birds we find their proximal extremities covered by an epiphysis, the centrale of Morse, that may represent the united bones of the distal row of tarsus. This epiphysis may rest just on the summit of the united metatarsals and *not* include that process found at the upper and posterior aspect of the bone tarso-metatarsus, the much disputed "calcaneal" process (Centrocercus), or it may dip down behind and completely include it (Cinclus). This fact will obviously do away with my terming this process the tendinous, as I did in my osteology of Lanius, and leave quite a knotty point for ornithologists to settle in the way of serial homologies. The first metatarsal is found articulating on the lower and outer edge of the inner metatarsal as the os metatarsale accessorium. A small sesamoid may be found beyond the trochleæ of the tarso-metatarsus, as in Eremophila.

The number and arrangement of the phalanges in the feet, as found in the various families and orders of birds is too well known to enter upon in so short a sketch as this simply pretends to be. The greatest, and at the same time the most usual number of separate joints, is fourteen, distributed in the order, 2, 3, 4, 5, running from first to fourth toe respectively. Among other birds we find only thirteen, twelve and eleven, and still fewer in such forms as the ostrich and emeu.

To tabulate our list then, we find for the

	Thigh	=	1	= Femur.
	Leg	=	2	= tibia and fibula.
	Knee	=	2	= patella and sesamoid of fibula.
Tarsus	Tibio-tarsus	=	3	= tibiale, fibulare and intermedium.
	Tarso-metatarsus	=	1	= centrale.
	Sesamoid between them	=	1	= tarsal sesamoid.
	Metatarsus	=	4	= three in tarsus metatarsus and the os metatarsale accessorium.
	Sesamoid beyond	=	1	= podal sesamoid.
	Phalanges	=	14	= greatest number in one foot.
		Total	29	in pelvic limb.

In this enumeration the reader will observe that if I have left out any such ossifications as the tendons may assume, they properly belong to the muscular system.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The consensus of scientific opinion regarding the mental condition of Guiteau, is at present identical with that expressed in our editorial of August, 1881. The importance of the examination of the brain of this person has not been overlooked, and an investigation has accordingly been made. The brain was delivered to some medical gentlemen of Philadelphia, and the report of one of them has been published in the newspapers. The result is about what was to have been anticipated where a simply medical expert is selected for such a work. The business of the physician being to alleviate and cure disease, his studies are chiefly in the direction of pathology (or diseased structure) and therapeutics. So the investigation of the brain of Guiteau, as reported by Dr. Shakespeare, was confined to a search for the evidence of disease. Like the other medical experts who testified during the trial, he seems to be ignorant of the science of anthropology, and of the various types of structure presented by the mammalian and especially the human brain. As was the case during the trial, the question of malformation is not referred to. Yet all mental qualities, normal and abnormal, doubtless depend on peculiarities of brain structure, such as may be totally independent of the question of disease. The study of the relative sizes, etc., of the masses forming the brain, is but the threshold of the investigation. The study of the cell-structure, on which so much depends, is a work of years, and the science of the anatomy of these parts has yet to be created. And yet the report before us does not hesitate to enter the perilous question of responsibility, and to make assertions regarding the freedom of Guiteau's will! Truly the need of an education in the natural sciences for medical men was never more strikingly displayed than in the Guiteau trial, and this its irrelevent appendix.

—— It is just now the fashion among the editors of the newspaper press to decry Arctic exploration. The scientific results to be obtained by such investigations are, however, too important to be surrendered to a temporary sentiment. As long as persons are found willing to undertake such expeditions, they should be sent, and the responsibility of their fate will rest with themselves alone.

The loss of most of Lieut. DeLong's party, however, is the more to be regretted since it seems to have been unnecessary. The greater part of their number might apparently have been saved, had they divested themselves of the unreasonable prejudice against eating human flesh.

—— It has been reported that a number of the council of the British Association for the Advancement of Science, agreed to a proposition to meet in 1884, in Montreal. It is further reported that other members have expressed dissatisfaction with this course, and desire to have the decision reversed. Such a meeting in this country would undoubtedly interfere with the meeting of the American Association the same year by drawing members from it. The more agreeable alternative would be to have the meetings combined into one grand association. The only objection to this proposition is the greater mass of papers that would be brought before such a meeting, and the greater length of time required to transact its business than has hitherto been thought available for the meetings of either association.

This objection could be gotten over by restricting the number of papers; but the difficulty of doing this satisfactorily is obvious.

—— The editor of the *Gardeners' Monthly*, who is also a contributor to the New York *Independent*, has several times recently presented himself as an antagonist of the NATURALIST. Being placed by our critic in the excellent company of Mr. Darwin, Professor Gray and Mr. Riley, we have heretofore permitted our friend to enjoy the diversion all to himself. We had hoped that the failure of his attempted corrections of these well-known authorities, would have inspired him with a little caution. But we now think it time to apply the language used by the late Mr. Darwin in a letter to one of our editors, that this gentleman "is the most inaccurate man he had ever known." We think Mr.

Darwin a little severe, however, when he says, "he has done more injury to science in America, than he had ever done it good." If he had said Philadelphia instead of America, we would have been more disposed to agree with him.

—— We publish to-day an article on the Calaveras skull, by the distinguished naturalist, Dr. W. O. Ayres. Dr. Ayres gives the fossil mammalia found in the Pliocene gold gravel of California (p. 851) as the "rhinoceros, Elotherium, horse, ox, camel, etc." We pointed out in the NATURALIST for January, 1880, that the occurrence of rhinoceros and Elotherium in these beds is impossible, unless transported from a long distance. The Elotherium, especially, could only have been brought there by man from Central Oregon or farther off. For camel should be read lama.

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RECENT LITERATURE.

HOUGH'S ELEMENTS OF FORESTRY.[1]—There has long been a demand for a book on the important subject of forestry, and in some respects that want is now met in the book under consideration. The general plan of Dr. Hough's book is excellent, and difficult as the subject is, he has in the main succeeded well in presenting it in an interesting and instructive manner. The successive chapters treat of soils and their preparation; climate, etc.; reproduction from seed; propagation; buds, leaves, wood, etc.; general views in regard to forestry; forestry laws; European forestry; ornamental planting; hedges, etc.; cutting and seasoning of wood; fuel, charcoal, etc.; forest fires; other injuries; insects; preservation of wood; turpentine, rosin, and other products. The chapters covering the foregoing subjects take up somewhat more than one-half of the book, and they are for the most part quite satisfactory. The one which is most disappointing is that on insects. We may hope that in a second edition this chapter will be rewritten and supplied with figures of American insects instead of European ones.

The second half of the book consists of descriptions of particular species, beginning with the oaks. The treatment here is not as satisfactory as in the previous chapters; many important trees receive but a passing notice, if any, while others of little more or even of less value, have long paragraphs and even several pages devoted to them. For example, the red oak (*Quercus rubra*) is not mentioned, while *Q. hinesii*, *Q. densiflora* and *Q. agrifolia*, of Cali-

[1] *The Elements of Forestry*, designed to afford information concerning the planting and care of forest trees for ornament or profit, and giving suggestions upon the care of woodlands, with the view of securing the greatest benefit for the longest time, particularly adapted to the wants and conditions of the United States. By FRANKLIN B. HOUGH, Ph.D., Chief of Forestry Division, U. S. Department of Agriculture, member of the American Philosophical Society, etc. Cincinnati, Robert Clark & Co., 1880.

fornia, all of little or no value, have each a paragraph; yet *Q. chrysolepis*, the only good oak of that coast is entirely ignored. Moreover, while the white oak is discussed in but little more than half a page, more than four pages are devoted to the chestnut. Somewhat more, too, as to the relative values of the different species would have added greatly to the usefulness of the book, which, in spite of the blemishes alluded to, is a valuable one.—*C. E. B.*

SCUDDER'S NOMENCLATOR ZOOLOGICUS.[1]—The compiler of this laborious work has rendered a most important service to descriptive zoölogy, and has saved working zoölogists an immense amount of research. It comprises a list of all genera established previous to 1880, which have not been recorded or are erroneously given in the nomenclators of Agassiz and Marschall, or the indexes of the *Zoological Record;* the number of such entries being 15,939. Besides these it also includes the genera of the *Zoological Record* for 1878 and '79 (2133 names, which had not been entered in the MS. of the second part, or Universal Index, at the time of its preparation); 2d, the genera in the index of Zoologischer Jahresbericht for 1879, not otherwise given; 3d, all genera, whether previously recorded correctly or not, which were furnished by the authors themselves, and a few other names.

The aid afforded by a number of working naturalists, who have sent the compiler lists of the genera proposed by them, has been very valuable, especially the MS. additions and corrections which the late Professor Agassiz had made to his Nomenclator.

The second part, or "Universal Index," will contain, with its cross references, about 80,000 entries, including all names appearing either in the first part of the present work, or in the nomenclators of Agassiz and of Marschall, or in the indexes of the *Zoological Record* through that for the year 1877.

The Smithsonian Institution proposes hereafter to issue decennial supplements to this list, and naturalists in all parts of the world are invited to send annually to the institution lists of the genera and subgenera which they have proposed during the preceding year.

In the Nomenclator the name of each genus and subgenus is given, with the name of the proposer, the periodical or work in which it appears as well as the page, derivation, year and the order and sometimes the family to which it belongs.

REVUE DES TRAVEAUX SCIENTIFIQUES.—The Department of Public Instruction and Fine Arts, France, has commenced the issue of a monthly review, under the charge of the Committee of Historic and Scientific Works, composed of twenty-three of the

[1] *Department of the Interior:* U. S. National Museum, 22. Bulletin of the U. S. National Museum No. 19, Nomenclator Zoologicus. By SAMUEL H. SCUDDER. Part 1, Supplemental List. Washington, 1882. 8vo, pp. 376.

most celebrated professors of the various sciences, with M. H. Milne-Edwards for president, Messrs. Faye and Wurtz for vice-presidents.

This review will contain not only the reports of the monthly proceedings of the committee, but also summary analyses, or at least notices relative to all the most important scientific works published in France or abroad.

As evidenced by the issue of 1881, this review will prove valuable to students in every department of science; the notices are often very full, amounting to a condensation of the work reviewed; no branch is neglected, and the list of names upon the committee is sufficient guarantee for the excellence of the work.

HOVEY'S CELEBRATED AMERICAN CAVES.[1]—This work contains a full and well-written popular account of several of the principal caves of the United States, including Mammoth, Wyandot, Luray, Weyer's, Howe's, etc. Much space is devoted to the Mammoth, which holds its own as by far the largest, grandest and longest of the series of water-worn passages and domes in the limestone strata that has yet been explored. Its known avenues amount to 223, and their length equals 150 miles, though much of this is not entered by visitors. The reader is conducted through fairy grottoes and gothic arcades, among labyrinths and over bottomless pits, until finally he emerges bewildered by the multiplicity and strangeness of the objects to be seen, and enriched by much information respecting the history and scientific aspects of the vast cavern.

Wyandot cave, Indiana, has twenty-three and a half miles of explored avenues, and contains domes and stalactitic formations that equal in beauty those of its larger rival. Weyer's, in the Shenandoah valley, would be considered a wonderful cave, were it not for the fairy scenes offered by the newer and neighboring Luray.

These caves are but the largest known out of thousands that stud the limestone regions of Kentucky, Virginia and Indiana, proofs of the power of water, impregnated with carbonic acid, in wearing away the solid rock to the drainage level. In this region every hill has its face grooved and furrowed, and the small streams disappear down sink-holes into the caverns below, to gather together and reappear at the foot of the bluffs, as strong springs or small rivers.

The fauna of the Mammoth cave, with its thirty-six species, is rich compared with that of Luray, which consist only of a few bats, rats, spiders, flies and a single myriopod (*Synpopus whitei*). The curious *Mucor stalactitis* Hovey, occurs also in this cave.

[1] *Celebrated American Caverns*, especially Mammoth, Wyandot and Luray, together with historical, scientific and descriptive notices of caves and grottoes in other lands. By HORACE C. HOVEY. With maps and illustrations. Cincinnati, Robert Clarke & Co., 1882.

The work commences with chapters upon the structure and varieties of caverns, the mineral, animal and vegetable contents of caves and cave dwellings, sepulchres and temples. In these chapters a large number of valuable facts respecting the caverns of various parts of the world, whether in limestone or other rocks, are brought together.

The descriptions are accompanied by the most authentic maps and by numerous illustrations, many of them sketched under the author's direction, by J. Barton Smith, of New Haven, Conn. The writer deserves great credit, not only for information so pleasantly imparted, but for his endeavor to give, wherever practicable, precise dimensions. Under rigorous measurement, Howe's cavern, N. Y., shrinks from seven, twelve, or even eighteen miles to three, yet the wonders of its Crystal lake and Winding way undergo no real shrinkage, and underground beauties generally do not need the inflations of fancy more than those of the upper region.

A few errors in dealing with old world places are the worst blemish of the book; the author makes cavern-temples of Karnac and Luxor, while he omits all mention of Ispambul, and speaks of the Grotto Azzuro of Capri *as under "the brilliant skies of Greece!"*

He also fails to notice Cope's reports of cave expeditions in Southwestern Virginia in 1869, and of the Port Kennedy, the Durham and the Northumberland county, Pennsylvania, caves, explored by Wheatley, Cope and Leidy.

Recent Books and Pamphlets.—Celebrated American Caverns, especially Mammoth, Wyandot and Luray, together with historical, scientific and descriptive notices of caves and grottoes in other lands. By Horace C. Hovey. Cincinnati, Robert Clarke & Co., 1882. From the publishers.

Injurious Insects of the farm and garden. By Mary Treat. New York, Orange Judd Company, 1882. From the author.

Discovery of Tripoli near St. John. Dr. L. C. Allison's lecture describing the organisms which produce it, and Mr. G. F. Matthew's remarks on the uses to which it is applied, before the Natural History Society of N. Brunswick, 3d May, 1881.

Somewhat about a few medicinal plants of New Brunswick. By Dr. G. M. Duncan, of Bathurst. Before the Natural History Society of N. B., April, 1881.

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GENERAL NOTES.

BOTANY.[1]

A Botanical Excursion to Mt. Mansfield and Smuggler's Notch.—Northern Vermont is well known as one of the most interesting botanical localities in New England, from the abundance

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

of scarce and local plants found there. It was the desire to collect and study in their native haunts some of the rarest of these northern plants, that induced our party of four to visit Mt. Mansfield in July. Mt. Mansfield is the highest of the Green mountains, rising some forty-three hundred feet above sea level.

The crest of the mountain, as seen from below, bears some resemblance to the profile of a human face, and hence the south elevation of the crest has received the name of the Nose, while the northern, distant about two miles and some three hundred feet higher than the Nose, is called the Chin. The view is too well known and has been too often described to call for notice here.

We approached the mountain from the Underhill side. After a hot climb up the path we reached the top and were taken care of at the Summit House. The plants along the path up the mountain did not differ noticeably from those usually observed in the White mountains. Little was done the first day except to investigate the crest of the mountain and enjoy the magnificent view of Lake Champlain and the Adirondack mountains, but the next morning with the arrival of Mr. F. H. Hosford, of Charlotte, an enthusiastic botanist and explorer, well known to collectors by his carefully-prepared specimens, the botanical work began in earnest.

With the exception of the vicinity of the Summit House, the crest of the mountain is destitute of trees. On the Nose in a nook in the face of the cliff, we found a few specimens of the rare *Aspidium fragrans*, readily recognized by its odor of new-mown hay, which lingers long after the fronds are pressed and dried. Here also was a single shrub of *Salix balsamea.*

In the damp moss under the dwarf evergreens, near the house, we gathered *Habenaria obtusata* and the tiny *Listera cordata*, ranked by Dr. Gray in his interesting paper on the statistics of the northern flora, among the twenty-one scarcest species of the region; also *Smilacina trifolia*, frequently mistaken by the careless observer for *Smilacina bifolia* and *Goodyera repens* in bud. Along the ridge joining the Nose and Chin, numerous specimens were collected. *Ledum latifolium*, *Coptis trifolia*, *Arenaria grœnlandica* were in full flower, while *Diapensia Lapponica* forming dense mossy cushions, was ripening its fruit. *Comandra livida*, with its minute axillary flowers was at first carelessly neglected from its resemblance to *C. umbellata.*

On the sides of the mountain near the top, we noticed *Habenaria dilatata*, conspicuous with its snowy white flowers; *Kalmia glauca*, one of the prettiest of our semi-alpine plants, and *Trillium erythrocarpum*, which looked strangely out of place blooming in July. From the Chin, after carefully taking our bearings, we struck, or rather endeavored to strike, a bee-line through the brush and bogs for the Lake of the Woods, which seems, as you look down on it from above, to be but a short distance from the summit; but of all things apparent distance is the most deceptive.

The thick undergrowth prevented us from seeing where we ought to go, and so we went astray while the damp mossy bogs and ravenous mosquitoes rendered life a burden. At length the lake was reached. On its shores grew *Streptopus amplexifolius*, *Claytonia caroliniana* just budded, *Andromeda polifolia* now in fruit, *Sambucus pubens*, *Vacinium uliginosum*, *V. oxycoccus*, *Amelanchier canadensis* var. *oligocarpa*, while *Viola blanda* abounded everywhere. We found our way back to the summit without difficulty, and returned to the house well satisfied with our day's work. The night was enlivened by the unearthly cries of the hedge-hogs which abound on the mountain; in this case they devoted their energies to gnawing an empty butter tub to secure the salt.

The next morning we left the summit covered with clouds, and descended by the carriage road to botanize in Smuggler's Notch. This pass, which received its name from the fact that it was used during the war of 1812 by smugglers in conveying contraband goods from Canada to the United States, lies between Mt. Mansfield and Mt. Shepley, hemmed in by cliffs sometimes towering to the height of 1000 feet. While Mt. Mansfield was frequently visited by botanists, the flora of the Notch remained comparatively uninvestigated. Frederick Pursh, an Englishman who traveled quite extensively in this country while collecting material for his Flora Americæ Septentrionalis, visited Mt. Mansfield in 1807, and here first saw *Aspidium aculeatum*, not before known to exist in America; but it is doubtful whether he entered the Notch. Dr. Robbins visited Mt. Mansfield in 1829, but probably not the Notch.

In 1839 Professor Tuckerman collected *Aspidium aculeatum* on the sides of Mt. Mansfield, but it is uncertain whether he visited the Notch. C. C. Frost many years ago collected this fern in the Notch, but seems not to have traveled far from the trail. Professor Eaton visited the Notch in 1855, "but got," as he says "only *Aspidium aculeatum*, a few mosses, and seventy trout."

But the rarities of the Notch were practically unknown till Mr. C. G. Pringle, a thorough investigator of our alpine flora, began the exploration of its steeps, Aug. 10, 1876, when fresh from a trip to Willoughby mountain. The next year Hoysradt and the Faxon brothers accompanied him thither, and in 1878 the Notch was visited by Professors Gray and Sargent, and others.

The flora of the Notch is quite similar to that of Willoughby mountain. A road leads to a tavern, now in ruins though formerly in some repute, at the entrance of the Notch proper. Across the road from the tavern is a large spring of clear, cold water, by the side of which we lunched. Along the side of the road and path grew *Geum macrophyllum*, *Calamintha clinopodium*, scarce, *Viola canadensis*, *Aspidium spinulosum* var. *dilatatum*, *A. aculeatum* var. *braunii*, while in the moss in the crevices of the rocks, we noticed the leaves of the rare *Viola selkerkii*, marked by their deep narrow sinus. About half way through the Notch we deposited our luggage on a high boulder, as the hedge-hogs are partial to leather bags, and left the path to explore one of the precipitous ravines or dry brook beds extending up the cliff. Climbing a steep mountain ravine is sometimes no easy matter; however by dexterity and diligent use of all shrubs in the neighborhood, we made our way up as best we could. The first plant of special interest discovered, was *Castelleia pallida*. Though the flowers (properly bracts) are sometimes colored, yet in all those we noticed, they were either greenish or whitish, in striking contrast with our brilliant "painted cup" (*Castelleia coccinea*) that reddens our meadows in spring. Next *Saxifraga oppositifolia* was found hidden under a sheltering rock, but a month past flowering. Here on all sides, among the rocks and in the rifts and crannies of the cliff, were the rarities we had come so far in search of. *Saxifraga aizoides*, with its yellow spotted flowers, and *S. aizoon*, with its cream-colored flowers and singular leaves, bearing along the edge a row of white cartilaginous disks, were in full bloom everywhere. *Saxifraga aizoides* was probably unknown to Linnæus as native to America, for he says of its distribution, "*habitat in Alpibus, Lapponicis Styriacis, Westmorlandicis, Baldo.*" At the date of the publication of Torrey and Gray's Flora in 1840, neither *Saxifraga oppositifolia*, *S. aizoon*, nor *S. aizoides* were reported in the U. S., except at Lake Superior or in the Rocky mountains. In little clusters in the wet moss on the rocks, nodded the purple bells of *Pinguicula vulgaris*, the leaves of which were covered with a mucilaginous substance, and in some cases the margins had rolled over minute insects as so well described by Mr. Darwin in his "Insectivorous Plants." When we turned our attention from the plants at our feet and looked around, the full grandeur of our position burst upon us; far below lay the narrow valley, opposite towered high cliffs, above the rocky walls rose steeply to the summit, while the cracks and crannies high above our heads were filled with the flowers of *Saxifraga aizoon*, *Pinguicula vulgaris*, *Potentilla fruticosa* and *Campanula rotundifolia*.

Among the less noticeable plants were *Hedysarum boreale*, *Astralagus alpinus Draba arabisans*, *Artemisia canadensis*, *Aster graminifolius*, first described by Pursh, who founded the species on a specimen from Hudson's bay, in the herbarium of Sir Joseph Banks, *Woodsia glabella* and *Asplenium viride*, which at the date of Gray's Manual was not recorded in the U. S. After collecting what specimens we wished, we crossed, with many a slip and stumble, to a brook, along which we descended. If the ascent was difficult, the descent was infinitely more so. We seemed about to pitch down headlong, while the wet, slippery rocks afforded such a precarious footing that the brook was preferable. The descent was a mixture of creeping, crawling, jumping and sliding, the only thoroughly enjoyable way being to sit in the bed of the brook and slide down in the water, an operation that slightly dampened the clothes. On reaching the path we took up our baggage, and shortly before sundown emerged at the upper end of the Notch; here we found a wagon waiting to carry us to our hotel at Underhill, where we arrived in due season, thus ending our excursion, feeling that we had enjoyed three days of rare pleasure.

Among the plants we did not collect, but which have been collected by Messrs. Pringle and Hosford, are *Draba incana*, *Primula Mistassinica*, *Gentiana amarella* var. *acuta* and *Polygonum viviparum*.

This brief sketch does not claim to be a study of the Notch flora, but simply records a few of its more noticeable features.

In connection with the flora of Mt. Mansfield and Smugglers' Notch, the following list of Vermont plants, given by Wm. Oakes in 1840, as not then found in any other of the New England States, may be of interest. In case of antiquated names, the modern equivalents are given in parentheses:

Anemone pennsylvanica L.
A. hudsoniana (A. multifida Poir.).
Corydalis aurea Willd.
Nasturtium natans (N. lacustre Gray).
Sisymbrium teres (Nasturtium tanacetifolium Hook & Arnn.).
Draba arabisans Michx.
Sinapis arvensis (Brassica sinapistrum Bois.). Introduced.
Cerastium nutans Rof.
Flœrkea proserpinacoides Willd.
Ceanothus ovalis Bigelow.
Lathyrus ochroleucus Hook.
Phaca robbinsii (Astralagus robbinsii Gray).
Zizia integerrima D. C.
Symphoricarpus racemosus Michx.
Viburnum pubescens Pursh.
Valeriana sylvatica Richards.
Aster ptarmicoides Torr. & Gray.
Solidago humilis (S. virga-aurea, var. humilis Gray).
Pterospora andromedea Nutt.
Justicia america (Dianthera americana L.).
Shepherdia canadensis Nutt.
Euphorbia platyphylla L.
Quercus macrocarpa Michx.
Populus candicans (P. balsamifera, var. candicans Gray).
P. monilifera Ait.
Ulmus racemosa Thomas.
Listera convallarioides Hook.
Calypso bulbosa (C. borealis Salisb.).
Trillium grandiflora Salisb.
Zannichellia palustris L.
Carex eburnea Booth.
Equisetum variegatum Schleicher.
Aspidium aculeatum Swartz (var. Braunii Koch).
Pteris gracilis (Pellæa gracilis Hook).

—*H. W. Preston.*

BOTANICAL NOTES.—In the September *Torrey Bulletin* E. L. Greene describes seven new species of Californian Compositæ, viz: *Pentachæta alsinoides*, *Hemizonia lobbii*, *Hemizonia clevelandi*, *Hemizonia cephalotes*, *Hemizonia oppositifolia*, *Verbesina venosa*, *Microseris attenuata*.——J. B. Ellis continues his descriptions of North American Fungi in the same number, giving the characters of four new species, viz: *Valsa lutescens*, *V. binoculata*. *V. tuberculosa*, *V. venusta*, *V. ampelopsidis*.——Three new grasses are described by Dr. Vasey in the August–September *Botanical Gazette*, *Muhlenbergia setifolia* from Western Texas, *M. glomerata*, var. *brevifolia* from South-eastern California, and *M. sylvatica* var. *californica* from the San Bernardino mountains, Cal.——In the same journal Dr. Gray names a new plant of interesting affinities, *Parishella californica*. It is related to *Nemacladus ramossissimus*, and must consequently fall into Bentham and Hooker's tribe Cyphieæ of the order Campanulaceæ. The genus is dedicated to the Parish brothers, the well-known botanical collectors.——The July *Quarterly Journal of Microscopical Science* contains two important botanical papers, one by F. O. Bower on the Germination and Embryogeny of *Gnetum gnemon*, and the other by Professor Huxley on Saprolegnia in its relation to the Salmon Disease. In the latter the eminent author, after careful investigation, concludes that "the growth of the fungus is the cause of the morbid affection of the epidermis, and not its consequence."——Thomas Christy's New Commercial Plants and Drugs, No. 6, a pamphlet of about one hundred pages, and published by Christy & Co., London, contains much valuable information on the vegetable fibers produced in tropical countries. Six lithographic plates of fibers prepared by Vétillart, of Paris, accompany the pamphlet, and add much to its value. Cross and longitudinal sections magnified 300 diameters are shown of the fibers of flax, hemp, jute, cotton, china-grass, New Zealand flax, Mudar bark (*Calotropis gigantea*), paper mulberry, Nepal paper-plant (*Daphne papyracea*) Esparto grass, Pita (*Agave americana*), Manilla hemp, Tecum palm, bow-string hemp (*Sanseviera zeylanica*), pine apple and "white fir." ——The most important papers in the *Journal of the Linnean Society*, No. 121, are the Action of carbonate of ammonia on Chlorophyll-bodies, by Charles Darwin, and Researches on the life-history of *Hemileia vastatrix*, the fungus of the "coffee-leaf disease," by H. Marshall Ward. The latter holds that "it may be fairly considered proved that 'leaf disease' here, as in so many other cases now known, is not antecedent to the fungus, but is consequent upon the injurious action of the mycelium." "No ground exists for considering the fungus as a 'product of vitiated plant-life,' or 'of the sap,' and just as little reason is there for the view that a sickly plant is prone to infection. Nay, experiments prove conclusively that a vigorous and healthy West Indian tree is as easily infected as one from Ceylon, and it has also been shown that such a vigorous plant may produce more vigorous mycellium and spore-groups, *i.e.*, may disseminate more of the disease producing fungus in a given period."——A neatly printed pamphlet of seventy-five pages, entitled Houghton Farm Experiments with Indian corn, has been published by Mr. Lawson Valentine, the proprietor of the farm at Montainville, N. Y. Dr. Miles' paper on Field Experiments, which occupies more than two-thirds of the pamphlet, contains much valuable matter botanically as well as agriculturally.

ZOÖLOGY.

The Bite of the Gila Monster (Heloderma suspectum).—Within the last week the Smithsonian Institution has received from Acting Assistant Surgeon A. T. Burr, U.S.A., now serving in Arizona, a very fine living specimen of this lizard. I understand that Dr. Burr has had this reptile in his care for nearly six months, and it arrived here in an excellent state of health.

Heloderma suspectum Cope is the largest of our North American lizards, and is found all through New Mexico, Arizona, Lower California, and the country to the southward. I have never had the pleasure of seeing this reptile in its native haunts, but have been told by those who have been so fortunate, that it is a wonderfully striking object to behold, as well we might imagine it to be, with its shining and flinty armor of jet-black and brilliant orange, irregularly arranged over its body, darting as it does among the rocks of that arid land.

The superstitious Indians, and still more superstitious Mexicans that reside in the country where the Heloderma is found, have always regarded it with dread and fear, attributing to its bite the direst venom. Enlightened folk have entertained in their minds doubts upon this subject, indeed I have seen specimens forwarded to the Smithsonian, by collectors from the above localities, completely perforated by a large carbine ball, so careful have they been not to handle this creature alive. In view of these facts then, and this interesting part of its natural history, well authenticated cases of bites of this lizard possess sufficient value for scientific record.

Dr. Burr's specimen is not the first representative of Heloderma that we have received from our vast Southwest, for from time to time quite a number of these lizards have been sent to us alive, and they thrive quite well for a long time, feeding on eggs served to them either raw or hard boiled.

In removing them from cage to cage, or handling them for other purposes, the utmost care has usually been exercised, due to their doubtful reputation and not over gentle appearance. Mr. Henry Horan, the superintendent of the National Museum, received on several occasions slight bites from these specimens, but the wounds were never followed by any untoward symptoms.

On the 18th inst., in the company of Professor Gill of the institution, I examined for the first time Dr. Burr's specimen, then in a cage in the herpetological room. It was in capital health, and at first I handled it with great care, holding it in my left hand examining special parts with my right. At the close of this examination I was about to return the fellow to his temporary quarters, when my left hand slipped slightly, and the now highly indignant and irritated Heloderma made a dart forward and seized my right thumb in his mouth, inflicting a severe lacerated wound, sinking the teeth in his upper maxilla to the very bone. He loosed his hold immediately and I replaced him in his cage, with far greater haste, perhaps, than I removed him from it.

By suction with my mouth, I drew not a little blood from the wound, but the bleeding soon ceased entirely, to be followed in a few moments by very severe shooting pains up my arm and down the corresponding side. The severity of these pains was so unexpected that added to the nervous shock already experienced, no doubt, and a rapid swelling of the parts that now set in, caused me to become so faint as to fall, and Dr. Gill's study was reached with no little difficulty. The action of the skin was greatly increased and the perspiration flowed profusely. A small quantity of whisky was administered. This is about a fair statement of the immediate symptoms; the same night the pain allowed of no rest, although the hand was kept in ice and laudanum, but the swelling was confined to this member alone, not passing beyond the wrist. Next morning this was considerably reduced, and further reduction was assisted by the use of a lead water wash.

In a few days the wound healed kindly, and in all probability will leave no scar; all other symptoms subsided without treatment, beyond the wearing for about forty-eight hours, so much of a kid glove as covered the parts involved.

After the bite our specimen was dull and sluggish, simulating the torpidity of the venomous serpent after it has inflicted its deadly wound, but it soon resumed its usual action and appearance, crawling in rather an awkward manner about its cage.

Taking everything into consideration, we must believe the bite of *Heloderma suspectum* to be a harmless one beyond the ordinory symptoms that usually follow the bite of any irritated animal. I have seen, as perhaps all surgeons have, the most serious consequences follow the bite inflicted by an angry man, and several years ago the writer had his hand confined in a sling for many weeks from such a wound administered by the teeth of a common cat, the even tenor of whose life had been suddenly interrupted.—*R. W. Shufeldt, M.D., U.S.A., 22d September, 1882.*

[NOTE ON THE PRECEDING PAPER BY THE EDITOR.—The question as to the venomous nature of Heloderma seems to be complicated by opposing testimony. The fissured teeth have long been known to herpetologists. Dr. J. G. Fischer, of Hamburg, has recently described[1] the efferent ducts of the salivary glands which issue at the bases of the grooves of the teeth, evidently with the effect to carry the saliva into the wound. I observed this many years ago, but do not know whether I published it, and I gave the Arizona species the name of *suspectum* on account of the impression I derived from the observation of this fact. It is, however, true that even small animals do not always die from the effect of the bite. Perhaps the condition of Heloderma in this respect is like that of the Opisthoglyph serpents which have a similar arrangement of one or more of the posterior maxillary teeth, and are harmless to man at least.—*E. D. Cope.*

A LAND SHELL NEW TO THE UNITED STATES.—*Ampelita rowelli* Newcomb can now be added to the fauna of the United States. The habitat of this species is given as Lower California in Binney and Bland, Part I, and "has been accredited to Arizona, but not on undoubted authority" (see note 256, Binney's later work).

I now have specimens collected on the Salt River mountains, about seven miles south of Phœnix, Arizona, and determined from the type for me by Dr. Newcomb.—*Henry Prime.*

GAVARRET ON ASTIGMATISM (*Revue Scientifique 15, Juillet, 1882*).—Astigmatism is an anomally of refraction of the eye caused by a difference in the refringent powers of its meridian. This may be caused by asymmetry of the curve of the cornea, (the most usual case) or of the crystalline lens, or of both. The variation may be regular or irregular. If a series of concentric black circles be placed in front of an astigmatic eye, the circles will appear, if the astigmatism be regular, as ellipses with their major axes in the meridian of the eye having the greatest radius of curve, but if the astigmatism be irregular, the margins of the circles will be irregular.

Regular astigmatism can be corrected by a suitable lens of spherical section or a combination of cylinder and sphere. The power of accommodation possessed by the crystalline lens interferes with a correct result. To obviate this atropine has been used, but this, besides other evils, may also give incorrect results, dependent upon the susceptibility of the patient.

The ophthalmometer of Helmholtz is an ingenious instrument for the measurement of this asymmetry, but the examination of a single eye needs eight readings of the instrument and long calculations.

A far simpler ophthalmometer has been invented by Drs. Saval and Schiötz. It depends upon the fact that, if the diseased eye be looked at through a lens of 10 to 20 centimetres focus, placed in a small hole pierced in the centre of a square of white pasteboard, the image of the square, reflected by the eye examined, will be rectangular in proportion to the degree of the astigmatism.

[1] Verhandlungen des vereins für Naturwissenschaft, v, 1882, fol. III.

By using other shapes of pierced cardboard and employing a spy-glass with two objectives separated by a bi-refringent prism, and provided with a graduated arc, the degree of astigmatism of the cornea can be calculated, but that of the crystalline can only be obtained by subtraction from the total astigmatism, which must be obtained by another and less precise method.

W. Leche upon the Milk Dentition and Homologies of the Teeth of the Cheiroptera.—The species the milk dentition of which was examined were *Vespertilio murinus* and *V. Daubentonii; Vesperugo Nathusii* and *V. noctula; Vesperus serotinus, V. borealis*, and *V. velatus; Plecotus auritus, Sturnira lilium*, and *Rhinolophus hipposideros*. In all the Vespertiliones the formula was: i. $\frac{2-2}{3-3}$, c. $\frac{1-1}{1-1}$, m. $\frac{2-2}{2-2}$; in Sturnira the third incisor of the lower jaw was wanting; while in Rhinolophus the only milk-teeth that could with certainty be found were: c. $\frac{1-1}{2}$, m. $\frac{2-2}{2-2}$.

In Rhinolophus the milk-teeth never break through the jaw; but remain concealed until their entire resorption.

In the other species the milk-teeth lie in more or less perfect alveoli upon the outer border of the jaws, outside and behind the developing permanent teeth. At a certain stage of development almost the entire set of milk-teeth can be found exterior to the nearly complete set of permanent ones, a singularity rendered possible by the small size and simple form of the permanent teeth. As many as 50 teeth may be found in nearly adult individuals. The milk-teeth have their crowns covered with enamel and always more or less three-lobed (the two outer lobes in some cases rudimentary), with the tips of the lobes hook-like and directed inwards and backwards. The root, always the greater portion of the entire length, is single, the second milk-incisor of Plauritas excepted.

The milk-teeth resemble each other greatly in each individual and throughout the tribe, instead of, as in other mammals, exhibiting characters similar to those of the second set. Our author considers, therefore, that both sets are typical, the first exhibiting the type of the homodont mammals, the second the higher type of the heterodont mammals. The permanent incisors are usually equal in number to the milk incisors, but in Dysopes they are $\frac{1-1}{2-2}$ against $\frac{2-2}{3-3}$; while in Desmodus the four upper milk-incisors are replaced by two enormous teeth which have not the remotest resemblance to their predecessors. From the position of the milk-molars with regard to the permanent ones, the following is the formula of the second. Vespertilio p.m. $\frac{3}{3}$ m. $\frac{3}{3}$; Plecotus p.m. $\frac{2}{3}$ m. $\frac{3}{3}$; Vesperugo p.m. $\frac{2}{2}$ m. $\frac{3}{3}$; Vesperus p.m. $\frac{1}{2}$ m. $\frac{3}{3}$; the reduction invariably taking place first in the upper jaw, instead of of in the lower, as usual in mammals. In some other genera the molars also are reduced, exhibiting in the Stenodermata a series commencing with Brachyphylla and Sturnira with m. $\frac{3}{3}$, and ending with Desmodus with $\frac{1}{1}$.

Early Stages of the Clam.—In the report of J. B. Ferguson, Commissioner of Fisheries of Maryland, Mr. Ryder records his observations on the early stages of the clam (*Mya arenaria*). The spawning period of this mollusk lasts from the 10th of September to about the middle of October, or for about forty days. The sex of the adults, in a spawning condition may be ascertained by opening the shell carefully and removing a small portion of the richly colored yellow body-mass with a knife, scissors or forceps. These fragments traced out in a watch-glass with a few drops of sea water, allow a milky fluid to escape. Under a magnifying power of four or five times, the eggs of the female are visible in this milky fluid as very minute white points of nearly uniform size, very nearly 1-500th of an inch in diameter. The male cells or spermatozoa are visible under a power of 250 diameters. Mr. Ryder finds it possible after a little experience to observe with the naked eye the differences between the male fluid and the eggs. In two or three hours after artificial impregnation, *i.e.* by pouring water containing the male cells over the eggs, development begins. The changes which occur in the egg succeed each other with considerable rapidity, and, as in the development of the oyster, there are very well marked periods of active change of form which alternate with periods of repose, while there is a lalateral symmetry which is just as well marked as in the oyster and unio. The development was followed as far as the formation of a gastrula, the process of which is the same as that of the oyster, and in a general way the process of segmentation of the egg of the clam appears to resemble, in its earliest stages, at least, the same process in Anodonta, as described by Flemming

Anatomy of the Ophiuridæ.—Extensive observations upon the Ophiuridæ, carried on by M. Apostolides, at the laboratories of Banyuls and Roscoff, add considerably to our knowledge of the anatomy of that interesting group. The mouth does not open directly into the intestine, but into an œsophagus, provided with a sphincter, by which it can be opened or closed at the will of the animal. The so-called heart is in no sense a center of circulation, but is a glandular organ with an excretory canal. The vascular apparatus consists simply of a system of lacunary spaces. The body-cavity being completely closed, a perivisceral nutritive fluid circulates within it.

The genital clefts give access to ample closed sacs, carrying upon their exterior surface the genital sacs, but serving principally for respiration. The animal opens the clefts by the movement of its arms or of the muscles around the mouth, and the sacs are then filled by the action of the vibratory cilia of the inner layer. This takes place slowly, and when it is accomplished, the creature ceases to move, and the sacs drive out the water by their own elasticity. This movement of the respiratory sacs is believed to serve not only the purpose of permitting a gaseous exchange with the nourishing fluid of the perivisceral cavity, but also to draw the blood from the arms into the peristomatic portion of that cavity, and force its return.

The blastosphere stage of the embryo is not followed by an invagination, as is usually supposed to be the case in all echinoderms, but by the delamination of the ectodermal cells to form the walls of the digestive cavity.

Zoological Notes.—The publication of the Bulletin of the U. S. Geological and Geographical Survey of the Territories ends with the issue of No. 3 of vol. 6th. The contents are purely zoölogical. Mr. J. A. Allen publishes a preliminary list of the works and papers relating to the mammalian orders of Cete and Sirenia; unfortunately owing to the author's poor health, the article is incomplete, the bibliography being only brought down to the year 1840. Two papers on new moths and notes on other species by A. R. Grote close the number.——Apropos of whales, Professor G. O. Sars gives, in the Forhandlingar i Videnskabs-Selskabet i Christiania, for 1880, most excellent figures of *Megaptera boops*, $\frac{1}{33}$ nat. size; and of the finwhale, *Balænoptera musculus* $\frac{1}{38}$ nat. size; the sketches will be of standard value.——Professor Sars has also issued a well illustrated third part of his Carcinological Contribution to the Norwegian fauna, comprising his voluminous monograph of the Mysidæ.——The anatomy of the oyster, with two excellent figures, is described by Mr. Ryder in the last report of the Fish Commissioners of Maryland. How an oyster fattens, and the nature of its food and its mode and rate of growth, with figures, are given at length in Mr. Ryder's interesting report.——Professor Verrill gives, in the Transactions of the Connecticut Academy of Sciences, a historical sketch of New England Annelida, with annotated lists of the species hitherto recorded. Nine excellent plates accompany Part I.——Bulletin No. 11 of the U. S. National Museum is a very complete bibliography of the fishes of the Pacific coast of the United States to the end of 1879, by Dr. Theo. Gill.——M. Fischer recently gave before the Paris Academy of Sciences a *resumé* of his studies of the malacological fauna of the Mediterranean. The number of species obtained from all the deep dredgings (555 to 2660 metres) was about a hundred and twenty, every one of them common to the Mediterranean and the ocean.——M. Leopold Maggi, a disciple of Haeckel, in that he retains the sub-kingdom Protista for the reception of the lowest forms of life, shows that osmic acid will at once reveal the presence of protozoa in drinking water by causing their deposition at the bottom of the vessel. The micrographic analysis of the waters by this simple method may prove highly useful, since diarrhœa, dysentery, goitre, snd other diseases are thought to depend on this protozoan life.——Herr Jickeli has discovered in Eudendrium and some other hydroids histological elements which seem to prove the existence of a nervous system.

——J. M. Velasco gives, in *La Naturaleza*, complete proofs of the transformation into Amblystoma of the axolotls of the lakes Xochimilco, Chalco and Zumpango, the last situated sixteen leagues north of Mexico. The transformed axolotls are well known in the localities round the lakes, and are called by various names which signify the absence of branchiæ, also by an Aztec word signifying terrestrial axolotl. The lake of Santa Isabel becomes dry every year. As the water lowers the axolotls commence to change, and continue a terrestrial life; but the axolotls of the other lakes which contain excellent water and an abundant vegetation, change also, and the transformed axolotls are common under stones or in humid places in the mountains south of Mexico.——Professor Hy. Ward, in the *Natural Science Bulletin*, gives some interesting particulars relating to the Apteryx. There are sixteen cervical vertebræ, short and strong, and resembling those of the moa; and eight dorsal vertebræ, the last anchylosed to the sacrals, and bearing a small rib. The ribs, four of which are joined to the sternum, are broader and flatter than those of any other bird, differing greatly from the rounded ribs of the Dinornis. The pelvis resembles that of the emeu in its length, narrowness and flatness, while the legs are much like those of the dinornis, but have a comparatively longer femur.

ENTOMOLOGY.[1]

THE BUCKEYE LEAF STEM BORER.—In our account of the proceedings of the entomological sub-section of the A. A. A. S., at the 1881 meeting (see AMERICAN NATURALIST, 1881, p. 1009), we gave a short abstract of Mr. E. W. Claypole's paper on the above insect, accepting the determination of the species as *Sericoris instrutana* and mentioning the fact that the work of *Proteoteras æsculana* Riley, upon maple and buckeye, was very similar. A letter recently received from Mr. Claypole, prior to sending his article to press, and some specimens which he had kindly submitted to us, permit of some corrections and definite statements. We have a single specimen in our collection, bred from a larva found feeding, in 1873, on the blossoms of buckeye, and identical with Mr. Claypole's specimens, which are in too poor condition for description or positive determination. With this material and with Mr. Claypole's observations and our own notes, the following facts are established:

1st.—We have *Proteoteras æsculana* boring in the terminal green twigs of both maple and buckeye, in Missouri, and often producing a swelling or pseudo-gall. Exceptionally it works in the leaf-stalk. It also feeds on the samara of maple, as we reared the moth in June, 1881, from larvæ infesting these winged seeds that had been collected by Mr. A. J. Wethersby, of Cincinnati, O.

[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

2d.—We have an allied species, boring in the leaf-stalk of buckeye, in Ohio, as observed by Mr. Claypole. It bears some resemblance to *Proteoteras æsculana*, but differs from it in the following particulars, so far as can be ascertained from the poor material examined: The primaries are shorter and more acuminate at apex. Their general color is paler, with the dark markings less distinctly separated. No distinct tufts of scales or knobs appear, and the ocellated region is traversed by four or five dark, longitudinal lines. It would be difficult to distinguish it from a rubbed and faded specimen of *æsculana*, were it not for the form of the wing, on which, however, one dare not count too confidently. It probably belongs to the same genus, and we would propose for it the name of *claypoleana*. The larva is distinguished from that of *æsculana* by having the minute granulations of the skin smooth, whereas in the latter each granule has a minute sharp point.

3d.—*Sericoris instrutana* is a totally different insect. Hence our previous remarks as to the diversity of food-habit in this species have no force.—*C. V. R.*

Defoliation of Oak trees by Dryocampa senatoria in Perry county, Pa.—During the present autumn the woods and roadsides in this neighborhood (New Bloomfield) present a singular appearance in consequence of the ravages of the black and yellow larva of the above species. It is more abundant, so I am informed, than it has ever been before. In some places hardly any trees of the two species to which its attack is here limited, have escaped. These are the black or yellow oak (*Q. tinctoria*) with its variety (*coccinea*), the scarlet oak and the scrub oak (*Q. ilicifolia*). These trees appear brown on the hill-sides from a distance, in consequence of being altogether stripped of their leaves. The sound of the falling frass from the thousands of caterpillars resembles a shower of rain. They crawl in thousands over the ground, ten or twelve being sometimes seen on a square yard. The springs and pools are crowded with drowned specimens. They are equally abundant in all parts of the county, which I have visited during the past week or two—the central and southeastern.—*E. W. Claypole, N. Bloomfield, Pa.*

Efficacy of Chalcid egg-parasites. — Egg-parasites are among the most efficient destroyers of insects injurious to vegetation, since they kill their victim before it has begun to do any damage; but few persons are aware of the vast numbers in which these tiny parasites occasionally appear. Owing to the abundance of one of them (*Trichogramma pretiosa* Riley) we have known the last brood of the cotton-worm to be annihilated, and Mr. H. G. Hubbard reported the same experience at Centerville, Fla. Miss Mary E. Murtfeldt has recently communicated to us a similar experience with a species of the Proctotrupid genus

Telenomus, infesting the eggs of the notorious squash-bug (*Coreus tristis*). She writes: "The eggs of the Coreus have been very abundant on our squash and melon vines, but fully ninety per cent. of them, thus far [August 2] have been parasitized—the only thing that has saved the plants from utter destruction."

On the Biology of Gonatopus pilosus Thoms.—Professor Josef Mik in the September number of the Wiener Entomologische Zeitung (pp. 215–221, Pl. III) gives a most interesting account of the life-history of the curious Proctotrupid, *Gonatopus pilosus* Thoms., which has not before been thoroughly understood. Perris in his *Nouvelles excursions dans les grandes Landes* tells how from cocoons of parasitic larvæ on *Athysanus maritima* (a Cicadellid) he bred *Gonatopus pedestris*, but this he considered a secondary parasite, from the fact that it issued from an inner cocoon. It appears from the observations of Mik, however, that it was in all probability a primary parasite, as with the species studied by the latter (*G. pilosus*) the larva spins both an outer and an inner cocoon. The larva of *Gonatopus pilosus* is an external parasite upon the Cicadellid *Deltocephalus xanthoneurus* Fieb. The eggs are laid in June or July, and the larvæ, attaching themselves at the junction of two abdominal segments, feed upon the juices of their host. But one parasite is found upon a single Cicadellid and it occasionally shifts its position from one part of the abdomen to another. Leaving its host in September, it spins a delicate double cocoon in which it remains all winter in the larva state, transforming to pupa in May, and issuing as an imago in June.

It will be remembered that the female in the genus Gonatopus is furnished with a very remarkable modification of the claws of the front tarsi, which are very strongly developed, and differ somewhat in shape in the different species. It has usually been supposed that these claws were for the purpose of grasping prey, but Professor Mik offers the more satisfactory explanation that they are for the purpose of grasping the Cicadellids, and holding them during the act of oviposition.

It is interesting to note that there is in the collection of the Department of Agriculture, a specimen of *Amphiscepa bivittata* Say, which bears, in the position described above, a parasitic larva similar to that described by Mik. It left its victim and spun a white cocoon, but we failed to rear the imago. It is probably the larva of a Gonatopus and possibly that of the only described American species of the genus, *Gonatopus contortulus* Patton (*Can. Ent.*, XI, p. 64).

Species of Otiorhynchidæ injurious to Cultivated Plants.—Of our numerous species of this family, we know the development and earlier stages of only one species, viz., Fuller's Rose-beetle (*Aramigus fulleri*[1]). A few other species have attracted

[1] Vide Annual Report Department of Agriculture, 1878, p. 257.

attention by the injury caused by them as perfect insects. They are as follows: *Epicærus imbricatus*, a very general feeder; *Pachnæus opalus* and *Artipus floridanus*, both injurious to the orange tree. Of a few other species we know the food-plants: thus *Neoptochus adspersus* feeds on oak; *Pachnæus distans* on oak and pine; *Brachystylus acutus* is only found on persimmon; *Aphrastus tæniatus* lives on paw-paw (but not exclusively); *Eudiagogus pulcher* and *rosenschœldi* defoliate the coffee-weeds (*Cassia occidentalis* and other species of the same genus). Two very common species, *Pandeleteius hilaris* and *Tanymecus confertus* appear to be polyphagous, without preference for any particular plant. Very recently the habits of another species, *Anametis grisea* Horn, were brought to our knowledge by Mr. Geo. P. Peffer, of Pewaukee, Wis., who sent us specimens of the beetle accompanied by the following communication: "The larger Curculio I send you is working around the roots of apple and pear trees, near the surface of the ground or around the union where grafts are set. I found fifteen of the larvæ on a small tree one and a-half inches in diameter. The beetle seems to lay its eggs just where the bark commences to be soft, near or partly under the ground. The larva eats the bark only, but they are so numerous as to girdle the tree entirely in a short time."—*C. V. Riley*.

Bombyliid Larvæ destroying Locust Eggs in Asia Minor.—The eggs of locusts in Cyprus and the Dardanelles, as we learn from the Proceedings of the London Entomological Society, are much infested with the parasitic larvæ of *Bombyliidæ*, though these were previously not known to occur on the island. This fact shows that the habit which we discovered among some of our N. A. *Bombyliids* recurs in other parts of the world, and we have little doubt that careful search among locust eggs will also reveal the larval habits of some of the *Meloïdæ* in Europe and elsewhere. Indeed, notwithstanding the closest experiments of Jules Lichtenstein which show that the larva of the Spanish blister-beetle of commerce will feed on honey, we imagine that its more natural food will be found in future to be locust eggs. The particular *Bombyliid*, observed by Mr. Frank Calvert, destroying locusts in the Dardanelles is *Callostoma fascipennis* Macq., and its larva and pupa very closely resemble those of *Triodites mus* which we have studied and figured (see Vol. xv, pl. vi). We quote some of Mr. Calvert's observations:

"On the 24th of April I examined the larvæ in the ground: the only change was a semitransparent appearance which allowed of a movable black spot to be seen in the body. On the 8th June about fifty per cent. of the larvæ had cast a skin and assumed the pupal state in their little cells: the color yellowish-brown darkening to gray in the more advanced insect. About one per cent. of the cells, in which were two skins and an aperture to the surface, showed the perfect insect to have already come out of them. A gray pupa I was holding in my hand suddenly burst its envelope, and in half a minute on its legs stood a fly, thus identifying the perfect insect. * * I found the fly, now identified, sucking the nectar of flowers, especially of the pink scabious and thistle, plants common in the Troad. (Later on I counted as many as sixteen flies on a thistle-head.) The number of flies rapidly increased daily until the 13th when the ground appeared pitted all over with small holes from whence the parasite had issued. A few pupæ were then still to be found—a larva the rare exception. The pupal state thus seems to be of short duration. It was very interesting to watch the flies appearing above ground; first the head was pushed out; then with repeated efforts the body followed; the whole operation was over in two or three minutes; the wings were expanded, but the colors did not brighten until sometime after. Occasionally a pupa could not cast off its envelope, and came wriggling out of the ground, when it was immediately captured by ants. Unfortunate flies that could not detach the covering membrane, adhering to the abdomen, also fell a prey, as indeed many of the flies that could not get on their legs in time. The fly for the first time (13th June) were seen to pair, but this rarely."

ANTHROPOLOGY.[1]

Anthropology at the American Association.— It will be recollected by those who attended the Buffalo meeting of the Association, that by special favor the anthropologists were allowed to hold a subsection by themselves. We were there made a permanent subsection, and at Cincinnati a permanent section. It is with some pride that we refer to these things, because we have not moved always in flowery fields. Opposition from without, no doubt has been experienced, but our chief difficulty is from within. Of these, let us kindly and frankly speak. We are in the freshman class of our science, but we are in danger always of putting on the airs of seniors. The remedy is plain; it is not to leave the college and remain an ignoramus, but to be humble and not put on the airs of a senior until such time as the faculty bestow that honor upon us. In plain words, gatherers of relics, skeletons, crania, ethnological material of every kind, and the data of other branches of anthropology are most necessary in their sphere, every student of this department of knowledge must begin with this and never wholly abandon it, yet they are not necessarily scientists, their work can hardly be called science. Therefore, we shall be of all people the most unwise, if we allow ourselves to rest content with the rudiments of knowledge, and subject ourselves to the ridicule of truly scientific people. The papers read at the association were generally of a very high order,

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

as most of our readers would judge by seeing the names of the authors. The full list is given below:

1. A scheme of Anthropology. Otis T. Mason.
2. The cross and the crucifix. Charles Whittlesey.
3. Notice of a collection of Sioux weapons and articles of dress. G. H. Perkins.
4. Recent archæological discoveries in Vermont. G. H. Perkins.
5. Stone implements from Bomoseen and Castleton valleys. J. McNab Currier.
6. A stone grave in Illinois. Charles Rau.
7. Chief deities in American religions. Albert S. Gatschet.
8. Beliefs and superstitions of the Iroquois Indians. Mrs. Erminnie A. Smith.
9. Home life among some of the Indian tribes. Miss Alice C. Fletcher.
10. A find of ceremonial weapons in Florida. A. E. Douglas.
11. Religious ceremonials of some of the Dakotan family of Indians. Miss Alice C. Fletcher.
12. On some hitherto unnoted affinities between ancient customs in America and on the other continents. I. W. Phené.
13. Indian migrations as evidenced by language. Horatio Hale.
14. The contents of eighty-four stone graves at Brentwood, Tenn. F. W. Putnam.
15. Discovery of the remains of a log building belonging to the stone-grave period in Tennessee. F. W. Putnam.
16. Account of mounds explored in Ohio and Tennessee. F. W. Putnam.
17. On the comparative phonology of four Sioux languages. J. Owen Dorsey.
18. The kinship system and marriage laws of the Dhegiha (Omahas, Poncas, &c.). J. Owen Dorsey.
19. Atlas and the Atlantes; 1. The Atlantes. 2. The Guanches. R. G. Haliburton.
20. Who made the native copper implements? P. R. Hoy.
21. Who built the mounds? P. R. Hoy.
22. On copper implements and ornaments from North America. F. W. Putnam.
23. A "find" of chipped stone implements on the Pacific coast, and exhibition of the specimens. H. N. Rust.
24. Remarks upon the Davenport tablet. H. N. Rust.
25. Monumental and art remains in the lake regions of Ohio, Pennsylvania and New York. Wills DeHass.
26. Influence of climate of Canada on Europeans. Wm. H. Hingston.
27. A few deductions from dictionary of the Tuscarora language. Mrs. E. A. Smith.
28. Mountain antiquities. Wills DeHass.
29. The bleaching of the Aryans. Mrs. Virginia K. Bowers.
30. Geological testimony to the antiquity of man in America. Wills DeHass.
31. Archæological exploration; progress of discovery. Wills DeHass.

A brief statement of the contents of the papers may be of use in directing those who desire to be better informed from the authors themselves.

Mr. Mason, in order to impress upon the members of the section the necessity of ascertaining accurately where each paper as well as its author stood with reference to the science as a whole, presented a scheme divided into four columns, based on the Greek words *genea*, *graphe*, *logos* and *nomos*. For the whole science, we would have anthropogeny, anthropography, anthropology and anthroponomy. And for any department of the subject a similar scheme of four would arise.

Mr. Whittlesey strenuously maintained that we have not sufficient evidence to predicate that the occurrence of the cross so frequently in American antiquities has anything to do with religion, much less with European influences of any kind.

Messrs. Perkins and Currier each described collections of great value which they had in their possession.

Dr. Rau described the opening of a stone grave in Illinois, containing the remains of a Kaskaskia Indian, thereby casting a doubt upon the opinion that the stone graves contain the remains of a race long since extinct and wholly different from our modern Indians.

Mr. Gatschet, from a long study of the religions of our aborigines, was able to classify their myths, and gave to the section the Klamath story of Old Bear and Little Weasel. The author is sure that he has discovered a substratum of nature worship under all our American religions.

Mrs. Smith has continued her researches among the Tuscaroras and other Iroquois tribes, and among other things carefully noted the manner in which the pagans took on christianity, in many cases blending the pagan rites with those of the church.

Miss Fletcher has lived in the wigwams of the Omahas, Ogalallas and Brulés, and has familiarized herself with that part of their domestic life not exhibited to the eyes of men. Her description of the sun-dance was exceptionally interesting.

Mr. Douglass exhibited a collection of beautifully polished stone implements from Florida.

Mr. Phené was one of the foreign guests, and gave an illustrated lecture upon similarities of monumental remains throughout the world.

Mr. Hale, the ethnographer of the Wilkes' expedition, from a long study of the transformations of words from tribe to tribe in our various Indian stocks, was able to make some valuable deductions respecting the former movements of our aborigines.

Mr. Putnam, in his four papers, described his own personal researches in the capacity of curator of the Peabody Museum. His large experience and good sense caused his communications to be listened to with a great deal of interest.

Mr. Dorsey, in our view, made the most valuable additions to our knowledge. Each of his papers is a monument to his great pains and personal research. In the former he has discovered a sort of Grimm's law running throughout the entire Sioux stock. In the latter he has traced with greater elaboration than Mr. Morgan, the rules of consanguinity and affinity in two of them.

Mr. Haliburton entertained the section with the recital of his experiences in the country of the Shuluhs or Shelhahs, south of the Morocco and in the Canary islands. The persistence with which old Greek and Semitic myths have continued in this region is truly marvelous.

Dr. Hoy gave the section the benefit of his experience in copper implements. On this subject there is no doubt that he is right. On the second paper the author has bestowed a great deal of labor, whether he is right or not.

Mr. Rust has lived many years among the Indians, and was able to explain some things by his experiences. The implements exhibited were very similar to those from Honduras figured in "Flint Chips."

Mr. Hingston is a surgeon of Montreal, and has been a keen observer of fecundity, longevity and vitality among Canadians, mixed up of English, Scotch, Irish and French, with a considerable sprinkling of Indians, but no German or other Europeans than those above mentioned.

Dr. DeHass, in his papers, gave the benefit of his own personal experience in exploration, and in one of them brought together all the various instances in which the antiquity of man has been alleged on our continent. We have seen these stories frequently before in different places, but Dr. DeHass has certainly done a great service in making them stand up in a line together.

The next meeting will be in Minneapolis, where more strenuous efforts must be put forth to make our section the best of all.

GEOLOGY AND PALÆONTOLOGY.

Theories of the Origin of the Loess.—Baron Richthofen (Geol. Mag. July, 1882) writes upon the origin of the Loess, in answer to H. H. Howorth. He states that, petrographically, stratigraphically and zoologically the Loess differs from all other formations; that in its nearly perfect homogeneousness it contrasts strongly with sedimentary strata deposited in shallow water; that between ridges of considerable height it fills up the hollows, presenting a concave surface; that its composition is everywhere hydrated silicate of lime, with some quartz and mica; that there is no stratification; that the tubes, incrusted by carbonate of lime, may be seen taken up by rootlets where vegetation occurs; that the shells are almost all land shells; that the mammalian remains are those of animals living on the steppes; and that whenever the Loess fills a basin between two hills, the slopes are covered by angular fragments of the adjoining rock. Water action will not explain these facts. Wind action will. Repeated depositions and repeated growths of grass explain the capillary structure. Dust storms in the present age deposit a measurable thickness of yellow dust wherever there is vegetation, and in districts where grass is the chief growth, successive deposits may reach hundreds and thousands of feet.

The steppe basins of Mongolia have a structure similar to that of the Loess, and all that is needed to give those basins the characteristic Loess scenery is water and an outward drainage.

Baron Richthofen's paper is followed by a continuation of Mr.

Howorth's, giving the evidence of the valley terraces in favor of a great post-glacial flood; and in the succeeding number Mr. Howorth publishes a rejoinder to Baron Richthofen. He urges that he, as well as Baron Richthofen, believes in the original sub-aerial nature of the deposits, as proved by the animal and vegetable remains, but that what is called the Loess is this old land surface redistributed by the catastrophe which closed the Mammoth period and formed the gap between Palæolithic and Neolithic man. He denies that the genera and most of the species of mammals found in the Loess are such as now abound in steppes, for the mammoth and the rhinoceros, the characteristic quadrupeds, are forest animals; and he asserts that the probabilities are that the lime-lined capillary tubes, which do not occur at a greater depth than 45 feet, were formed by the percolation of water. Wind-driven deposits would be sorted, the heavier dropped first, whereas heavy grains occur throughout the Loess, mixed with the lighter. Baron Richthofen asserts that the Loess-covered portions of Europe must have had a steppe climate long enough for the deposit to be formed, but if so, how could the Helices and other damp-loving molluscs exist? Whence did the dust come to form this vast deposit? Wind blowing over grass raises no dust. As, according to Baron Richthofen the steppes of Mongolia are really Loess, and as the Loess is known to exist in Russia, where can we possibly look for a dry area large enough to supply this dust?

Mr. S. V. Wood contributes an additional theory to this much vexed question. In arctic climates where the soil is not covered by ice, the surface would annually thaw and be converted into mud by the melted snow. On all inclined surfaces it would slide downward from the frozen soil below, and thus leave a fresh surface exposed to the same agencies. Repeated depositions of this mud would fill the valley, and constitute the Loess.

The Recent Discoveries of Fossil Footprints in Carson, Nevada.—Monday evening, Aug. 28th, the California Acad. of Scien. held a special meeting, with Vice-President Justin P. Moore in the chair, to hear a carefully prepared paper on the "Carson Footprints," read by Joseph Le Conte, M.D., L.L.D., Professor in the Universityof California. He began by explaining that his attention was first attracted to the Carson prison stone quarry in 1868, when he received from it the tooth of a species of the horse. On June 20th, 1882, he first reached the quarry and saw the footprints now uncovered, and found there the Committee of the Academy diligently at work, with whom he, as only a member, desired most heartily to coöperate. He then described the locality as a remnant of a sandstone elevation, which had been cut into by erosion. An opening about 100 yards square had been quarried into the ledge, which is surrounded on three sides by vertical cliffs from 10 to 32 feet high, on the floor of which the nearly level strata appear well exposed. The strata consist of heavy bedded, grayish and creamy sandstone, separated by thin layers of shale. The sandstones in many places, especially in the eastern cliff, are strongly affected with cross laminations, indicating deposit by rapid shifting, overloaded currents—in other words, river flood deposits. We have, therefore, the mouth of an ancient stream. There appear to have been two shale floors about two feet apart, on which layer tracks are found. The whole area uncovered is literally strewn with these tracks. Parts of the area cleared have been trampled over by men and horses for eight or ten years, without attracting scientific attention. Their importance was first recognized by the intelligent Warden, Major Garrard, and their hardness has been the means of preserving them. Besides the tracks, a considerable number of fossils have been found which may assist in determining their age. Among these are fragments of tusks and molars of an elephant, and molars and fragments of jaws containing molar teeth of two species of horse. These were but imperfectly petrified. Two species of fresh-water shells have been found, an Anodonta and Sphærium, also one Gastropod, Physa. Vegetable remains are also abundant, occuring mostly as matted masses of silicified herbaceous plants. The age of the strata seems difficult to determine, but judging from the mammalian remains alone, there can be no doubt that the deposit is either Quaternary or the Upper Pliocene.[1] The molars discovered at Carson, above the tracks, indicate the *Elephas primigenius* rather than the *americanus*. The teeth of the horse indicate the *Equus major*, which although similar to modern horses, was somewhat larger. The lithification of the strata and fossilization of plants and organic remains, and the slight tilting of the strata, may be adduced as evidence of an earlier age than the Quaternary. The strata somewhat resemble a lake terrace deposit. Although Miocene lake deposits are here not far off, Professor Le Conte thought the presence of horse and elephant a bar to that age. The ancient Pliocene lake was the most extensive, covering the whole basin region from the Sierra Nevada to the Wahsatch. Its extensive deposits have been largely covered up by the later deposits of the two great Quaternary lakes in the same region. Carson plains was about 240 feet above the level of these latter lakes; hence, a smaller and very shallow contemporaneous lake must have existed at a higher level, probably emptying into the greater lake.

The tracks supposed to be human naturally excite the greatest interest, being several hundred in number. No one who studies them can fail to observe their remarkable general resemblance to human tracks, both in their form and in the apparent singleness of each impression. Their size calls for explanation; although

[1] The age was indicated as Pliocene from specimens sent one of the Editors, in the NATURALIST, March, 1882, p. 195.

well defined as rights and lefts, their straddle is unusually wide. He thought they might have been made by a human foot enclosed in a rawhide sandal much larger externally than the foot. This would at first make a flat track until soaked through, after which it would leave a round impression, but no toe marks. If not by man the tracks could only be made by some clumsy plantigrade quadruped like a bear or a gigantic ground sloth, Mylodon, such as lived in the Quaternary. Professor Le Conte desired to hold his final scientifically expressed opinion in reserve, awaiting further testimony. The interest among scientific men is intense on any subject calculated to show evidence of the antiquity of man, especially in Pliocene or Miocene ages.

Origin and Mode of Formation of Saline Mineral Waters.—M. Dreulefait, in a lecture upon this subject recently delivered before the French Scientific Association, took occasion to discredit the usual theories which attribute the formation of the beds of the gypsum, rock-salt, etc., that mineralize such waters, to the action of sulphuric acid from the depths of the globe, or to any other *internal* agency, and to attribute their origin entirely to causes acting *exteriorly* to the primitive crust of the earth.

The rocks forming the first solid envelope must have solidified at a temperature of 2000° to 2500° C., at which chlorine, sulphur and their combinations must have existed completely disassociated in the atmosphere. Chloride of sodium would form at a comparatively high temperature because it can support such a temperature without disassociation of its elements, but chloride of magnesia could not, since it decomposes at 100 C. in the presence of water, have been formed until the temperature of the earth was about 100 C., and the greater part of the water was already condensed.

Here, then, is the source of the salts found in the earth's crust, in the sea, and in mineral waters. The water, condensed by the lowered temperature, dissolved the soluble salts already deposited, as well as those continuously produced by the action of the acids within it. These salts were principally sulphides and chlorides produced by the union of sulphur and chlorine with the metals sodium, lithium, potassium, calcium, and magnesium already deposited in the more ancient crust of the earth.

Thus the masses of chloric and sulphuric salts which exist in the sedimentary beds of the globe have been formed by the spontaneous evaporation of isolated portions of the ocean.

This can be verified by the facts which occur in the evaporation of sea-water for the production of salt. The substances precipitated, in the order of their occurence, are :

1. A feeble deposit of carbonate of lime with traces of strontian, and of sesquioxyde of iron mixed with a little manganese.

2. Gypsum. This deposit does not occur until the water has by evaporation diminished to one-fifth of its original volume.

3. Common Salt. The deposit of gypsum ceases when .88 of the original volume of water has evaporated, and that of salt commences when only one-tenth of the volume remains, and continues till that quantity has been reduced one-half.

4. Sulphate of magnesia. A still further evaporation causes the deposition of this salt, mingled however, with chloride of sodium. When the only three parts out of a hundred remain, the quantities of sulphate of magnesia and common salt are equal.

5. Carnallibe, or double chloride of potassium and magnesium. This is deposited when the water has been reduced to a little less than one-fiftieth of its original volume.

Spontaneous evaporation goes no further; a bitter mother liquor is left that never dries at the ordinary temperature of the hottest regions of the globe. This liquor contains much chloride of magnesium.

Taking these facts in their order, and applying them to the saline beds found in different parts of the earth, it is evident that the substances last deposited must be rarest, since at each stage the evaporation is more advanced, and the chances favorable to further deposition diminished. This is borne out by the facts, since gypsum is most common, chloride of sodium next. We may also predicate that if one of the substances last deposited in artificial evaporation be found in the crust of the earth, beds of all those substances which are previously deposited will be found around it. This is always the case, gypsum occurs without common salt, but never common salt without gypsum. At Strassfurth, Prussia, all these substances occur, with, in addition, boracic acid combined with magnesia. Chemists have been of opinion that since "borate of magnesia is almost insoluble in water, it ought to have been deposited in the inferior beds," and have appealed to volcanic agency to explain its occurrence. Analysis, however, shows that boracic acid exists in the mother liquor left after evaporation, and in such quantity that spectral analysis, or the flame of hydrogen, reveals its presence in a single drop.

Thus boracic acid, occurring abundantly in the midst of the deliquescent salts of the mother liquor, ceased to be a rare substance, and may be expected to be found where deposits of gypsum and salt occur, and there only. M. Dreulefait goes on to state that he has proved his deductions by observations carried on throughout a considerable portion of Southern Europe and Northern Africa, and has come to the conclusion that the presence or absence of volcanic agencies makes no difference to the quantity of boracic acid found in saliferous districts. The salt springs of the non-volcanic parts of the south of France, Switzerland, and Germany are as rich in boracic acid as those of the ophitic districts of Engadine or the Pyrenees.

The lecturer then treated of the salt pools formed in the delta of the Rhone, and showed how they are repeating the action by which the older beds of gypsum and salt were formed. The Karabogaz or Black Gulf on the east of the Caspian sea has already deposited the remains of all its forms of life, and is nearly ready to deposit gypsum. A narrow channel communicates with the Caspian, through which it can be calculated that 350,000 tons of solid matter pass in twenty-four hours, ever to remain in the gulf, since the channel is too shallow to admit of any counter-current. Complete separation, which must ultimately be caused by the proved lowering of the level of the Caspian itself, will in time cause the Karabogaz to become concentrated sufficiently to deposit its chloride of sodium.

The water of the dead sea is a mother liquor, from which the saline masses found around it have been derived. M. Lorbet, in his explorations of Palestine, discovered, especially around Lake Tiberias, now 212 metres below the Mediterranean, a plateau covered with rolled pebbles exactly at the level of that sea, and indicating that at a former epoch Lake Tiberias, the Jordan valley, and the still lower Dead sea, with the regions around them, formed a gulf like that of Karabogaz or like the pools of the estuary of the Rhone.

THE SO-CALLED LEADVILLE PORPHYRY. — Professor Alexis Julien read a paper at the Montreal meeting of the American Association, on this subject, in which he described the result of his examination of the rock in question, in thin sections under the microscope. He finds that it is not an eruptive rock, but is sedimentary. Its material consists of the debris of the erosion of plutonic rocks, redeposited in the Silurian ocean. He concludes that the rock is not a porphyry but must be called a felsite tufa. The importance of this conclusion in estimating the form of any metallic ores contained in this deposit, is obvious, and will be invaluable to mining experts.

PERMIAN VERTEBRATA.—Professor Cope read a paper before the American Philosophical Society in which he described the pelvic arch of the *Diadectidæ*, and the following new species from the Texas Permian: Pelycosauria, *Edaphosaurus* (g. n.) *pogonias*, which is allied to *Pantylus*, and proves that that genus must be placed in the Theromorphous order. *Ectocynodon aguti*. Microsauria, *Diplocaulus magnicornis*, a remarkable species with a large flat horn on each side of the cranium. Rachitomi, *Acheloma* (gen. allied to Eryops) *cumminsi*, and *Anisodexis* (g. n. allied to *Leptophractus*) *imbricarius*.

GEOLOGICAL NEWS.—In the *American Journal of Science*, S. H. Scudder shows that Palæocampa, from the carboniferous strata of Illinois, is a myriapod of a new and strange type. Palæocampa has ten equal body segments, each with a pair of stout, blunt legs, and four stiff-spreading bunches of spines of complex structure.

The Archipolypoda of the Mazon creek nodules have stout forked spines and two pairs of legs to each segment. Palæocampa may therefore be considered as a precursor of the Chilopoda, just as the Archipolypoda are the precursors of the Diplopoda, and the discovery of these types prove that at this early period the divergencies of structure among myriapods were as great as they are to-day.——In the same journal Messrs. McGee and Call write upon the Loess of Des Moines, Iowa, giving faunal tables of the fossils, which have a less aquatic facies than the modern mollusca of the same district.——Messrs. Scott and Osborn describe *Orthocynodon*, an ancestor of the Rhinoceros, from the Bridger Beds of Wyoming. It is the oldest known representative of the line, and differs from Amynodon in the erect lower canines, similarity of premolars and molars and other particulars. He has little of the rhinocerotic character in the skull, but the possession of canines and loss of the median incisors point it out as related to Amynodon.

MINERALOGY.[1]

The action of Heat upon Crystals of Boracite.—Mallard contributes to the Mineralogical Society of France an interesting paper upon the change which heat produces in the optical properties of boracite. The leading mineralogists of Germany—Klein, Zirkel, Groth, etc., hold that such changes are due simply to unequal internal tension, such as may be produced in glass. That the biaxial character caused by heat is an essential and characteristic character of boracite, due to the twinning of twelve rhombic crystals around a point, is again strongly urged by Mallard in the present paper. He supposes each individual of the *pseudo-symmetrical* crystal to be a pyramid whose base forms a face of the external dodecahedron, and whose summit is at the center of the crystal. By cutting sections in various directions through the crystal, and examining them optically both before and after heating, he shows that there are persistent optical properties which cannot be explained by irregular tension. He concludes that by the action of an intense and prolonged heat, a series of very thin plates are formed, alternately twinned with each other according to a definite crystallographic law. He shows that analogous phenomena may be produced by the action of heat upon sulphate of potash, and that such invariable phenomena could not be produced by tension or pressure in a colloid substance.

Prehnite.—This zeolite, so frequent in rocks of igneous origin, and recently found to so frequently exhibit curious optical properties, has been carefully described by Professor B. K. Emerson in its associations and alterations in the Deerfield Dike of Connecticut. Prehnite is regarded as the oldest mineral in the veins in which it appears. Frequently the motion of the rock walls produces slickensides upon the prehnite, and sometimes

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

breaks it up into sheets, which are re-cemented by prehnite. The prehnite often encloses diabantite, and then varies in color from deep oil-green to jet-black. This black prehnite is sometimes combed out by the slipping rock into long fibres, resembling hornblende or chrysotile. The prehnite also occurs as a finely crystallized double cone or spindle, forming beautiful specimens. This peculiar form is the result of the twinning of three individuals around a common axis, and the resulting optical properties are peculiar. Prehnite also occurs in amydaloidal cavities which are blackened as though held in the flame of a candle. A black substance covers the fibres of prehnite, looking like a net-work of soot-covered cobwebs. This black substance is the result of alteration, and is probably chlorophæite. In other cases the prehnite has changed into a pale-green scaly mass, which appears to be diabantite.

AMERICAN MONAZITES.—In the *American Journal of Science* for October, Professor E. S. Dana and Mr. S. L. Penfield contribute valuable articles upon American monazites. From a careful measurement of a small monazite crystal from Alexander county, North Carolina, by Professor E S. Dana, the following axial ratio was obtained:

$$c \text{ (vert)} : b : \grave{a} = 0.95484 : 1.03163 : 1$$
$$\beta = 76° 20'$$

A table is given containing a list of the more important angles calculated from these data, and agreeing closely with the results of goniometrical measurement. The axial ratio is closely related to that of monazites from other localities.

Mr. Penfield has analyzed the monazites from Portland, Ct., from Burke county, N. C., and from Amelia county, Va. The latter is the substance originally thought to be an altered microlite. Each analysis showed a considerable percentage of thoria, there being over fourteen per cent. in the monazite from Amelia county, Va. In each case, if the thoria is omitted from the analysis, the ratio is obtained of $(Ce, La, Di)_2 O_3 : P_2 O_5 = 1 : 1$, this being the ratio of a normal phosphate of the cerium metals, $R_2 P_2 O_8$. Moreover, there is just sufficient silica in each analysis to make a thorium silicate. Since, therefore, some monazites contain no thoria, and the thoria is here present in varying amount, it is probable that thorium silicate exists as an impurity. That this is indeed the case was proved by examination of a thin section of the mineral under the microscope. A dark resinous substance was seen scattered through the section, and when the latter was moistened with hydrochloric acid, white blotches, composed of gelatinous silica took the place of the resinous spots, the rest of the section being unchanged. It is evident, therefore, that the thorium silicate is a foreign admixture in the monazite. It probably exists as thorite or orangite.

MINERALS FROM PIKE'S PEAK.—Pike's Peak has already become famous for the number and beauty of the mineral species in its vicinity. Besides the extraordinary specimens of amazon-stone (microcline) from that locality, there have been found smoky quartz, albite, fluorite, biotite, siderophyllite, columbite, gothite, arfvedsonite, astrophyllite, zircon, limonite pseudomorphs, etc. Most of these occur in cavities in granite. Recently Messrs. W. Cross and W. F. Hillebrand have added several species, new to this locality. Several crystals of colorless or pale greenish *topaz* were found, one specimen being a fragment, which must have belonged to a crystal a foot in diameter. Two imperfect crystals of *phenacite* were found, this being the first locality known in the United States. *Cryolite*, *thomsenolite* and several undetermined species were also found.

MINERALOGICAL NOTES.—The *volcanic ash* ejected from Vesuvius during the eruption of February 25, 1882, has been analyzed by Ricciardi. The ash was black and magnetic. When heated, it gave off hydrochloric acid. It contained particles of magnetite and awgite, and numerous crystals of leucite. As shown by analysis, it also contained a small percentage of apatite. Sulphate and chloride of ammonium were also present, and could be dissolved out by water.

Mountain cork has been recently used in Germany as a substitute for animal charcoal for the removal of color from molasses. The mountain cork, a variety of amphibole, is dried, ignited and soaked in molasses, then again dried and ignited. This process is repeated several times until some 3.5 per cent. of carbon has become fixed in the mineral, which is then ready for use. It is more efficient than charcoal in removing the alkalies from molasses.

GEOGRAPHY AND TRAVELS.[1]

DE BRAZZA'S EXPLORATIONS ON THE OGOWE AND THE CONGO.—At a recent meeting of the Geographical Society of Paris, M. Savorgnan de Brazza described his recent journeys in the territory between the Ogowé and Congo Rivers, of which, previously, few details had been known. He was directed by the French Government to trace the Alima River, discovered by him on his first expedition (1875–8), to its junction with the Congo and to establish stations on the Ogowé and the Congo.

M. de Brazza left France in December, 1879, ascended the Ogowé, and succeeded in negotiating with the tribes on its banks and establishing a regular system of transport on the river. He founded his first station, Franceville, at the confluence of the Passa with the Ogowé. From here in June, 1880, he dispatched 770 natives in 44 canoes to meet his coadjutor, Dr. Ballay, at the coast, and then started alone, with a small party of natives, for the Congo.

[1] Edited by ELLIS H. YARNALL, Philadelphia.

Two or three days journey from Franceville, the nature of the country changes. To the clayey soil of the Ogowé basin and its richly wooded and moist valleys succeeds a sandy, arid, and hilly country, with here and there, in the neighbourhood of a village, a group of palm trees. This is the aspect of the country which forms the water shed between the Ogowé and the tributaries of the Upper Congo; and it is a singular fact that these narrow sandy tracts of country, along the water's bed, are everywhere inhabited by one and the same tribe, the Bateké, reputed, probably erroneously, to be cannibals. When he had passed the Leketi, a southern branch of the Alima, his route lay across the plateau of the Achicuya, an elevated district lying about 2600 feet above the sea-level, and separated from another similar plateau (the Aboma) by the River Mpama. The chief of the Achicuya received M. de Brazza in a friendly manner, and a simlar reception awaited him on reaching the Aboma tribe. These latter are a fine race of people, handsomer and braver than any he had yet met with. It was here that M de Brazza first received definite information regarding the Congo and the powerful chief Makoko, whose sovereignty the Aboma acknowledge. Leaving their district, the party next travelled along the Lefini River—the Lawson of Mr. Stanley. M. de Brazza had just finished constructing a raft for the navigation of the stream, when a messenger from King Makoko arrived with offers of friendship. This much facilitated his further proceedings. He descended the Lefini with the envoy as far as Nyampo, leaving there the raft and journeying by land for two days across an uninhabited table-land. His march over a sun-scorched plateau was most wearisome, and he was beginning to find fault with his guide, when at 11 o'clock at night, after a forced march, he came in sight of the Congo. It appeared like an immense sheet of water, the silvery sheen of which contrasted with the sombre hue of the lofty mountains around. Towards the north-east the water-line extended to the horizon, and the river swept in a noiseless, slow current past the foot of the hills beneath him.

From here he visited Makoko, who gave him a most friendly reception, and entertained him for twenty-five days. A treaty was finally concluded by which the king placed his states under the protection of France, and ceded a tract of country, to be selected by M. de Brazza, on the shores of the Congo. Another treaty was also arranged with the Ubanji, who appear to occupy the region between the Alima and Stanley Pool. The second French station was placed at Ntamo, on the left bank of Stanley Pool, which M. de Brazza considers the key to the Congo interior. Stanley Pool is 93 miles nearer to the Atlantic coast than is indicated on Stanley's map.

By these treaties and discoveries, M. de Brazza maintains that the rights of priority of the French nation are clearly established over the region between the Ogowé, the Equator, and the Congo and over the tract of country on the southern bank of the Congo from Impila to the confluence of the River Djué, to the south of Stanley Pool.

The station at Ntamo was established on October 1, 1880, and named Brazzaville. Leaving the station in charge of a sergeant and three men, M. de Brazza tried to find a new route to the sea by the valley of the N'Duo, which empties itself into the Niari and leads from Ntamo to the coast in a nearly due westerly direction. He was obliged, however, to abandon this, and continue his journey down the Congo. He arrived at the Gaboon in December, 1880. Failing to find Dr. Ballay or any reinforcement for his expedition here, he again, for a third time, ascended the Ogowé and reached Franceville in February, 1881, where he found about 100 natives engaged in various industries and the settlement self-supporting. During the following six months preparations were made to transport a steamer, to be sent in sections, from France, from the Ogowé to the Alima—a path being cleared by 400 laborers. This steamer has, however, not yet reached the Ogowé.

In October, 1881, M. de Brazza set out from Franceville to endeavor again to explore the Niari valley route, from Stanley Pool to the Atlantic. He was more successful in this second attempt. The Niari proved to be a beautiful river which enters the Atlantic under the name of Quilliou, and flows for a long distance without rapids or falls past a broad, fertile, and densely peopled valley, lying athwart the great parallel terraces over which, ladder-like, the neighboring Congo has cut its bed on its way to the ocean. After many adventures, including a fight with a hostile tribe, M. de Brazza reached the coast at Landana on the 17th of April, 1882.

The valley of the Niari is the best line for a railway to Brazzaville or Ntamo.

Should the French choose to avail themselves of these discoveries, and occupy and hold the stations established by M. de Brazza, the political as well as geographical results can not fail to be of great importance.

The London *Athenæum*, however, asserts that the road along the Congo is far preferable to the route of M. de Brazza, which is considerably longer, and leads to a part of the coast where communication with the land is only possible in surf-boats, while the Congo is accessible at all times to vessels of the largest burthen.

Mr. Stanley has recently returned to Europe. He has now seven steamers on the Congo, and has founded four factories on ground ceded by the native kings.

STEARNS' EXPEDITION TO LABRADOR.—The Stearns' Expedition to the coast of Labrador, reached home safely, on the 12th of September. Mr. Stearns went as far north as Triangle Harbor, a few miles above Square Island. A number of specimens of various kind were taken, but the greater part of the time was spent in hand dredging. The results have been sent to the Smithsonian Institution, and will soon be published. Mr. Stearns is about publishing a work on Labrador that will probably combine the greater part of our present information on that subject. It will be uniform with his New England Bird Life, the second volume of which will soon appear, and probably come out under the name of the same publishers, Messrs. Lee & Shepard, of Boston, Mass.

MICROSCOPY.[1]

MICROSCOPY AT THE AMERICAN ASSOCIATION.—The first meeting of the new section of Histology and Microscopy, during the Montreal meeting of the American Association, fully justified the recent action of the Association in thus enlarging the scope and prominence of its former subsection of microscopy. Large and interesting sessions were held on four days during the week of the meeting, and many important papers were read. Easily first among the attractions of the meeting was the presence of the honored leader in microscopy, Dr. Wm. B. Carpenter, of London, and many microscopists who have heretofore only admired his judgment and skill as an author, found new pleasure in his genial presence, and in his thoughtful, suggestive and conclusive remarks. His rational and conservative views in regard to angular aperture were received with evident approval by the audience.

MARTIN'S UNMOUNTED OBJECTS.—The unmounted material from the laboratory of the late Mr. John Martin, of Maidstone, England, has been forwarded by his family to the Natural Science establishment of Professor Henry A. Ward, of Rochester, N. Y. It consists of a variety of hairs, scales, feathers, spines, spicules, seeds, pollens, sections of skin, hoofs and horns, infusorial earth, diatoms, foraminifera, etc. The specimens are folded in papers, and packed in small pill boxes. They are offered for sale at ten cents per box.

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SCIENTIFIC NEWS.

— Professors Silliman, Johnson and Brewer, of the National Academy's committee on sorghum culture, have been visiting Rio Grande, near Cape May, New Jersey, for the purpose of inspecting Mr. Hilgard's sugar works there. They consider the success of the method there adopted, as assured. The sorghum crop has long been an important one in this country, and its true status will now be more generally known, through the labors of Mr. Collyer and this committee.

—Dr. W. Kowalevsky of Moscow is at present in this country, and is studying the fossil vertebrata of Prof. Cope's collection in Philadelphia.

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

— Professor Owen has dubbed the anti-vivisectionists, bestiarians, to distinguish them from the humanitarians.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The following is a list of the papers read in the biological section:

SECTION F—BIOLOGY.

The fertilization of Yucca. Thomas Meehan.
Demonstration of a series of Brains prepared by Giacomin's method. William Osler.
Description of a new species of Alcyonoid Polyp. Robt. E. C. Stearns.
On the Polymorphism of *Lycæna pseudargiolus*. W. H. Edwards.
Note on the sterility of the Canada thistle at Yellow Springs, Ohio. E. W. Claypole.
On the mouth of the larva of Chrysopa. Wm Saunders.
Some remarks on the flora of North America. Professor Asa Gray.
Achænodon from the Bridger Eocene beds. Henry F. Osborn.
The Placental development in Mammals. Henry O. Marcy.
The motion of roots and radicles of Indian corn and beans. W. S. Beal.
Observations on the fertilization of Yucca, and on structural and anatomical peculiarities in Pronuba and Prodoxus. C. V. Riley.
A sketch of the history of our knowledge of the Budding of Salpa. W. K. Brooks.
Fritz Müller and the Nauplius of Decapods. W. K. Brooks.
Examination of some controverted points of the physiology of voice. T. Wesley Mills.
Illusions of motions, with exhibition of apparatus. H. P. Bowditch.
Cross Heredity from sex to sex. Mrs. A. B. Blackwell.
Achenial hairs and fibers of Compositæ. G. Macloskie.
Blastesis tridens: a pear-tree fungus. Wm. H. Seamen.
On a recent species of Heteropora from the strait of Juan de Fuca. J. F. Whiteaves.
Insects *versus* flowers in the matter of Fertilization. E. W. Claypole.
On the Gall-mites. W. A. Buckhout.
A sketch of the history of our knowledge of the budding of Salpa. W. K. Brooks.
Fritz Müller and the Nauplius of Decapods. W. K. Brooks.
A new sexual character in the pupæ of some Lepidoptera. J. A. Lintner.
On the position of the Gamopetalæ.
Note on the occurrence of traces of a northern flora in Southwestern Ohio. E. W. Claypole.
Progressive growth of dermoid coat of the membrana tympani. Clarence J. Blake.
The morphology of arteries. Frank Baker.
Emulsions of petroleum and their value as insecticides. C. V. Riley.
The Jessup collection to illustrate American forestry in the Museum of Natural History, Central Park, N. Y. Albert S. Bickmore.
The hibernation of *Aletia xylina* in the U. S. a settled fact. C. V. Riley.
Observations on the elm-leaf beetle (*Galeruca xanthomelæna*). G. Macloskie.
The organic compounds in their relation to life. Lester F. Ward.
The primary divisions of the Ungulata. Edward D. Cope.
On the habits of Cryptobranchus. Burt G Wilder.
Classification of organisms. Lester F. Ward.
Some observations on the action of frost upon leaf-cells. C. E. Bessey.
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A PILGRIMAGE TO TEOTIHUACAN.

BY R. E. HILLS.

THE pyramids of Teotihuacan are situated in a beautiful valley adjoining that of Mexico on the Northeast, and possessing greater beauty and fertility than its more famous neighbor. To reach these ruins, we left the city by the six o'clock morning train, for the station of San Juan Teotihuacan. Our party consisted of four Americans, one a resident of Mexico. As the sun had not risen, we found the air chilly and penetrating, and overcoats very comfortable. Our leader prudently carried an umbrella, not to keep off the rain, for it never rains here in March, but to protect himself from the fierce rays of the sun, which in the clear atmosphere of this altitude are very effective at midday.

About eight o'clock we alight from the train to be besieged by numerous small boys, who offer for sale various relics from the ruins. After engaging the services of four Indian boys as guides, we set off afoot to visit the ruins.

Accounts differ as to the origin of these works. We are informed by Ixtlilxochitl that they were built by the Toltecs after their migration from Hue Hue Hapalan.

Mr. Bancroft places this event in the fifth or sixth century, Professor Short thinks that the evidence in favor of the fourth century is fully as good. On the other hand, Mons. Charnay's recent excavations have led him to believe that the works at Tula were built about A. D. 660, and as the Teotihuacan works are of very much the same character, and at no great distance from Tula, the presumption is that their age is about the same.

In selecting their site, the builders certainly exercised better judgment than did the later race, who built the wonderful city on the shore of Lake Tezcuco—a lake whose only outlet is the atmosphere. In fact, the government has finally been compelled to attempt the artificial drainage of this lake; a contract for the construction of a canal for this purpose having been already made.

The principal works at Teotihuacan consist of two truncated pyramids—the "Mound of the Sun" and the "Mound of the Moon." The first measures 761 by 722 feet at the base, 216 feet in height, and its platform measures 59 by 105 feet, according to the figures of Señor Garcia y Cubas.

From a distance a zigzag pathway leading up its eastern side is plainly discernible, but from either its foot or its summit the pathway is not noticed. In the centre of the platform stands a pillar of stone and cement, five feet in diameter, and four and a half feet high. Two explanations of this pillar may be offered. In case the pyramid was a religious structure, the pillar may have been used as an altar, or a pedestal for some sculptured image. If the pyramid was an astronomical structure, a possibility by no means remote when we remember the knowledge of astronomy possessed by this race, the pillar was doubtless a part of the apparatus employed in observing the movements of the heavenly bodies.

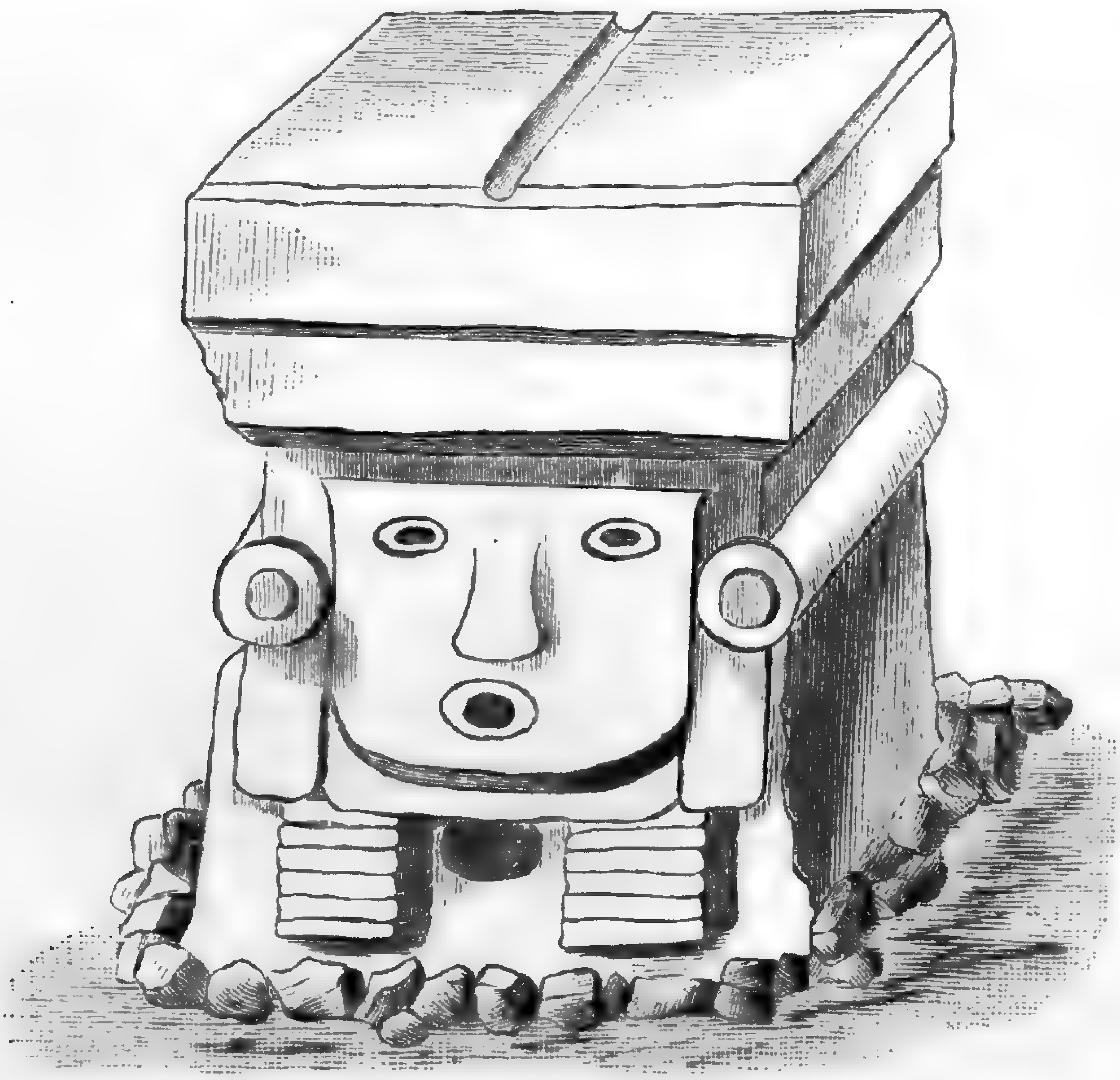
From this summit we look to the north and see a series of beautifully rounded hills which look as if they might have been made by the hand of man, so regular are their outlines. To the west is the hill which hides from our view the lovely valley of Mexico.

In the distance, toward the south, are the white peaks of Popocatapetl, Ixtacihuatl and Malinche, while at our feet we may see the villages of San Juan, San Sebastian, San Martin and Santa Maria, so near that we can catch the sound of their bells as they ring out from the white tower of the Spanish-built churches.

The "Mound of the Moon," according to our former authority, measures 512 by 426 feet at the base, 137 feet in height, and has a platform 19½ feet square. In addition there is a step or platform about half way from base to summit. From near this mound extends an avenue between two rows of singular ruins to the Rio San Juan, a distance of more than a mile. This is called the "Path of the Dead," and passes by the "Mound of the Sun" on the west. These ruins have the appearance of immense houses which have been totally destroyed, leaving only great masses of material with no recognizable structure, and now largely overgrown with vegetation.

The pyramids themselves are very regular in shape, but are covered with loose fragments of volcanic rock varying in size from six to eighteen inches. Amongst these rocks have grown up numerous shrubs, flowers and cactuses. These give a very ragged appearance to the structures.

Near the "Path of the Dead" is the mouth of a cave of unknown depth, which has ramifications to the right and left. There



Monolith near the Pyramids of Teotihuacan.

is a tradition that a subterranean passage exists between the pyramids. If this is true the cave is probably connected with this passage. As our party had not prepared to explore any caves our investigations ceased when we had exhausted the stock of wax matches we happened to have in our pockets. At the mouth of this cave stands the huge monolith described by Almaraz (Apuntes, pp. 354–5), which he says "was found among the débris of a tlaltel" or mound. It is about five and a half feet wide and thick, and according to the above author, ten and a half feet high, and weighs over fifteen tons. At present, however, it stands only six feet above ground, and is surrounded by the small volcanic rocks which cover the surface in all directions. An attempt was once made to remove the monolith to the city of Mexico, but it was found too heavy and was abandoned. The natives relate that soon after the conquest, the Spaniards attempted to cut the stone in two, but after each day's work with chisels, the stone was miraculously restored in the night to a perfect condition, and they finally desisted. The accompanying cut shows the face of the stone as it now appears.

Near the "Mound of the Sun" may be seen the ruins of the "Palace." Its present magnificence consists in a solid floor of cement, some smoothly plastered walls about three feet in height built at an angle of perhaps fifteen degrees from the vertical, and a stairway of six or seven stone steps leading down into the débris.

In the ploughed fields in this vicinity we found large numbers of obsidian implements and terra-cotta figures. The arrow-heads are exactly similar in shape and size to those made of flint, by the North American Indians, and of common occurrence.

The knife-blades are from one and one half to one and three-fourths inches long, from three-eighths to five-eighths of an inch wide and only one-eighth of an inch thick in the center.

One figure apparently represents a horned animal, and is the only one of the kind which has come under the writer's observation. It measures one and three-fourths inches in length and the same in height, from tip to tip. In the group of terra-cotta figures, two have a decidedly Egyptian appearance, while one is as certainly African, and another shows a strong suspicion of the Turk. Many of the figures of heads seem to be wanting the left ear; whether it was purposely omitted or has been easily knocked off in consequence of having been molded separately and afterward attached to the head, it is difficult to determine. Two images represent the heads of animals, while another is a perforated disc, one and three-sixteenths inches in diameter, and half an inch thick, with a depression on one side eleven-sixteenths of an inch in diameter. There is a great variety of countenance exhibited on these figures. The material also seems to vary, to a certain extent, some of the clay being of a finer grain than the rest, and, therefore, susceptible of a smoother finish.

In regard to the ruins in general, Bancroft says, "Humboldt speaks of hundreds of these mounds" (such as compose the 'Path of the Dead") "arranged in streets, running exactly east and west, and north and south from the pyramids." "According to Latrobe, the mounds extend for miles towards Teźcuco; and Waddy Thompson is confident that they are the ruins of an ancient city nearly as large as Mexico."

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THE GRAY RABBIT (LEPUS SYLVATICUS).

BY SAMUEL LOCKWOOD.

(Continued from November number.)

THE thrifty house-dame, who has a way of "culling simples" for her cuisine and leech-craft, feels badly hurt when the spring discloses the fact that of her savory pot-herbs the finest tussock has been used by a rabbit as a form through the winter, and the whole middle of it has been killed by the heat of the occupant's body. In a friend's garden a large mat of thyme was thus nearly ruined. Who has not heard of improvident humans eating themselves out of house and home? What self-possession and decorous restraint in this our little solitaire. However pinching the winter's cold and scarce the food, Coney keeps a wise care for his covert from the storm.

In some things certainly the gray rabbit is quite particular, and sometimes too much so for its own good. So inquisitorious is it of small things on the way, that when in full retreat before the dog, the whistle of the hunter to stop the hound, will sometimes stop the rabbit also. Even the clicking when setting the hammer of the gun will check the poor dazed thing in its flight, for it must know what the unusual sound is. True the pause is only for an instant, but that is enough for the sportsman's aim. In the woods the rabbit will course through the underbrush, then, after making a tremendous leap at right angles, will double his track. These movements it will vary with zig-zags, greatly bothering the hounds; not seeming to look for a hole unless it be closely pressed, and a hollow tree offers an illusive asylum. In cleared land it makes for a known hiding place. And generally it knows all the good spots in a wide territory. My friend, Mr. Geo. H. Vanderbeck, an intelligent farmer, gives me the following: Once after a heavy fall of snow he marked a rabbit trail at considerable distance from the house. It led in a straight line to the hennery, in which the game was found, having sought this shelter from the cold. From the directness of the trail it was evident that the animal had full knowledge of this retreat. He told me too of an old buck which he had often tried to take, but which would either by a direct or circuitous route, retreat to a deserted marmot's or woodchuck's hole, which it had long occupied.

Two distinct kinds of tracks have been mentioned, that which is made in retreat and that which is made when foraging. To these a third must be added having two sets of imprints, in lines close and parallel to each other, and the step-marks at very short distances. These are the courting tracks. At the turn of mid-winter, or about the beginning of February the male looks up his mate or mates. While the love emotion is on, prudence is off; hence, less cautious than usual, they do fall into some indiscretions which imperil their safety. In truth it is with these simple folks much as it is with some thought to be wiser—when much love is in, some wit is out. If the snow or the ground be soft, these double-tracks, or courting ways, betray what is going on, and sometimes the nearness of the lovers. Our rabbit likes a bit of play in the evening twilight and the early morning dawn, hence it has been called a crepuscular animal. But it is essentially a nocturnal, like the rodents generally; and the evening and the morning are its wooing day. The connubial impact made, the doe has much to pull through, for the gay father is away with other loves. If the season prove favorable, three and perhaps four litters are to be raised ere the next winter comes. As an old rabbiter said: "Three crops in one season is only moderate for a she rabbit."

As to the breeding habits of the wood-hare, it must surely have undergone a change in the well populated places east. A thorough hunter tells me, he has never found a nest in the woods nor even a very young rabbit there; that for breeding they prefer the cleared land. This habit secures an open look-out and guards against surprise.

But the breeding nest of the gray rabbit is a simple affair. A hole is scratched sloping downward into the ground about eighteen inches. The slope is slight, so that the nest is very near the surface. It has a bed made of dry leaves and grass, and on top some fur or hair, which the mother has torn from her own breast. The litter numbers from four to six. So small is the hole that the mother cannot nestle in it with her young, but she suckles them at the front or entrance, where she adjusts herself, then by a sort of *wuzzling*, not *purring*, sound, she calls the little ones, the call being at once obeyed. The maternal brooding and fondling which impart so much comfort to the mother's care, are unknown to our gray rabbit. During the suckling period she occupies a slight depression in the ground a few yards off, from which the motherly watch is kept. I think she can give the alarm to her little ones, for they will keep well back in their nest and very quiet in time of danger, while the mother from her form will endeavor to divert an enemy. But despite these vigils something may happen to bring the tenderlings to grief. Should they escape preying animals, for the mother is courageous in defence yet the sloping nature of the nest invites the rain, and a storm may drown the whole litter. Then the shallowness of the nest is such that the plough has often turned up all to perish in the cold winds of March. Should all go well, three weeks of suckling will suffice, when they become so large as to crowd their cave-like nest. Now the mother sets them adrift. The rabbit litters when very young, ere it has attained half its growth. A female may have two litters raised before she is a year old.

As already hinted, the male of *L. sylvaticus* gives himself no concern about the little ones, and is of loose morals at best. As for the petted *L. cuniculus*, he is no better than a beastly blue-beard in his own household. But lest all father hares be set down as so depraved, I shall instance, by way of episode, a pretty exception, even should the story seem to some sensational. In the months of May and June, 1860, Professor F. V. Hayden and his party of U. S. explorers, found themselves up in the Alpine snows of the Wind River mountains, where they were detained several days in an attempt to feel their way to the Yellowstone. On the 31st of May Dr. Hayden declared that a new species of hare was around, as he had observed unusually large hare tracks in the snow. As the Doctor expressed himself to us: "The tracks were very large, the feet being wide-spread, and the hair thick between the toes, thus really furnishing the animal with snow-shoes." In June one was captured, and the Doctor named the species, *Lepus bairdii.* The animal seemed limited to that small Alpine territory. But one specimen was secured, and no more was heard of this hare until 1872, when Dr. Hayden and party were in that region in the months of August and September. At this time five specimens were obtained by Mr. C. Hart Merriam, the naturalist to the Hayden Survey; of these, four were adult males, and all had large teats and udders full of milk. The hair around the nipples was wet and stuck to them, showing that they had just been suckling their young. To make all certain, resort was had to dissection, when the sex was demonstrated. Not only did Mr. Merriam make dissection, but also Dr. Josiah Curtis, a naturalist of the U. S. Geol. Survey, with the same result. In the face of such testimony disbelief would seem discourtesy. This hare is doubtless an Alpine form, says Allen, "inhabiting the snowy summits of the high portions of the Rocky mountains." It has been found as far south as New Mexico. In winter its entire dress is white; but in summer the pelage generally is dark plumbeous, like that of the house mouse, "the feet are wholly white." If not in exquisite taste, it certainly is peculiar—for white satin shoes can hardly look well on large splay feet. It is a pity that as yet nothing has been learned of the female. We want to know more of their family matters. How much of this nursing is done by the mother; or does she relegate all to the obliging father; or are there two broods to be suckled, the first being unweaned when the second one arrives? In the rigor of their mountain home do the leverets need longer nourishing than their little cousins in the plains? The larger rodent, the beaver, allows two litters in the lodge, but the first litter is supposed to be weaned. If a long suckling of the little hares is necessary, so that one litter is not weaned before the other comes, it would be interesting to know if two nests are occupied, the older litter being left for the father to finish their bringing up. The wood-hare east is polygamous. It is hardly supposable that Baird's hare is so too, as that would make his duties as wet-nurse somewhat exacting. If then he is the one husband of the one wife, in every way his virtues outshine all that can be said for his loose kinsman in the east. But we need more light.

The striking out of the hind limbs of an adult rabbit with the claws distended, has often proved more than a match for a cat.

And little wonder that the hind limbs, with their armament of claws should be quite effective when we recall that grand out-fit of muscles, which enables them to make such prodigious leaps. We spoke of the surprise of the immigrant at the lusty kicking of the entrapped rabbit. Such conduct is, however, exceptional, or at most it lasts for a very short time. When taken by the hand, the captured rabbit at first, in its terror, utters a plaintive but musical cry; it is not properly a squeak; and after a few impotent struggles, it is dazed into a passive submission. Thus an adult gray rabbit may be carried lying full length on one's arm, the front toes being loosely held between the fingers, although it has been taken but five minutes from the trap. After a little show of resistance it has submitted to the situation. Once when riding with my daughter, we came upon a gorgeous patch of *Lupinus perennis* by the roadside. I got out to gather some, when a young rabbit sprang out of the glowing bed of purple bloom. It dashed into a heap of brush near by, which enabled me to capture it without inflicting injury. I bore my pretty prize to the carriage. But though only for a moment, that plaintive whistle in the minor key, so flute-like and so pitiful, kept piping in our ears. Our hearts misgave us. Daughter plead for the little prisoner's release; that decided the matter. I bore it gently back to the bed of lupines, where it easily hid itself, and like a helpless little prince was safe under the royal purple.

This almost non-resistant quality of the gray rabbit, has given me a liking for it. It is your pampered tame one that excels in the mulish accomplishment of kicking at his master. But when "striking out" becomes a virtue, the mother gray-back has been known to shine. Once when inspecting the animals of a certain institution, unconsciously I was getting too near a long-eared mongrel, at which his tender shouted: "Keep away from that mule or he'll stoop up at you, and if you do excite his upsetting sin you'll get his compliments, and you won't forget it either!" We ejaculated: "The long-eared hybrid!" "Yes, sir, that's so," responded the animal-man, "he is high bred. His father before him was a good trick mule." What sharp observers these "animal-men" are. Who but the mule-man could so tersely describe the precise pivotal politeness of the beast. And what method in his salaam to a stranger. First the ears are set well back. Next, down goes the head, then, as if this formalist were fulcrumed at the middle, upward and backward go the heels; and the impression made is not to be forgotten. But for real "fancy sparring," no trick-mule could equal the deftly hitting of that mother gray-back who fought a huge black snake to rescue her young one. The reptile was rapidly bearing it away. A little low cry, though at quite a distance, was heard by the mother-hare, for their sense of hearing is marvelously keen. A few desperate leaps and she had caught up and joined issue with her dreadful foe. The snake dropped its prey, its sulphurous eyes glowed in luminous rage, and it sprang. But the heroic mother leaped into the air, making a curve over its enemy, and just at passing the middle of this arc putting in most deftly a double shot behind, which sent the serpent rolling and squirming in the dust. This feat was several times repeated, the snake darting and snapping wildly, until its mouth was filled with hair, without inflicting any real hurt on the little heroine. The reptile was cowering fast and would fain slink away; but the witness of this fierce battle now came to the rabbit's aid. The black reptile was soon destroyed, and the brave mother left to her little one.

I think the above should warrant a clear distinction between timidity and cowardice. It is the bravery of maternal desperation. Though succumbing at last, I have witnessed a gallant fight of a young rat with a large pine snake (*Pituophis melanoleucus*). These very serpents are fond of young rabbits, and will capture them much as they do birds. Call it enchantment, fascination, charming, or what one will, there is a fearful nervous subjection. The poor little beast loses head. A farmer in the Pines told me that he saw at some distance up the road, a half-grown rabbit, and was somewhat surprised to see that it did not stir at his coming, but looked steadily at one spot. There was a large pine snake slowly crawling up to its victim. Said he: "I went up to the rabbit, gave it a push with my foot, when it went off at a lively gait. You see the spell was broken. The snake seeing me, made for the woods and got away.

The mink and the weasel are especially feared by the wild rabbit. In Europe the ferret is used to hunt rabbits. If our common weasel appears in a neighborhood, the rabbits will soon be exterminated for a considerable area.

In the winter the gray-rabbit is very destructive to young trees, and is the dread of the nurseryman, although much mischief laid to them is chargeable to the field mice, which will bark trees both below and above the snow line. The rabbit will girdle young trees, and the very small trees of the nursery it will not only bark, but will cut off the branches and eat them. I have in mind a nurseryman who had not yet learned this fact, and would not permit a gray rabbit to be in any way molested on his premises. The tender hearted fellow soon woke up to his mistake. The animals became emboldened and took possession, and very soon many thousands of young trees were utterly ruined. At last, in dismay, he besought the help of his neighbors, and a war of extermination was proclaimed.

Could it be got at, the ancient lore as touching the ancestry of *L. sylvaticus*, would be well worth the telling. Even before history began, though a numerous, the coneys were always a feeble folk, and fair game for all animals carnivorously inclined. In classic Greek we find a word meaning " killing of hares," and the word hare a synonym for coward. And as for the poor fellow who was harried or hen-pecked, their philosopher Posidonius would say: " he led a hare's life." If remoteness of origin may count for much, the ancestry of the hares is extremely ancient. I am puzzled by a small fossil bone now lying on my table. It is from the Dakota Miocene, and is part of the left side of the under jaw of a hare. There are a number of these fossil or extinct American hares, for which Professor Leidy raised the genus Palæolagus, " the ancient hare." This jaw is, I think, that of a young individual, but I dare not guess the immense remoteness of that period in which it had to fulfill its mission as a prolific food provider for the numerous and terrible Felidæ then existing. Probably the environment or life conditions of the Leporidæ have improved since the Miocene times; for my fragment has the five molars so strongly set, and yet so small, that the owner surely was a smaller animal than our gray-rabbit, itself so small among those to which it is germane, as to merit the epithet familiar to naturalists—" the little wood hare." I think the ancient could not achieve the deft leaps of the modern. As I see it, the body was shorter and thicker set, and its pug face, could a fancier but imagine the style, would educe the fancy name, " chunky chaps."

As already seen, the wild rabbit is very prolific; hence it is the only one of our large rodents that in any measure holds its own against the onflow of civilization. And yet its enemies are many.

Even the domestic cat will take to the woods and become almost a fera, and subsist largely on young rabbits. To man with dog and gun, the pursuit of the rabbit seems to have a fascination. To me, the yelping bark of the hound when he has scented the little thing, is always distressing. Old rabbit hunters claim that the three different kinds of sounds, when the dogs are baying, denote different grades of strain in the hounds. There is the short snappish yelp of the hound of low degree; the whining, yet almost percussive howl which marks the dog of fair and even good points; then there is that long-drawn, deep-mouthed baying which leaves that ancestral war-whoop far behind—

"The wolf's long howl on Ounalaska's shore."

This can be heard far away, and denotes the hound of highest strain. I dislike them all, but this specially exaggerated wolfish baying is to me indescribably dismal. But judgments differ. Doubtless the devotee hears music in the frenzy of the howling dervish. I knew the father of a necessitous family. He kept one of these fiendishly accomplished brutes. The man must have had not an ear but two, for music, the one sa a pietist in church, the other as an enthusiast afield; for he said to a fellow sport: "In meetin' I have my favorite hymn, but the sound of that hound when he has nosed a rabbit, is to me real heavenly music!" As the poor miner declared, when half dazed over the death of his chum, this whole business is "too technical for me!"

I am so much pleased with the sight of little gray-back in the orchard near my study. With no dog near, he is in an interesting repose, and the scene is innocent and pretty. In the confidence of safety, it squats, snips off at its base a dandelion leaf, then sits up, and enjoys the crispy dainty. What a picture—ears erect and wide open; and that nibbling or clipping diminution of the leaf, those soft staring eyes, and that funny winking mug. Now for that habit of circumspection. Poised on its hind feet, with neck a little stretched, how those lustrous eyes survey the situation, while the ears are set erect and expanded to catch the slightest sound. Ah! it has heard something, and off it goes at almost flying speed, bearing that cottony caudal tuft aloft behind it. If for mere display that white cockade may suggest a spice of vanity in rabbit life; but if from other motives it may hint at some serious verities in its experience. If it be the "white feather," who will blame timidity where every hand is hostile? if a flag of truce, it has never been regarded. How much this little mammal has to do in sustaining the faunal balance in the east! To how many forms of life is it a food supply —to the creeping reptiles, the raptores of the birds, the rapacia of beasts, and even all-rapacious man. "Behold, therefore, the goodness and severity of God." Such is the rectitude of existence that whether beast or man, "no one liveth to himself, and no man dieth to himself."

> "The whole temporal show related royally,
> And built up to eterne significance,
> Through the open arms of God."

But why tempt the depths? So here endeth this memoir of "little cotton tail."

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THE PALÆOZOIC ALLIES OF NEBALIA.

BY A. S. PACKARD, JR.

HAVING studied the anatomy and development of Nebalia, we are prepared to compare it with a group of fossil forms which are scattered through the older Palæozoic rocks from the lowest Silurian to the Carboniferous. In a brief article[1] Mr. Salter, nearly twenty years since, sketched out the characters and showed the relationship of Ceratiocaris and a number of allied forms to Nebalia in the following paragraph:

"Before the structure of Ceratiocaris was known, of which genus a reduced figure is here given, the rostral portion of Peltocaris could not have been understood. But a reference to the accompanying series of wood-cuts[2] will show that a tolerably broad rostrum, placed in the same relative position, occurs in Ceratiocaris. In the recent Nebalia it is fixed, and in Dithyrocaris and other genera it is perhaps yet to be discovered. Again, Ceratiocaris, together with its movable rostrum, has a bivalved shell, yet habitually keeps its valves half closed, as I learn from perfect specimens."

Salter then enumerates the characteristics of the fossil genera, beginning with Hymenocaris, which he considers the more generalized type, and in the wood-cuts, which we partly here produce, shows the geological succession of these genera, which also serves as a genealogical table. He regards them as Phyllopods, associating with them Estheria and Apus, regarding the latter as

[1] On Peltocaris, a new genus of Silurian Crustacea, by J. W. Salter, Quarterly Journal of the Geological Society of London, Vol. XIX, 1863, p. 87.

[2] Our Fig. 1.

"the most complete and decided form, and it is one of the latest of the group, as it commences in the Trias." He also says: "The links between these coal-measure forms and those of recent times,

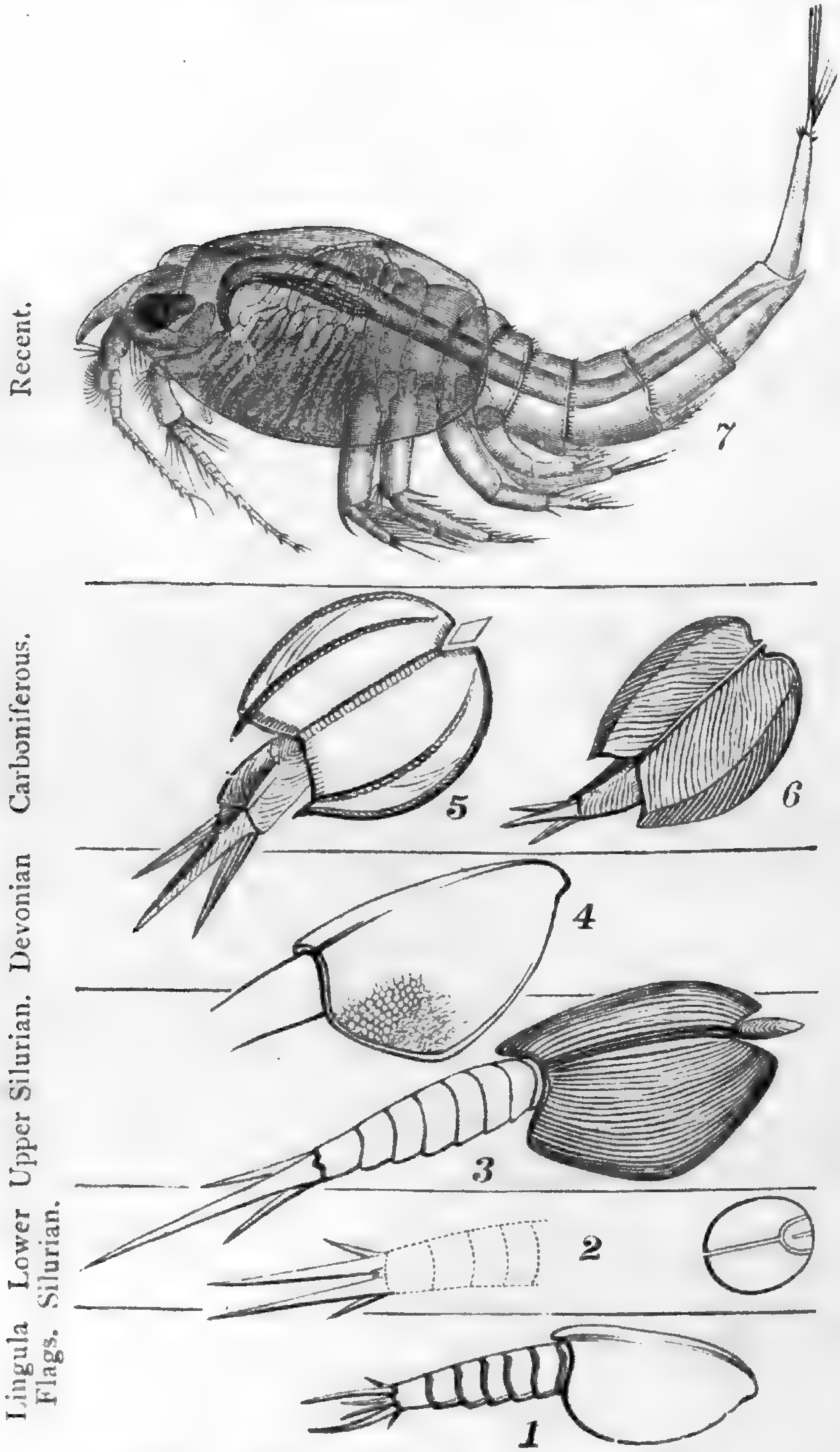

FIG. 1.—Hymenocaris (Lingula Flags). FIG. 2.— Peltocaris (Lower Silurian). FIG. 3.—Ceratiocaris (Upper Silurian). FIG. 4.—Dictyocaris (Devonian). FIG. 5.—Dithyrocaris (Carboniferous). (FIG. 6.—Argus.) FIG. 7.—Nebalia (recent).

are many of them wanting; but in Nebalia we have a good representative of the compact, shield-shaped form of Ceratiocaris the two valves soldered into one, and the rostrum attached, the eyes being still beneath the carapace." It is evident from this that Mr. Salter regarded the fossil genera he enumerates as allied to and as the ancestors of Nebalia, and as representatives of it in Palæozoic times. He evidently adopted the views of Milne-Edwards and others as to the Phyllopodous nature of Nebalia.

Discarding the Phyllopod forms, we here reproduce Salter's figures and geological succession, which has been confirmed by the discoveries of Barrande and H. Woodward. Salter's figure of Nebalia is, however, replaced by an original one of *Nebalia bipes.*

In his article on the structure and systematic position of Nebalia,[1] Claus thus refers to the Palæozoic forms:

"It is generally considered that the oldest Palæozoic Crustacean remains whose shells and form of the body partly resemble Apus and partly show a great similarity to Nebalia, for this reason are considered to be Phyllopods, though we are without any information as to the nature of the limbs. But now the instructive error, to which the consideration of Nebalia gave occasion, will lead us to exercise greater caution in the interpretation of such incomplete and imperfectly known remains.

"In Ceratiocaris Salter, we have a great Nebalia-like carapace by which a series of free segments were covered, and moreover a long well-separated, lancet-formed rostrum. On the other hand, the form of the abdomen, with the powerfully developed telson beset with lateral spines, indicates a different form, which also finds expression in the appendages of *C. papilio* Salt., figured as antennæ or thoracic limbs. If these representations indicate true limbs, then they remind us most of the larval limbs of Decapods. So also the position of Dictyocaris Salt., and Dithyrocaris of Scouler to the other Silurian fossils regarded as Phyllopods (Hymenocaris, Peltocaris) will remain problematical until we have obtained more precise explanations as to the nature of their limbs.

"It is in the highest degree probable, however, that all these forms are not true Phyllopods, but have belonged to a type of Crustacea of which now there are no living representatives, but which, taking their origin from forms allied to the lower types of Entomostraca, have prepared the way for the Malacostracan type. Such a connecting link, which has served to the present day, we evidently find in the genus Nebalia."

In 1879,[2] without knowing the views of Claus, just quoted, we

[1] Siebold u. Kölliker's Zeitschrift, XXII, 1872, p. 329.

[2] The Nebeliad Crustacea as types of a new order. By A. S. Packard, Jr. AMERICAN NATURALIST, February, 1879, Vol. XIII, p. 128.

published a brief notice of the leading characteristics of the group, and proposed that the Palæozoic fossil forms, Ceratiocaris, etc., be united with the Nebaliadæ to form a separate order of Crustacea under the name of Phyllocarida.

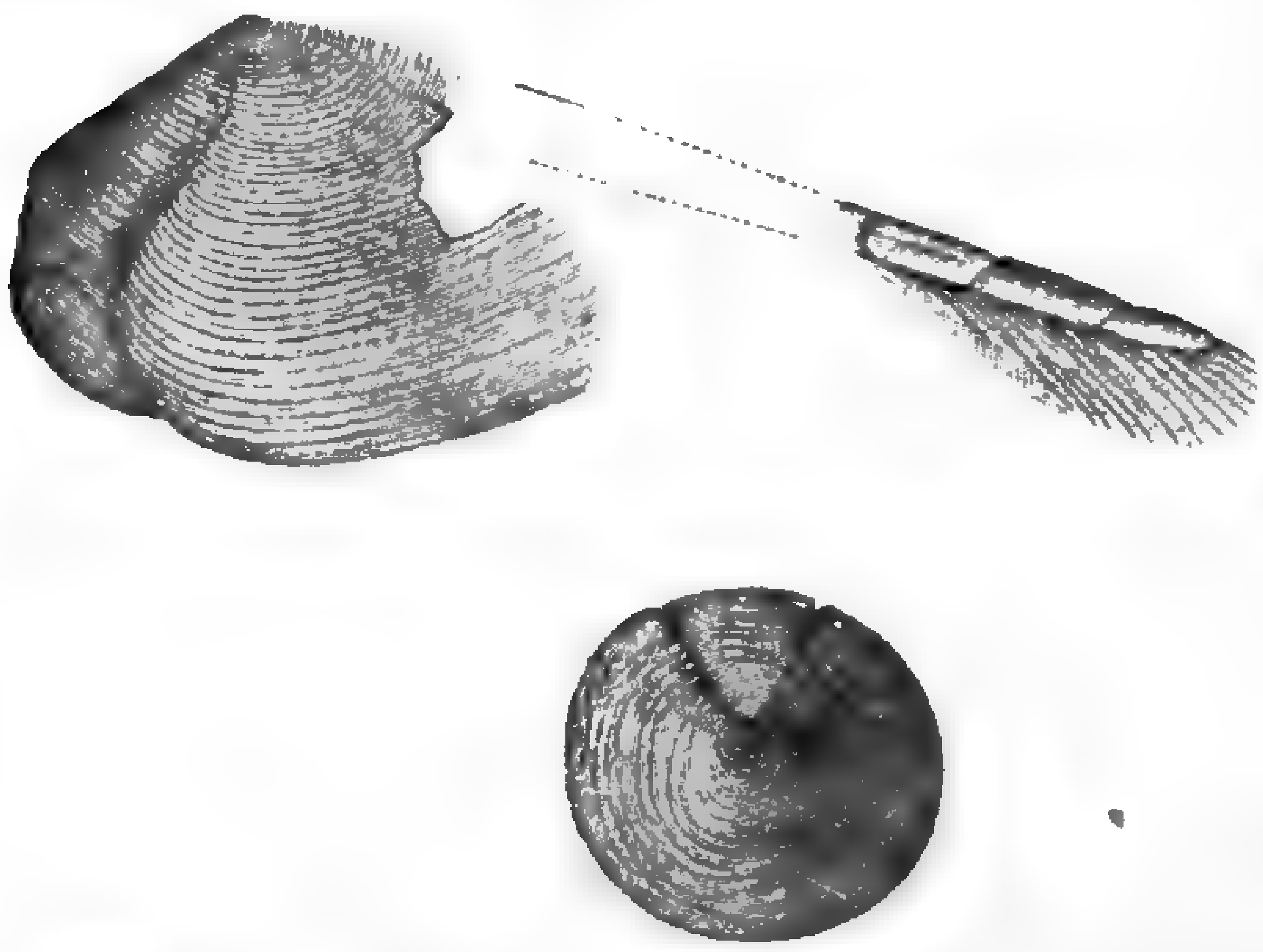

FIG. 8.—*Discinocaris browniana*, natural size; side view and disk with the wedge-shaped rostrum in situ. After Woodward.

Of the fossil forms, Hymenocaris was regarded by Salter as "the more generalized type." The genera Peltocaris and Discinocaris characterize the Lower Silurian period, Ceratiocaris the Upper, Dictyocaris the Upper Silurian and the lowest Devonian strata, Dictyocaris and Argus the Carboniferous period.

On examining the figures of Salter and of Barrande, for we have been unable to study any of the fossils themselves, owing to their extreme rarity, the relationship to Nebalia is very marked, as seen in the form of the carapace, the nearly free or detached rostrum, unless the separation took place after the death of the animal, and also of the rather long, slender abdomen. Upon examining the appendages at the end of the abdomen there is to be seen an important distinction from Nebalia; a long, slender telson is usually present, with a single pair of large caudal stylets, or cercopoda, in form like those of Nebalia. But in Hymenocaris and Peltocaris the telson appears to be represented by a pair of small (in Peltocaris minute) spines. In the presence of the telson in the typical fossil genus Ceratiocaris, we certainly have an important character separating the type with its allies from Nebalia, and allying them to the Decapods; and thus in the provisional synopsis of the order presented in the memoir soon to be published in Hayden's Report, we have placed the fossil forms in a separate sub-order from the Nebaliadæ.

While the posterior edges of the abdominal segments in Hymenocaris appear to be spined as in Nebalia, there are some characteristics of importance in the fossil forms which deserve mention; these are the sculptured carapace, especially of Dictyocaris, in which the surface is reticulated.[1] Moreover the size of these

[1] It should here be remarked, that while the carapace of Nebalia is smooth, upon making a section of it a reticulated structure is plainly seen in the parenchyma or soft parts of the shell, but it is entirely too minute to be perceptible in the shell even

genera was enormous, but if we, as we seem to be warranted in doing, regard Nebalia as a survivor and decrepid or old-age type of the order, which has lost the ornamentation of the integument, the size and the telson even being dwarfed, smooth-skinned, and in general very simple compared with the forms which existed at the time when the type culminated and before it began to die out, we may have an explanation of the greater simplicity of the carapace and abdomen of Nebalia, as compared with its Palæozoic ancestors.

From our total lack of any knowledge of the nature of the limbs of the fossil Phyllocarida, we have to be guided solely by analogy, often an uncertain and delusive guide. But in the absence of any evidence to the contrary,[2] there is every reason to suppose that the appendages of the head, thorax and abdomen were on the type of Nebalia, since there is such a close correspondence in the form of the carapace, rostrum and abdomen.

But whatever may be the differences between the fossil forms represented by Ceratiocaris, etc., they certainly seem to approach Nebalia much nearer than any other known type of Crustacea; they do not belong to the Decapods; they present a vague and general resemblance to the zoëa or larva of the Decapods, but no zoëa has a telson, though one is developed in a postzoëal stage; they do not belong to any other Malacostracous type, nor do they belong to any existing Entomostracous type, using those terms in the old sense. No naturalist or palæontologist has referred them with certainty to the Decapods, or to any other Crustacean type than the Phyllopods. To this type (in the opinion of Metschnikoff and Claus, who have studied them most closely)

under high powers. This structure may be comparable with that of Dictyocaris, especially as Salter remarks (*Ann. and Mag. Nat. Hist.*, 1866, p. 161): "The entire surface of the carapace is marked with hexagonal reticulations one-thirtieth of a line in diameter, of which the areæ are convex and the bounding lines sunk on the exterior aspect. This would, I think, indicate the ornament to be connected with the structure of the carapace rather than to be a mere external sculpturing. As no films can be obtained thick enough to furnish a section for microscopic examination, the point cannot be ascertained."

[2] Close scrutiny of specimens in existence may yet show indications as to the nature of the limbs; for example, Salter figures, in the *Annals and Magazine of Natural History*, 3d series, Vol. v, 1860, p. 154, Fig. 3*e*, what he calls the jaws of *Ceratiocaris papilio*, but the figure appears to us rather to represent a four jointed piece of an antenna. In Fig. 2 there are represented the tergal portion of seven segments lying under the carapace. If fresh attention were directed to the discovery of the nature of the limbs, success might result.

they certainly do not belong; and thus, reasoning by exclusion, they either belong to the group of which Nebalia is a type, or they are members of a lost, extinct group. The natural conclusion, in the light of our present knowledge, is, that they are members of the group represented by the existing Nebalia.

FIG. 9.—*Dithyrocaris neptuni* Hall; telson and cercopoda, natural size. From Hall.

In order, then, to summarize our present knowledge of the living Nebalia and its fossil allies, we will give what we regard as the characters of the group, which may be regarded as provisional, though perhaps of some present use.

External diagnostic characters of the order Phyllocarida.—Body compressed; consisting of twenty-one segments—five cephalic, eight thoracic and eight abdominal. Carapace compressed, with, no regular hinge, loosely attached to the body by an adductor muscle; with a movable rostrum inserted in a depression in the front edge, the carapace covering the basal joints of the abdomen. One pair of stalked eyes; no simple eyes. Two pairs of well-developed, many-jointed, long, large antennæ, the first pair biramous, the second pair with a very long flagellum in the male. Mandibles weak, with a remarkably long three-jointed palpus. Two pairs of maxillæ; the first with a remarkably long, slender, multiarticulate exopodite; second pair well developed, biramous; no maxillipedes; eight pairs of biramous, broad, thin, respiratory, thoracic feet, not adapted for walking; the exopodites divided into a gill and flabellum; four pairs of large and two pairs of small abdominal swimming feet; no appendages on the seventh segment, the terminal one bearing two long caudal appendages (cercopoda). No telson present in the living species; well developed in the Ceratiocaridæ. Young developed in a brood sac; development direct; no marked metamorphosis; the young but slightly differing from the adult.

Remarks.—By the sum of the foregoing characters the Phyllocarida appear to be excluded from any other group of Neocaridan Crustacea.

The differential characters separating them from the Decapods or any other Malacostracous type, are:

1. The loosely-attached carapace, the two halves connected by an adductor muscle.

2. The movable rostrum, loosely attached to the carapace.

3. The very long and large mandibular palpus; the long, slender appendage of the first maxillæ, and the very long biramous maxillæ.

4. The absence of any maxillipedes.

5. The eight pairs of pseudophyllopod thoracic feet, not adapted for walking; the animal swimming on its back.

7. No zoëa-formed larva.

The differential characters from the Phyllopods are the following:

1. Carapace not hinged; a rostrum present.

2. Two pairs of well-developed long and large multiarticulate antennæ; the hinder pair in the male longer than the first pair.

3. The thorax and its appendages clearly differentiated from an abdomen.

Internal Organs.—No functional shell gland; no highly-developed liver tubes like those of all Phyllopods; stomach and cœcal appendages (liver) entirely unlike those of Phyllopods.

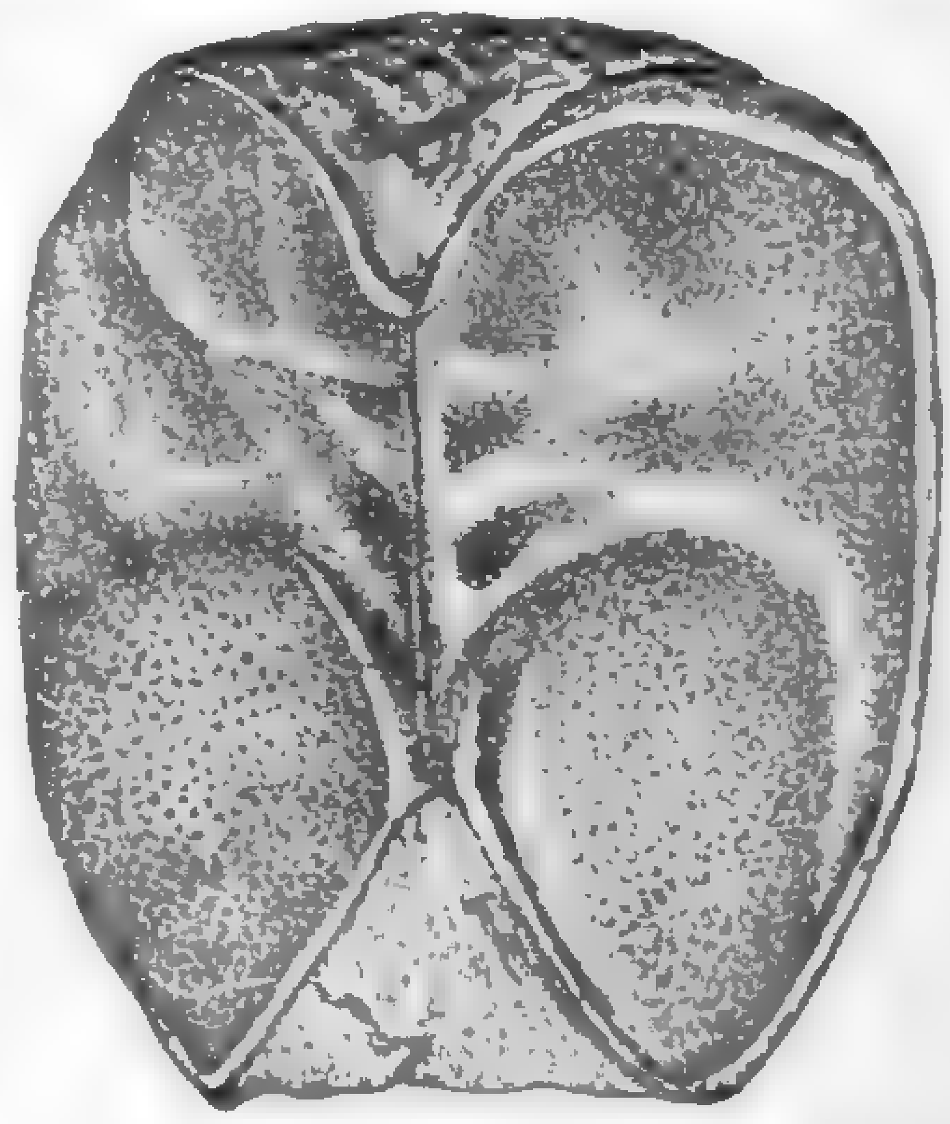

FIG. 10. — *Echinocaris multinodosus.*

The nervous system is entirely unlike the Phyllopod type, and approaches more the Decapod and Tetradecapod type.

The resemblance to the Copepoda is in some points quite striking; this is seen in the equal size of the two pairs of antennæ, in the form of the abdomen, and the two caudal appendages, as well as the spines on the hind edge of the segment, in the well-developed palpus of the mandibles, in the absence of maxillipedes, as well as the simple reproductive glands.

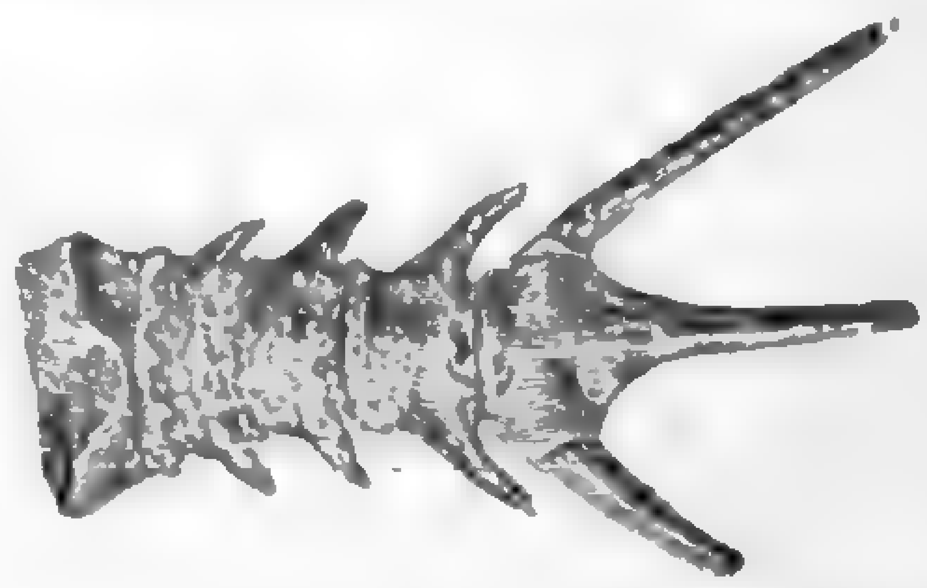

FIG. 11. — *Echinocaris sublevis.*

FIG. 12.—*Echinocaris punctatus;* abdomen, dorsal view, natural size. From Hall.

In short, we regard the Phyllocarida as an accelerated, prematurative type of Crustacea which became well established in the lowest Primordial period, flourishing at a time when there was no Malacostracous forms, and which culminated in the Upper Silurian period, and became nearly extinct at the close of the Carboniferous. Judging the group by the structure of Nebalia alone, whether we consider the external or the internal structure, it is a highly composite or synthetic type, combining Copepod, Phyllopod and Decapod-like features with more fundamental characteristic ones of its own. The group existed at a time when, save in the Carboniferous period, no Malacostraca, or at least very few, existed, and they thus anticipated the incoming of the more specialized Decapods.

Like many other synthetic, ancient types, the fossil representatives were of colossal size compared with the living survivors.

While some of the fossil forms were of moderate size, though very large compared with Nebalia, some must have been of gigantic proportions. For example, in *Dithyrocaris neptuni* Hall, of which Fig. 9 represents the telson and cercopoda of natural size, the entire animal must have been some two feet in length. The *Echinocaris punctatus* must have been nearly a foot in length, while the Echinocarides (Figs. 10 and 11), described recently by Mr. R. P. Whitfield, were considerably smaller.

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AMERICAN WORK ON RECENT MOLLUSCA IN 1881.

BY WILLIAM H. DALL.

(Continued from November number.)

Psychology.—Owing to the secluded life of most mollusks they are not easily subjected to long-continued observation, and perhaps for this reason notes on their affections or mental processes are nearly unknown. But that careful observation would reveal in many mollusks a much higher degree of intelligence than they are usually credited with, there can be little doubt. A small contribution to this subject is contained in the paper on "Intelligence in a Snail," by the writer (Am. Nat. Dec. 1881, pp. 976–7). The observations there noted indicate that some species of the genus Helix are capable of recognizing a call or sound, and of distinguishing it from other calls or sounds. Since this was printed the writer has had information of two other cases of the same kind, though the facts are less clearly indicated than in the one first mentioned. Dr. Lockwood's observations on Mytilus indicate a certain degree of intelligence, and it cannot be doubted that observations on cephalopods would show that these highly organized mollusks are capable of more or less complex mental operations.

Geographical Distribution and Catalogues.—In the Annals N. Y. Acad. Sci. (II, pp. 117-126) in an article "On the relations of the fauna and flora of Santa Cruz, W. I.," Bland shows, from a discussion of the land shells, that it is probable that St. Thomas and other islands of the Virgin group were formerly connected with Santa Cruz, but that in spite of a submarine ridge (with, however, 700 fathoms of water over its greatest depression) extending to Saba, there is no evidence of a dry-land connection of the latter with the rest. He also places some facts on record in regard to an asserted desiccation of the island of Santa Cruz, and concludes that there is no sufficient proof of it nor of an alleged conflagration caused by the French colonists in 1650.

To the "History of Fremont county, Iowa," Professor Call has contributed a chapter on the geology and natural history, which has been separately issued, with new pagination, with the date of Nov., 1880. The Mollusca are treated of on pp. 34–36, where is given a list of thirty fresh-water and ten land shells, none of them peculiar to the locality, more than half of which are bivalves, mostly Naiades.

In the Annals N. Y. Acad. Sci., II, 1881, pp. 129–139. Dr. Stearns discusses the introduction of *Helix aspersa* L., in California, together with the synonymy, relations and habitat of several South Californian species.

"On the geographical distribution of certain fresh-water mollusks of North America, and the probable causes of their variation" (Part I, Jan., 1881, pp. 8; Part II, July, 1881, pp. 11; Journ. Cincinnati Soc. Nat. Hist, IV, 1881). The two papers above cited contain an interesting resumé, from Professor Wetherby's point of view, of a number of singularities in geographical distribution of American fresh-water shells. We are of the opinion that when the facts are fully determined in regard to the fossil as well as the recent forms, which unfortunately is not yet the case, results of value will be obtained. The author wisely does not, as yet, endeavor to formulate any results, but calls attention to the facts with a promise of further studies in the future.

Stearns (AM. NAT., May 1881, pp. 362–6) discusses the distribution and synonymy of "*Mya arenaria* in San Francisco bay," arriving at the doubtless correct conclusion that it has been introduced probably not earlier than 1872 or 1873, on oyster "seed," planted by importers from the eastern coast, to grow and fatten in the bay. It has now almost entirely superseded other "clams" in the San Francisco markets, and has spread or been introduced also at Santa Cruz.

Dr. Lockwood notes (AM. NAT., Nov., 1881, p. 908) the finding of the third fresh specimen (since 1876) of *Argonauta argo* L., on the New Jersey coast. Two occurred at Long Branch, the other fifteen miles south of it. One was living when found. The argonaut may therefore be said with truth to belong to the fauna of the east coast of the United States.

"Observations on the species of the genus Partula Fér., with a bibliographic catalogue," by W. D. Hartman, M.D. (Bull. Mus. Comp. Zoöl., IX, No. 5, 8vo, pp. 171–196, with two diagram plates, Nov., 1881).

This paper contains no descriptions of new species, but is a succinct review of the genus in general, with a list of the species with references to descriptions and figures; a list of terrestrial species as distinguished from those which live in trees; another list of spurious species in which the reference to *P. auriculata* Pfr., as a Tornatella would seem to be a typographical error. There is also an account of an examination of two bushels of duplicates from the Pease collection now in the possession of the Mus. Comp. Zoölogy, and two plates of diagrammatic maps prepared by Andrew Garrett, showing the distribution of the forms of Partula on five of the Polynesian islands. It would seem as if a very important contribution to the study of the origin of species might be made by a keen-eyed and competent observer who should be willing to devote himself for a year or two to the study of these extremely local races, their environment and hybridization, on one of these islands. It is perhaps unnecessary to say that the information in this paper is fuller and more accurate than is to be elsewhere found on the same topic, and that it will be a welcome contribution should Dr. Hartman complete, as it has been rumored was his intention, a similar annotated synonymical catalogue of the Achatinellidæ.

Dr. W. D. Hartman has had printed "A Catalogue of the genus Partula" (F. S. Hickman, West Chester, Pa., 1881, 8vo, pp. 14, cuts), enumerating the species with their synonyms, and dividing them into two sections, of which one contains ten and the other five subordinate groups, and these again are subdivided by characters of less importance. To the divisions of the sections new names have been applied, and they are termed subgenera, though the characters by which they are separated are superficial rather than structural. These subgenera are as follows: Partula (*P. faba* p. 6); Nenia (*P. N. auriculata*, Brod. p. 7); Astræa (*P. A. dentifera*, Pfr. p. 7; preöccupied in cœlenterates, 1789); Clytia (*P. C. umbilicata*, Pse. p. 8; preoccupied in cœlenterates, 1812); Ilia (*P. I. lutea*, Lesson, p. 8; preoccupied in crustacea, 1817); Œnone (*P. Œ. hebe*, Pfr. p. 9; preoccupied in vermes, 1817); Helena (*P. H. Otaheitana*, Brug. p. 9); Pasithea (*P. P. spadicea*, Reeve, p. 10;

preoccupied in cœlenterates, 1812, and otherwise); Ægá (*P. Æ. decussatula* Pfr. p. 11; preoccupied in crustacea, 1815); Echo (*P. E. arguta*, Pease, p. 11; preoccupied in insects, 1853); in the second section Latia (*P. L. ganymedes*, Pfr. p. 12; preoccupied in mollusca, 1849); Evadne (*P. E. bulimoides*, Lesson, p. 12; preoccupied in crustacea, 1846); Harmonia (*P. H. gibba*, Fér. p. 13; preoccupied in insects, 1846); Matuta[1] (*P. M. rosea*, Brod. p. 14; preoccupied in crustacea by Fabricius); Sterope (*P. S. carteriensis*, Quoy and Gaim. p. 14; preoccupied in insects, 1850. The types are illustrated by rather coarse wood-cuts in the text.

This catalogue represents, better than any previous arrangement, the relations of the different species to each other, and is the result of some years conscientious study, aided by the best existing collection of the shells themselves. It is, therefore, unfortunate that, at the last moment, as it were, it should have been somewhat hastily printed. We are authorized, on the part of the author (who as much as any one else regrets the circumstance), to state that he desires to withdraw, as far as lies in his power, the names applied to the sections of Partula, which he is now of the opinion are perhaps hardly important enough, from a systematic point of view, to deserve naming; and that he has in preparation a new catalogue which will embody some revisions, some new species lately described and but recently received by Dr. Hartman, and in which he will adopt the classification indicated by Dr. Pfeiffer in his posthumous work, "Nomenclator Heliciorum Viventium," etc.

A list of the Mollusca (two cephalopods, twenty-five gasteropods, twenty-three lamellibranchs) forms part of a paper by Mr. R. Rathbun, on "The littoral marine fauna of Provincetown, Cape Cod, Mass.," in the Proc. U. S. Nat. Mus., III, pp. 116–133, June, 1880. A reference to this paper was accidentally omitted from this record for 1880.

In AM. NAT., May, 1881, pp. 390–91, Professor R. E. Call describes a new Texan Unio, *U. bollii* Call, from the Colorado river, Texas, collected by the late Professor Jacob Boll. It is perhaps most nearly allied to *U. quadrans* Lea. We may here call attention, though not strictly within our limits, to his list in the July number (p. 585) of the recent land and fresh-water shells found

[1] Printed Matata, but the derivation given shows this to be a typographical error.

fossil in the Iowa loess, and which in his opinion determine it to be a lacustrine formation.

"Notes on *Succinea campestris* and *S. aurea*" (AM. NAT., May, 1881, pp. 391–2). Professor R. E. Call extends the limits of the first species as far as New Orleans in the west, and Charleston, S. C., on the north, and of the second to Central and Southeastern New York. He also adds Southwest Iowa (Nishnabotna river) as a new and so far the most western locality for *Unio pressus* Lea.

Our Home and Science Gossip, a monthly periodical published at Rockford, Illinois, has a "department" devoted to *Conchology* which deserves encouragement and a better proof-reader. In the number for June 15th, 1881, A. A. Hinkley mentions a pond near the Pecatonica river, near Rockford, and Mercer county, Illinois, as localities for the rare *Limnæa zebra* Tryon.

W. W. Calkins announces a "complete monograph" of the molluscan fauna of Illinois, to be published within the year, and asks for coöperation from local naturalists. The object of Mr. Calkins is a worthy one, and which should be promoted at home and imitated in other States of the Union, especially if Mr. Calkins gives as good figures of the species as those which have illustrated some of his papers noticed in this record for previous years.

J. B. Upson contributes notes on *Limnæa desidiosa* Say, and *Physa gyrina* (found by "millions," in a rain-flooded stone quarry which was thirty-five rods from any stream of water), *Unio alatus* Say, and *Vertigo simplex* Gould. Large numbers of the Unio from Rock river, were examined. Two-thirds proved to be males. Young ones were extremely rare. The nacre of the females, without exception, was much lighter than that of the males, being sometimes nearly white, while the males were of various shades of purple. In the male shells the intensity of color varied with the "thickness of the mantle," the shells of darkest hue being secreted by "the very thickest mantle." They sometimes produce pearls. The Vertigo was described by Gould in 1840, and has been found in Canada and New England. In the winter of 1880–81, Mr. Upson found it near Cedar Keys, Florida, associated with *Pupa rupicola* Say, on decayed wood. No intermediate stations are known, and further confirmation of this very interesting discovery would be gratifying.

Mr. Upson also contributes hints to collectors, and offers prizes for the best collections made by children of the public schools.

It will be seen that this little miscellany is by no means without interest, but worse typographical blunders than those which occur in it are rarely to be found, and the editor has included an account of "coon oysters" on the coast of Florida, clipped from some exchange, under the head of *Icthyology !*

Descriptive and Systematic Papers.—As usual, the recorder finds it difficult to assign many papers to any of the definite heads used in this record, since they combine descriptive and other matters under one title, and the recorder's time and facilities do not permit him to attempt any exhaustive analysis like that of Professor von Martens in the *Zoölogical Record.* Still the rough arrangement here adopted is not without a certain use, and for that reason has been retained.

"On the genera of Chitons," by W. H. Dall (Proc. U. S. Nat. Mus., 1881, pp. 279–291, Dec.). In this article the writer has given brief but sufficient diagnosis of all the divisions of the Chitonidæ recognized by the late Dr. Carpenter and himself, both recent and fossil. All the groups are restricted, some here first characterized, but most of them have heretofore been made public. In the present arrangement all are brought together in their systematic relations, and their chief characteristics tabulated. The writer observes, "with the above data and those comprised in my report on the Limpets and Chitons of Alaska, students should be pretty well able to refer any Chiton of whose characters they have made themselves masters, to its proper place in the general classification." The following names are proposed for Palæozoic Chitons on the authority of Dr. Carpenter's MSS., and should be credited to him. Chonechiton, Pterochiton, Loricites and Probolæum. Cymatochiton Dall, is proposed for Cymatodus Carpenter, preoccupied in vertebrates.

Among recent genera and subgenera hitherto only in MS. or imperfectly characterized, diagnoses are given of Deshayesiella Cpr., Callochiton Gray, Stereochiton Cpr., Leptoplax Cpr., Spongiochiton Cpr., Callistoplax Cpr., Angasia Cpr., Ceratozona Dall (for Ceratophorus Cpr., non Diesing, 1850), Pallochiton Dall (Hemphillia Cpr., non Binney), Fannettia Dall (Fannia Gray, non Robineau-Desvoidy, 1830), Sclerochiton Cpr., Lucilina Dall (Lucia Gld., non Swainson, 1833), Francisia Cpr., Dinoplax Cpr., Middendorfia Cpr. (Dawsonia Cpr., 1873, preoc.), Beanella Dall (Beania Cpr. non Johnstone), Arthuria Cpr., Aulacochiton (Shuttleworth restr.) Cpr., Fremblya H. Adams (= Streptochiton Cpr., MS.), Euplaciphora (Shuttleworth restr.) Cpr., Guildingia Cpr., Macandrellus Cpr., Stectoplax Cpr., Choneplax Cpr., Chitoniscus Cpr. (non Herrmanssen). It is believed that the publication of these tables will be beneficial in several ways, as in giving a general view of Dr. Carpenter's classification, and especially in calling attention to the characters which it is desirable should be distinctly noted by those who may describe new species of Chitonidæ, for the want of which it is impracticable in the majority of cases, to properly classify by determining the genus or even to subsequently recognize the species. The publication of the entire monograph only awaits the preparation of the illustrations (already drawn) which have been delayed by circumstances entirely beyond the writer's control.

"The Cephalopods of the northeastern coast of America." Part II. "The smaller Cephalopods (etc.)," by A. E. Verrill (Trans. Conn. Acad. Sci., v., pp. 259–446, pl. XXVI–LVI, June, 1880, Dec., 1881). Part I of this important work was noticed in this record for 1880. The second part is now completed, forming full material for a manual of the subject, which it is understood will be issued in the form of a "Report on the Cephalopods," in connection with the "U. S. Fish Commission Report for 1879," which appears early in 1882.[1] The first two sheets, which appeared in 1880, contain references to additional specimens of *Architeuthis harveyi*, and a full description of *Ommastrephes illecebrosus* (Lesueur) Verrill. The new names applied in the subsequent portion of the paper are Cheloteuthis for *C. rapax* n. s. (by typographical error Chiloteuthis) from a somewhat imperfect specimen which is subsequently referred to as a synonym of *Lestoteuthis fabricii* (Stp.) Verrill (*Sepia loligo* Fabr. Fauna Grönl.); Desmoteuthidæ V. fam. nov. containing Desmoteuthis n. g. erected upon *Leachia hyperborea* Stp.; two new varieties (borealis and pallida) of *Loligo pealei* Lesueur; Stoloteuthis n. g. for *Sepiola leucoptera* V.; *Rossia megaptera* V. n. s. from near Newfoundland; and Alloposidæ V. fam. nov. for Alloposus V. (1880). An appendix follows, with descriptions of additional material and a crit-

[1] Separate copies of this article in advance of the Report were received from the printer at the Smithsonian Inst. April 10, 1882.

icism of several papers by Streenstrup and Owen, published nearly simultaneously with the earlier parts of Verrill's work, thereby causing some entanglements in nomenclature, for an account of which the reader is referred to the paper itself. Several new names appear in this appendix, e. g. *Brachioteuthis* (*beanii* V.) g. et sp. n. from fish stomachs off Martha's Vineyard; *Chiroteuthis lacertosa* V. n. s. for a form from the eastern coast of North America of which a fragment was referred to *C. bonplandi* by Verrill in the Bull. Mus. Comp. Zoölogy. VIII, Mar. 1881; Stoloteuthis (cf. antèa); Inioteuthis n. g. with *I. japonica* and *I. Morsei* V. spp. n. from Yedo Bay, Japan, collected by Professor Morse. Then follows a conspectus of the families, genera and species of Cephalopods included in this paper, specimens of all of which, except *Taonius pavo*, have been examined by the author. The plates reflect much credit on the artist, Mr. Emerton, those which are lithographed coming out with particular beauty.

"Some notes on American land shells" (I–II, pp. 8 and 13, Journ. Cincinnati Soc. Nat. History, IV, Oct. and Dec., 1881). In these papers Professor A. G. Wetherby discusses the habitat, location, synonyms, etc., of a large number of species of pulmonates. *Ariolimax* var. *hecoxi* is proposed for a form from California which appears to differ from *A. columbianus.* When fully extended, living specimens reach nine inches in length. An albino variety of *Helix fidelis* is noted from Washington Territory. In the second part the molluscan fauna of Roan mountain, North Carolina, is considered, and *Helicodiscus fimbriatus* n. s. is described (p. 9, separate copies). *Patula sampsoni* is proposed as a name for a form closely allied to *P. dorfeuilliana* Lea from Eureka Springs, Ark. The paper closes with an appeal to and some instructions for collectors.

In the *American Journal of Science* (Volume XXII, pp. 411–14, Nov., 1881), Professor Verrill briefly reviews recent papers relating to the East American invertebrate fauna.

Professor Angelo Heilprin (Proc. Acad. Nat. Sci., Phil., Dec., 1881, pp. 423–28) publishes "Remarks on the molluscan genera Hippagus, Verticordia and Pecchiolia," in which he calls attention to and details the confusion existing in regard to these genera, without, however, finally resolving the difficulties. He is disposed to retain Hippagus as distinct from Crenella (to which it has very generally been referred), on the ground that the shell (of Lea's types of Hippagus) is thicker and the umbones more prominently developed and spirally twisted than in Crenella, while on the possibly eroded hinge line he observes no crenulations. In general, however, these would hardly be taken to be "sufficient differences to warrant a generic separation."

Bland, in the Annals. N. Y. Acad. Sci. (II., pp. 115–16), describes (with a figure) a somewhat remarkable new species of Triodopsis (*T. levettei* Bld.) from the vicinity of Santa Fé, New Mexico. In the same publication (pp. 127–28 with cut) he has an article entitled "Notes on *Macroceramus kieneri* Pfr., and *M. pontificus* Gld.," in which he figures the former (from types) and comes to the conclusion that the two are distinct, and that *M. kieneri* Pfr., is not a member of the fauna of the United States.

Geo. W. Harper describes and figures (Cin. Journ. Nat. Hist., IV., part 3, p. 258, Oct., '81) *Patuli bryanti* n. s., from North Carolina, which bears a relation to *P. perspectiva* such as *Helix cumberlandiana* does to *H. alternata.* He also figures, with notes upon the species, *Hyalina significans* Bland.

Rafael Arango describes (Proc. Acad. Nat. Sci., Philadelphia, 1881, pp. 15–16) *Choanopoma acervatum*, *Cylindrella paradoxa*, *C. incerta*, these three illustrated by good cuts, and *Ctenopoma nodiferum*, all new species, together with *Ctenopoma wrightianum* Gundlach, n. sp. These new pulmonates are from Cuba.

Economic Shell-fisheries and Miscellaneous Notes.—The daily press in this, as in almost every field, gathers good wheat as well as chaff, and, occasionally, articles which would do no discredit to permanent scientific literature. Such of the latter as have fallen under the writer's notice are here mentioned as well as more pretentious documents and reports, as in previous years.

"The Oyster Industry," by Ernest Ingersoll (Tenth Census, Section X, Fishery Industries, Monograph B., Dept. Interior, 4to, p. 252, pl. XXX-XLII, Washington, 1881). This forms one of the special monographs on the history and present condition of the fishery industries, by G. Brown Goode, Assistant Director U. S. Nat. Mus., and a staff of associates. It contains descriptive and statistical reports on the oyster industry from Maine to Texas and California; an account of the natural history of the oyster, a glossary of terms and statistical tables. Six of the plates illustrate the development of the oyster from observations by Professor W. K. Brooks (elsewhere noticed) and the remainder tools, barges, etc., pertaining to the business. The vast accumulation of facts brought together is an evidence of great industry, and can be properly estimated only by a specialist familiar with this field. Doubtless, there is some inequality in the character of the information, such as would inevitably result from the sources from which it is derived. Its value will be chiefly realized in the future. For the present, the only criticism which occurs to us, is, that we miss in addition to the accumulated facts, a brief digest from which their bearings might be rapidly gathered. It is probable, however, that this is easier to point out than to remedy.

Report of the Commissioners of Shell-fisheries of Connecticut (Hartford, 1881, 8vo, pp. 35–132), presented to the legislature, January session, 1882. This first report of the Shell-fish Commissioners is included in the same covers, with the sixteenth report of the Fish Commissioners of the State, which occupies the preceding thirty-four pages of the volume. The Shell-fish Commission was established by an act of the legislature approved April 14th, 1881, entitled "An act establishing a State Commission for the designation of oyster grounds," which board is given by Section 1, exclusive jurisdiction over the offshore grounds, north of the New York State line, in Long Island sound, suitable for or occupied by oyster beds. They are empowered to survey and map all the grounds above mentioned, to ascertain the ownership of any that may be claimed by right of occupancy and the area of the natural beds, to report a plan for an equitable taxation of the property in said fisheries, and an annual report of the state of their condition. They are also empowered in the name of the State to grant by written instruments perpetual franchises in such unclaimed grounds, as are not and have not for ten years been natural clam or oyster beds, to citizens of the State applying for them, paying expenses of survey and one dollar per acre for the same for the purpose of planting or cultivating shell-fish thereon. The deeds are to be registered, maps of special sections made, boundary buoys or stakes set, and provision is made for a legal settlement of disputes.

During the seven months, ending with Nov. 30th, 1881, about $8400.00 had been paid into the State treasury from receipts, while $4000.00 had been drawn for expenses incurred.

The report contains, first, an account of lands registered as private property; second, a brief statement of the character of the business of oyster cultivation as practiced in Connecticut; third, the report of J. P. Bogart, Esq., engineer of the board, in relation to surveys made, accompanied by a map of the triangulation executed, and a general map of the State oyster grounds; and lastly, an appendix containing the forms of deeds used, and a compend of the laws of Connecticut relating to shell-fish and fisheries. It is creditable to the State of Connecticut that the importance of the subject has received legal recognition, and to the commissioners, Messrs. R. G. Pike, W. M. Hudson, and Geo. N. Woodruff, that so much has been accomplished with so little expense. This has doubtless been largely due to the intelligence and efficiency of the engineer of the board as well as to the exertions of the members of the commission themselves. Should Maryland and Virginia take similar action in the waters of the Chesapeake, and execute the laws already on the statute book, the inevitable depopulation of the oyster grounds now rapidly approaching, and which will deprive over forty thousand people of their means of livelihood, might be long postponed if not entirely prevented. The crass ignorance of those most interested, however, and its effect on State politics, are such that little in the way of rational legislation is to be hoped for, until after the business in the Chesapeake has practically destroyed itself.

General information about the oyster and clam trade can be found in the weekly issues of Hopson's *Sea World*, etc., for the year 1881.

An important article on "Chesapeake oysters" and the oyster trade of that region generally, can be found in the *New York Herald* for Oct. 11th, 1881, and another on "Oysters in season," in the issue of Aug. 26th, 1881. The business began in Baltimore in 1834, but was of little consequence until 1836, when a packing-house, dealing at first chiefly in raw oysters was established by C. S. Maltby. On both shores of the Chesapeake collectively, there is capital to the amount of more than seven and a half millions of dollars invested—over seventeen million bushels of oysters were handled—over forty thousand people and nearly ten thousand vessels and boats were employed in the business, while the wages earned are about seven millions of dollars. This article is largely indebted to the Census Report on the oyster industry for its facts, but presents them in a compact and handy shape.

The consumption of oysters in New York, as appears from the second article referred to, between September 1st and January 1st, is about fifty thousand baskets *a day* (*sic*), containing about two hundred oysters each. From January to May the consumption is about twenty-five per cent. less. This appears to be at the rate of ten millions oysters a day, or eight oysters *per capita* for the entire population of the city, an estimate which seems grossly excessive on the face of it, unless it be understood that the New York dealers sell oysters to private parties or small dealers in the surrounding country, which are included in the above figures, as well as the actual local consumption.

A large natural bed of oysters, covering over one hundred acres was discovered in Smithtown bay, on the north shore of Long Island, N. Y., in September, 1881. It is in deep water and very rough bottom. The discovery created an immense excitement among the fishermen, who flocked from every quarter to avail themselves of the unclaimed treasures.

Lippincott's Magazine (May, 1881, pp. 479–492) has a well-illustrated article on oysters and oyster culture, here and abroad, under the title of "Oyster culture," by W. F. G. Shanks.

"Deterioration of American Oyster beds" is the subject of two articles, by Lieut. Francis Winslow, U. S. N., in the *Popular Science Monthly* (Vol. xx, No. 1, pp. 29–42, Nov., 1881; No. 2. pp. 145–155, Dec., 1881), in which the danger to the Chesapeake beds, now imminent, is pointed out, and remedies are discussed and illustrated by instances of experience of European communities. So long as the community most directly interested remains, from ignorance, obstinately incredulous and unwilling to take any precautions whatever, or even enforce the existing laws, nothing can be done, and it is probable they will awake to the danger only when it is too late.

The Sea World, Fishing Gazette and Packer's Journal, a quarto weekly periodical, devoted in large part to the annals and interests of the edible shell-fish trade, has completed its third volume. It is published by W. B. Hopson at New Haven, Conn., and apparently printed and issued in New York. Those interested in the economical shell-fish will find it worth while to refer to its files. In the number for Dec. 7th, 1881, an interesting account is given of oyster culture, near Groton, Conn., in the Poquonock river. White birch bushes, of proper size, are cut and stuck into the river bottom (soft mud) where there is about twelve feet of water at low tide. The spat adheres to the bushes and grows finely, twenty-five bushels of oysters (seven bushels marketable and the remainder "seed" oysters) having been taken from one bush which was four inches through the butt and had been set eighteen months. The average yield, however, is about five bushels to the bush. As the bottom is muddy, the spat which is caught by the bushes would otherwise be a complete loss. The oysters are said to be of fine flavor and rather peculiar shape. About fifty acres are devoted to this business. Although the bushes are always under water, a strong opposition to this mode of planting has been developed in the neighborhood which threatens to terminate the trade. The ostensible ground is, that it is liable to produce disease in the vicinity, which would seem to be an unwarranted assumption, and the editor ascribes the attack on the planters to "the determined opposition to oyster culture which has always been noticeable in that section of Connecticut." Why any one should oppose the cultivation of oysters does not seem clear.

In New Haven, Conn., in the autumn of 1881, was reported a singular scarcity of oyster shells for use in planting new beds for the "spat" to settle upon. The value of a bushel of the shells had risen to five and even seven cents a bushel. Formerly surplus oyster shells were used in making roads about New Haven and the smoothness, hardness and freedom from dust of the "shell roads" was so well known as to become proverbial. But the scarcity of the shells, unless it proves to be merely temporary, will soon make the "shell road" a thing of the past.

The franchise for fish and oysters in the Gulf of California is held by Don Guillermo Andrade by a concession from the Mexican authorities. A party has recently gone to investigate the islands covered by his concession, with a view of establishing packing establishments, for putting up turtle flesh and oysters in cans for export.

The "Market Review for 1881" (San Francisco, Cal.), states that the quantity of abalones (Haliotis of several species) shipped by sea from California in 1880, was 6372 sacks, valued at $46,179.00; and in 1881, 4522 sacks, valued at $18,529.00. This is exclusive of the quantity shipped by rail which is probably much greater. Owing to the demand for iridescent buttons now in fashion, the manufacture of these shells is very large. In this country the work is largely done in Philadelphia and New York. A considerable quantity of the shells are shipped to France; of the more solid and perfect shells, solid buttons are made, the refuse is ground up and mixed with cement which is molded into buttons, which display in their substance myriads of brilliant particles. The compound may be more conveniently and artistically treated than the solid shell itself, as well as at less cost.

An account of "Pearl diving (for *Margaritiphora californica* Cpr.) in the Gulf of California" taken from the "Youth's Companion" appears in the San Francisco *Bulletin* for Nov. 9th, 1881. Two or three tons of fresh shells were obtained per day when weather permitted. They were allowed to die before being searched for pearls. The locality was called Bonita bay, being about fifty miles north of Loreto. The water was forty feet deep and only about one shell in one thousand contained a valuable pearl. Sharks and squids rendered diving (in a suit of rubber armor) exciting, if not dangerous.

Eleven thousand bushels of clams (*Venus mercenaria* L.) were sent to market by the fishermen of East Hampton, Long Island, N. Y., in 1881.

In the Bulletin of the United States Fish Commission (I. p. 21, Apr. 13th, 1881) Mr. John A. Ryder prints an extract from a letter to Mr. Tryon, by Henry Hemphill, calling attention to the valuable qualities of *Glycimeris generosa* Gould, as a food mollusk. It is found at Olympia, Washington Territory, and is said to resemble "scrambled eggs" in taste. They are called "Geoducks" by the urchins of Olympia, and "Kwenuks" by the Indians. The Fish Commission is investigating the question of transplanting these valuable mollusks to the east coast of the United States. In the same publication (pp. 200–201) with the title of "On the habits and distribution of the Geoduck," etc., is printed a letter from Hemphill on the same subject, in which he mentions that a large specimen will afford a pound of delicious flesh for food. They burrow very deeply into the sand, however, and do not come much above extreme low tide limits, so that it is not easy or convenient to get at them except at low spring tides. On the other hand, they are said to be finer eating than any other mollusk, not excepting the oyster.

At a recent meeting of the Harbor Commissioners in San

Francisco, the Chief Engineer reported that the San Rafael ferry-slip, now six and one-half years old, was practically ruined by the teredo and would have to be replaced. Nearly all the submerged wood-work was actually destroyed.—*San Francisco Bulletin.*

W. N. Horton, of Olympia, W. T., has invented a plan for circumventing the teredo. He is also the inventor of a process for boring logs for water pipes and pumps. His machinery cuts out a cylinder two inches thick, from between the core and the outside of a log and of any desired caliber. By retaining the core and filling the cylindrical excavation around it with a special cement, it is thought that the ravages of the teredo would be confined to the outer part of a pile, so treated, and the core which is expected to sustain the needed weight would be protected by the cement, which in its turn would be preserved from friction by the outer coating of wood and bark.

In the *Sea World* elsewhere alluded to (Dec. 7th, 1881), a resumé of facts relating to the giant cuttlefishes, is given, under the title of "The Devil Fish of the Atlantic."

In the *Weekly Bulletin*, San Francisco, Aug. 24, 1881, in an article on "San Francisco Fishermen," it is stated, that the Octopus (*O. punctatus* Gabb) is largely used for food by the Italian fishermen of that port, being made into a kind of chowder with vegetables and a sauce of olive oil and lemon juice, after the intestines have been removed, and is considered as especially appropriate food for fast-days. They are also dried for export by the Chinese.

In the Gulf of California the ten-armed cuttles sometimes attack the divers for pearl oysters. One killed, while attacking a diver, had arms twelve feet long, and a body larger than a beef barrel (*Ib.*, Nov. 9th, 1881.)

The *New York Herald*, of Nov. 25th, 1881, gives three columns to an account, by Mr. Morris, of the capture of an immense squid (*Architeuthis harveyi* V.) at Portugal cove, Newfoundland, on the 10th of November, and a resumé of facts relating to these animals. The specimen in question was brought to New York. *Harper's Weekly* for Dec. 10th, '81, has an illustrated article on the same subject apparently by the same author.

A fictitious account of an imaginary capture of a giant squid ("Architeuthis") appears in *Lippincott's Magazine*, Aug., 1881, p. 124, from the pen of Mr. C. F. Holder.

"Mortality among Architeuthidæ." Professor Verrill (*Am. Journ. Sci.*, XXI, p. 251, Mar., 1881) notes a strange mortality of giant squids ("Architeuthis"), which, according to Capt. J. W. Collins, occurred in Oct., 1875. Twenty or thirty specimens were found floating on the water and secured for bait by the fishing fleet. They were mostly somewhat mutilated when found.

A novel mission in England sends beautiful sea-shells, which are generally collected by children, to little sick people in homes or hospitals. Since May, 1879, it has distributed a quarter of a million of shells from the West Indies, South Africa and Spain, as well as from the English coast.—*Foote's Leisure Hour.*

A specimen of *Tridacna gigas* Lam., weighing 528 pounds, was obtained by Professor Ward, of Rochester, New York, at Singapore. It was thirty-six inches long and twenty-seven broad, and was presented to the California State Mining Bureau, by Mr. J. Z. Davis.—*S. F. Bulletin*, Mar. 2d.

Erratum.—By an inexplicable and unfortunate "lapsus" in this record for 1880 (p. 716), the name of W. H. Ballou was substituted for that of Rev. W. M. Beauchamp, who should have been credited with the authorship of the note on the distribution of *Bythinia tentaculata* in the United States (cf. AM. NAT., July, 1880, p. 523, and Mar., 1882, pp. 244–5).

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THE ORGANIC COMPOUNDS IN THEIR RELATIONS TO LIFE.[1]

BY LESTER F. WARD.

IN a paper on the "Formation of the Chemical Elements,"[2] read March 29, 1879, before the Philosophical Society of Washington, I proposed the following *cosmical definitions* of the three principal known forms of matter:

"*1. Chemical Elements.*—Substances whose molecules are composed either of those of other chemical elements of less atomic weight, or of such as are too low to be capable of molar aggregation, and therefore imperceptible to sense: formed during the progress of development of star-systems at temperatures higher

[1] Read before the Philosophical Society of Washington, January 28, 1882; also read before the Biological Section of the American Association for the Advancement of Science at Montreal, August 29, 1882.

[2] "Evolution of the Chemical Elements," in the *Popular Science Monthly*, Vol. XVIII (February, 1881), pp. 526–539.

than can be artificially produced, and hence too stable to be artificially dissociated.

"*2. Inorganic Compounds.*—Substances whose molecules are composed of those of chemical elements or of other inorganic compounds of lower degrees of aggregation: formed in the later stages of the development of planets at high but artificially producible temperatures, and therefore capable of artificial decomposition; and constituting the greater part of the solid crust of cooled-off bodies, their liquid, and a portion of their gaseous envelope.

"*3. Organic Compounds.*—Substances whose highly complex and very unstable molecules are composed of those of chemical elements, inorganic compounds, or organic compounds of lower organization: formed on the cooled surfaces of fully developed planets at life-supporting temperatures."

In that paper I endeavored to show that the so-called chemical elements differ from one another in ways which strongly suggest the possibility that some of them may have been evolved from simpler constituents in much the same manner as the inorganic compounds are formed. These latter were therefore treated as simply forming the continuation of a uniform process of evolution, varied in its character only by the conditions of temperature affecting the globe at the period when these substances were respectively formed upon it. The passage above quoted from the same paper shows also that the development of the organic compounds was looked upon as the still further prolongation of this uniform law operating under the greatly lowered temperatures prevailing on the surface of the earth's crust after its formation. This law was further shown to be none other than that which is known to prevail in each of the higher domains of phenomena, in the mineral, the vegetable, and the animal world—the production of aggregates of higher orders of complexity through the re-compounding of units of lower degrees of simplicity. As indices of this law, and facts of primary significance, it was shown that throughout the scale, so far as traceable, even in the domain of the chemical elements, the molecules constituting each progressively more complex unit, exhibit *increase of mass* accompanied by *decrease of stability*.

The present paper will aim to take the subject up where the former left it, and to confine itself exclusively to an examination of the last and highest of these products of Nature's alembic—the Organic Compounds.

These substances, as they exist on the globe, are for the most part products of organization, and they were long supposed to possess such subtile properties and composition as to be ever necessarily inscrutable to man. But quantitative chemistry has, within the last half century, not only succeeded in the complete analysis of all such substances obtained from organized beings, but it has also effected the synthesis, or reproduction out of their inorganic elements, of thousands of them. Thus Wöhler, Berthelot, Kolbe, Friedel, Piria, Wertheim, and others have accomplished the manufacture of such bodies as urea, formic, oxalic, lactic, and salicylic acid, numerous alcohols and ethers, glycerine, and a host of essences, including wintergreen, vanilla, mustard, cinnamon, camphor, etc., as well as alizarine and indigo dyes. These facts are sufficient to obliterate completely the line of demarkation formerly supposed to exist between the chemical constitution of inorganic and organic compounds, and when it is remembered that the latter differ as widely from one another as they do from the former in complexity, the uniform process of molecular aggregation cannot be regarded as interrupted at this stage. There is also much indirect evidence, though amounting to proof in but few cases, that the organic compounds, at least some of them, are sometimes directly formed by nature out of their inorganic constituents without the intervention of organized bodies.

These substances have their peculiar properties depending, like those of all other substances, on their molecular constitution ; the artificial glycerine possesses the same sweet taste as the natural product, the manufactured spices yield the same aromas, and the laboratory dyes the same colors as those of the Orient. Many organic compounds are exceedingly complex, their molecules being relatively large, containing several thousand times as much matter as a molecule of hydrogen. Their instability, moreover, bears some proportion to their complexity. Most of them are colloidal in structure and refuse to crystallize; a few of the simpler ones, however, in which the proportion of oxygen is large, as sugar, for example, become crystalline under certain conditions.

The only element which is never absent from any of these compounds is carbon. Oxygen is almost universally present, and the hydrocarbon group from which it is wanting is quite distinct from all others. Hydrogen comes next in point of regularity, and these three elements make up the great bulk of all organic matter. When nitrogen is added a marked change is made in the nature of the compounds. The nitrogenous group is distinguished especially by its great instability, and also by the number of isomeric forms which these bodies are capable of assuming. The only other elements that enter to any great extent into organic compounds are sulphur and phosphorus. These occur in limited but definite proportions in many of the most complex substances.

The remarkable contrasts which the elements of organic compounds present when compared with one another have been frequently pointed out by different writers, and they are certainly adequate to explain most of the properties possessed by these bodies. The chief characteristic of oxygen is its great chemical activity, or tendency to combine with other substances, while that of nitrogen is its inertia, or inability so to combine. Carbon is a solid at all temperatures producible on the globe, while all the other three chief constituents of organic matter are practically incapable of solidification. This fact is a measure of the degree of cohesion of the homogeneous molecules composing the respective molar aggregates; that of carbon is intense, while that of hydrogen is exceedingly slight. While this in each case depends on the degree of heat, it will be relatively the same among them all at any given temperature.

It would appear that all the attempts, so to speak, on the part of nature to form compounds of the gaseous elements alone have resulted, where successful, in substances which are at once pronounced inorganic, such as water, H_2O, ammonia NH_3, nitric acid, HNO_3, etc. It is remarkable that while the chief compound of the two persistent gases, hydrogen and oxygen, is liquid (water) or solid (ice) at our temperatures, that formed of the persistent solid, carbon, in combination with one of these gases, oxygen (carbonic dioxide, CO_2), is a gas at all ordinary temperatures and pressures. Notwithstanding this, it can not be doubted that carbon is the agent which, by its great molecular cohesion prevents the dissolution of the higher compounds and renders organic substances possible.

As already remarked, the transition from the inorganic to the organic is, from the point of view of chemical structure, purely nominal, and the existence of any hard and fast line marking off one of these fields from the other has long been denied. If there were any advantage to be derived from such a line perhaps it could not be drawn in a better place than that where carbon unites with hydrogen or nitrogen, either with or without oxygen. This, it is true, would place all the hydrocarbons, as well as cyanogen in the organic series. On this view, therefore, the inorganic compound most nearly related to the organic series would be carbonic acid, or, as it is now more properly called, carbonic dioxide, CO_2, of whose inorganic origin there can be no doubt. The simplest organic compounds consist chiefly in the addition of different proportions of hydrogen to this basis and the reduction of the proportion of oxygen. In the various hydrides (methylic, CH_4, ethylic, C_2H_6, amylic, C_5H_{12}, etc.), the oxygen disappears altogether. In the alcohols it reappears only in the addition of one oxygen molecule, to the respective hydrides. The acids result from an additional increase in the proportion of oxygen (formic, CH_2O_2, acetic, $C_2H_4O_2$, etc.). The actual development of the organic compounds, as it may be supposed to take place in nature, would seem to be in the reverse order to that above given, the organic acids being first formed from inorganic compounds by the addition of hydrogen, then the alcohols from these by still further increase of hydrogen accompanied by a reduction of oxygen, and lastly, the hydrides from the alcohols by the loss of the one equivalent of oxygen remaining in the latter. The different kinds of acids, alcohols, and hydrides, arise from varying the proportions of hydrogen and carbon. The simplest change possible may be indicated thus:

$$\overbrace{CO_2}^{\text{Carbonic dioxide.}} + H_2 = \overbrace{CH_2O_2}^{\text{Formic acid.}};$$

$$CH_2O_2 + H_2 - O = \overbrace{CH_4O}^{\text{Methylic alcohol.}};$$

$$CH_4O - O = \overbrace{CH_4}^{\text{Methyl.}}, \text{ etc.}$$

When we look at the higher and more complex compounds, we can readily see that they may be composed of the lower ones as their molecular constituents. This is, to a great extent, assumed by chemists, and the chemical synthesis of a large number of these substances has been carefully worked out. In the formation of sugar ($C_{12}H_{22}O_{11}$), starch ($C_{12}H_{20}O_{10}$), gum ($C_{12}H_{20}O_{13}$), etc., the proportion of oxygen is quite large, and the phenomena of crystallization may occur under certain circumstances.

The oils are a still more complex group, being formed by the union of very feeble acids with the common base, glycerine ($C_3H_8O_3$). They are colloidal under all conditions, and decompose much more easily than the amyloids.

The most important organic compounds, however, especially from the biological point of view, are those containing nitrogen. These fall under two general classes, and constitute the so-called organic bases on the one hand, and the albuminoids on the other. The former of these groups have been for the most part extracted from vegetables of which they constitute the "active principles," or characteristic properties, although, as we saw, a large number of them have been artificially manufactured. As illustrations of the nature and composition of these substances may be mentioned, morphine ($C_{17}H_{19}NO_3$), narcotine ($C_{22}H_{23}NO_7$), quinine ($C_{20}H_{24}N_2O_2$), strychnine ($C_{21}H_{22}N_2O_2$), etc. It will be seen that the principal particulars in which these fundamentally differ from the organic compounds already considered, consist in the addition of a small percentage of nitrogen and the reduction of the proportion of oxygen; yet the properties which they possess are a hundred-fold more active.

The composition of the organic bases, however, though somewhat complex, is simple compared with that of the albuminous compounds. These contain, in addition to the elements of the former, small, but rather definite proportions of both sulphur and phosphorus. The number of molecules of each of the components indicates a large, complex molecule as the unit of composition. The expression for albumen as given by Liebig was: $C_{216}H_{338}N_{54}S_3O_{68}$. Could this be relied upon this substance would contain 679 equivalents of different weights, which, when reduced to the standard of hydrogen, would indicate a molecule for albumen 4870 times as large as the hydrogen unit. The molecule of fibrin is supposed to be still larger than that of albumen.

The substances thus composed, as we should naturally expect, are very unstable and possess remarkable properties. They constitute the substance of the muscles and nerves of the animal system and the fibrin of blood. They are also found in all cells whether animal or vegetable. The base of the entire group is known as *proteine*, so named from its remarkable power of assuming different isomeric forms, of which it presents some thousand or more. Proteine contains no sulphur nor phosphorus, and its formula as given by its illustrious discoverer, Mulder, is, $C_{18}H_{27}N_4O_6$. Each of its units would thus be composed of 65 elementary molecules, the combined mass of which would be equal to 395 molecules of hydrogen. All the actual known substances of this group have, therefore, more complex molecules than those of this still, to a great extent, theoretical one.

While the albuminoids possess none of the active properties of the organic bases, they far exceed them in the power they have to change their form, and adapt themselves to the needs of organized beings. All properties in material bodies are the result of reactions taking place in their molecular constitution when brought into contact with other bodies. They are recognized only when they directly or indirectly affect the senses. As a rule, the larger their molecules, the more powerful their effects. In the case of the albuminoids, with their comparatively enormous units of aggregation, the entire substance is transformed with only slight external influence, either of heat or chemical contact, and either assumes new characters or breaks up into the simpler organic compounds of which it is composed.

The general law above stated, that in the progress of the evolution of matter from the simplest elemental state to the most complex organic compound, there has constantly been increase in the mass and decrease in the stability of the molecules, holds good throughout, and to it may now be added a third principle, obviously correlated with the above, and merely constituting a corollary to it, that *pari passu* with these changes there has been an *increase in the activity of the properties* manifested by the substances evolved.

Although varying through wide degrees in this respect, all the substances thus far mentioned possess sufficient stability to be retained, handled, and examined, and to the ordinary observer they present very much the same general appearance. While possessing many special qualities distinguishing them from other bodies, the albuminoids, as well as all the other organic compounds, appear to be and are incapable of any visible automatic movement.

We are obliged, however, to suppose that these, like other solids, even the densest crystals or metals, possess at all times molecular activities. It is these activities that determine the respective properties of all substances, and constitute the multiple and varied in nature. In proteine bodies, these molecular activities are much more extensive and varied than are those of simpler bodies. The molecular units are so much larger that their motions must be, as it were, *molar* in comparison, while within these larger primary units there are lesser units of different orders of aggregation, each of which manifests its own appropriate activities, and thus modifies the general properties of the whole. The reason why we are unable to see these motions, is simply because they are still on far too small a scale to be directly observed either by the eye or by any of the appliances yet devised for intensifying human vision.

The development of the albuminoids, highly complex as they are, is not alone sufficient for the immediate genesis of life. A form of matter still more complex, must be reached before this result is possible. But there is no evidence that this form of matter is produced by any different process from that by which other forms of matter are produced. From the molecule of hydrogen to that of albumen, the process of evolution has been uniformly the same, viz., that of compounding and recompounding, of doubly and multiply compounding; in short, it has been the process of molecular aggregation. It would be contrary to the law of uniformity in natural phenomena, upon the recognition of which modern science is based, to assume an abrupt change in the process at this point, and upon those who maintain such a *saltus* must rest the burden of proof.

Dealing, as we constantly must do, with molecules only, we are able to form conclusions only from observed effects, but we have seen that, without changing the elementary substances which analysis can demonstrate to be present at any stage of the process, with each new step in the progress of aggregation new and higher properties are created. From the inert properties of carbon and nitrogen in the free state, of water and carbonic acid, the simplest compounds, we have, by further successive compounding, the more active ones of ammonia and nitric acid, the sweet taste of sugar and glycerine, the powerful narcotic principles of nicotine and morphine, the deadly toxic properties of strychnine, and, manifesting themselves in a wholly different manner, the still higher order of properties, including those of isomerism, exhibited by the proteine bodies; all of which we seem bound to ascribe to the respective orders of combination and complication, under which these substances, possessing the same elementary constituents, exist when they display these qualities. In short their properties must be regarded as the result of the respective molecular constitution of each substance.

With still higher states of aggregation, could such be conceived as possible, we should therefore naturally expect still higher forms of activity, still more marked properties. But we have learned that, while we may safely predict higher properties from higher degrees of aggregation, we have no basis whatever upon which to predict the nature of these properties. Not even in the simplest inorganic reagencies can we foretell the result of the union of any two elements. We cannot even say which of the three states of matter, the gaseous, the liquid, or the solid, our new compound will exhibit at our temperatures. The invincible solid, carbon, when joined with oxygen, becomes a gas; the type of gases, hydrogen, when combined with another gas, oxygen, results in a solid at 32° Fahr. Much less can we predict the other more special properties, even of these primary compounds. *A fortiori* is human prevision inadequate to presage the result of organic combinations. That the re-compounding of the proteine bodies should result in a new form, possessing the quality of spontaneous movement is *a priori* just as probable as that the addition of a molecule of oxygen should convert the hydrides into alcohols.

This complex stage of aggregation is no longer an hypothetical one. The molar aggregate resulting from such a recompounding of the albuminoids has been discovered. It exists under diverse conditions and manifests properties fully in keeping with its exalted molecular character. This substance, discovered by Oken in 1809, and by him denominated *Urschleim*, recognized by Dujardin in 1835, and called *sarcode*, and thoroughly studied by Mohl in 1846, who named it *protoplasm*, has now passed unchallenged into the nomenclature of modern organic chemistry under the last mentioned designation.

Protoplasm is a chemical substance, found in considerable abundance in nature, not only within the tissues of organized beings, but as we might almost say, in a mineral state, wholly disconnected from such beings. There is no more doubt that it is a natural product than there is that ammonia is such a product. Its composition has been ascertained with considerable accuracy, and is found to be substantially the same under whatever form it may occur. According to the highest authorities this substance contains, approximately, fifty-four parts of carbon, twenty-one parts of oxygen, sixteen parts of nitrogen, seven parts of hydrogen, and two parts of sulphur in one hundred parts. These proportions doubtless vary somewhat, and traces of other ingredients may, perhaps, be occasionally detected, but the above description is sufficient to fix the chemical character of protoplasm. To write its symbolic formula is impossible in the present state of science, but so is it still impossible, to write that of the albuminoids with any reliable accuracy. Their numerous isomeric forms show us that the grouping of the molecules is subject to constant changes. This is doubtless true to a far greater extent of protoplasm. It is a substance whose molecular units are probably compounded of the units of the proteine bodies, which enter bodily into them in the same manner that oxygen and hydrogen enter into water, or, as we suppose ammonia, carbonic acid, and the compound radicals to enter into the more complex organic compounds.

The many conditions under which protoplasm is found to exist on the globe; may for convenience, be divided into two general classes: the free, and the dependent state. It is a matter of fact that it is found in a free state under a number of forms, both in the sea and in fresh water, and such bodies as Haeckel's Protogenes, and Huxley's Bathybius are simply representatives of it in this condition. On the other hand, protoplasm is present in all organisms, whether animal, vegetable, or protist, and of which, though small in relative quantity, it constitutes by far the most important of all their material constituents. To distinguish the wholly independent, amorphous, and spontaneously developed form of protoplasm above described from that which is found in the tissues of organisms and inseparable from them, Professor Haeckel proposes to apply to it the term *plasson*, or *plasson bodies*, which, while it should not lead to the notion that there is any essential difference in the matter itself, is convenient to aid in retaining the conception, not generally acknowledged, of its purely chemical character.

It is, however, difficult to describe the properties of the plasson bodies without giving rise to the idea of life, since the leading one is that of spontaneous mobility, or motility, as it has been technically called. Anything that moves is naturally supposed to be alive, and if this were a test of life, all forms of protoplasm would be living things. And, indeed, there would be really no objection to this view, provided the idea of life could be rigidly confined to this and a few other simple phenomena. But the tendency is always strong to couple with the notion of life that of *organization*, and few can be brought to recognize either that life can be the product of chemical organization, or that it can precede morphological organization. We are apt to associate with the conception of life, that of nerves, muscles, joints, limbs, stomach, and even sense organs. From the plasson bodies all these are as completely wanting as from a lump of gypsum. The spontaneous movements and all the transformations through which these substances pass, only constitute the mode in which their chemical activities manifest themselves. These activities belong to them in the same sense that sweetness belongs to sugar or astringency to alum. In fact, the primary distinction between these most complex of all known bodies, and the less complex ones seems to be, that while in the latter all their activities are molecular, in the former they are to a certain extent molar, and carry with them the whole or a portion of the substances themselves.

The plasson bodies have recently been made to constitute a special field of scientific research, and as much by accident as otherwise, it has been occupied by the biologists instead of by the chemists. These, like judges on the bench, have constantly ruled in favor of their own jurisdiction, and it is in this way that these substances have come to be regarded as forms of life, although their biographers have from the first insisted that they are not organized beings. Perhaps this bit of history is not unfortunate, since it teaches us to disconnect the ideas of life and organization in the biological sense, and thereby directs our thoughts towards the most profound truth, both of biology and of chemistry, which is that life is the result of the aggregation of matter. A plasson body performs all the essential functions of a living organism. It is capable of motion, nutrition and propagation. To these Professor Haeckel adds sensation, for how can the other functions be conceived of without the aid of this one? But we might almost as well ask, how can a crystal grow without sensation. Nor has that great naturalist failed to perceive these extreme consequences of this extension of the biological jurisdiction, for he seeks to escape them only by pushing it still farther, and proclaiming the animation of all material atoms, even of the lowest orders—*die Atom-Seele.* It seems far simpler, as well as more correct, to recognize in protoplasm a true chemical substance, but one whose properties constitute the fundamental element of life.

Such a conclusion is no longer the bold speculation that it would have been pronounced a few years ago, and this paper could not be more fittingly concluded than with the words of Professor O. C. Marsh, uttered in 1877, that "if we are permitted to continue in imagination the rapidly converging lines of research pursued to-day, they seem to meet at the point where organic and inorganic nature become one. That this point will yet be reached, I cannot doubt."

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THE REPTILES OF THE AMERICAN EOCENE.

BY E. D. COPE.

REMAINS of *Batrachia* are rare in North American formations later than the Permian. There are two or three species of *Stegocephali* known from the Trias, above which formation that order is not known to extend in any country. No Batrachians have been obtained from the Jurassic or Cretaceous systems excepting from the top of the latter, in the Laramie. Here occur the salamandrine genera *Scapherpeton* and *Hemitrypus* Cope. A single specimen of a frog from the Eocene is mentioned below, and then we miss them until the Loup Fork or Upper Miocene, where *Anura* and salamanders have been found.

The vertebral column and part of the cranium of a probably incompletely developed tailless Batrachian, were procured by Dr. F. V. Hayden, from the fish shales of the Green River epoch, from near Green River City, Wyoming. They are not sufficiently characteristic to enable me to determine the relation of the species to known forms. It is the oldest of the order *Anura* yet discovered, the fossil remains of the known extinct species having been derived from the Miocene and later formations of Europe.

The Eocene period, was, of the divisions of the Tertiary, the most prolific of reptilian life. It is true that the orders of reptiles which characterized the Mesozoic periods no longer existed. The *Dinosauria* had perished from the land; the *Ichthyopterygia, Sauropterygia* and *Pythonomorpha* no longer inhabited the sea, and the *Pterosauria* had disappeared from the air. What occasioned the remarkable change in reptilian life at the close of the Laramie epoch can only be surmised. During that time the principal land population of North America consisted of *Dinosauria*, of which there were many species and genera. With the opening of the Puerco Eocene, these huge beasts had entirely disappeared, and a population of small and medium sized Mammalia took their place. The comparative feebleness of the new comers precludes the idea that they assaulted and drove out or killed the *Dinosauria*, or that they devoured their food and left them to starve. The only probable hypothesis must suppose that a change of climate ensued, either in a depression of the temperature, or in a desiccation of the atmosphere, which greatly reduced the amount of vegetable life. The large *Dinosauria* would perish from lack of food, where smaller animals could live. That there was a general desiccation at the beginning of the Eocene period in central North America is indicated by topographical evidence. It was towards the close of the Laramie that the elevation of the Rocky mountains was completed, and their greatest effect in retaining the clouds and rains, must have been apparent. Nevertheless, this effect could not have continued, since the later Eocene and Miocene epochs were rich in forests and animal life.

The Eocene reptiles were not a new creation, nor a new evolution, but a remnant of the types that had coëxisted with the monarchs of life during previous ages. We must except from this statement the serpents, which first appear in numbers at this time, only one cretaceous species having been found by Dr. Sauvage, in France. The crocodiles, tortoises, and lacertilians represent orders already abundant in the Mesozoic faunæ. Their decadence in Central North America did not commence until the Miocene period, when the crocodiles and nearly all the tortoises disappeared. From the Loup Fork or Upper Miocene, only a few traces of lizards have been obtained, and snakes were apparently not very numerous. On the eastern coast regions, crocodiles existed, and tortoises were more numerous during the Miocene period; but here also they were less abundant and varied than during the Eocene.

LACERTILIA.

Of lizards I have obtained the remains of a half dozen of species, but none of them in a complete state of preservation. Professor Marsh has been more fortunate, as he described from his material from the Bridger beds, twenty-one species.[1] He arranges these under five generic heads, as follows: *Thinosaurus* Marsh, five species; *Glyptosaurus* Marsh, eight species; *Xestops* Cope (1873, *Oreosaurus* Marsh, not Peters), five species; *Tinosaurus* Marsh, two species; and *Iguanavus* Marsh, one species. As Professor Marsh does not give us any clue to the affinities of these forms, they cannot be further considered here. In Lieutenant Wheeler's Survey Report[2] I have pointed out that the dermal scuta and a few other fragments which I obtained in the Wasatch beds of New Mexico, were probably referable to the *Placosauridæ*, a family created by Gervais to receive certain *Lacertilia* of the Eocene of France. To this family no doubt some of the species described by Marsh from the Bridger horizon are to be referred.

The Puerco epoch is characterized by the presence of the suborder *Choristodera*, of which one genus, *Champsosaurus* Cope, holds over from the Laramie Cretaceous. These were large and medium sized animals, somewhat resembling Crocodiles. They have, according to Lemoine, who has discovered them in France, ambulatory limbs, adapted for swimming.

OPHIDIA.

The snakes of the Eocene are not very numerous as to species.

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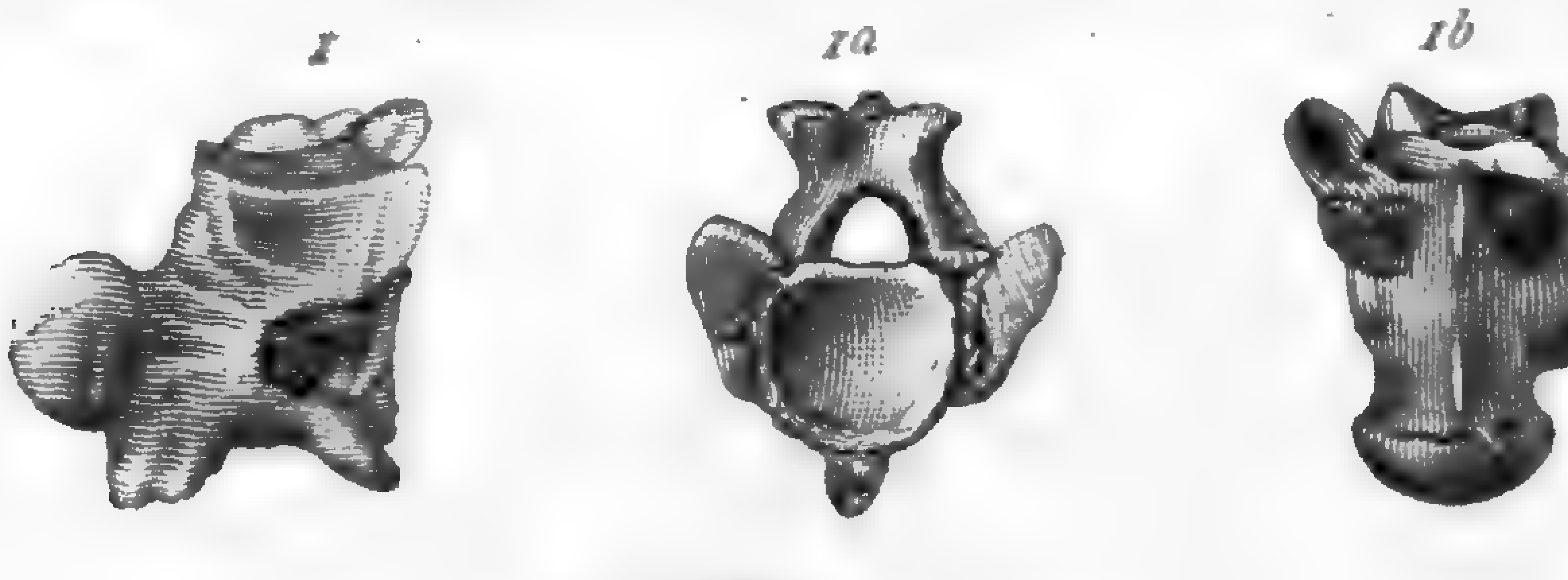

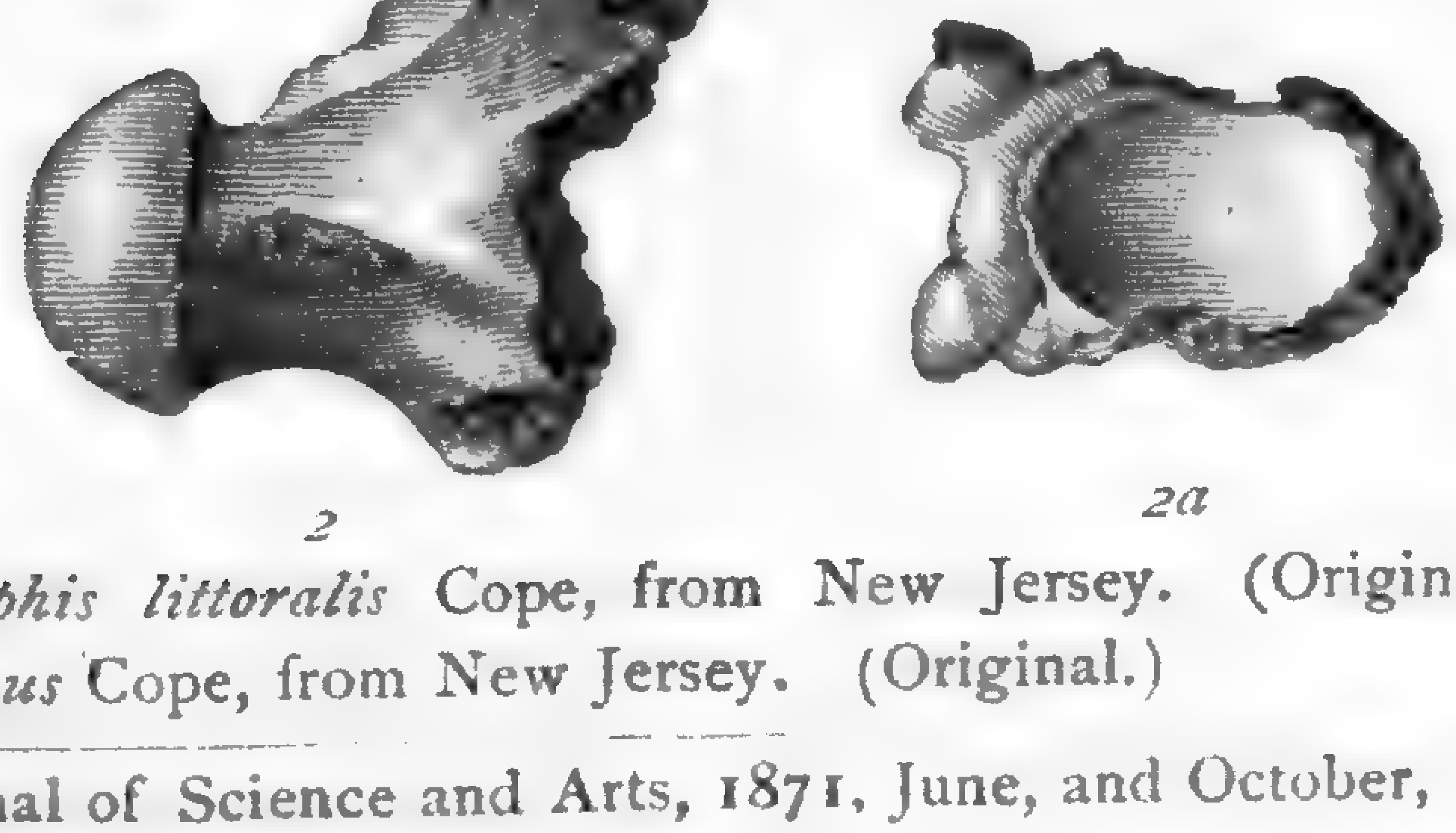

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FIG. 1.—*Palæophis littoralis* Cope, from New Jersey. (Original.) FIG. 2.—*Palæophis halidanus* Cope, from New Jersey. (Original.)

[1]American Journal of Science and Arts, 1871, June, and October, 1872.

[2]Vol. IV, pt. II, p. 42, pl. XXXII, fig. 26–36.

The first known American species (*Palæophis littoralis* and *P. halidanus*) were determined by myself from New Jersey specimens. None have been procured from beds lower than the Bridger, and in that formation I found a single form. Professor Marsh described five species.

Species of the genus *Palæophis* occur in the Eocene of England. They are supposed by Owen to be related to the Peropodous or Boæform families. They reached as large a size as the largest existing snakes. Other smaller Eocene species are said to have similar affinities.

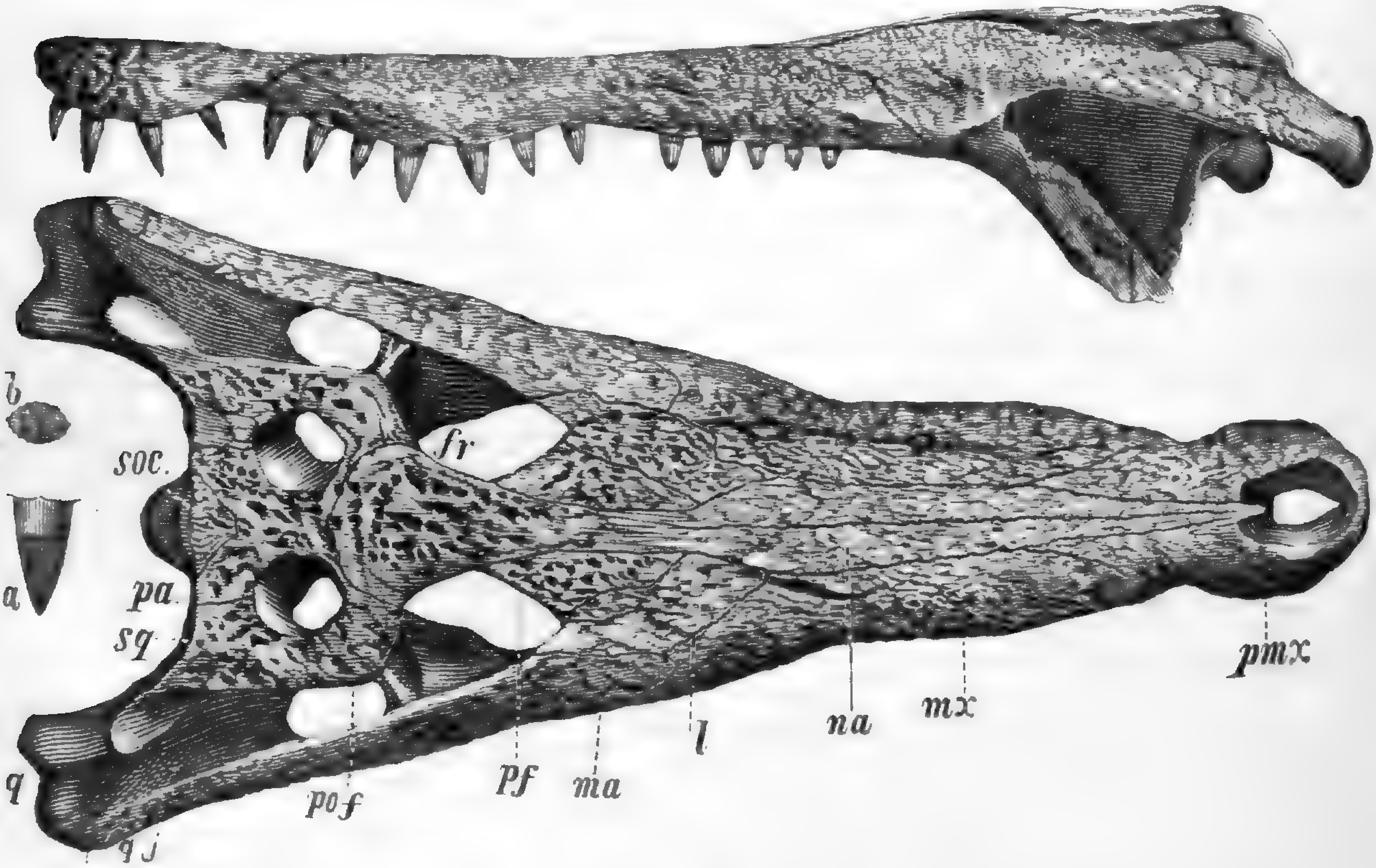


FIG. 3.—Skull of *Crocodilus acer* Cope, from Utah, nearly one-third natural size, lateral and superior views. FIGS. *a* and *b*.—Lateral view and section of a maxillary tooth. *Pmx*, premaxillary bone; *mx*, maxillary; *na*, nasal; *l*, lachrymal; *pf*, prefrontal; *ma*, malar; *fr*, frontal; *pof*, post-frontal; *pa*, parietal; *soc*, supraoccipital; *sq*, squamosal; *q*, quadrate; *qj*, quadratojugal. (Original.)

CROCODILIA.

The fauna of the Eocene periods of the United States included a number of species of *Crocodilia*, some of which were represented by great numbers of individuals. They were equally numerous in the Wasatch and Bridger epochs, but none have been found in the Green River formation proper. They are moderately abundant in the Wind River beds, and a species is known from the Manti beds of Utah. None are known from the Miocene formations east or west of the Rocky mountains, but they are not rare in the marine Miocene of the Atlantic coast. All the species belong to two genera, *Plerodon* Meyer, and *Crocodilus* Linn. One species of the former is found in the Wasatch beds, with three or four species of *Crocodilus*. In the Bridger beds I know of six species of the latter genus.

It is a fact that the American genus *Alligator* is nowhere found in the Tertiary formations of our continent. It is evident that it is a specialized form of *Crocodilus*, which first appeared in Europe in Tertiary times, and subsequently in this country.

CROCODILUS Linn.

The Eocene species of true crocodiles differ much in size and characters, ranging from the *C. heterodon*, which is not larger than an *Iguana*, to the *C. antiquus* and *C. clavis*, which rival the existing species of the East Indies.

The species are divided into two sections, which are distinguished by the form of the frontal bone. In the one it is thin, and has low lateral olfactory crests. Such species are as yet only known from the Wasatch formation. They are the *C. grypus* Cope and *C. wheeleri* Cope. The species of the second section have massive frontal bones with strong lateral olfactory crests. The *C. heterodon* of the Wasatch belongs here; also the *C. elliottii* of the Bridger, and the *C. clavis* of the Washakie basin. The frontal bones of several of the species are unknown. The species may be also distinguished by the sculpture of their teeth, some having the crowns grooved or channeled, and others having them smooth or finely lined. Of the former kind are *C. subulatus* Cope, *C. acer* Cope and *C. sulciferus* Cope; all the other species come under the second head. The *C. squankensis* Marsh, from the Eocene of New Jersey has the enamel peculiarly rugose. A peculiarity of the composition of the crowns of some of the species has been noticed, on account of which I proposed a genus, *Thecachampsa*. In this type the crown is composed of concentric hollow cones, one within the other. I have not been able to separate the crowns of the recent crocodiles into such bodies, and they are generally too thin to display more than a very few such layers, were they so separable. This character was first observed in some species of the Atlantic Coast, *e. g.*, *C. antiquus* Leidy, and

C. squankensis Marsh; and the two Eastern Miocene species, *C. sericodon* Cope (type of *Thecachampsa*) and *C. sicaria* Cope.

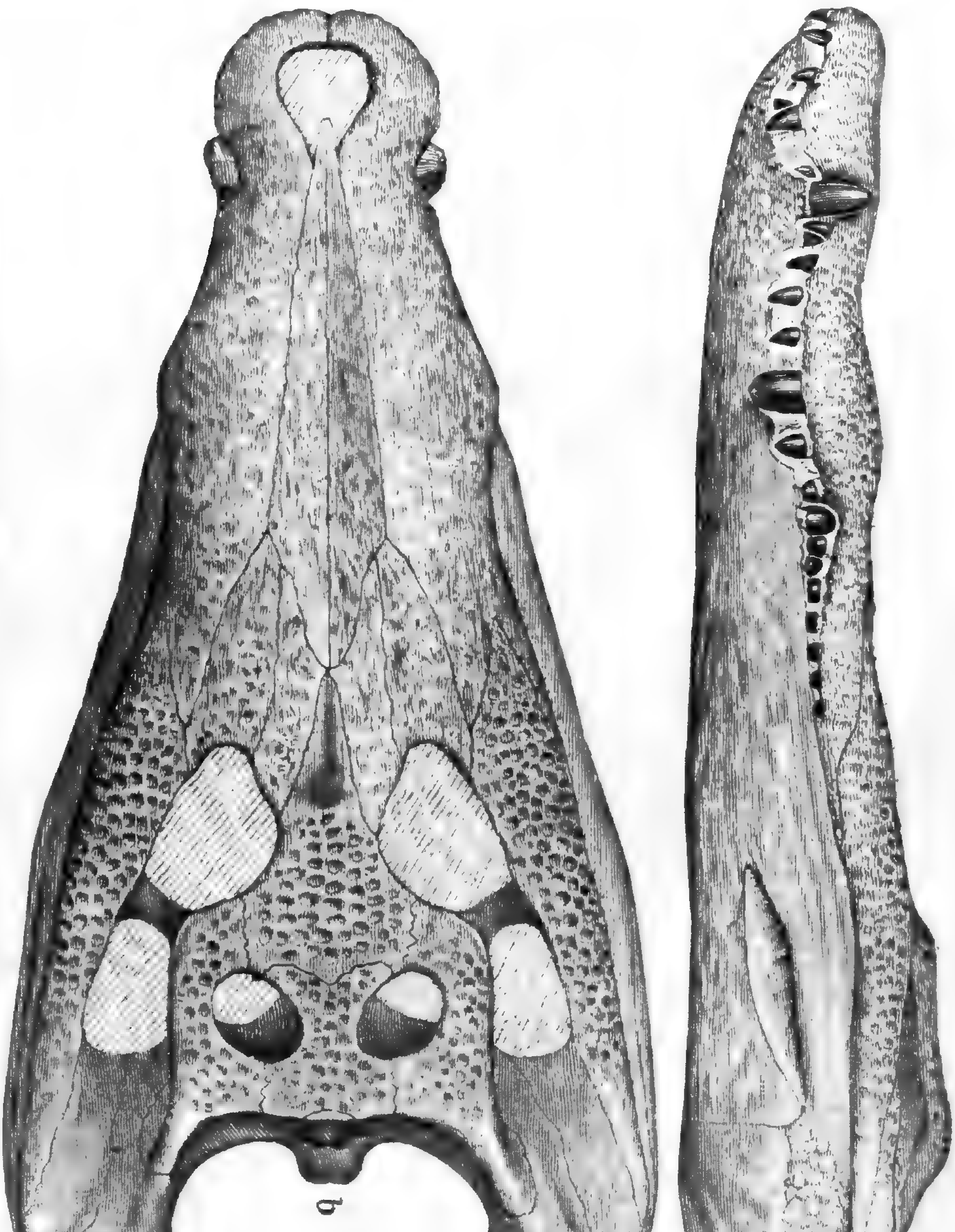


FIG. 4.—*Crocodilus affinis* Marsh, from Wyoming, nearly one-third natural size, lateral and vertical views. (Original.)

The forms of the crowns vary considerably. In nearly all Crocodilia the posterior teeth have short and obtuse crowns; but in *C. heterodon* Cope, this character is carried very far. The

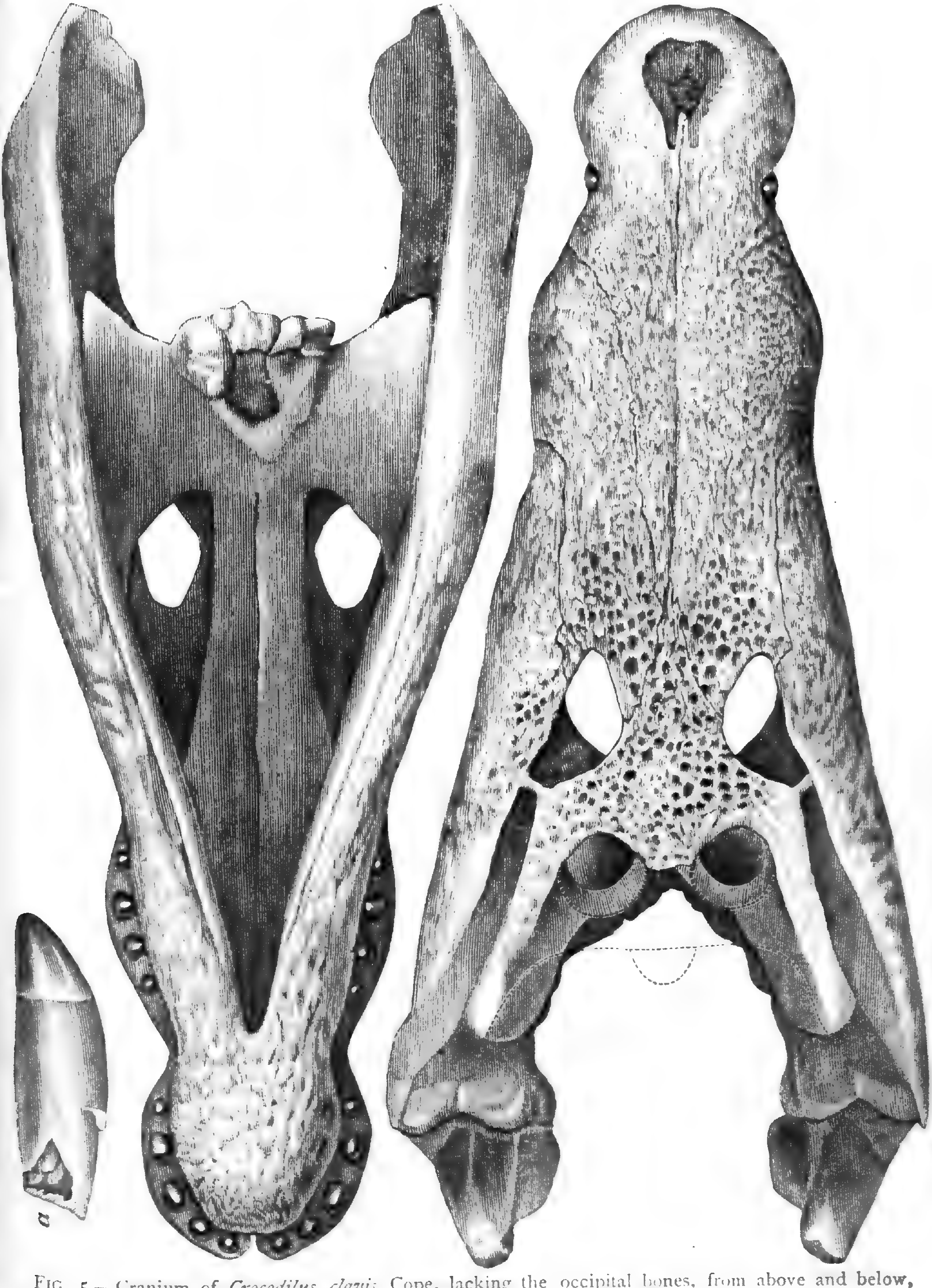


FIG. 5.—Cranium of *Crocodilus clavis* Cope, lacking the occipital bones, from above and below, less than one-eighth natural size. *a*.—A maxillary tooth, one-half natural size. (Original.)

posterior crowns are oval, bean-like bodies, with a median line from which fine incised lines radiate.

Species with obtusely conic crowns are *C. antiquus* Leidy; *C. clavis* Cope; *C. elliottii* Leidy; and *C. affinis* Marsh. *C. subulatus* Cope has the crowns acutely conic and curved or straight, while in *C. acer* Cope, they are compressed and have cutting edges. Finally, in *C. xiphodon* Marsh, they are much compressed and sharp-edged.

The *Crocodilus (Thecachampsa) serratus* Cope, of the New Jersey Eocene, presents the remarkable peculiarity of a finely serrate ridge along the middle line of the front and back of the neural spines of the vertebræ.

In *C. heterodon* the osseous scuta of the back are articulated together by suture, as in some of the alligators.

Plerodon Meyer.

This genus only differs from *Crocodilus* in the presence of two large teeth in each jaw in the position usually occupied by the single so-called canine tooth. It includes the *P. rateli*, an abundant species in the French Miocene. I detected a species in the Wasatch formation of New Mexico, the *P. sphenops* Cope. It is about the size of the alligator, and has a narrow muzzle.

The following list shows the distribution of the Eocene crocodiles now known:

Puerco epoch. Three species undetermined.

Wasatch epoch. *Crocodilus wheeleri, C. grypus, C. heterodon, C. acer.*

Bridger epoch. *C. subulatus; C. sulciferus; C. xiphodon; C. polyodon; C. affinis; C. elliotti; C. clavis.*

Claiborne epoch (marine). *C. antiquus; C. fastigiatus; C. squankensis; C. serratus.*

In general characters, so far as known, there is considerable resemblance between the Eocene and existing species of *Crocodilus.* The *C. acer*, for instance, resembles in the form of its skull the *C. americanus*, of the West Indies and Mexico, but differs in the absence of the strong convexity of the frontal bone, and the more strongly grooved teeth. In general, the recent species have more pronounced cranial ridges than those of the Eocene period.

Testudinata.

The Eocene forms of this order are of unusual interest. I have seen sixteen species from the Wasatch formation, and thirty-two from the Bridger and Washakie. Of these, six are common to the two formations, as indicated by imperfect material, leaving a total of forty-two. Three genera, *Emys*, *Trionyx*, and *? Plastomenus* hold over from the Cretaceous period, while six appear for the first time. Of these, five genera are not known to continue later than the Eocene period. In order to understand their relation to members of the order which lived in other periods, I give a general sketch of the classification of the *Testudinata*.

Three primary divisions of this order are generally recognized. The first of these, the *Athecæ,* includes one living and one extinct genus. It is characterized by the absence of the combined coössification of ribs and skin, which form the carapace of other tortoises, and by the annular shape of the inferior shell or plastron, which has no connection with any other part of the skeleton. In the recent genus *Sphargis* (the leather-back turtle), the skin is filled with small osseous plates, which form by their union a dorsal shield.

The other two suborders have the usual carapace and plastron, but they differ in some curious particulars. The greater number of the tortoises of the southern hemisphere cannot draw their heads into their shells, but throw them round sideways when they wish to protect themselves. As if to compensate for this defect, they have the pelvis united by suture below to the plastron, which insures strength but not elasticity. Then they have a peculiar frontal bone, and an additional scutum of the front of the plastron. This group is called the *Pleurodira*. In North America its species are only known as fossils of the Cretaceous period, and will therefore not be further mentioned here. The group which has characterized the Northern Hemisphere since the beginning of Tertiary time, although some of its members appeared earlier, is the third division of tortoises, the *Cryptodira* of Duméril and Bibron. They draw the head within the shell by a sigmoid flexure of the cervical vertebræ; the pelvis is not coössified with the plastron; the frontal bone reaches the palatine below, and there is no additional scutum of the plastron.

Three prominent divisions or tribes may be recognized among the *Cryptodira*, by the various modes of articulation of the plastron with the carapace. In the first, the breast-plate sends out a few digitations to the edge of the dorsal shield on each side, but forms no true union with it. These are the *Dactylosterna*.[1] The species are all aquatic, and many of them of marine habitat; they are the least specialized of the order, after the *Athecæ*. In the second tribe or *Clidosterna*, the plastron and carapace are united by a close suture at their edges of contact between the positions of the fore and hind legs; and the plastron in addition, sends upwards, at the armpit and groin, on the inner side of the carapace, a process or abutment, which gives great strength to the union. In this division belong the fluviatile and many land

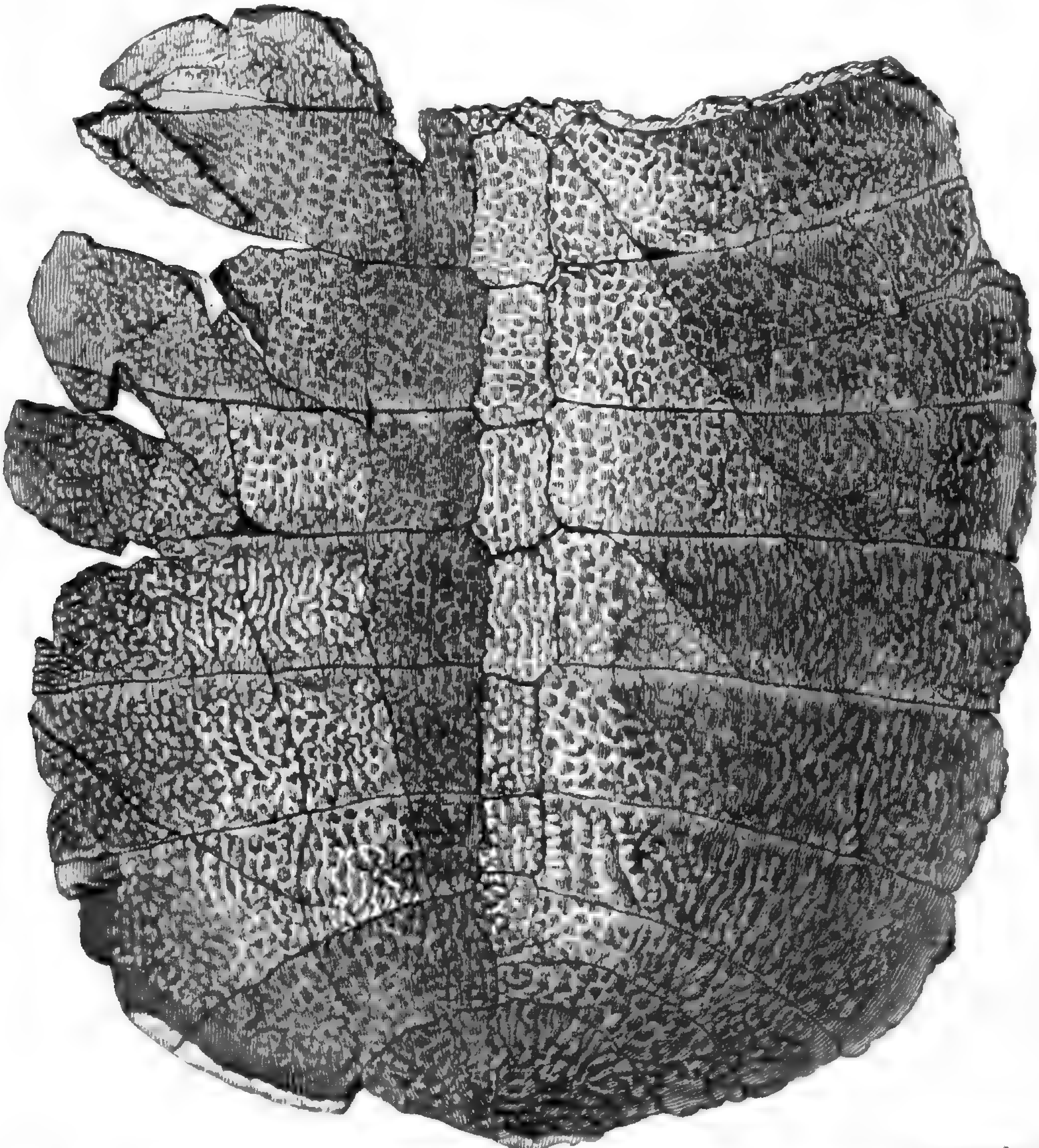


Fig. 6.—*Trionyx scutumantiquum* Cope, from the Bridger formation of Wyoming, one-fourth natural size. (Original.)

tortoises. The third division, or *Lysosterna*, is less abundantly represented by species than the other two. The plastron and carapace are closely joined, but not by suture. Their straight

[1] See Proc. Amer. Philos. Society, 1881, p. 143.

applied edges are separated by a thin layer of cartilage only, and there are no buttresses to strengthen the union. These are the tortoises which close the shell partially or wholly, by a hinge across the middle of the plastron; and they are exclusively inhabitants of the land.

The families of the *Dactylosterna* are the marine turtles (*Cheloniidæ*), the snappers, (*Chelydridæ*), a family which connects the two, (*Propleuridæ*), and the *Trionychidæ* or soft-shelled turtles. The *Propleuridæ* belong to the cretaceous beds only, but the others abound in the Tertiaries.

In the marine Eocene of New Jersey, parts of huge turtles are found, but enough is not yet known of them to assure us to

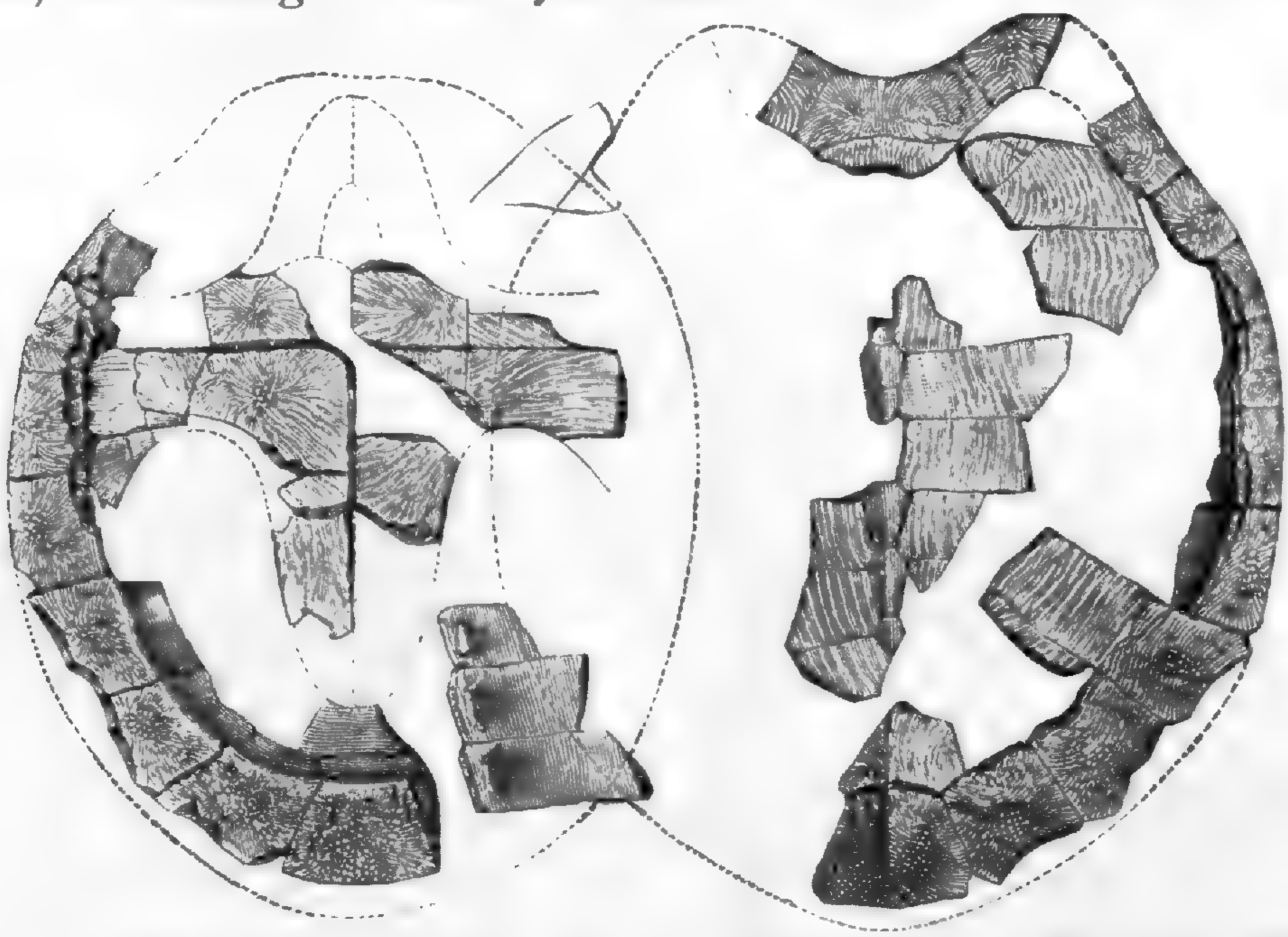


FIG. 7.—*Anostira ornata* Leidy, from the Bridger beds of Wyoming, one-half natural size, superior and inferior views, with section of marginal bone. From Leidy.

what family they belong, except that they are not *Trionychidæ*. The sutures of their shells are very deeply interlocking and splintery. They form the genus *Lembonax* Cope.

In the lacustrine Tertiaries of the West the only families of *Dactylosterna* represented are the *Trionychidæ* and *Chelydridæ*. Although found in the Western rivers at the present time, the *Trionychidæ* are only represented in a fossil state in the Eocene beds. They are unknown in the Miocene of the West, though common in the marine Miocenes of the coast. Species of *Trionyx* are very abundant in the Wasatch and Bridger beds, one of which is represented in the wood cut, Fig. 6. One genus of *Chelydridæ* occurs in the Bridger formation, the *Anostira* of Leidy (Fig. 7). Its two species differ from the existing snappers in having the marginal bones of the carapace united by suture with the plastron, in which they resemble *Clidosterna*, and in being elegantly sculptured as in the *Trionychidæ*.

The *Clidosterna* are represented by three families, the *Baënidæ*, the *Emydidæ*, and the *Testudinidæ*. The first named family is of much interest, as it displays marked points of resemblance with the *Pleurodira* and the *Chelydridæ*, as well as with *Emydidæ*. Like the first named, it has the additional scuta of the plastron (integulars); like the second, it has the caudal vertebræ concave behind instead of in front, and has an additional row of scuta on the plastron, in contact with the marginals of the carapace. Then it has an additional bone on each side of the plastron (intersternal) as in *Pleurodira*. This family appeared in Europe in the Jurassic period (*Platychelys*), and has been found in the American Laramie Cretaceous (*Polythorax* Cope). In the Eocene we have the genus *Baëna* Leidy, with four species, one of which is figured below

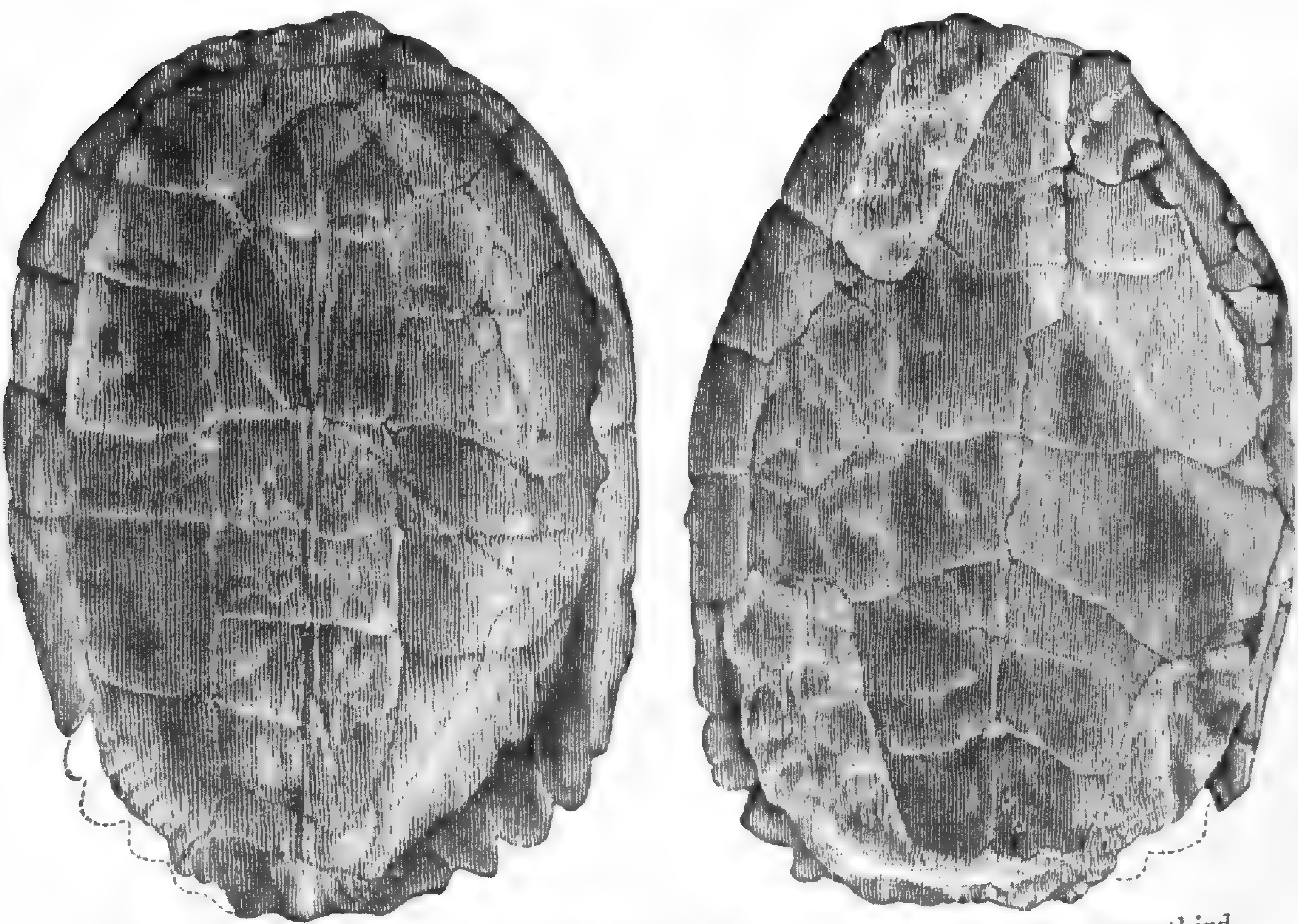


FIG. 8.—*Baëna arenosa* Leidy, from the Bridger beds of Wyoming, one-third natural size. (Original.)

(Fig. 8). Species of *Baëna* range from the size of a red belly (*B. arenosa*) to that of a loggerhead (*B. hebraïca*). The genus is only known in the Wasatch and Bridger.

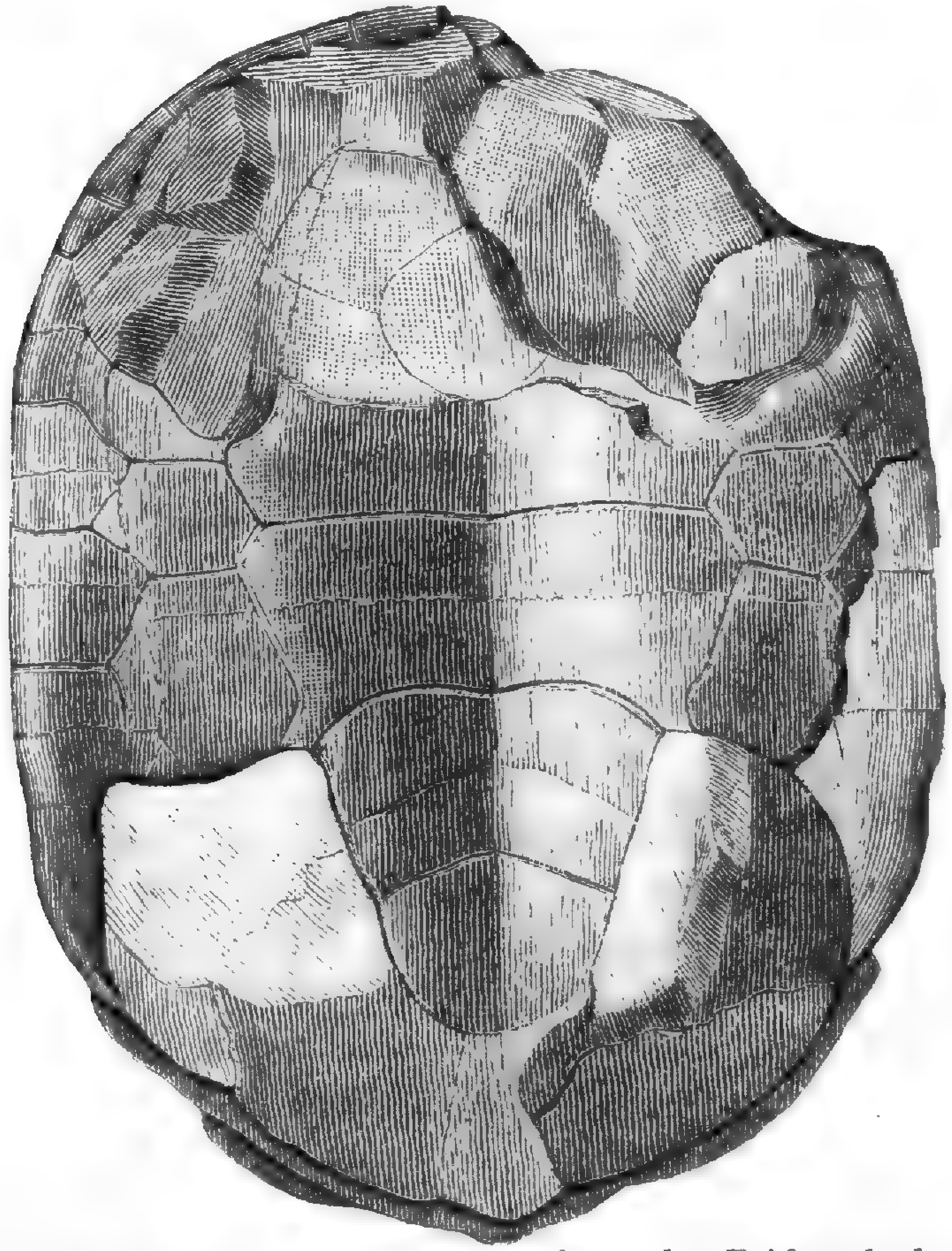


FIG. 9.—*Dermatemys wyomingensis* Leidy, from the Bridger beds of Wyoming. (From Leidy.)

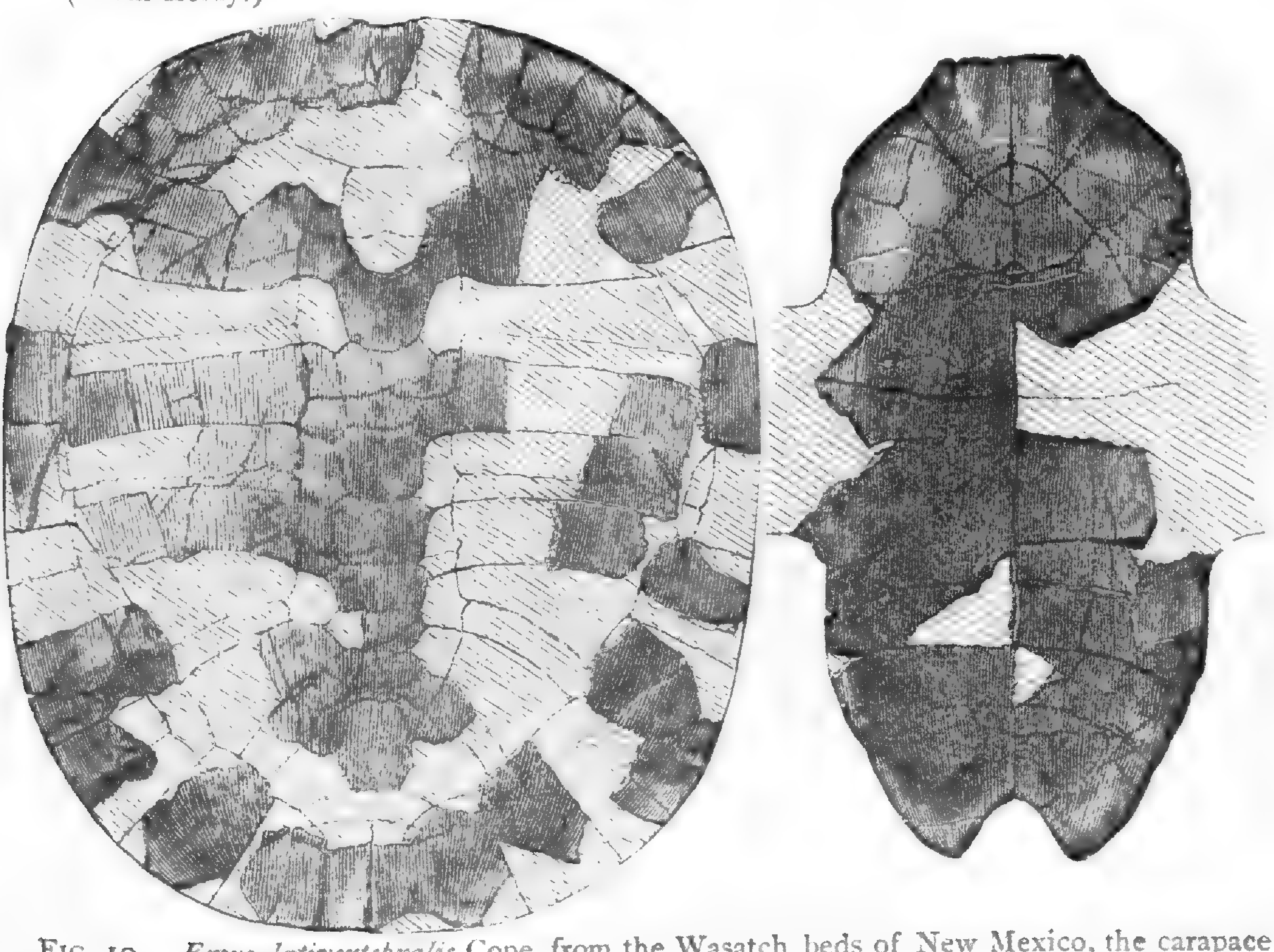


FIG. 10.—*Emys lativertebralis* Cope, from the Wasatch beds of New Mexico, the carapace from above and the plastron from below, one-third natural size. (Original, from Report of Wheeler's Survey, Vol. IV.)

The *Emydidæ* abound in the Eocene beds, and continue in greatly reduced numbers through the Miocene to the present time. But two genera occur in the Eocenes, *Dermatemys* and *Emys*, and these still exist. *Dermatemys* is known by two species, one from the Wasatch, and one from the Bridger (Fig. 9), and by two or three living species from Mexico and Central America. These tortoises have the general appearance of the *Baënæ*, in their narrowed sternal lobes, but they lack the essential characters of that genus, except the intermarginal row of scuta on the sides of the plastron. There are many species of *Emys* in all the Eocene beds. They are all nearly smooth, and of medium size, Fig. 10 represents one of them from the Wasatch bed of New Mexico. Its bones are light and thin; those of *E. shaugnessiana* Cope, are very thick. The surface of *E. septaria* Cope, from the Washakie basin, has delicate radiating lines.

A number of elegantly sculptured species, some of which are of small size, occur in the lacustrine Eocenes. They belong to the genus *Plastomenus* Cope, and they are not yet sufficiently well known to make it clear whether they are *Emydidæ* or not.

One genus of *Testudinidæ* ranges through our Eocenes. This is *Hadrianus* Cope, which only differs from *Testudo* in having two anal scuta instead of one, so far as the carapace is concerned. There are, perhaps, three species, two of which, *H. corsoni* and *H. octonarius*, grow to a large size (Fig. 11–13). They were heavy animals, and represent the earliest of the huge land tortoises of the genus *Testudo*, which still people the Gallapagos and Mascarene islands of the Pacific ocean.

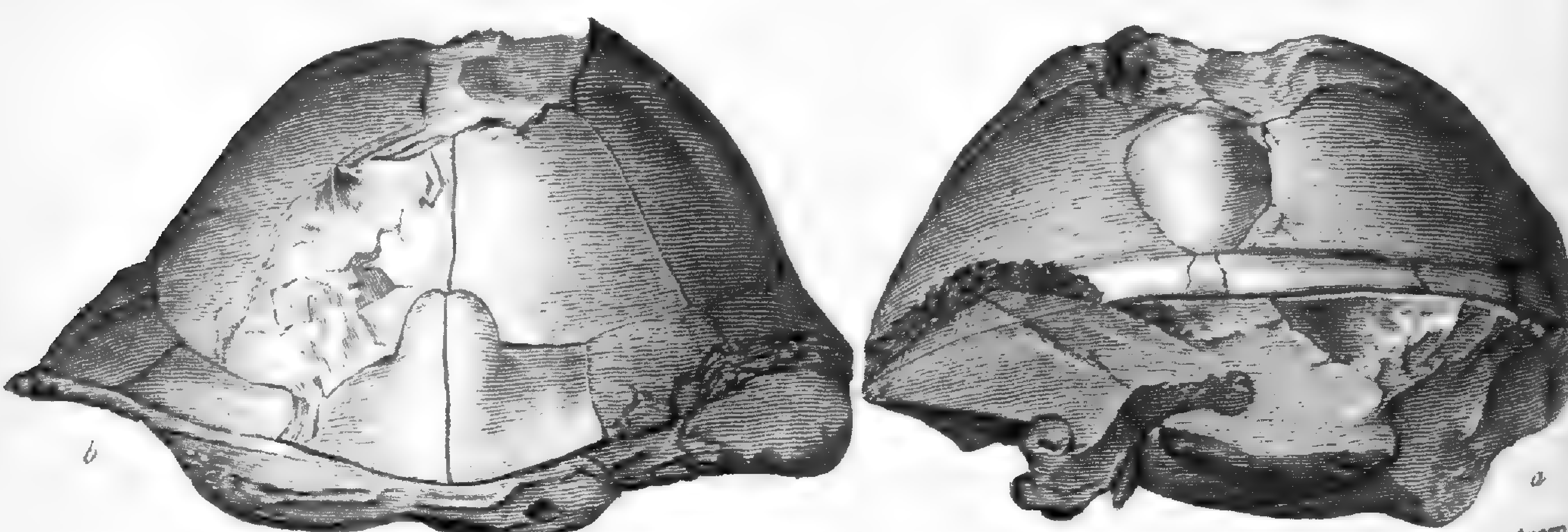


FIG. 11.—*Hadrianus octonarius* Cope, from the Bridger bed of Wyoming, one-eighth natural size extremities *a* anterior, *b* posterior.

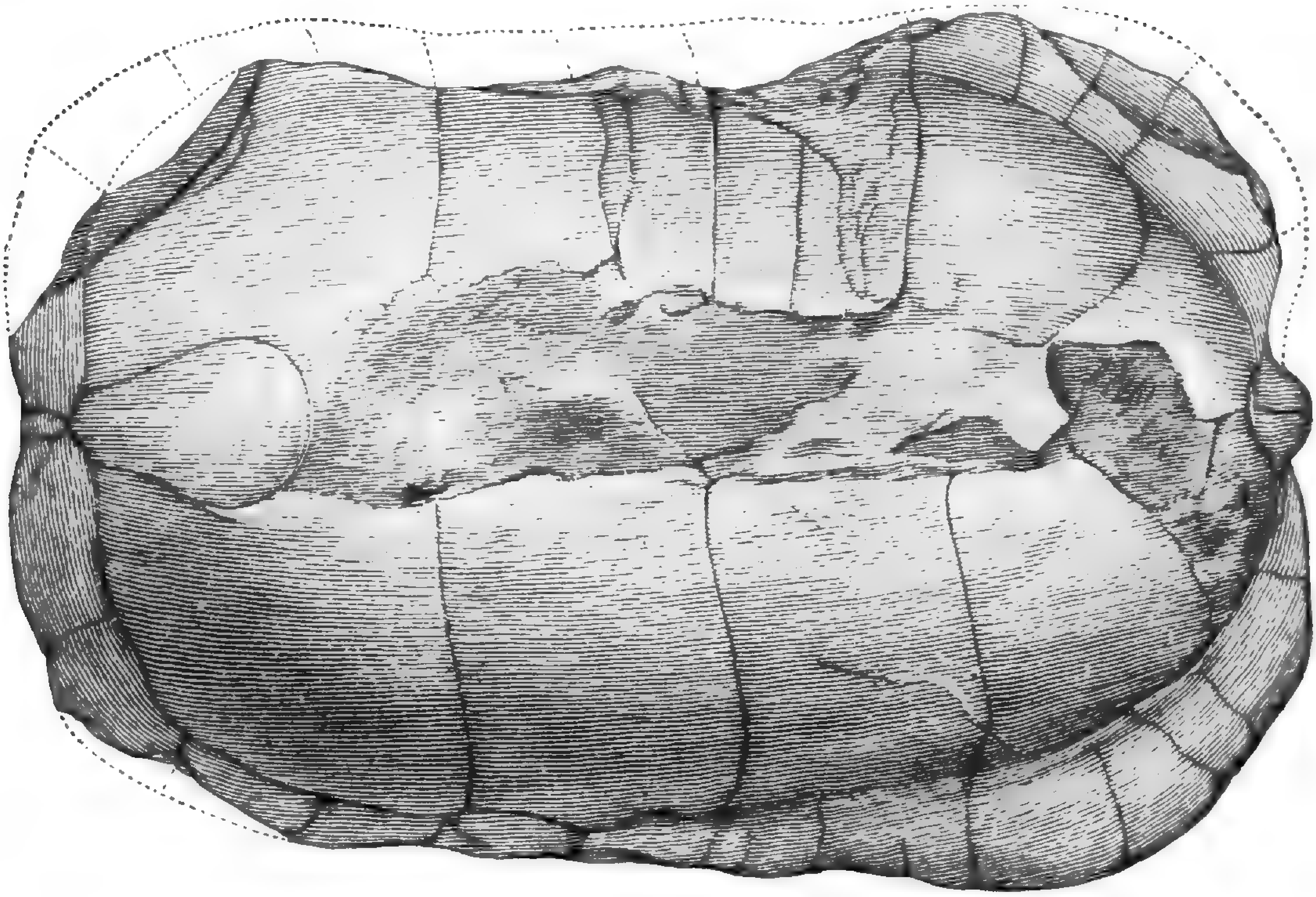
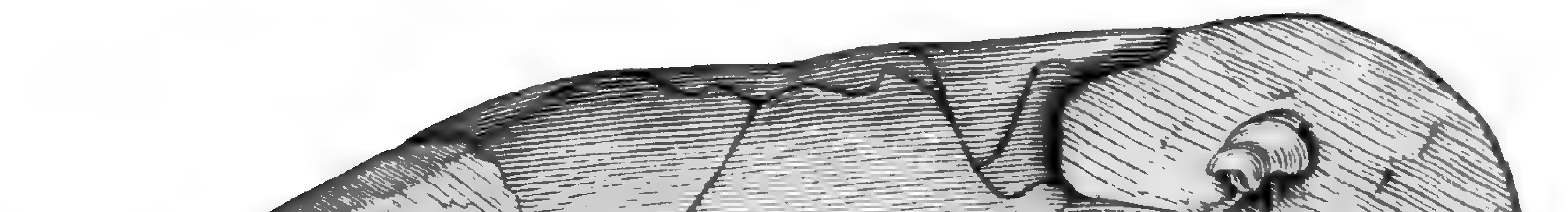


FIG. 12.



FIGS. 12–13.—*Hadrianus octonarius* Cope, from the Bridger bed of Wyoming. Fig. 12.—Superior view. Fig. 13.—Inferior view, one-eighth natural size.

The whole number of species of reptiles thus far discovered in the Eocene of North America, is as follows:

Crocodilia	18
Testudinata	42
Lacertilia	25
Ophidia	6
	91

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

——The question of the admission of women to our universities periodically agitates the controllers of those institutions, as new sets of female aspirants present themselves. This will no doubt go on until women have the same opportunities as men for higher education. The reasons why they should not enter the universities, as presented by those who oppose their claims, do not appear to us to possess much weight. The diversity of the objections is curious. On the one hand, we are told that the inferiority of the sex is such that university advantages are useless to them. Others insist that the superiority of women is so great that they should not be exposed to the vicissitudes of the student life. Some are afraid of "unsexing" them; others fear that they will be unfitted for the duties of domestic life.

We believe these estimates of woman's character to be mistaken, and the fears to which they give rise to be groundless. The relative position of the female sex was fixed before the origin of mankind, and it will not be readily changed in any material respect. When there is a prospect of changing the anatomy and physiology of woman, the possibility of "unsexing" her will present itself, and not sooner. It is the ignorance of this fact that gives rise to much of the solicitude which we hear expressed. There are a few abnormal individuals of each sex, whose sex characters are not pronounced, but this irregularity is very apt to right itself in a second generation, if any there be. For the mass of both sexes the obvious necessity is to make the most of them, intellectually, affectionally, and physically. The policy towards woman has too often been to dwarf them in one or all of these respects. In the East the physical and emotional are encouraged, and the intellectual is suppressed. In the West the physical is discouraged, shall the intellectual be so also? To suppress the intellectual development of woman, argues ignorance of his own position on the part of man. This ignorance gives rise to unmanly fear, and to injustice to his own children, and to the race. Women cannot be too highly developed, and the mind cannot be omitted from a true development. As men are the sons of women, they lose nothing by the education of their mothers. Compulsory education is quite as much needed for women as for men, and good results might be anticipated were it applied.

There are some objections to coeducation, but they are more than counterbalanced by the necessities of the case. It is true that women attain maturity earlier than men; hence they frequently outstrip male students in college and university competition. Were the competition postponed a decade in the lives of each, the results would generally be different. In fact, the objection is not a serious one, for the girls may be classed at school with older boys, as they are to be with older men in later years. If girls and women are to have university education, they must share it with men, for there cannot be two sets of buildings and two faculties for the two sexes, where one will do the work.

A different class of objections is raised from the supposed risks to propriety and morality incident to the association of the sexes in a large educational institution. As university students are generally supposed to be beyond the age of tutelage, these objections are not more applicable than to single women in other walks of life. Those who have had a proper home education are not likely to give ground of complaint, and those who have not received such training, are not likely to do better by exclusion from university education. On the contrary, such education must give them a better knowledge of men and their relations to them. And the more that is known of the facts of this question by both sexes, the better. They will discover that there are boundaries set by natural law, beyond which neither sex can pass without suffering of body or mind; and that in this, as in every other relation of life, "honesty is the best policy."

Finally, women should have university education to open to them additional avenues for obtaining a livelihood. Those who oppose it are unwittingly sustaining the too large numbers of prostitutes, incapable wives, and under-paid working women.—*C.*

—— The *Atlantic Monthly* for October has an excellent article, by Mr. Hewett, on the administration of universities. It shows what has long been obvious, that the existing American system is a bad one, and that its faults are chiefly due to the fact that the faculties have no share in the government of our great schools. Mr. Hewett points out the self-evident fact that the persons best adapted for the management of educational institutions, are practical educators, *i. e.*, professors and teachers. We hope that trustees and incorporators of our universities will more and more see the necessity of selecting their new members from this class, so that in time something more like the German system may prevail in America.

—— In criticising, in our last number, the determination of the Mammalia, said by Professor Whitney to have been found accompanying the Calaveras skull, we do not wish to be understood as doubting the determination of the age of the skull itself. There is good reason for believing that skull to have been buried at the period of the deposition of the gold-bearing gravel, in which it is said to have been found.

RECENT LITERATURE.

LANKESTER ON DEGENERATION.[1]—Mention should have sooner been made of this book, which, with the previously published essay by Dr. Anton Dohrn,[2] draws attention to a phase of development, which has been somewhat neglected of late years; although the French naturalists a generation ago had a good deal to say about arrest of development, retrograde development and retrograde metamorphosis. The author recognizes the fact that there are numerous and important exceptions to the general law of progressive development, that some important groups are due to retrogressive development, or to put it into one word, Degeneration. Lankester explains what he means by degeneration thus: The lizard-like creature Seps has remarkably small limbs, and in Bipes there is only a pair of stumps, representing the hinder limbs. No naturalist, he says, doubts that Seps and Bipes represent two stages of degeneration, or atrophy of the limbs; that they have, in fact, been derived from the five-toed, four-legged ordinary lizard form, and have nearly or almost *lost* the legs once possessed by their ancestors.

"This very partial or local atrophy is not, however, that to which I refer when using the word Degeneration. Let us imagine this atrophy to extend to a variety of important organs, so that not only the legs, but the organs of sense, the nervous system, and even the mouth and digestive organs are obliterated,—then we shall have pictured a thorough-going instance of Degeneration."

The examples of degeneration given by the author need only to be mentioned, as they are sufficiently striking, and are universally regarded as such. These are the groups of which Sacculina and Peltogaster, Lernæa and Lepas are examples. The Ascidians are regarded as the result of such a process, and their most important stages of degeneration are represented and briefly discussed, though the figure of the larval Ascidian side by side with the tadpole, on p. 42, is greatly exaggerated, *a la* Haeckel, and is misleading to the lay-reader. The author also speaks of the Ascidians as if they were universally regarded by zoölogists as Vertebrates, whereas they are regarded as Mollusks by some, and as worms by many.

The author considers the antecedents of degeneration to be[3]: 1. Parasitism; 2. Fixity or immobility; 3. Vegetative nutrition; 4. Excessive reduction in size.

Lankester also regards the sponges as due to degeneration, and "as only somewhat less degenerate we have all the Polyps and

[1]*Nature Series. Degeneration.* A chapter in Darwinism. By Professor E. RAY LANKESTER, F. R. S. London: Macmillan & Co., 1880. 12mo, pp. 75. Price, 75 cents.

[2]Der Ursprung der Wirbelthiere und das Princip des Fanctionswechsels. Genealogische Skizzen von Anton Dohrn. Leipzig, 1875. 8vo, p. 87.

[3]See also Cope, Consciousness in Evolution, 1875, and Modern Doctrine of Evolution, AMER. NATURALIST, 1880, 266.

Coral-animals; also the Starfishes." He regards the Lamellibranchiate mollusks as having degenerated from a higher type of head bearing active creatures like the cuttle-fish. The Polyzoa he appears to regard as degenerate mollusks, and the Rotifers as having degenerated from forms provided with legs.

The author then claims that certain human races are degenerated descendants of higher, more civilized peoples; such as the present descendants of the Indians of Central America, the modern Egyptians, "and even the heirs of the great Oriental monarchies of prae-Christian times," while the Fuegians, the Bushmen, and even the Australians may also be degenerate races. Thus while he is indisposed to regard all the human races as degenerated from an early high type of mankind, he recognizes the fact that numerous races have fallen away from a higher stage.

We are inclined to think that the examples of degeneration mentioned by the author are really such. There are other examples not referred to by Professor Lankester, such as the lice and Mallophaga, which are degenerate Hemiptera. Among the Diptera are numerous wingless degraded forms, and when we take into account the fact that nearly all Dipterous larvæ are nearly headless and evidently degenerated forms, we are inclined to think that the entire group of Diptera, numbering at least 20,000 species, are the result of a retrograde development; the Tipulidæ may be an exception, but we were before reading this book disposed to regard the entire order as having degenerated from a lost type, with close affinities to the lower Lepidoptera.

GEIKIE'S PHYSICAL GEOGRAPHY.[1]—Professor Geikie, the author of this little book, formerly held the chair of geology in the University of Edinburgh, but is now director of the Geological Survey of Great Britain. As an authoritative text book this publication, therefore, needs from us no recommendation; but besides that, it is written in a clear, graphic, attractive style, and the matter is well arranged. We have found the book more useful for teaching purposes than any other. It full enough and readable enough to attract and win the scholar's attention. There are some, though but few, points which in a subsequent edition might be revised; to the *Challenger's* soundings in the Pacific ocean might be added the results of the U. S. steamer *Tuscarora*, from San Francisco to Honolulu and Japan, also the results of the U. S. Coast Survey soundings in the Caribbean sea, and the origin and depth off Florida of the Gulf Stream. The author has devoted more space than is usual in similar class-books to the phenomena of the atmosphere, but the treatment of the whole subject is throughout broad and catholic.

[1] *Elementary Lessons in Physical Geography.* By ARCHIBALD GEIKIE, LL.D., F.R.S. Illustrated with wood-cuts and ten plates. London and New York, Macmillan & Co., 1881. 12mo, pp. 375. $1.

Geikie's Geological Sketches.[1]—This collection of essays, by one of the foremost geologists of the day, not only contains some matter of purely geological interest, but will serve, by the genial spirit and clear, attractive literary style of the author to attract the notice of that large and increasing class in the community—our general readers. The study of geology has gained new interest and fascination in these latter days in connection with biological questions, and from the fact that no tourist can travel through a land and appreciate the nature of its people, without taking into account the qualities of the soil they inhabit. While writerst like Buckle and perhaps Taine have carried to an extreme the independence of man and nature, overlooking the social and moral forces, as well as the laws of heredity; how dependant the making of a people like the English, for example, has been upon the physical geology of Great Britain is well brought out by Professor Geikie in the closing sketch of this book—a chapter which will, perhaps, interest the thoughtful reader as much as any in the book.

Again, fresh attention is being called, especially by some American and Canadian geologists, to the pervasive and powerful agency of so simple a geological agent as rain in eroding lake basins and river valleys; this hitherto not sufficiently appreciated agent having been kept too much in the background by extreme glacialists. The effect on the mind of so good and fair an observer as our author, of the results of atmospheric erosion in the volcanic region of Auvergne in France, bears the strongest and clearest testimony to the past as well as present intensity of pluvial forces, which have done nearly, if not quite as much as plutonic agencies in making our earth what it is.

But none the less is Professor Geikie on proper occasions, a staunch glacialist, and in the interesting record of his Norwegian journeys, we have fresh confirmation by an expert, of the well-grounded theory that laid ice once capped Scandinavia as well as Scotland, the present representatives being but pigmies compared with the former rivers of ice, which filled and remolded, aided by subglacial streams, the valleys of Northwestern Europe.

In the essay on rock-weathering we have further evidence that it will not do to build public structures of freestone or marble in northern countries like Great Britain or the Northern United States.

Professor Geikie's record of his rapid journey to Montana and the Yellowstone Park, which have been widely read and appreciated, find here a place of permanent preservation, and the stimulus of foreign observation and travel in the mind of one brought up in so small and isolated a geological area as the British Isles,

[1] *Geological Sketches at Home and Abroad.* By **Archibald Geikie, LL.D., F.R.S.** Director General of the Geological Surveys of the United Kingdom, with illustrations. New York, Macmillan & Co., 1882. 12mo, pp. 332.

is perceptible in the succeeding chapter on the lava fields of Northwestern Europe.

TREAT'S INJURIOUS INSECTS OF THE FARM AND GARDEN.[1]—One of the most hopeful signs of improvement in agriculture is the increased attention that is paid to injurious insects, the depredations of which have for many years attracted attention from entomologists, have at length forced themselves upon the notice of legislatures, and are now at last beginning to awaken the agricultural mind to the importance of the study of the life-history of the pests, with a view to combating them. In the words of the author, "There is a surprising lack of knowledge among otherwise well-educated people as to the life-history of even the most common insects. The question asked not only by those in my immediate neighborhood, but by letters from all parts of the country, show how slight is the popular knowledge on this most important branch of Natural History." Too true—even a non-entomologist finds himself surprised at the vastness of the ignorance, yet the mere asking questions is a great advance upon the state of mind that referred a plague of caterpillars to the providence of God.

In the two hundred and eighty pages of this little book all those insects that have developed into conspicuous pests are figured and described in terms sufficiently simple for the comprehension of any reader who is able to discriminate an insect from a spider or a myriapod, or the orders of insects from each other. That readers in search of knowledge may be without excuse, the author prefaces her work with information on the above essential points.

The subject is dealt with under the heads of, Insects injurious to Garden Vegetables; Insects injurious to Root Crops and Indian Corn; Insects injurious to Cereal Grains and the Grass Crops, including Clover; Insects injurious to Fruit Trees; Insects injurious to Small Fruits, and Insects of the Flower Garden and Greenhouse. In many cases methods of extermination or at least of palliation, that have previously proved successful are detailed, but, as is remarked with respect to the pea-weevil, in order to exterminate an insect from a district it is necessary that agriculture shall have progressed to such a point that all the farmers of a district shall mutually agree to carry out the proper measures in unison; in the case of the last-mentioned insect, such a result would be arrived at were all to cease the cultivation of peas for a simple year—a cheap price for the benefit accruing.

Among facts not very widely known are the destruction wrought among cabbages, by *Plusia brassicæ*, Riley; and that caused on parsley, carrot, and other cultivated umbellifers by the

[1] *Injurious Insects of the Farm and Garden.* By MARY TREAT. Fully illustrated. New York, Orange Judd Co., 751 Broadway. 1882.

green, black-and-yellow-spotted caterpillers of the beautiful black yellow-spotted swallow-tail butterfly.

The Lepidoptera and Coleoptera take the lead in the number of destructive species, and it is hard to say which works most damage, as most of our cultivated plants appear to have enemies in both ranks, though the potato and sweet-potato are especially affected by beetles, and the cabbage and fruit-trees generally, by caterpillars. The Hemiptera, with Phylloxera, the Chinch-bug and the aphides, come next in destructive powers; the Diptera contribute several species, the Hymenoptera, though principally beneficial to man, furnish him with saw-fly enemies; and the one destructive locust enumerated is a host in himself. The work is printed in clear type and forms in all respects an attractive volume. —*W. N. L.*

U. S. Fish Commission Report for 1879.—This stout volume is full of good material, whether piscicultural or zoölogical or botanical. Several excellent papers, purely scientific and yet of value in the connection in which they appear, are sandwiched in between the commissioner's own report and the chapters relating to fish-culture. The most important of these, and abundantly illustrated with excellent wood-cuts, are Professor W. G. Farlow's Marine Algæ of New England, and Professor A. E. Verrill's report on the Cephalopods of the north-eastern coast of America. A large proportion of the volume is devoted to translations from European authors, which will undoubtedly prove useful to pisciculturists in this country, though there are chapters by H. W. Mason, Livingston Stone and Charles G. Atkins on the propagation of salmon. These reports are doing great good in both a practical and scientific direction.

Recent Books and Pamphlets.—A system of Human Anatomy, including its medical and surgical relations. By Harrison Allen, M.D. Section I. Histology, by E. O. Shakspeare, M.D. Section II. Bones and Joints, by H. Allen, M.D. Philadelphia, 1882. From the author.

United States Commission of Fish and Fisheries. Report of the Commissioner for 1879. Washington, 1882. From the department.

The Mungoose on sugar estates in the West Indies. By D. Morris, M.A. Kingston, Jamaica, 1882. From the author.

Official Report on the Creston group of mines in the State of Durango, Mexico. By Professor Adolphe Rock. Philadelphia, 1882.

On Fishes Tails. By E. T. Newton, F.G.S. Reprint from the Journal of the Quekett Microscopical Club. London, 1882. From the author.

Camps in the Caribbees. The adventures of a naturalist in the Lesser Antilles. By Fred'k A. Ober. Boston, 1880.

Thèses présentées a la Faculté des Sciences de Lille, Université de France, pour obtenir le grade de Docteur ès Sciences Naturelles. Par Persifor Frazer, A.M., de Philadelphie. 1re Thèse: Memoire sur la Geologie de la parti sud-est de la Pennsylvanie. 2me Thèse: Propositions donneés par la Fuculté. Lille, 1882. From the author.

Report of Proceedings of the National Academy of Sciences, from Nov. 16, 1880, to the close of the year 1881.

National Academy of Sciences, Constitution and Membership. Washington, 1882. From the society.

Cacao: How tó Grow and how to Cure it. By D. Morris. M.A. Kingston, Jamaica, 1882. From the author.

Uber eine neue Eremias-Art aus dem Thal des Krododil-flusses in Transvaal. Von Dr. Franz Steindachner. Aus dem LXXXV Bande der Sitzb. der k. Akad. der Wissensch., I Abth., 1882. From the author.

Batrachiologische Beiträge. Von Dr. Franz Steindachner. Aus dem LXXXV Bande der Sitzb. der k. Akad. der Wissensch., 1882. From the author.

The Channel Tunnel. By Professor Boyd Dawkins, M.A. Ext. from the Trans. Manchester Geological Society, 1882. From the author.

The American Journal of Forestry. Edited by Franklin B. Hough. Cincinnati, Oct., 1882. From the editor.

Notice sur les espéces du genre Philothamnus, qui se trouvent au Muséum de Lisbonne. Par J. V. Barboza de Bocage; also, by the same author: Aves das possessões portuguezas da Africa occidental; and Liste des Mammifères envoyés de Caconda (Angola) par M. D'Anchieta. Extracto de Jornal de Sciencias Mathematicas, Physicas e Naturaes, Ne XXXIII. Lisboa, 1882. From the author.

Descriptions of ten new species of Monticulipora from the Cincinnati group, Ohio. Index, etc. By U. P. James. Cincinnati, 1882. From the author.

Jamaica. Annual Report of the Public Gardens and Plantations for the year ending 30th Sept., 1881. By D. Morris, director. Kingston, Jamaica, 1882. From the author.

Beiträge zur Paläontologie Osterreich-Ungarns, und des Orients, herausgegeben Von E. v. Mojsisovics und M. Neumayr. Wien, 1882. Der jungtertiäre Fischfauna Croatiens. Von Drag. Kramberger-Gorjanovic. Beiträge zur Kenntniss der fossilen Diatomeen Osterreich-Ungarns. Von A. Grunow.

Brief mention of some of the men who aided in developing the science of geology in America. Descriptions of three new species of fossils, and remarks upon others. By S. A. Miller. Description of a new species of Bourguetocrinus. By P. de Loriol, etc., etc. From the Jour. Cin. Soc. Nat. Hist., Oct., 1882. From S. A. Miller.

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GENERAL NOTES.

BOTANY.[1]

New Species of North American Fungi.—*Diplodia Pyri* E. and M.—Spots, light brown, small, border nearly obsolete; perithecia black, scattered, mostly epiphyllous; spores oval, brown, 24–25×9–12 μ. On living lvs. of *Pyrus malus.* Newfield, N. J., Sept., 1882.

Septoria Silenes E. and M.—Spots small, light yellow; perithecia brownish-yellow, soft, innate, scattered, 56 μ. diam.; spores yellowish, cylindrical, curved, triseptate, 48 × 3 μ. On living leaves of *Silene stellata*, Chester Co, Pa. Dr. Martin.

Septoria psilostega E. and M.—Spots golden yellow, mostly occupying the margin of the leaf; perithecia hypophyllous, scattered, yellow, very delicate, exuding a mass of amber colored spores which viewed separately are subhyaline, filiform, straight or curved, faintly triseptate, 60×3 μ. On lvs. of *Galium pilosum.*

Septoria Smilacinæ E. and M.—Spots gray, oblong, border broad, dark-pink; perithecia light-brown, conoid, mostly epiphyl-

[1]Edited by Prof. C. E. Bessey, Ames, Iowa.

lous, 114×3 μ.; spores hyaline, filiform, guttulate, 63–114 × 3 μ. On lvs. of *Smilacina*, Chester Co., Pa. July, 1882.

Septoria Symploci E. and M.—Spots white, 1-1½^{mm} diam. border brown and a little raised; perithecia brown, subglobose, hypophyllous, semi-immersed, scattered irregularly, 112 μ. diam.; spores hyaline, cylindric-clavate, spuriously 2–3 septate, curved, 24–30 × 3 μ. On fading leaves of *Symplocos tinctoria*. Green Cove Springs, Fla., Feb., 1882. Dr. Martin. Differs from *S. stigma* B. and C. in its longer spores.

Septoria lepidiicola E. and M.—Spots pallid, subregular, ¾^{mm} diam., perithecia dark-chestnut color, crowded, 74 μ diam. spores hyaline, cylindrical, slightly curved, ends obtuse, guttulate or septate, 24–33 × 2½–3 μ. On living leaves of *Lepidium Virginicum*. W. Chester, Pa., June, 1882. *S. Lepidii* Desm. has ovate spores 6–8 × 4–6 μ.

Septoria lactucicola E. and M.—Perithecia punctiform, minute, scattered, on brown, concentrically wrinkled spots, ½–1½ centim. diam. spores filiform, mostly curved 25–30 μ. long. On living lvs. of *Lactuca Canadensis*. Newfield, N. J., Sept., 1882. Quite different from *S. Lactucæ* Pass.

Phyllosticta clethricola E. and M.—Perithecia amphigenous, erumpent, on pale-brown spots 2–10^{mm} diam. Spores subhyaline, guttulate, ovate 9 × 6 μ. On lvs. of *Clethra alnifolia*. Newfield, N. J., Sept., 1882.

Phyllosticta bataticola E. and M.—Perithecia few, minute, black, on small, white, round spots with a purplish border; spores oblong-elliptical 5 × 2 μ. On lvs. of *Batatas edulus*. Newfield, N. J., Sept., 1882. *S. Batatas* Cke. has larger brown perithecia on much larger spots and has rather larger spores.

Phyllosticta Orontii E. and M.—Perithecia brown, epiphyllous, 56 μ. diam. on large yellow spots with an indefinite border; spores ovate, 6 × 2½ μ. On lvs. of *Orontium aquaticum*.

Phyllosticta iolani E. and M.—Spots light-brown, border a little darker; perithecia black, innate, amphigenous, upper portion deciduous, 90 μ. diam., spores sub-hyaline, oblong 9 × 2 μ. On lvs. of some *Solanum*. Lexington, Ky., Aug., 1882. Professor W. A. Kellerman.

Phyllosticta toxica E. and M.—Spots gray, round, small, border dark-brown; perithecia black, epiphyllous, innate, 70 μ. diam., spores sub-hyaline, nearly globose, granular, 6–7½ μ. On fading lvs. of *Rhus Toxicodendron*. Decorah, Iowa. E. W. Holway.

Ascochyta Smilacis E. and M.—Spots pallid, round, border brown; perithecia black, globose, innate, epiphyllous, 140 μ. diam. spores sub-hyaline, ovate, triseptate, 11–22 × 6–7 μ. On lvs. of *Smilax rotundifolia*. Concord, Pa.

Glæosporium Betularum E. and M.—Spots light-brown, nearly round, 2–3^{mm} diam., border dark; pustules brown, amphigenous, 120–140 μ., falling out and leaving a dark cup-shaped scar; conidia hyaline, obovate and ovate, 9–10½ × 6 μ., hyphæ hyaline. On lvs. of *Betula nigra* and *B. lenta*. Bethlehem, Pa., Sept., 1882. E. A. Rau. Differs from *G. Betulæ* Mont., and *G. betulinum* Kickx., in its *ovate* conidia.

Macrosporium Solani E. and M.—Hyphæ brown, erect, somewhat curved, caespitose, septate, 50–70 × 3–4½ μ.; conidia brown, oblong-obovate, pedicellate, endochrome divided by transverse and longitudinal septa; pedicel hyaline, septate above; conidia, including pedicel, 100–140 μ. long by 15–18 μ. wide. Growing mostly on the under surface of eroded spots and faded portions of the dying leaves of *Solanum tuberosum*. Newfield, N. J.

Macrosporium Catalpæ E. and M.—Hyphæ brown, curved, nodulose, 8–12 septate, erect, amphigenous, 90–135 × 6 μ; conidia brown, obovate and pyriform, sub-muriform, 27–54 × 15–27 μ. On brown spots on the lvs. of *Catalpa bignonioides*. Bethlehem, Pa., Oct. 1882. E. A. Rau.

Macrosporium herculeum E. and M.—Amphigenous, on dark-gray, round spots; hyphæ erect, brown, caespitose, flexuous, sparingly septate, 70–80 × 5 μ; conidia brown, clavate, multiseptate with a few imperfect longitudinal septa, 200–225 × 21–26 μ. On lvs. of *Nasturtium Armoracia*. Newfield, N. J.

Cercospora canescens E. and M.—Spots brown, border yellowish-brown, broad and irregular; hyphæ caespitose, brown, 110 × 6 μ., conidia, hyaline, cylindric-clavate, 5–8 septate 117 × 6 μ. On fading leaves of *Phaseolus*. In gardens.

Cercospora flagellare E. and M.—Spots pallid, ½–¾ cent. diam., sometimes confluent; hyphæ tufted, brown, crooked and nodulose 75–80 × 4 μ., bearing at their tips the long, 80–112 × 4 μ., slender conidia, attenuated above, and 8–10 septate. Amphigenous, but more perfectly developed on the under side of the leaf. On lvs. of *Phytolacca decandra*.

Cercospora Echinocystis E. and M.—Hyphæ brown, fasciculate, scarcely septate, hypophyllous 42 × 4 μ on white round, indefinitely bordered spots; conidia hyaline, cylindrical, clavate, 80–105 × 3 μ., 3–6 septate. On lvs. of *Echinocystis lobata*. Lexington, Ky., Professor W. A. Kellerman.

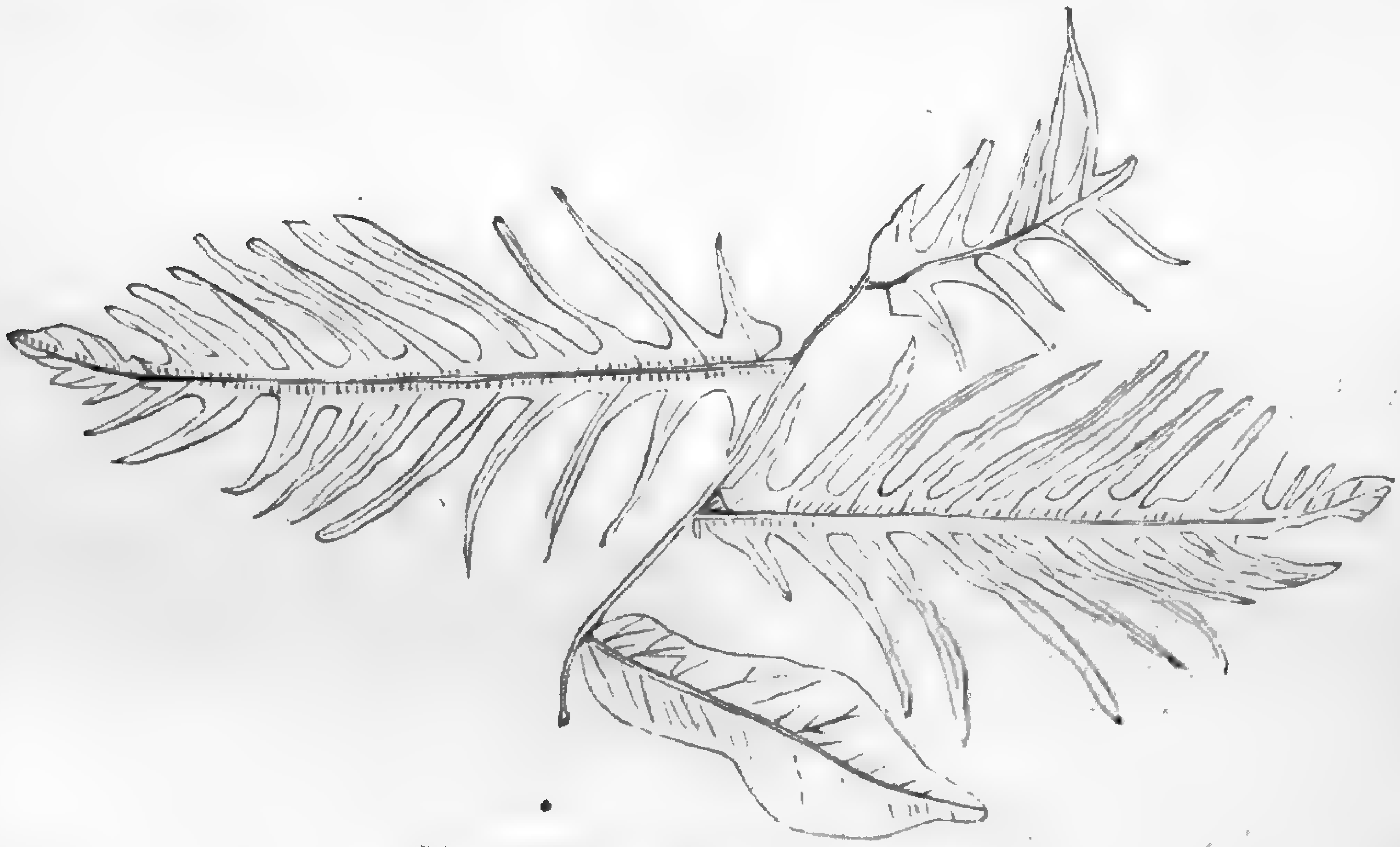
Cercospora Dioscoreæ E. and M.—Hyphæ caespitose, brown, scarcely septate, hypophyllous, 30 × 3½ μ.; conidia sub-hyaline, cylindrical, 3–8 septate, 54–90 × 4–5 μ. The upper surface of the leaf is mottled with dark-brown spots with a yellow border, but the fungus is found on the under surface. On lvs. of *Dioscorea villosa*. Chester Co., Pa.

Ramularia Plantaginis E. and M.—Spots small, round, light-gray, border reddish-brown; hyphæ caespitose, hypophyllous, hyaline; conidia, cylindrical, 15–21 × 3–4½ μ. On lvs. of *Plantago major*. Kentucky, Professor W. A. Kellerman.

Ramularia Celastri E. and M.—Spots small, white, border dark-brown; hyphæ sub-hyaline, fasciculate, 24 × 3 μ.; conidia oblong-cylindrical, hyaline, guttulate, uniseptate, 18–21 × 3 μ. On lvs. of *Celastrus scandens.* Chester Co., Pa.

Oospora Tulipiferæ E. and M.—Hyphæ subhyaline, becoming brown, septate, caespitose, 42 × 3 μ., on light-brown spots, with a dark, narrow border; conidia subhyaline, ovate or fusiform-concatenate, borne on the tips of the hyphæ, 7–9 × 3–4½ μ. On lvs. of *Liriodendron.* West Chester, Pa., Dr. Martin, and Bethlehem, Pa, E. A. Rau, Sept. and Oct. Common.—*J. B. Ellis, Newfield, N. J., and Dr. G. B. Martin.*

Cut-leaved Beech.—Miss Kate Furbish sends tracings (here reproduced one-third natural size) of some pinnately lobed leaves of the beech, taken from a tree at Chesterville, Me. Dr. Packard found similar leaves at Brunswick, Me. The latter we have examined, and find that the lobing is due to the early breaking down of the parenchyma midway between the veins, the growth of the rest of the leaf tissue continuing in the usual way. Probably Miss Furbish's specimens were produced in the same manner.



Pinnately lobed Beech leaves.

Agency of Water in Forest Destruction.—The note in reference to the discussion of this topic before the Philadelphia Academy (see p. 622, July number, Am. Nat.) is correct, so far as it goes, and yet from its brevity possibly gives a very different impression of the facts than actually occurred.

The discussion arose from a letter read from Professor Sheafer, of Pottsville, detailing a case where a large area of forest was destroyed by the construction of a beaver dam. Mr. Meehan simply gave instances of a similar character, where, by the formation of railroad embankments, immense areas of forests had been destroyed, and geological instances from now treeless prairies, in which buried forests had evidently been destroyed by water. He incidentally referred to his former addresses before the Academy, on the washing away of the soil on the tops of high mountains, and the relation of the "timber line" to these facts, and suggested that in theories of the disappearance of forests both in the past and in the present, the agency of water as well as of climate should not be overlooked. It was not this that Professors Leidy, Heilprin, Koenig, and Redfield opposed, but in their experience they had found that so far as the question of the "timber line" was concerned, climatic influences had as much, if not more to do in deciding it, than the mere washing away of the soil by rains or melting snows.—*Thomas Meehan, Germantown, Pa.*

On the Heterœcism of the Uredineæ.—Charles B. Plowright recorded last year in the December number of *Grevillea*, the results of a series of experiments upon the barberry cluster cup (*Æcidium berberidis*) and wheat rust (*Puccinia graminis*), which led him to "differ from the eminent botanists abroad who do accept the heterœcism of *Puccinia graminis* as established beyond question." This year he made another series of experiments, the results of which he gives in the September *Grevillea* as follows: "This year another series of cultures was instituted, in which the promycelium spores [sporidia] of *Puccinia graminis* were sown upon young barberry plants, with the unvarying result of producing the Æcidium, the check plants remaining free from the fungus. Young wheat plants, which were kept continuously covered by bell glasses from the time they were first sown till the experiment was concluded, were also found, when infected with ripe *Æcidium berberidis* spores, to become infected with Uredo, while similar plants not so infected remained healthy,"

The experiments were so conclusive that Mr. Plowright, who entered upon them "biassed against" the doctrine of heterœcism, now fully accepts it.

Note on Gerardia.—It may be worth recording that *Gerardia pedicularis* L., although blooming profusely about Providence this season, yet owing, perhaps, to the long-continued drouth, is not nearly so much frequented by humble-bees as usual. Indeed, I notice more honey-bees about the plants. The consequence is, that much fewer flowers are perforated in the manner I have before described. In a half hour's careful observation I did not see one humble-bee avail himself of the holes already cut, nor make a new perforation. All entered by the open mouth of the corolla. There would seem then to be no necessary impediment to their means of ingress. Does not the diminished number of seekers account for the legitimate action of the few? Absence of active competition renders it unnecessary for the remaining bees to adopt a burglarious habit.—*W. W. Bailey, Brown University, Sept. 4, 1882.*

ZOÖLOGY.

A NEW GENUS AND SPECIES OF THE CRUSTACEAN FAMILY LYNCODAPHNIDÆ.[1]—*Lyncodaphnia*, gen. n. (Plate XVI, Fig. 1–4). Form much as in species of Alonella, etc., truncate behind; superior antennæ like Macrothrix, attached movably to the end of a blunt prominence beneath the head; second or swimming antennæ slender, four-jointed ramus with three long setæ and a stout thorn at the end of distal segment, the joint following the short basal one with a thorn above, the following joint unarmed (!); three-jointed ramus as in Macrothrix, the basal segment armed with a much elongated seta; eye relatively small, pigment fleck (*macula nigra*) present; *intestine twice convoluted*, expanded in front of the rectum, opening in the "heel" of the post-abdomen; post-abdomen slender, sub-triangular, margined behind with a double series of spines; terminal claws large, and furnished with a long and short spine near the base; shell margined below by stout movable spines.

Few more interesting forms than the one forming the type of this very peculiar genus have been found, since it combines in a curious manner those characteristics hitherto regarded as distinctive of the families Daphnidæ and Lynceidæ. Kurz says:[2] "Keine cladocerenfamilie bildet eine so streng in sich abgegrenztes natürliches Ganze, wie eben die Lynceiden," and this after recognizing the relationship of Macrothrix and Lathonura to the Lynceids, by placing them in the sub-family Lyncodaphnidæ. The form above referred to, however, has quite as close affinity to the Lynceidæ as to Macrothrix, though it resembles the latter rather more on a superficial examination, indeed if one were to divide the animal back of the heart and examine the two portions independently, it would be impossible to avoid referring the head to Macrothrix and the body to some Lynceid genus. Thus is furnished another of those curious intermediate forms which remind us that the possibility of distinguishing families and genera, lies alone in the meagerness of our knowledge.

There can be no doubt that this genus should stand next to Macrothrix, but it will be necessary to modify a little the diagnosis of the Lyncodaphnidæ to receive it, and it then appears that it cannot longer remain a sub-family of the Daphnidæ, hence I have proposed to give it equal rank with that body and the Lynceids as an independent family, Lyncodaphnidæ, including the genera Macrothrix, Lyncodaphnia, Drepanothrix, Lathonura (= Pasithea), Ilyocryptus. As thus limited a very natural group is formed, in size and isolation corresponding well with the other related families.

[1] Series secunda generum (Daphnidæ), sub-fam. Lyncodaphninæ Kurz. Danmark's Cladoceras, p. 134. Dodekas neuer Cladoceren, P. E. Müller, p. 24.

[2] Kurz. Dodekas neuer Cladoceren nebst einem kurzen Ubersicht, der Cladoceren fauna Bönmens, p. 30.

Lyncodaphnia macrothroides.

Lyncodaphnia macrothroides, sp. n. — Form sub-rectangular, greatly elongated; length $\frac{12}{100}$ cm; height $\frac{5}{100}$ cm or less; first antennæ long and slightly curved, bordered behind by about ten spines, and terminating in two or three sword-shaped unequal spines and several sense-hairs, about $\frac{17}{1000}$ cm long; swimming antennæ very slender, as in Macrothrix, $\frac{6}{100}$ cm long; head not marked off by a depression from the body, small and extending below into a blunt elevation for attachment of antennæ; labrum rather large; eye small; macula nigra conspicuous but not large; anterior feet strongly armed with curved spines; intestine anteriorly is furnished with cœca, is twice convoluted, broadened before entering the rectum, and opens some distance beyond the anal setæ in the heel of the post-abdomen; post-abdomen rather slender, toothed behind with a double series of about twelve prominences, ciliated near the anus but distally becoming strong, sharp teeth; terminal claws large, curved only at the end, pectinate and bearing near the base a small and large tooth; eggs much like those of Macrothrix. Male not seen.

Occurs in Lake Minnetonka, Hennepin county, Minnesota; rare.—*C. L. Herrick.*

FOOD OF THE NESTLINGS OF TURDUS MIGRATORIUS.—In this vicinity robins usually rear two broods in a season—sometimes three—and occasionally young birds that are hatched in May will mate and repair the nest in which they were born, or build a new one, and rear a brood in August and early September, thus becoming parents at the age of about four months. The nestlings of the earlier broods are mostly, if not exclusively, fed upon animal food—insects in all stages of development—while the later broods receive a large share of fruit when in the nest, and after leaving it, so long as they require the attention of their parents. Near the farm-house, or in the village, the old birds take strawberries, currants, gooseberries, cherries, and the cultivated small fruits generally for their young as well as for themselves, and in the fields and woods they use almost indiscriminately strawberries, blackberries, huckleberries, blueberries, and wild cherries for their nestlings, without giving up the use of insects. The latest broods frequently get a taste of early grapes, nor is it uncommon for the parents to carry to their little ones mouthfuls of mellow apples and pears. There are but few small fruits, cultivated or wild, that are not, to some extent, appropriated as food for the nestlings when the parents can get them, and I think from observations of several years that at least one-third, probably one-half, of the food of nestling robins consists of the various fruits in their respective seasons. In the later broods, insects predominate as food during the first half of their nest-life, the fruits being principally used during the remainder and until the young are able to take care of themselves.

The statement often seen in the books that "robins feed their young entirely upon animal food," is altogether too sweeping. Without doubting the veracity of the person who first made use of this expression, I think his observations must have been confined to the earlier broods, and in the season before any fruits were ripe or approximately ripened. That robins can be reared upon animal food alone is probably true; that they are not so reared when fruits are obtainable is equally true, and in a dearth of insects they can be raised upon food consisting largely of fruit.

I am fully aware of the fact that in areas of some extent—usually quite limited however—the small-fruit grower sometimes finds the robins very annoying, and even injurious, but to the community at large, and certainly to the agriculturist and market gardener, they are decidedly beneficial and of incalculable worth, from their enormous destruction of noxious insects, especially in spring and early summer. Protected as they are by law a part of the season, I sincerely wish that the "close" time were measured by the year.—*Elisha Slade, Somerset, Mass.*

MORE COMPLAINT ABOUT PASSER DOMESTICUS.—This proliferous gourmand is adding a new item to his bill of fare with us this season. As soon as wheat was fully headed out, dozens of these pests could be seen in one flock to settle down in the fields on the wheat-stalks and commence picking out the grains. Now that wheat is cut and shocked, they light on these and take their fill. I have noticed similar reports in some of the agricultural papers. —*J. Schneck, Mt. Carmel, Ill.*

A PROLIFIC GARTER SNAKE.—July 26th, 1882, a specimen, thirty-four inches long, of *Eutænia sirtalis* B. and G., was brought to me from which were taken *seventy-eight* young; these varying from seven to five inches in length. The young were pressed from the vent. The first twenty or so were free from any covering. The remainder were in sacks, from three to five snakes in each.

May not this latter fact lead us to think this species possibly also ovo-viviparous as well as viviparous? I do not know that the number of young is without a precedent, but it exceeds, by far, anything I have observed.—*J. Schneck.*

THE SPOTTED SPREADING ADDER VIVIPAROUS.—Since sending the note on the *Garter Snake*, I have learned of a still more remarkable case. A "spotted spreading adder" was shot in two, near the middle; when *eighty-seven* young were taken from her body. The snake was a large one of this species. The young were near six inches long. This occurred within the last two weeks, and in the presence of nearly a dozen persons, from several of whom I have gathered the facts.—*J. Schneck.*

HABITS OF THE ENGLISH SPARROW.—The following interesting note has been received from Dr. A. K. Fisher, of Sing Sing, N. Y.: Knowing your great *fondness* for *Passer domesticus* I send you a brief account of one of the various ways in which he imposes upon his superiors. The following was related to me by a friend, who was an eye-witness. You well know that when robins are feeding their young they will often collect a number of worms, forming a large billful, before making a trip to the nest. Well, the sparrow noticed this, too, and when the robin would alight to pick up something more, he would dash down beside the robin and snatch whatever might be in his mouth, then fly a few feet off. The robin would hop after him, when he would make another short flight until the robin would give up and go and hunt for something more. My friend saw the sparrow do this five or six times one afternoon.—*Elliott Coues, Washington, D. C.*

THE BLACK-FOOTED FERRET (*Putorius nigripes*) IN TEXAS.—Mr. Frank J. Thompson, of the Cincinnati Zoölogical Gardens, informs me of the reception there of a living specimen of this rare species, perhaps the first one ever placed on public exhibition. It was captured near Abilene, in Taylor county, Texas, a locality far beyond the previously known range of the species, as assigned in my " Fur Bearing Animals."—*Elliott Coues, Washington, D. C.*

THE OCCURRENCE OF DEMODEX PHYLLOIDES CSOKOR, IN AMERICAN SWINE.—The meat inspector for thecity of Toronto, Mr. R. Awde, has just handed me for examination, a piece of pork skin, marked by numerous white spots shining through the epidermis, which on separation of the subcutaneous tissue, turn out to be sebaceous glands, enlarged to the size of a grain of barley, and crowded with multitudes of mites (Demodex) in various stages of development. The mites belong to the species described by Dr. Johann Csokor (Verhandl der K. K. zool-bot. Gesell in Wien. Vol. XXIX, 1879, p. 419, et seg. and Pl. VIII), as occasioning large cutaneous pustules and even ulcers in a herd of swine from Galicia; so far as I am aware it has not been recorded since.

Demodex phylloides measures only 0.24^{mm} in length, while *D. folliculorum* (the little mite which occurs in the sebaceous glands near the nose in man) is often twice as long. This difference in length is solely due to the excessive shortness of the abdomen in *D. phylloides*, for the cephalothorax in the latter form is undoubtedly more robust than in any other of the described species.

D. canis occasions a very troublesome cutaneous affection in dogs. *D. ovina* occurs in the meibomian glands in sheep (vide Zürn, Schmarotzer der Haussaügethieren), and Mr. W. Faxon has recorded *D. folliculorum* from the ox, but from an economic point of view. *D. phylloides* may possibly become more disastrous than any of these should its attacks attain the extent described by

Csokor, which of course would destroy or materially depreciate the market value of the animals affected. Csokor calls attention to the fact that all of the herd in question were affected, as indicating a much readier infection by contact, than has been observed in the case of the dog. It is further to be noted that the mites in each gland are not to be reckoned by individuals or tens, as in other animals, but by thousands.

Mr. Awde finds about one pig in twenty affected, from now to the end of the pork season. The parts involved (as also in Csokor's cases) being the head, belly, and legs.—*R. Ramsey Wright, University College, Toronto.*

HOW BAD WEATHER AFFECTS THE BIRDS.—The early part of this season was very cold and wet, seriously impeding every operation on the farm. The temperature finally became more genial during the month of June, though the rains have kept coming at frequent intervals. Grasses, wheat, oats, and potatoes have been growing very satisfactorily, but corn, our great staple, has been sadly impeded, and its promise to-day may be set down as simply "doubtful." Coupled with all this ill luck, we have had a frequent repetition of high winds—tornadoes, in many localities, as the reader will remember. At my place we had a terrible gale the night before the destructive tornado at Grinnel; trees were blown down, fences destroyed, and the crops damaged in all directions.

This state of things has had a very disastrous effect upon the birds. They have not been as plenty as during previous seasons. I noticed this especially in regard to the house wrens, blue birds, redwing blackbirds, crow blackbirds, blue jays, Baltimore orioles, and indigo birds, possbily other species might be included. It has seemed to me that they have been kept away by this untoward weather. Then again, after the terrible storms, we have found many young birds dead, while the winds and beating rains have destroyed many nests. My attention has been directed to this subject all the season through, and I cannot but regard it as having been thus far, a most unfavorable year for all kinds of small birds.—*Charles Aldrich, Webster City, Iowa. July 3, 1882.*

PROTECTIVE CHANGE OF COLOR IN A SPIDER.—I suppose you know the little flower spiders, that conceal themselves in the flowers, aud seize any unwary insect that may chance to come within their reach. I have generally found them white and yellow. I suspected they changed their color, and by experiment, I, find that this is so. If I take a white one and put it on a sunflower, it will get quite yellow in from two to three days. I believe they capture almost anything, but they seem to be partial to the bees. I found one the other day with a wasp, the latter was not yet dead, but it was tightly held by the throat by the spider. The next day the wasp was found lying dead under the flower.—*James Angus.*

THE STRUCTURE AND DEVELOPMENT OF THE SKULL IN STURGEONS.—Professor W. K. Parker has been working out the development of the skull in *Acipenser ruthenus* and *A. sturio*, the Russian sterlet and the common sturgeon of the shores of Great Britain. The larvæ of the sterlet that were dissected varied from one-third to seven-twelfths of an inch in length, yet even in the smallest of these the cartilage was becoming consolidated. In the skull of the sturgeon the *symplectic*, which supports the mandibular and hyoid arches, is a separate cartilage, as in the Selachians, not a mere osseous center as in *Lepidosteus* and the Actinopteri; the peculiar modifications of the primary arches of the face show themselves during chondrification, thus the hyoid arch is from the first, inordinately large, yet in the larva the head of the great subdivided hyoid pier only articulates with the auditory capsule. There is no room for doubt that all the branchial arches are developed in the outer walls of the large respiratory pharynx, quite independently of the base of the skull and the fore part of the spinal column. Professor Parker declares that he has come to the conclusion that no true branchial or visceral arches exist in front of the mouth; the first cleft is that between mandible and hyoid, and the first arch, the mandibular. The true axis of the cranial skeleton ends under the fold of the mid-brain, and the "trabeculæ cranii" are merely fore-growths from the parachordals. In the sturgeons the ganoid scutes of the head are so far under the influence of the huge chondrocranium, to which they are applied, that they may be called frontal, parietal, etc., yet such scutes are not the exact homologues of the bones so named in the Actinopteri. The sturgeons, on the whole, stand between the Selachians and the bony ganoids, yet not directly in the line between the Selachians and the bony ganoids, and not directly in the line between any one family of the former and any one family of the latter. Larval sturgeons are miniature sharks in appearance, since for weeks they have a shark-like mouth, true teeth in the throat and on the lips, and very long exposed gills.

THE AMYLOLYTIC AND PROTEOLYTIC ACTIVITY OF PANCREATIC EXTRACTS.[1]—Dr. W. Roberts gives the result of his researches upon the Amylolytic (sugar-forming), and Proteolytic action of the pancreatic juices. Following Kuhne, he proposes to distinguish soluble ferments, devoid of powers of growth and multiplication, from organized ferments, such as yeast, by giving them the name of *enzymes.* The pancreas is the source of two enzymes, *pancreatic diastase*, and *trypsin*, which latter has the proteolytic power of converting casein into *metacasein*, which curdles by simple boiling. The pancreatic juice of the pig has great diastatic power, since it is capable of transforming four times its weight of dry starch at 40° C., to the point at which it no longer

[1]Proc. Royal Society. May 5th, 1881.

gives a color reaction with iodine, in five minutes. If the diastatic power of the pig's pancreatic juice be represented by 100, those of the ox and sheep, feeders on matters poor in starch, are respectively only eleven and twelve. Cold retards the action of the pancreatic juice; a temperature of from 30° to 45° C., is most favorable to diastetic, while one of 60° C. is most favorable to proteolytic or tryptic action; and these actions cease to take place at 70° C., and 80° C., respectively. Double the quantity of an enzyme will do its work in half the time, while half the quantity will require double the time, but this rule of inverse proportion is controlled by the rule that an enzyme liberates its energy at a progressively retarded rate.

THE BIRDS OF HELIGOLAND.—The Bull. Soc. Zoöl. de France (1882) contains an interesting account of the birds of Heligoland, by M. E. de Selys Longchamps. Herr Gatke, secretary of the local government, is the resident ornithologist, and has collected 400 species out of the 500 known in Europe, including many examples of some of the rarest species. In his own words, "Birds from very different regions, from the north and south of Europe, and all the north of Asia and America, choose this solitary rock as a place of repose during their migrations." The island, a more or less clayey and ferruginous rock of lower iriassic age, of so little consistency that, at the rate it is wearing away, it will disappear in four or five hundred years, lies in the direct course of the birds which migrate every year from Southern Europe and Africa to the Arctic regions. As many as 15,000 larks were captured on the evening of Nov. 6, 1863. M. Gatke has proved, by the concordant dates of the captures of erratic birds, that these accidental migrations are regular up to a certain point, since for the same species they take place at the same time of the year, and in general consist of several species coming from the same geographical regions. Among the birds taken are *Phyllopseuste borealis* (Arctic Asia, N. E. America); *Phyl. nitidus* (Himalayas); *Phyl. coronatus* (Malaysia); *Calamodyta agricola* (India — not before observed in Europe); *Cal. certhiola* (coast of Sea of Ochotsk); *Pluvialis virginicus* (Alaska); *Totanus rufescens* (America), and *Larus roseus*, a circumpolar bird, lacking in most collections.

ZOOLOGICAL NOTES.—The *Quarterly Journal of Microscopical Science* for October, contains a brief account, by Dr. R. Horst, with excellent figures, of the development of the European oyster. He claims, contrary to Lacaze Duthiers and W. K. Brooks, that the bivalve shell of Ostræa is originally unpaired, not developed from two separate halves, which afterwards unite and form a hinge.——The thread cells and epidermis, with the lateral glands of Myxine, the hag-fish have been studied by J. E. Blomfield.——The eye of Spondylus has been found by S. J. Hickson, to be similar to, though less developed, than the eye of Pecten.——In the same journal, P. H. Carpenter continues his notes on Echinoderm morphology.——E. R. Lankester claims that he has discovered in the tail of Appendiculariæ, that the muscles are arranged in a series of segments (myomeres), seven in number, one corresponding to each pair of nerves given off by the axial nerve cord. ——H. N. Moseley, from a study of the soft parts, finds that the corals Seriatophora and Pocillopora are genuine corals like Madrepores, as regarding the latter genus confirming Verrill's opinion as to their affinities.——The Cilio-flagellate Infusoria have been studied by Bergh, who proves that the external membrane or skeleton consists of cellulose, this being the first time that cellulose has been demonstrated in the cell-wall of the Protozoa. The protoplasm of these organisms says Prof. Parker, in his review of Bergh's work, is usually divided into ectoplasm and entoplasm. The latter has been found by Bergh to contain chlorophyll, diatomin (the yellowish-brown coloring matter of diatoms), and starch. Chlorophyll is already known to occur in many animals of widely separated groups; starch has hitherto been proved to exist only in the green Turbellarians, and diatomin has never before been known out of the vegetable kingdom. Bergh believes that in many genera of these infusoria, the nutrition is entirely like that of a plant, and that no solid nutriment is ever taken up. Bergh figures the lasso-cells or trichocysts of Polycricus, as originally discovered by Bütschli.——Mr. A. Agassiz, continues in the Proceedings of the American Academy of Arts and Sciences, his account of the young stages of osseous fishes. Many interesting points of relationship between the embryos of bony fishes and their fossil forms, have been traced by comparing the structure of the tail of the fish embryo, as it passes from the leptocardial stage through the various stages of heterocercality, to a so-called homocercal stage. This relation, says Agassiz, is very marked, and has led to some important generalizations. He finds, however, that the comparisons of the pectorals, or of the dorsal and anal fins does not lead to such interesting results, though as far as the pectoral fins are concerned, their resemblance in the early stages of the bony fish embryo to the Crossopterygian type of pectorals is very striking. Excellent figures are given of the very young striped bass, blue fish, butter fish, toad fish, goose fish, sculpin, lump fish, stickleback, cod, smelt, and a few others.——Besides an elaborate and beautifully illustrated article, with anatomical details on the larvæ of mayflies, by A. Vayssiére, recent numbers of the *Annales des Sciences Naturelles* contain a continuation of A. Milne-Edwards memoir on the avi fauna of the Antarctic regions. The stomachal armature of the crab, *Birgus latro*, is described by M. Mocquard. The more notable articles in the number issued in August, are Rietsch's study of *Sternaspis scutata*; Fuch's paper on the fauna of deep seas, and Giglioli's essay on the deep-sea fauna of the Mediterranean; there are besides, several ornithological papers by Oustalet and others.——*Zeitschrift für Wissenschaftliche Zoologie*, August 1, contains an elaborate memoir by H. Ludwig, on the embryology of a star fish, *Asteria gibbosa.* There is throughout the Echinodermata a mode of development, which must be spoken of as a metamorphosis, all the larvæ being ciliated, with a mouth and anus on one side. The processes by which the primary larva is converted into the echinoderm appear to be essentially the same in all cases; all that happens in a more complicated history, being the fact that in the secondary larvæ there is an absorption of those larval parts which had themselves become secondary. The secondary characters are not to be regarded as having anything to do with the future organization of the echinoderm, but as adaptations proper to the larval life, and disappearing at its close. There is no true solid morula in the earliest phases of development, but a blastosphere with a unilaminate wall; the gastrula is formed by invagination. Especial attention is given to the mode of origin of the hydrocœl, the blood vascular system and stomodæum, as well as the skeleton.

ENTOMOLOGY.[1]

A NEW RICE STALK-BORER: GENUS-GRINDING.—We quote the following from an article on a new Lepidopterous insect which, in the larva state, bores the stalks of rice. The article occurs in the annual report of the U. S. Entomologist for 1881-2, already printed:

"We have had some difficulty in deciding as to the true specific determination of this insect, chiefly because of a close general resemblance which it must possess to other species. Mr. Grote, when we showed him a specimen last autumn in New York, thought it might possibly be his *Chilo crambidoides*, while Professor Fernald determined it, from a specimen which we sent him, as *Diphryx prolatella* Grote,[2] stating at the time that he might be wrong, but that, having seen Mr. Grote's type, he considered our insect identical with it so far as he could trust his recollection. The specific description of *D. prolatella* certainly does agree very closely with the species we are considering, which has also the mucronate clypeus of Diphryx, but in order to refer our insect to *D. prolatella* we must assume that Mr. Grote erected his new genus, *Diphryx*, on a mutilated specimen which had lost its maxillary and part of its labial palpi, for the genus is founded on short labial papi which hardly exceed the face, and the absence of maxillary palpi—characters decidedly exceptional and remarkable in the family. In order to settle the matter, therefore, we again referred, through Mr. Henry Edwards, a perfect specimen

[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

[2] N. Am. Moths, Bull. U. S. Geol. Survey; VI, No. 2, p. 273.

to Mr. Grote, who upon this second more careful examination decides that it is neither of the species mentioned, but an undescribed species of Chilo."

Accepting Mr. Grote's decision, we described the insect as *Chilo oryzællus*, but ventured the following opinion: "As Mr. Grote's types are in London he may be mistaken even in his final opinion, and the careless manner in which he has often made other genera renders it quite possible that Diphryx is a myth, founded on an imperfect specimen as above indicated."

In order to get positive information on the point in doubt, we subsequently mailed specimens of our *C. oryzællus* to Lord Walsingham, with the request that he compare them with the type of *Diphryx prolatella*. His Lordship promptly replies by date of October 1, 1882: "I had no difficulty in finding this and ascertaining that you are completely justified in your conclusion that the Crambid No. 2557 [*C. oryzællus*] is the same species. Grote's type is a female, and has the palpi (labial) broken off, the shorter maxillary palpi alone remaining."

It is apparent, therefore, that Mr. Grote not only founded the genus Diphryx on what has no existence in nature, but mistook, besides, the maxillary for labial palpi.

Effect of Pyrethrum upon the Heart-beat of Plusia brassicæ.—While engaged in experimenting for Professor Riley, with different samples of Pyrethrum, upon various lepidopterous larvæ, in September of the present year, I was much interested in noting the enormous increase in the rapidity of the pulse which the poisoning occasioned with the larvæ of the cabbage Plusia. These larvæ are so very delicate and transparent that the course of the vital fluid can be observed with ease, and repeated countings show the normal heart-beat to range between 44 and 68 per minute, averaging about 56. In the first convulsions from the effects of Pyrethrum the pulse immediately rose, and in the course of ten minutes reached from 150 to 164, and usually subsided in the next fifteen minutes to the neighborhood of 140. As the convulsions ceased the pulse fell but slightly, but became very weak, until, finally, it could be counted no longer. The last count before the heart ceased to beat, apparently through the paralyzing of its walls, showed a rate invariably of about 130 to the minute.—*L. O. Howard.*

A Butterfly Larva injurious to Pine Trees.—In the course of some remarks recently made by Dr. H. A. Hagen before the Entomological Society of Ontario, at its meeting in Montreal, he gave an interesting statement of the injury of *Pieris menapia* to pine forests in Washington Territory, and particularly in Colville valley, twelve miles from Spokan.

The caterpillar, found in all stages, destroys mostly the yellow pine, but in some rare cases tamarack. The eggs are of the usual Pieris form and are laid in a series of a dozen or two in a straight line on the leaves. The caterpillar eats all the leaves except the fasicle at the end. Then all the tips turn upward and give to the tree a chandelier-like appearance. The larva comes down rom the tree on a thread, some fifty feet or more. In the middle of July near Spokan, a number of old males were found; higher up in the valley they grew more numerous, in some places many thousands being observed on one tree, presenting the appearance of snow flakes in the distance. The larva was found in all stages and the chrysalides were abundant.

On July 24th females and fresh males abounded. They paired at once and laid eggs the same day. The destruction seems to have been great but localized, and Mr. S. Henshaw and Mr. H. R. Stretch assisted Dr. Hagen in his observations.

The species has long been known to differ from the rest of its genus in its pine-feeding habits, and to be uncommonly numerous, at times, in various parts of the Rocky mountain region; but we have never heard of such disastrous consequences as those reported by Dr. Hagen.

ENTOMOLOGY IN WASHINGTON TERRITORY.—In following Dr. Hagen's remarks on the insects observed during the past summer in Washington Territory, Mr. S. Henshaw mentioned, at the late meeting of the Entomological Society of Ontario, some points of interest observed during the trip. Among the Hymenoptera, bees and wasps were very abundant, the forms of Odyneri being especially so; very few Multillidæ were found; the agricultural ant was observed in Montana.

Lepidoptera Rhopalocera were extremely abundant in specimens, but comparatively few species were observed.

Papilio machaon form *oregonia* occurred abundantly at Umatilla, Or., June 24th, and was also taken at several points in W. T., along the Yakima and Columbia rivers. Among the Heterocera, very few Sphingidæ occurred, five species of Ægeridæ were taken, and the most interesting Bombycid is a "basket-worm" (Thyridopteryx sp.?), found in Colville valley, W. T., and also in Montana. Cossus was very abundant on cotton-wood, and a number of interesting Notodontoid larvæ were taken. Night work yielded very poor results.

With the Diptera, Tabanidæ, Asilidæ, Bombyliidæ and Syrphidæ were most numerously represented. The occurrence of *Eristalis tenax* at Portland, Or. (common in Europe, and recorded in this country, first in 1875, from N. E. Geo. and Ill.), is of interest.

Two species of Omus (Dejeani and Audouini?) were common at Portland, Or., and the last named occurred at one locality east of the Cascade mountains in W. T. The distribution of Audouini (?) was confined to the mountain cañons, while Dejeani was equally common in such situations and along the river banks.

A number of Clivinæ and other Carabidæ usually found in moist situations, were taken in the driest parts of sand plains.

The most important discovery among the Orthoptera, is the capture of two specimens of Myrmecophila at Portland, Or. So far as known, there is but a single authentic record of the occurrence of the genus in this country.

A few species of Perlids were very abundant; a large series of two rare Gomphids were taken, and the occurrence of the genus Calopteryx on the banks of the Yakima, is of importance, as it is the first record of the genus west of the Rocky mountains, which were supposed to be a barrier to their western progress. As species occur far north, it is suggested that the passage is through the mountain passes beyond the limits of the United States.

A point of interest, and noticeable throughout W. T., is the late hour at which insects are on the wing. It was a matter of common occurrence to see Odonata belonging to the genera Aeschna, Libellula, Diplax, &c., hawking about from after sundown till dark. In New England and Europe, with the exception of a few species of Aeschna and Cordulia, none are seen on the wing later than the early afternoon.

THE ARMY-WORM IN 1882.—The damage to crops from the Army-worm in the more northern States, which we predicted in the June number of the NATURALIST, while not nearly so great as in 1880, has still been marked in certain localities, notably in Saratoga county, N. Y. The year 1882 will, however, be noted as a disastrous Army-worm year in many of the Southern States Never before in the history of its appearances has the worm been so general south of Mason and Dixon's line. The first week in May it appeared in force in the northern counties of Alabama, and shortly afterwards in nearly all the southern counties of Tennessee. Later, alarming reports were received from Kentucky, North Carolina, Virginia and Maryland, and in June some fields of grain in the District of Columbia were badly damaged. The first week in August a correspondent in Avoyelles parish, La., sent us genuine northern Army-worms, with the report that they were greatly injuring the corn crop, but were not so numerous as they had been in May and June. Moreover, Dr. Chas. Mohr informs us that the hay crop around Mobile, Ala., was completely ruined by an army-worm which, from all accounts, seems to be the true *Leucania unipuncta*.

THE WHEAT-STALK WORM ON THE PACIFIC COAST.—Mr. J. A. Starner, of Dayton, Columbia county, Washington Territory, has recently sent us wheat-stalks containing larvæ which he states have caused a shortness of the crop for several years. An examination of the stalks showed many larvæ and pupæ seemingly identical with those of *Isosoma tritici* Riley, described in the March number of the NATURALIST, and working in a precisely similar manner. From the great difference in locality, the presumption would be that the species would prove distinct, for *tritici* has never been found farther west than Washington county, Missouri. The rudimentary wing-pads of the pupæ, however, showed the western species to be wingless like *tritici*, and the imago, when it was subsequently bred, proved specifically identical.

We remember seeing, in 1879, a correspondence in the columns of the *Pacific Rural Press*, relative to a wheat-stalk worm which was doing some damage to the crop in California. Specimens were referred to Dr. Packard, who pronounced them in all respects similar to *Isosoma hordei*, the well-known joint-worm fly, except that they lacked wings, It seems quite probable that this insect was also *I. tritici*.

DESERVED HONOR.—We are glad to learn from a note in the June number of the (London) *Entomologist* that Miss Eleanor Ormerod has been appointed consulting entomologist to the Royal Agricultural Society, of Great Britain. We have had, on several occasions, the pleasure of referring to the excellency of Miss Ormerod's writings in economic entomology, which is beginning to be appreciated even in Great Britain.

IMPORTANT WORK ON CYNIPIDÆ.—Dr. Gustav Mayr has followed up his excellent paper on "Die Genera der gallenbewohnenden Cynipiden," by another, just published, entitled, "Die Europäischen Arten der gallenbewohnenden Cynipiden." In this latter paper 142 species of 22 genera are described by means of the synoptical tables which Dr. Mayr has adopted and uses altogether for this kind of work. From its completeness, and from its very practical form, this paper cannot but give an added impulse to the study of the Cynipidæ, both in Europe and in this country.

REMARKABLE FELTING CAUSED BY A BEETLE.—A few weeks ago we received from Mr. Henry Hales, of Ridgewood, N. J., a piece of pillow ticking, the inside of which was felted with a fur-like coating made from particles of the feathers with which the pillow had been filled. The felting is remarkably dense, evenly coating the whole surface of the piece of ticking, and greatly resembling in softness, smoothness and color the fur of a mole. We give Mr. Hales's own words:

"Enclosed I send you a piece of pillow-case which was filled with chicken feathers of various colors, in a neighbor's house. The pillow was noticed to gradually shrink, and when opened to ascertain the cause, it was found that a little beetle had bred and multiplied in the pillow, stripped all the soft parts of the feathers off the stems and felted the pillow-case inside with the feathers, making it one uniform color. The whole fabric, over a yard square, was all evenly covered as the enclosed piece which was cut from it. Do you know the insect? Is it an unusual occurrence?"

The insect is the common Dermestid beetle, *Attagenus megatoma.* An examination shows that the short, downy particles of feathers are all inserted by their basal ends, and the explanation of the felting is of course simple enough, when the barbed nature of these fine feathers is remembered, the barbs all directed towards the apex. In the regular shaking of the pillow, each of the minute particles of feather whenever caught in the cotton fabric by its base, became anchored in such way that every additional movement would anchor it firmer. The remarkable thing about the present case is that the felting should be so beautifully regular. We do not remember to have seen any published account of a similar felting resulting from the work of a beetle.—*C. V. Riley, in Rural New Yorker.*

Location of Taste in Insects.—J. Kunckel and J. Gazagnaire find that gustation in the Diptera begins with the paraglossæ, at the point at which the false tracheæ open, and is continued along the false tracheæ, becoming intensified at the extremity of the epipharynx, where quite a group of nerve-endings occurs; it is prolonged along the margins of the epipharynx and operates at the entrance or throughout the cavity of the pharynx.—*Journal of the Royal Microscopical Society.*

Vitality of Insects in Gases.—From the apparent indifference of some insects to foul and poisonous emanations as well as the varying sensitiveness of others under similar conditions, it would seem reasonable to conclude that there is a substantial difference in the delicacy of their respiratory functions, which might be indicated approximately by subjecting individuals of various groups to artificial atmospheres of deleterious or irrespirable gases.

This opens a wide field of experimentation both in the methods employed, the reagents used, and the insects examined. More from curiosity than any other motive, I have made some trials in this direction, and the results may at least be tabulated, though they have not been extended enough to admit of any very interesting deductions.

The vessels used in these experiments were large glass bottles, the mouths of which were fitted very tightly with rubber corks, these latter were perforated by two circular holes in which were secured a long and short glass tube made air-tight in their fittings by the pressure applied to the rubber cork upon insertion. These glass tubes were one-half inch in diameter, and served as an inlet and outlet for the gases, upon charging the bottles, and were in turn closed by small rubber corks.

The gases used were oxygen, hydrogen, carbonic oxide, carbonic acid anhydride, prussic acid vapors, nitrous acid fumes, chlorine, laughing gas (nitrous oxide) illuminating gas and ammonia. The experiments were made at the commencement of the fall of 1881, and but a few species of insects, and those the most common were obtained for trial, and from want of time the experiments were necessarily incomplete.

Oxygen.—The insects introduced in this gas at first showed slight symptoms of exhilaration and excitement, moving rapidly, flying, accompanied with a restless inclination to jump; this passed away and the prisoners seemed totally unaffected by the excess of oxygen about them and when finally they succumbed, it seemed in some cases as much due to confinement as to the super-excitatory qualities of the gas they were breathing. Their resistance to the hurtful effects of the oxygen varied extremely, both in individuals of the same species and of different species, but in all cases the gas impaired their vitality only after long exposure to its influence.

Flies (*Musca domestica*) lived in the jars, completely charged with oxygen, from nine through fourteen, fifteen, twenty-three, to twenty-nine hours.

Colorado beetles (*Doryphora decemlineata*) were confined in oxygen for three days, and at the end of that time showed only a slight torpidity, which entirely disappeared when they were liberated, and they resumed their destructive habits apparently uninjured.

The larvæ of the Colorado beetle died in the oxygen after displaying great discomfort under its action after one and one-half day's exposure.

Meal bugs (*Upis pennsylvanicus*) were introduced into the oxygen with the Colorado beetles, and behaved in a similar manner though noticeably rendered more torpid and inert. They recovered completely upon their release. The common yellow butterfly (*Colias philodoce*) fluttered convulsively in the gas, but yielded to any injurious influence exerted by the gas over it, very slowly, dying in twelve hours, possibly as much from the effects of its own violence and consequent exhaustion, as from the power of the gas.

Moth (*Noctua*—) unexpectedly exhibited great vitality, living over one and one-half days.

Harvest men (*Phalangium dorsatum*) evinced considerable excitement in the oxygen, and lived twenty-four hours.

Hydrogen.—Flies (*Musca domestica*) were instantly knocked down and after a few struggles became quiescent, with complete paralysis and plication of legs, in fifteen to twenty minutes, or in some cases in five minutes. Though this prostration closely resembled death, and was so in many instances, yet some of the flies were actually alive for a long time afterwards. After twenty-four hours confinement one fly revived sufficiently to fly, though its legs remained crumpled beneath it.

Colorado beetles evinced a wonderful vitality in this suffocating atmosphere; the relation of two experiments will illustrate this.

In the first case a good-sized vigorous individual was dropped into the bottle, the vessel fully charged and the openings shut. The hostile atmosphere quickly affected the insect; after a few exertions to break its way out, it fell over, opening the elytræ and protruding its wing membranes, and although occasionally moving, it remained for a long time motionless. In an hour these movements were more noticeable. The beetle remained here for ten hours longer at the end of which time it was kicking, and after the least possible admission of air which failed to elicit any signs of relief from its fellow prisoners, commenced to walk. It was taken out in twenty-four hours, and revived so thoroughly as to appear actually unharmed.

In a second case several individuals apparently succumbed at once, but in twelve hours recovered partially and crawled around, and after remaining in the gas almost two days, were removed, and were active and lively. These were then introduced into an atmosphere of carbonic acid anhydride, in which they remained four hours, and then eventually recovered, when refreshed by air and food.

The snapper (*Elater communis*) displayed very inferior power of resistance to the noxious effects of the gas, reviving in one case, but feebly in twenty-four hours, and in another found dead in thirty hours.

Moths (*Noctua*––) died in twenty minutes, though instantly upon introduction, were thrown on their backs and paralyzed.

A black wasp (*Pompilus unifasciatus*) died in ten minutes.

Carbonic Acid Anhydride.––Flies (*Musca domestica*) were instantly overcome, and died in from ten to fifteen minutes.

A large blue fly, bluebottle fly (*Musca cæsar*) was in a dying state in two minutes, but revived completely upon its release.

Colorado beetles recovered after three hours exposure during which time they remained upon their backs almost motionless. The surprising vitality of those previously exposed to hydrogen has been given above.

Bed-bugs (*Cimex lectularius*) also recovered to a slight degree after two hours' exposure.

Carbonic Oxide.—Colorado beetles revived after remaining in this virulent atmosphere eight, twenty, thirty and forty-five minutes.

Ants (*Formica rubra*) died in thirty seconds and in one minute.

Prussic Acid Vapors.—This poisonous atmosphere acted fatally upon every insect exposed to it, though the indestructible Colorado beetle resisted its attacks more stubbornly than any other experimented with.

Nitrous Acid Fumes.—These fumes acted with fatal rapidity, and destroyed without perceptible distinctions in the time of their death the feebler and stronger insects.

Chlorine.—Chlorine corrodes and disintegrates the tissues; and the insects exposed to a dense atmosphere of this gas were immediately killed. It was, therefore, used simply as a diluent of the ordinary air. The Colorado beetles lived in an atmosphere overpoweringly odorous of chlorine for one hour, and partially revived upon their release.

Nitrous Oxide (*laughing gas*)—The Colorado beetle gave in this gas no signs of exhilaration, lived two hours, and died upon removal; probably from exhaustion.

Young of the common grasshopper (*Caloptenus femur-rubrum*) were confined two hours in this gas and were but little affected.

Moths (*Noctua*) died in an hour and a-half.

Illuminating Gas.—The gases used were variable mixtures of hydrogen, marsh gas, carbonic oxide, and hydrocarbons, a notoriously dangerous and irrespirable compound.

Colorado beetles were instantly prostrated, folding up their legs underneath them, and gave in twenty minutes scarcely discernible indications of life. After an hour they were taken out and partially revived; some entirely recovered. The paralysis of the legs was the noticeable feature, especially that of the front pairs.

Croton bugs (*Ectobia germanica*) behaved similarly in the illuminating gases, and on being removed after half an hour's confinement recovered almost completely.

Young of grasshopper (*Caloptenus femur-rubrum*) evinced signs of life one hour after their introduction, and one individual taken out at that time appeared completely lifeless, yet recovered and was sufficiently strong to force its way out from under a beaker glass. Others left in one day were killed.

A cicada (*Cicada pruinosa*) died in ten minutes. Flies imprisoned in these gases, though they instantly fell to the bottom of the jars in an almost lifeless state, recovered after five minutes immersion on being removed. A longer imprisonment dispatched them.

It seems quite feasible that insect cases made air-tight could be charged from time to time with ordinary illuminating gas, and their contents thus protected against the inroads and devastations of Anthreni and Dermestes. Other objects could, of course, be so treated. The cases should be thoroughly tight, and the gas a pure and well-cleaned product. I have kept admirably some specimens in this way, but have noted several aberrant phenomena when specimens were moist. Some fragments of mummy skins, which I had in gas were in excellent condition after a long trial; they had been taken from a decomposing subject. On moistening them a rich growth of Fungi started out over them, which flourished in the atmosphere of gas for a short time, but after repeated charges sickened and died.

I am convinced that in place of ordinary illuminating gas the vapors of Prussic acid diluted with air or pure carbonic oxide, injected into tight insect boxes, will prove most efficacious for the protection of their contents.—*L. P. Gratacap.*

ANTHROPOLOGY.[1]

THE ANTHROPOLOGICAL INSTITUTE.—If we were pained to learn from Professor Flower's presidential address that the Anthropological Institute of Great Britain was on the decline, we are pleased to say that the August number of the Journal is one of the very best that has yet appeared. The original papers are the following:

On the twelve tribes of Tanganjika. By Edward C. Hore.
Notes on the Napa Indians. By Alfred Simson.
Notes on a Patagonian skull. By G. W. Bloxam.
From mother-right to father-right. By A. W. Howorth and L. Fison.
Analysis of relationships of consanguinity and affinity. By A. Macfarlane.
On Aggri beads. By John Edward Price.
On the aboriginal inhabitants of Andaman Is. I. By E. H. Man.

The twelve tribes of Tanganjika are the Wajiji (Ujiji), Warundi, Wazige, Waviri, Wamsansi, Ubwari, Ugoma, Waguha, Marungu, Itawa, Walungu, Wafipa, Ulcawendi. Of course, Mr. Hore, had to change the initial letter of most of his names from the old spelling, in order to confound our card catalogues.

The Napa Indians are in the "Oriental Province" of Ecuador. There are two classes, *Indians* and *Infidels.* The former speak Quichua, eat salt, and are semi-christianized; the latter, not.

The *Infidels* are the Zaparos, Piojes or Santa Marias, Catos, Tutapishcus, Anhishiris, Intillamas, Meguanas, Copalureus, Tamburyacus, Payaguas, Cuaranos, Pucabarrancas, Lagarto-Cochas and Tagsha-Curarais. The paper of Mr. Simson relates especially to the *Indians.* In it are described the making of the *bodoquera*, or blow-gun, aborginal fishing, social customs, journeys for salt and poison, intoxication, &c.

The paper of Messrs. Howitt and Fison starts out with the following propositions:

1. Many tribes reckon descent through females, others through males.

2. The latter bear evident traces of the former regulation.

3. Where traces appear, uterine preceded male descent.

Changes proceed from causes and motives, that is, from internal and external force. The external theory does not account for the origin of the change, it only pushes it further back. Internal causes or motives are either orderly or disorderly. Orderly changes are produced by the gradual alteration of laws relating to property.

Savage peoples are divided into *Classes* and *Clans*, the former being a social distinction, the latter, local or physical. The *Classes* are further divided into *Totems.* The individuals bearing these totemic names are scattered throughout the clans and tribes, having perpetual succession through mother-right or father-right. Now there is necessarily a conflict between the local and the social, and the extremely interesting and learned paper unfolds

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

the working and interlacing of the two systems among the Australian tribes with which the authors are so familiar.

Mr. Macfarlane, following up the investigations of inquirers into the law and biography of consanguinity and affinity in all times and tribes, seeks to develop a "systematic notation capable of denoting any relationship whatever." There are but two fundamental ideas in consanguinity, the first may be represented by the letters *p* and *c*, meaning parent and child; the other is sex, denoted by the letters *m* and *f*. Mr. Macfarlane shows how the remotest relationship may be indicated by such formulæ as *f p p p p p m*—a man's great, great, great grandmother.

Mr. Man's communication, pages 69–116 is a series of chapters in answer to the British Instructions to Observers, treating of the form and size, anatomy, color, odor, hair, development and decay, crosses, reproduction, abnormalities, pathology, physiognomy, motions, powers, senses, psychology, morals, magic, witchcraft, distribution, topography, communities, arithmetic, habitations, government, &c., of this interesting race.

Asia.—The volume of Stanford's Compendium of Geography and Travel relating to Asia has just appeared. No ethnologist can afford to exclude these volumes from his library. The series are based on Hellwald's "Die Erde und ihre Völker," but so much original matter has been added that we may well call the series a new work. Already the following are completed: "Australasia," by A. R. Wallace and A. H. Keane; "Africa," by Keith Johnson and A. H. Keane; "Central America, the West Indies and South America," by H. W. Bates and A. H. Keane; and "Asia," by A. H. Keane and Sir Richard Temple, Bart.

Mr. Stanford will soon publish "Europe," by Sir A. C. Ramsay and A. H. Keane, and "North America," by F. V. Hayden, A. R. C. Selwyn and A. H. Keane. It will be perceived that the name of Mr. Augustus H. Keane is attached to each volume; in addition to assuming the main responsibility for the work on Asia, he is the ethnological editor of the series. After the usual amount of preface and introduction (pp. 1–28) the body of the book is divided as follows:

A. Western Asia: Mohammedan States.
B. Southern Asia: British Political System.
C. Northern Asia: Russian Political System.
D. Eastern Asia: Buddhist States.

From chapter to chapter, in its appropriate place, the ethnography of each region is worked out. The term is to be taken in its widest sense, since administration, statistics and commerce are not neglected. In the appendix of this volume, just as in others of the series, especial attention is given to the races and languages of the areas covered by the work. The Asiatic continent exhibits the birthplace of two of the five great families of mankind, the Caucasic and the Mongolic. These two Mr. Keane differentiates as follows:

	Ideal Mongolic Type.	Ideal Caucasic Type.
Shape of head.	Normally brachycephalic.	Normally dolichocephalic.
Facial angle.	Prognathous, 76°–68°.	Orthognathous, 82°–76°.
Features,	Square, angular and flattened.	Rounded off and oval.
Cranium.	1200–1300 cu. cm.	1300–1400 cu. cm.
Cheek bones.	High and prominent.	Low and inconspicuous.
Ears.	Large and projecting.	Small and close to the head.
Mouth.	Large, with lips thick.	Small, with red, thinnish lips.
Nose.	Broad, flat, concave.	Long, narrow, high, straight or convex.
Forehead.	Low, receding, narrow.	Straight, broad, well developed.
Eye.	Small, almond, oblique, &c.	Large, round, straight, &c.
Chin.	Small and receding.	Full and projecting.
Neck.	Short and thickset.	Long, slender and shapely,
Figure.	Squat, angular, heavy.	Symmetrical, slim, active.
Hands and feet.	Rather small.	Medium and large.
Stature.	5 ft. to 5 ft. 4 in.	5 ft. 4. in. to 5 ft. 9 in.
Complexion.	Yellowish, tawny, or olive, &c.	Fair or white to brown, &c.
Hair.	Dull-black, coarse, cylindric.	Wavy, color variable, elliptical.
Beard.	Scanty.	Full, bushy, and often long.
Eyebrows.	Straight and scanty.	Arched and full.
Expression.	Heavy, uniform.	Bright and varied.
Temperament.	Dull, taciturn, &c.	Energetic, restless, &c.

To these two blood-stocks belong as many as thirty language-stocks. In the comminglings of history, language and blood have ceased to be coördinate among certain peoples; notwithstanding, on the whole, the radical Aryan forms have been preserved separate from the Mongolian. The following is Mr. Keane's Scheme of the Asiatic races:

I. Mongolic or Yellow Type.

Stock Languages.	*Races.*	*Main Divisions.*
1. Tibeto-Burman	Tibetans	Bod-pa, Tangutan, Sifan, Himalayan tribes, No. Assamese
	Burmese	Burmese, Kakhyon, Arakanese, So. Assamese
2. Khasi		Khasia tribes
3. Mon		Talaings of Pegu
4. Tai	Tai	Siamese, Shan, Lao, Ahom
5. Sinico-Annamitic	Chinese, Annamese	Chinese, Tongkinese, Cochin-Chinese
6. Koreo-Japanese	Koreans, Japanese, Lu-Chu	
7. Ural-Altaic	Finno-Tatars	Mongolian, Tungus and Manchu, Turki, Samoyede, Ugrian
8. Malayan	Malays	Malay, Formosan

II. Caucasian or Fair Type.

Stock Languages.	*Races.*	*Main Divisions.*
9. Kartveli	Caucasians	Georgian and Mingrelian
		Svan, Khevsur, Pshav and Laz
10. Cherkess		Circassian
		Abkhasian
		Kabard
11. Chechenz		Chechenz
12. Lesghian		Daghestan tribes
13. Aryan	Iranians	Tajick
		Baluch
		Kurd
		Ossetian
		Armenian
		Afghan
	Galchas	Zarafshan
		Wakhi
		Siah-Posh Kafir
	Hindus	Panijabi
		Hindi
		Bengali
		Assamese
		Nepalese
		Oriya
		Marathi
14. Semitic	Semites	Assyrian
		Aramæan
		Hebræo-phœnician
		Arab
		Himyantic
		Abyssinian

III. Races and Languages of Doubtful Affinities.

15. Brahni of Baluchistan.
16. Dravidian } of the Deccan.
17. Kolarian } of the Deccan.
18. Sinhalese of Ceylon.
19. Khmer of Cambodea.
20. Aino of Yesso and Sakhalin.
21. Chukchis } Hyperboreans, N. E. Siberia.
22. Yukaghis
23. Kamchadales
24. Giliaks
25. Aborigines of S. W. China.
26. Negritoes of Andaman island, Malacca.

The alphabetic list of races, which terminates each of the preceding volumes of the Stanford series, is omitted for want of space, containing 3000 entries. This list, however, with much additional information, will be issued in a separate form.

Anthropology in America.—The Biological Society of Washington has issued its first volume of Proceedings, a neat pamphlet of 110 pages, containing the organization, constitution, list of members, and an account of papers read to May 26, 1882. An excellent feature of this work is one that all societies desiring to economize their means will do well to imitate. Instead of publishing all papers *in extenso*, a reference is given to all places where the whole or parts of papers appear in print.

Mr. Calvin M. Young, of Darla P. O., Ohio, sends to the editor, a photo of a specimen of the polished ornament commonly called the brooding bird, in which the animal is a turtle, and not a bird. We have seen the beaver taken off in the same way. The turtle-form is exceedingly rare, if it is not the only example. The image was found near a mound in Miami county, Ohio, two miles west of Stillwater river.

Mr. William Kite, of Germantown, Pa., draws attention to the existence of doughnut-shaped stones in Pennsylvania, similar to those so common from California. Mr. Kite says, " I have in my possession two such specimens, one from Chester county, Pa., and one on the outskirts of Germantown. The latter is the more curious, as it has a saucer-like cavity worked on both sides of the stone."

THE AMERICAN ANTIQUARIAN.—The third number of Vol. IV, of this established quarterly is well above the average in merit. The original papers are as follows :—

The native races of Colombia. By E. G. Barnev.
The divinity of the hearth. By Rev. O. D. Miller.
Palæolithic man in America. By L. P. Gratacap.
Early European pipes found in the United States. By E. A. Barber.
The Prehistoric architecture of America. By Stephen D. Peet.

The correspondence and notes in this Journal are qnite as valuable as the original communications.

GEOLOGY AND PALÆONTOLOGY.

A FOSSIL CROATIAN WHALE (*Mesocetus agrami*)[1].—P. J. Van Beneden, in the " Memoirs of the Royal Academy of Sciences of Belgium," gives an account of the remains of a whalebone whale contained in the museum of Agram, Croatia. These remains are not only of interest from their affinities with existing species, but from the light they shed upon the changes undergone by the European seas since the Tertiary epoch. The Black Sea during that period covered Austria, Bavaria, Wurtemburg, and the lower part of Switzerland, and contained true whales, whereas now its cretacean fauna consists of only three dolphins.

The remains consist of the hinder portion of the cranium, a mandibular condyle, several vertebræ and a part of a rib. The form of the condyle is a mean between that of the existing whalebone whales and that of the dolphins, showing habits intermediate in some respects between these two groups. When the transverse section of the cranium of Mesocetus is compared with that of *Balænoptera rostrata*, a striking difference is observable in form and in the relative development of the bones composing them. The former is spread out laterally at the expense of the height; the sphenoid is at least twice as broad as high, and the palatine plate forms a horizontal cavity under the sphenoid; whereas in

[1]Une Fossile Balenie de Croatie, appartenant au genre Mèsocèto, par P. J. Van Beneden.

the existing species the sphenoid is much higher than wide, and the fold of the palatine is vertical.

ORIGIN OF THE PRAIRIES.—I notice in the AMERICAN NATURALIST for May a note on "The origin of the prairies," in which the Indian custom of burning the grass is made to play a major part. Now, it seems to me, that this may help to account for the slow spreading of forests, but not for the origin of the prairies. Why did not trees spring up over one part of the country as well as another? This is the question; not why did not the forests spread? A reason often given is that the forests flourished only along streams because the prairies are too dry, but the timber often covers the highest points and is not found on the lower ones.

Did not the native grasses cover the ground first and thus prevent all light seeds from finding a place to grow? and as only the light seeds would be transported by the wind, and thus spread rapidly, the extension of the tree-covered areas was very slow.

We observed several years since, that in Northern Ohio trees of the genus Populus, other than *P. tremuloides*, were very rare. Now they are not uncommon. Wherever a brushpile was burned at the proper season, if it was not a period of drought, the cottonwood appeared. The seeds must have come with the winds, and wherever they found soft earth ready to receive them, if the season was favorable, they grew. Of course the oak, hickory, walnut and beech could not travel in this way.

It seems to me that in these facts we have an important element of the solution of this much-debated question.—*J. W. Huett, Ottowa, Ill.*

DAVIS' CLASSIFICATION OF LAKE BASINS.—This is a valuable essay, by Mr. W. M. Davis, on a topic in physical geology which has not before received such detailed and special treatment. It is reprinted from the Proceedings of the Boston Society of Natural History (Vol. XXI, 1882). The author's primary classification of lakes is into three classes: *A*. Construction or orographic basins, of which (1) great basins such as Great Salt lake and the great lakes of Central Africa are examples, (2) mountain trough basins (the western part of Lake Superior), (3) fault basins (the Dead sea and other species); *B*. Destruction or erosion basins, of these are the following species: (1) Glacial erosion basins, (2) wind erosion, (3) solution, (4) pit crater basins; and *C*. Obstruction, barrier or enclosure basins, of which the most important are (1) fan delta barrier basins, (2) ice barriers, (3) moraine barrier basins, (4) drift barrier basins and a number of other species.

The author claims that the Great lakes, the Italian and other lakes, regarded by Ramsay, Logan, Newberry and others as due to glacial erosion, are more properly examples of what he calls "drift barrier basins." He considers that besides the small

PLATE XVII.

Restoration of *Loxolophodon cornutus* Cope, one-twelfth natural size. From the Bridger Eocene of Wyoming.

moraine barrier lakes, which are now found on Pike's peak, and in the Alps and the north-and-south lakes in Central New York, such as Cayuga, there are many others "whose obstruction must be given the more general name of glacial or fluviatile drift." Farther on he says: "The detritus of the glacial period was deposited with much irregularity, and it must often have interrupted the drainage lines of pre-glacial times; we cannot doubt that the greater number of lakes in Canada, New England and the Adirondacks, are of this origin, but nowhere are drift barriers of more significance than in the region of our great lakes." Davis believes that the evidence ordinarily quoted to prove their glacial origin proves only their glacial occupation. He regards Lake Erie as the effect of simple subaërial erosion slightly modified by glacial action, while he does not feel obliged to regard the other great lakes as the "work of the great ice-plow." He considers St. Mary's river, Niagara and the St. Lawrence to be "all post-glacial overflows after the obstruction by drift and the change of level by northern depression were accomplished." The brief discussion is of a good deal of value, and will be read with interest in connection with the discussions now going on between Professors Newberry, Lesley, Spencer and other of our geologists.

Collett's Geology of Indiana for 1881.—This volume is fully equal to if not superior to its predecessors in interest and value, both from a practical and scientific point of view. Mr. T. H. Johnson's report on the transverse strength and elasticity of building stones is valuable and graphically illustrated, and Professor Collett, the State geologist, has been efficiently aided in his work by Messrs, R. T. Brown, M. N. Elrod, A. J. Phinney and John N. Hurty. The volume is largely made up of palæontological matter supplied by Professor James Hall and Dr. C. A White, being illustrated with fifty-five plates, rendering the volume of much educational value.

Two new Genera of Mammalia from the Wasatch Eocene.—The *Phenacodus laticuneus* differs from the species of *Phenacodus* in the form of its superior premolars. The second, possesses two cusps while there is but one in the genus *Phenacodus*. The new genus may be called *Diacodexis*. The species referred by me to *Pachynolophus* do not belong to that genus, which is identical with *Propalæotherium*. In the heel of the last inferior molar, and general dental characters, they agree with *Lophiodon*, but they have seven superior molars, the first premolar well developed. The genus may be called *Heptodon*, the type is *Lophiodon ventorum* Cope.—*E. D. Cope*.

White's Carboniferous Invertebrate Fossils of New Mexico.—We have received a report, by Dr. C. A. White, printed as an appendix to the forthcoming volume of the Wheeler Survey west of the 100th meridian. The collection described represents the coal-measure division of the Carboniferous system of the Upper Mississippi, and is closely allied to that upper division of that group.

Geological News.—The Journal of the Cincinnati Society of Natural History contains descriptions of three new species from the Hudson river and Niagara groups, by S. A. Miller; a description of a new species of Bourguetocrinus, by P. De Loriol, of Switzerland, and remarks upon a species of Cristatella, by C. Schlumberger, of Paris, both from the Ripley group of the Cretaceous, Alabama; a description of two new crinoids from the shales of the Niagara group, New York, by E. N. S. Ringueberg, and an article on American Palæozoic Bryozoa, by E. O. Ulrich. The latter is the first of a series, and contains not only descriptions of twenty-five new species, but discourses upon the general structure of the class; upon the affinities and zoölogical position of the Monticuliporidæ and Fistuliporidæ, which the author is inclined to place among the Bryozoa rather than among the Cœlenterata; as well as a scheme of classification of the American Palæozoic Bryozoa. —— M. P. de Tchihatchef, in a discourse delivered at Southampton, combated the idea that the deserts of Asia and Africa are beds of the sea recently raised, and stated his belief that the deposits of sand are of atmospheric origin, and are the product of influences acting from the more or less remote geological epoch, when the rocks from which they were formed, and which in many places still pierce through the superficial sand, were first raised.——J. F. Whiteaves (Am. Jour. of Science, Oct.) notices the occurrence in the Utica formation of *Siphonotreta scotica*, a spinose brachiopod not before known to occur in North America.——Mr. W. E. Abbott, in a paper in the Journal of the Royal Society of New South Wales, refers to and endorses the opinion of Mr. Russell, that the amount of precipitation over the watershed of the Darling exceeds the evaporation plus the amount carried off by the river, and that there must therefore be an underground drainage. The fact that wells sunk in the vicinity of the Darling have a flow independent of the variations in that river, seems to support this opinion.——In the Geological Magazine, Mr. T. F. Jamieson writes in support of the theory, propounded by him in 1865, that the submergence of the land during and after the conclusion of the glacial period was caused by the weight of the ice upon the elastic crust of the earth. The shifting of the centre of gravity of the earth consequent upon the weight, according to the theory of Mr. Croll, will not, in his opinion, account for the existence of raised beaches in high northern latitudes, as at the transference of the weight of the ice from the north pole to the south, and submergence caused by it would cease as the weight diminished, allowing no time for beaches to form. A submergence caused by actual sinking of the crust from superincumbent pressure would, on the contrary return but slowly to its former level, and probably some amount of permanent depression remained.——In the same magazine, Mr. Woodward describes five species of phyllopod Crustacea from shields found in the Upper Devonian of the Eifel, and one from the Wenlock shale of South Wales; Mr. W. H. Twelvetrees has some notes upon the geology of the country at the base of the southwest slopes of the Urals; Mr. S. V. Wood continues his argument for the formation of the Loess from the sliding into the valleys of the thawed soil-cap annually left unprotected upon the heights: Mr. Howorth adduces the evidence of the valley terraces in favor of the occurrence of a great post-glacial flood; and Mr. Flight continues his history of meteorites.——Among the numerous interesting and valuable papers contained in the Bulletin of the Geological Society of France, during the year 1881, are the following: On the importance of the central chamber of the Nummulites, by M. da la Harpe; On the Micaceous schists of the environs of Saint-Léon (Allier), France, by M. Michel-Lévy; On the connection between the propagation of heat with the cleavage of rocks and the movements of the soil that have produced them, by M. Ed. Jannettaz; Note on the Tertiary Echinidæ of Belgium, by M. Cotteau; On the geology of the environs of Saint-Amand, by M. Dagincourt; The Quaternary of Chelles, by M. Ameghino; Contact of the Bathonian and Callovian beds on the eastern border of the Paris basin, by J. Wohlgemuth; First fruits of the Eocene flora of Bois-Gouët (Loire Inferieur), by M. Ed. Bureau, with descriptions of two new species; On the geology of the Pyrenees of Navarre, Guipuzcoa and Labourd, by M. P.-W. Stuart-Menteath; On the general geology of Spain, by M. P. Rey-Lescure; On the Lingulæ of the "grès" Armorican of La Sartthe, by M. A. Guillier; Geological notes on French Guiana, after the explorations of Dr. Crevaux, by M. Ch. Velain, with a map of the province, and numerous figures of sections of the rocks. The river Oyapock, though only 435 kilometres in length, carries down more water than the Rhone, and the greater portion of its course is among gneissic rocks mingled with granite, which cause numerous cascades, and render its ascent impracticable; Synchronism of the Turonian of the Southwest with that of the south of France, by M. H. Arnaud.

MINERALOGY.[1]

Some New Minerals in Meteorites.—An examination of a mass of meteoric iron from Melbourne, Australia, has been made by Dr. W. Flight,[2] of the British Museum, with the result of the discovery of several new compounds of nickel and iron.

The meteorite, which fell in 1854, consists entirely of metallic minerals, containing no rocky matter. The iron contains 7–9

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Proc. Royal Soc., No. 218, p. 343.

per cent. of nickel, with small percentages of cobalt, silicium and copper. Lying on the plates of meteoric iron, which make up the mass, are thin metallic flexible plates of the thickness of writing paper of a substance having the composition $Fe_5 Ni_2$. It is this mineral which forms the figures on etched surfaces, and not, as generally believed, schreibersite. The name *Edmonsonite* is proposed for this mineral.

Nodules of troilite and graphite, and square prisms of what appears to be rhabdite $(Fe_4 Ni_3)$ P. occur through the mass.

Two other minerals were noticed, and are probably new. One occurs as brass-colored oblique crystals, cleavable across the base, and having a composition agreeing with the formula $(Fe_9 Ni_2) P_2$. Another phosphide whose formula was $(Fe_7 Ni_2)$ P. occurred in square prisms, bright externally, and dull, almost black within.

The occluded gases in the meteorite amounted in bulk to 3.59 times the volume of the iron, and consisted of carbonic acid, 0.12; carbonic oxide, 31.88; hydrogen, 45.79; marsh-gas, 4.55; nitrogen, 17.66.

Corundum and its Alterations.—Dr. F. A. Genth has made another valuable contribution to our knowledge of the genesis of minerals in a paper read before the American Philosophical Society, on August, 18, 1882. The paper is in part an appendix to his former paper on corundum and its alterations, and in part a collection of mineralogical notes on various subjects.

Of the alterations of corundum, the first described is an alteration into spinel of the corundum from Carter mine, Madison county, N. C. When containing fissures, it was observed, sometimes only by a small dark line, that a change had commenced, which, extending sometimes through large masses, had converted the corundum into a massive greenish-black spinel of granular structure. The spinel finally passes into prochlorite. Particles of spinel were also observed in corundum from Shimersville, Lehigh county, Pa., and were regarded as the result of alteration. At Toures county, Ga., corundum was surrounded by an alteration into greenish-white, cleavable zoisite.

Several examples are given of the alteration of corundum into feldspar. The oligoclase of Unionville, Pa., is regarded as such an alteration. A number of instances are given of alteration into mica. A specimen from Haywood co., N. C., showed a large crystal of muscovite to which albite was attached, while through both substances there occurred remnants of corundum crystals, disseminated through the mass. The particles of corundum are corroded as though by a dissolving agent, and the whole mass has the appearance of a coarse granite in which corundum replaces the quartz. In some specimens from Alabama, the corundum crystals are surrounded by a layer of sub-fibrous mica, outside of which is a fine scaly mica, much of which has changed into brown scales, which exfoliate when heated. The corundum is rounded and corroded, but the sub-fibrous mica forms a ring around it with perfect hexagonal sides and sharp edges. Many of the crystals are almost completely changed into compact mica.

Several new localities are given of the alteration of corundum into margarite, fibrolite and cyanite. The interesting fact is recorded, that since these alterations of corundum occur in rounded masses in the gravel beds of the Southern States, the alterations here described must have taken place prior to the formation of the graveldeposits.

Of other alterations, those of orthoclase into albite, and of talc into anthophyllite are described. Some very interesting pseudomorphs of talc after magnetite, from the great serpentine bed in Harford county, Maryland, were observed. Octahedrons of talc, of a white color and pearly lustre, had the scales arranged parallel to the octahedral planes, and sometimes contained a nucleus of magnetite, more or less altered. Dark spots often of definite shape occur throughout the steatite bed, and it is suggested that the entire steatite bed is an alteration from one of magnetite.

Analyses are given of gahnite from North Carolina and Colorado, and some alterations of the latter into a chloritic mineral are described.

Minute grains of rutile and zircon were detected in the "Edge Hill rocks," of Bucks county, Pa. Small crystals of sphalerite and prehnite from Cornwell, Pa., are analyzed and described. A compact variety of pyrophyllite, having the appearance of kaolinite, and not exfoliating when heated, was described as occurring in seams in the slates and anthracite of Drifton, Luzerne county, Pa. Analyses of beryl and allanite from Alexander county, N. C., and of niccolite from Colorado are given, and some octahedral, cavernous crystals from a furnace bottom at Argo, Colorado, are shown by analysis to be probably artificial alisonite.

The paper contains numerous analyses which are especially valuable from the well known accuracy of Dr. Genth's work.

The Paragenesis of Minerals.—The study of the origin, successive formation and repeated alterations of minerals, is one of the most fruitful branches of mineralogy. As such studies progress, the science becomes more generic, and, entering a broader field, ranks with geology in unfolding the cosmogonic truths.

Of recent mineralogical papers, one of the most important is that by Professor B. K. Emerson[1] on the minerals of the Deerfield Dyke. Not only is each species carefully described, but its precise method of occurrence and of association with other minerals is given so as to show its comparative *age*. A table is added which shows at a glance the paragenesis of the species found.

Chemical analyses were not needed to establish the results obtained, and the mere inspection of the locality with the exact description given, is of far greater value than any list of chemical

[1] Amer. Journ. Sci., Nov., 1882.

analyses, such as would have contented most writers, while chemical analyses are often needed to establish the identity of a species. The broader study of the *origin of species* can be done by close observation alone.

The attention of our younger mineralogists should be particularly called to the value of a full description of the *associations* of minerals. The selected specimens in our cabinets, from which all "dirt" has been removed can teach us nothing of their origin. It is the rough masses in their natural home, interpenetrated by more recent minerals, or occurring in veins in those which are older, which, with their products of decomposition, are most worthy of study, both macroscopically and microscopically. A study of mineralogical development may finally lead to a new basis of classification, such as has already been attempted in lithology.

A MOUNTAIN OF MARTITE.—An iron mountain, the Cerro de Mercedo, which rises abruptly out of the plain near the city of Durango, Mexico, and which, a mile in length, is so covered by masses of iron ore as to conceal all rock outcrops has been reported upon by Mr. John Birkenbine, and the ore further described by Professsor B. Silliman. The ore has the streak and composition of hematite, but the octahedral character of the crystals showed it to be martite, and it is probable that the whole mass has been altered from magnetite.

ANALYSIS OF HELVITE.—Mr. R. Haines contributes to the Franklin Institute Journal, a correction of his analysis of the Helvite, from Amelia Co., Virginia, found by the writer and first recorded in the April NATURALIST. A re-examination of the specific gravity showed his first determination to have been erroneous, owing to the small amount of material at hand. It is now found to be 3.29. A new analysis gave total SiO , 32.49 per cent. of which 5.17 per cent. was insoluble in sodic carbonate, and is regarded as gangue. The full analysis was not completed.

GEOGRAPHY AND TRAVELS.[1]

PROCEEDINGS OF THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION.—The meeting of the British Association for the Advancement of Science, this year, was held at Southampton, from August 23d to 30th.

The subject of the opening address of the president of the Geographical Section, was the Central Plateau of Asia.

"Thi area," he said, "which is one of the most wonderful on the surface of the earth, contains nearly 3,000,000 of English square miles, and is equal to three-fourths of Europe. Its limits, its exterior configuration, its central and commanding situation in the Asiatic continent, will be clearly perceived from the large diagram of Asia which is exhibited here. As compared with some of the more favored regions, it is singularly destitute of natural advantages. Though it has several deep depressions of surface, yet its general elevation is very considerable, and some of

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[1]Edited by ELLIS H. YARNALL, Philadelphia.

its large districts are the most elevated in the globe. It is walled in from the outer world and excluded from the benign influence of the sea by mountain chains. Its climate then is very severe on the whole, more distinguished for cold than for heat, but often displaying extremes of temperature high as well as low. It offers from the character of its contour, extraordinary obstacles to communication by land or or water. Though seldom inaccessible to courageous explorers, it is generally hard of access, and in several respects very inhospitable. In the progress of civilization it is, with reference to its historic past, excessively backward. Its capacities for the production of wealth have been but little developed. Its population is scanty, scattered, and uncultured. Its agriculture comprises only a few areas widely segregated from each other, and many of its largest districts are amazingly desolate. Nevertheless this plateau has eminent claims on the attention of geographers, for several reasons, which may be summarized thus :—1. A mountain system which dominates the greater part of Asia, and includes stupendous ranges with the loftiest peaks yet discovered in the world. 2. A series of heights and depressions almost like the steps of a staircase within the mountainous circumvallation of the plateau. 3. The sources and the permanent supply of rivers which, passing from the plateau, flow through densely populated regions, and help to sustain the most numerous families of the human race. 4. A lacustrine system, comprising lakes, of which some are saline while others have fresh water, and of which many are situated at great altitudes. 5. The home of conquering races, whence warrior hordes poured during several centuries over nearly all Asia and a large part of Europe. 6. Natural products of value, variety, or interest, and pastoral resources susceptible of indefinite development. 7. An enormous field for scientific research, with many regions which, though not wholly undiscovered, yet need much further discovery. 8. An imperial jurisdiction offering many problems for the consideration of social inquirers."

The consideration of these points in detail occupied the remainder of Sir R. Temple's address.

Mr. John Ball discussed some points of the physical geography of South America, and especially the "remarkable contrast that exists between the climate of the eastern and western sides of the continent. On the eastern side of the great range of the Andes, which extends from north to south, a distance of more than 3500 English miles, you find throughout the vast empire of Brazil, from some degrees north of the equator to the tropic of Capricorn, copious rains which maintain extraordinary fertility and the full luxuriance of the tropical fauna and flora. On the opposite or western side, the tropical climate, with its characteristic vegetation, extends to the Pacific coast from the Isthmus of Panama to the Bay of Guayaquil. But the headlands which mark the southern limit of that bay—Capes Parinas and Blanco—also mark a sudden and complete change of climate. From the latter cape, lying about five degrees south of the equator, the comparatively narrow strip of land lying between the Andes and the Pacific coast—for a distance of fully 1500 miles—lies in what has been called the rainless zone of Western South America." Again, "in the southern province of Brazil and thence southward to the estuary of the Plata, the climate shows a gradual transition from the moist tropical type to the dry character of the *pampas* region, which in a more marked degree prevails in the south of the Argentine territory and through Eastern Patagonia. Exactly an opposite change occurs on the western side. In Chili, from Copiapo, where rain is rare and insufficient, to Valdivia, where it is excessive in amount, there is, as you travel southward, a gradual and steady increase in annual rainfall, with a corresponding change in the vegetation. The coast south from Valdivia, extending throughout Western Patagonia to the western end of the straits of Magellan, is apparently the part of the earth out of the tropics where the annual rainfall is greatest."

At Tumbez, on the south side of the Bay of Guayaquil, are frequent heavy rains and a mean temperature of about 82° F., with rich tropical vegetation; whereas at Payta, scarcely a hundred miles distant, no rain falls for two years at a time, and the average temperature is much lower than at Tumbez, while the coast is absolutely bare of vegetation.

The mildness of the climate, and especially of the winter climate, of the straits of Magellan is also without adequate explanation.

Mr. Joseph Thomson read a valuable paper on the Geographical Evolution of the Tanganyika Basin.

The various stages in the evolution of the Tanganyika Basin were summarized as follows;—"The first appearance of the future continent; we have been led to believe from various theoretical considerations, was the appearance of a fold of the earth's crust bounded by two lines of weakness converging towards the south, which fold gradually rose till it appeared above the ocean, first along these two lines of weakness, in the form of a series of islands, which finally join, enclosing in their centre a large part of the ocean. This enclosed water area formed a great central sea, and the enclosing land along the line of weakness is now indicated by the east and west coast ranges. In the second stage the continent of Africa south of 5° N. latitude presented the outline of the continent of to-day. The third stage shows the central plateau with the great central sea very much diminished in size and almost coinciding with the present Congo Basin. There is as yet no evidence of the existence of Tanganyika. After an enormous period of undisturbed deposition of sand in the sea, the fourth stage is ushered in by a period of great continental convulsions. On the line of the future Tanganyika a huge boss of rock is intruded into the throbbing crust, and the surrounding region elevated to a considerable extent, followed by the subsequent collapse of the body of the elevated area originating the great abyss of Tanganyika. The fifth great stage is marked by the formation of a channel through the western coast mountain causing the draining of the great central sea, which immediately becomes the inner drainage area of the Congo. The sixth stage then sees Tanganyika isolated as a lake by itself, from which time dates the moulding of its present scenery, the formation of an outlet, the freshening of its waters, and the lowering of its level; and, finally, we have seen that the intermittency of the lake's outflow is explained by the probable fact that the rainfall and evaporation nearly balance each other in ordinary seasons."

One of the most learned and elaborate papers was by M. P. deTchihatchef, on the Deserts of Africa and Asia.

After treating at length of the geology and physical changes of the desert of Sahara, he gives the following resumé of the most prominent features in its geological history:—

"1. The records of this history are very old, for the southern regions of the present Sahara were represented during the Devonian period by a certain number of isolated masses of limestone, gneiss, and micaschiste, the limestone containing Devonian fossils. Those masses conserved through all the succeeding ages their insular position, and never sunk again under the sea. 2. It was during the Cretaceous epoch that a large portion of the present Sahara was upraised under the shape of variously ramified masses, so that the sea of the following geological periods could penetrate into their interior, forming numerous gulfs and bays. 3. The Sahara was represented until the Quaternary epoch chiefly by those cretaceous masses which since their upheaval have never been covered by the sea.

"During the Quaternary period, among the gulfs which washed the shores of the cretaceous land, the largest occupied the present country of Jgharghar; the northern extremity of that gulf reached the place of Biskra, and the southern the cretaceous plateaux of Tademayt and Tinghert; the town Uargla occupies almost the central part of the gulf. As from the north, the last was entirely secluded from any communication with the sea, the littoral part of Algeria having been upraised a long time before, and consisting then, as now, in more or less high mountains, the large quaternary gulf could not find any other way in the interior of the Saharian cretaceous continent than through the present gulf of Gabe; and what proves that here was really the entrance of the quaternary gulf, is the narrow strip of diluvial deposits which, surrounded by cretaceous rocks, extends from Gabes unto the salt lake of El-Fedjedj (Tritonis lacus). This geological fact is important in reference to the question, so long discussed, of the ancient communication between the lake and the sea; it confirms the hypothesis of Commander Roudaire, and I am not aware that this argument, which I consider as the strongest of all, has ever been urged in his favor. The upheaval of the quaternary large gulf (and of many other smaller ones) was the last marine phasis which the Sahara underwent. 4. Once entirely raised up in all its parts, the Sahara had still to undergo a subaerial operation which consisted in the formation and accumulation of sands. It closes the fourth and last stage of her long geological history, without speaking of the different climatic and topographical modifications of quite recent times. This history, as it has been shown, proves that there can be no longer question of a recent emersion of the whole Sahara from the bottom of the sea. It is true the Libyan desert is probably somewhat younger than her Saharian sister, for tertiary uncovered deposits (Eocene and Miocene) have there a larger development than the Cretaceous ones; but, even admitting that the Libyan desert has been upraised after the Miocene period, it cannot be called recent."

As regards the great desert of Asia—the Gobi, there is abundant evidence to show its ancient formation, and it is "probable that after its upheaval this large surface has never been overflooded by the sea, as little as the Sahara-Libyan desert since the Cretaceous and Tertiary periods, or the Turkestan deserts since the Palæozoic epoch. Once more, in the Gobi, as in the other two deserts, the sand accumulations had nothing to do with marine deposits; they were chiefly produced by atmospheric agencies, and, as far as the Gobi is concerned, the frequent silicious rocks, as granite, syenite, gneiss, &c., were particularly apt to yield sufficient materials to the formation of quartz sands. It is superfluous to add that the upheaval of those deserts did not take place at once, but successively, as we have seen in the Sahara-Libyan desert, where Cretaceous and Tertiary rocks appeared, the one after the other, leaving still large tracts occupied by sea or fresh water basins, which were filled up only during the Quaternary epoch, or even in a more recent one. Therefore it is highly probable that, like the Sahara-Libyan desert, the Asiatic deserts were also crossed, long after the upheaval of their chief portions, by gulfs, or contained numerous fresh water basins."

The Geography and Meteorology of Kansas was treated of by Dr. Litton Forbes. It would be impossible perhaps, to find a country of equal extent where the physical changes produced by the advent of civilization have been so numerous or so important. Not only has the fauna been in great part changed, but the flora also, as well as the amount of rainfall and the general hygrometric conditions of the atmosphere. Not merely has the number of inches of annual rainfall increased, but it has also been more equitably extended over a larger extent of country. The progression westward of the rainfall of Kansas, in proportion as settlement has extended westward, is a most important fact. It may be due in part to the planting of timber, but is probably much more directly dependent on the immense acreage under wheat, corn, and other crops, which afford protection to the earth from the sun's rays, and so check a too rapid evaporation.

The State of Kansas forms a rectangular parallelogram, which measures about 400 miles from east to west, and about 200 from north to south, and contains over 82,000 square miles. Though to the eye apparently one vast, level plain, it is really a more or less elevated plateau, which slopes eastward at an appreciable angle. The highest, or western portion of the State, is about 4000 feet above the level of the sea, while the average height of the whole country may be placed at about 2375 feet. The main water course is the Arkansas river, which has a fall of about six feet in the mile. In spite of the absence of hills, Kansas is singularly free from marshland or swamps. This is due, in part, to the friable nature of the soil, and in part to the natural slope of the land towards the east. What is known as the "Great Arkansas Valley of South-western Kansas," embraces a width of fifty miles, nearly the whole of which is sloping upland. The soil here is a sandy loam, of alluvial origin, and of great depth and fertility. A remarkable peculiarity of the Arkansas river is that it never overflows its banks, but, so to say, underflows them. The water filters through the gravelly stratum underlying the surface-soil of the valley, and may always be found by digging for it. From a meteorological point of view, Kansas may be said to be divided into three distinct zones, marked off by the amount of rainfall. In the extreme east the rainfall assimilates itself to that of Missouri, and is ample for all purposes of agriculture. In the middle zone, which may be said to lie in Central Kansas, the rainfall is less, yet amply sufficient for all purposes of farming or pasturage. The vegetation here is extraordinarily profuse, and is sub-tropical in character. The third and last zone lies in the western and south-western portions of the State. Here the climate resembles that of Colorado, and the rainfall is insufficient for agriculture, though sufficient for grazing purposes. It would seem, however, that the limits of the zone of moderate rainfall are constantly proceeding westward as civilization advances. Twenty five years ago the frontier of agricultural production was placed at about the ninety-sixth degree of west longitude. Ten years later it had advanced to the ninety-seventh, five years later to the ninety-eighth, while to-day it may be said to extend to the one hundredth. Along with this advance the character of the flora of the country has appreciably changed. The "blue stem" grass and other plants, which require moisture, have displaced the buffalo or "gramma grass," which is the natural covering of the great plains. Whether the procession westward of the rainfall will continue as heretofore, once it has reached the meridian of 100°, may fairly be open to question. The prevailing winds from May to September are from the south and south-west. But inasmuch as the western limit of the Gulf of Mexico is in the ninty-eighth meridian, it follows that these winds must blow over the arid and thirsty soil of Mexico, and will contain therefore but little moisture. Hence this western part of Kansas must long continue to be an essentially dry country. Cultivation may no doubt modify the climate, but the process will be slower and more difficult than in Central Kansas.

POGGE AND WISSMANN.—Letters have been received from Dr. Pögge, dated November 27, 1881, written at Mukenge, the residence of the chief of the Tusselanga in about 6° S. lat. and 22° 22′ 10″ E. long. (Greenwich). The travelers had, in turning the territories of the Muata Yanvo, been obliged to take a north-easterly direction and after forty-four days' march from Kimbunda crossed the Kassai on the 21st of October. The Kassai at this point had a width of about 350 yards. Here Wissmann separated from his companions and started in a southerly direction, whilst Dr. Pögge took a northerly course towards the territory of the Tusselanga, reaching on the 30th of October, the residence of the chief Kalamba Mukenge. This place, with its well built huts and population of about 1000 souls, lies between the sources to two rivulets flowing towards the Lulua, and having excellent drinking water, and would form a capital site for a station if the Lulua should prove available for water communication with the yet unknown regions beyond. But it appears that this river, notwithstanding its breadth of more than 300 yards, is very shallow and full of rapids. Pögge describes the country as fertile; every where madioca, maize, millet, and beans are cultivated, and the four kinds of oil palms, which grow chiefly in the forests, are seen planted in the cultivated fields. Of game animals occur only the wart-hog and a small species of Cape buffalo, but the rivers are full of hippopotami and the woods of various species of *felidæ*. The grey parrot is also found here. The climate is warmer than in the Muata Yanvo's country, but everywhere salubrious and the natives are friendly and peaceable. The chief articles of trade are slaves, especially female, and india-rubber; ivory being little dealt in. The chief market for ivory lies some eight days' journey to the N. N. W. of Mukenge at a place called Kabao, in the Tukette country.

With regard to his further movements, Dr. Pögge hoped to leave Mukenge on the 29th of November and to cross the Lulua and meet Lieut. Wissman in Bacua-Carimba. Both would then, under the protection and guidance of the chief Kalamba-Mukenge, travel eastward as far as the Lake Mukanga, distant ten days march, and then onward six days march to the Mobondi-Stani, further two days' march to the Lubilash river, and two days beyond that, to the great Mobondi chief Fumo-Kole. As far as that point only was the traveler able to obtain information regarding the route. Should no insuperable obstacle be encountered, the travellers would travel along the trade road leading to Nyangwe on the Lubilash (the upper course of the Congo,) reaching which place Pögge would return to Mukenge whilst Wissmann would strike for Zanzibar. Põgge calculates that his journey to the Lubilash and back to Mukenge will take six months.

African Exploration.—The Royal Geographical Society has decided to send a new exploring expedition to Africa under the command of Mr. Joseph Thomson. After organizing his company at Zanzibar, Mr. Thomson will proceed from Mombas on the East African coast to Mount Kilimandjaro, and after ascending this celebrated peak, he hopes to advance through an entirely unknown region to the shores of the Victoria Nyanza, returning to the coast by a more northerly route so as to visit, if practicable, Lake Baringo and Mount Kenia.

Lieutenant Giraud, a young French naval officer, has sailed from Marseilles for Zanzibar. He intends to go either to Lake Tanganyika, or more probably by the north shore of Lake Nyassa, to the Chambeze River. He will follow this stream to its outlet in Lake Bangweolo, which he proposes to circumnavigate. He then hopes to descend the Lualaba-Congo to the sea.

The French Government has decided against the scheme of M. Roudaire of flooding a portion of the Sahara, considering that the cost will exceed the advantages to be gained.

Professor Guido Cora in an address before the Italian Geographical Society, describes the Desert of Sahara as an immense tract of country, with a mean elevation of from 1300 to 1650 feet above the level of the sea, in which sand does not occupy more than one-fifth of the entire area, and where large chains of mountains are found attaining a height of from 6550 feet to 8200 feet. In some parts it only rains once in some twenty years, while in others there is a regular rainy season; the temperature there rises to 122° F. and falls to 19° 4′ F., and the loftiest mountain tops are covered with snow and ice for several months in the year. The fauna and flora have a special importance. Lastly, the Sahara has a population of some 3,000,000, and contains towns of from 5000 to 10,000 inhabitants. It has a total area of 3,700,000 square miles, stretching on the north to the Great Atlas and the Mediterranean, between the two Syrtes to the south of Cyrenaica and Lower Egypt; on the east it is conterminous with the Valley of the Nile; on the south it is bounded by a line running from El Obeid to Lake Chad, to the middle course of the Niger, and the lower part of the Senegal; and lastly, on the west it reaches the Atlantic Ocean.

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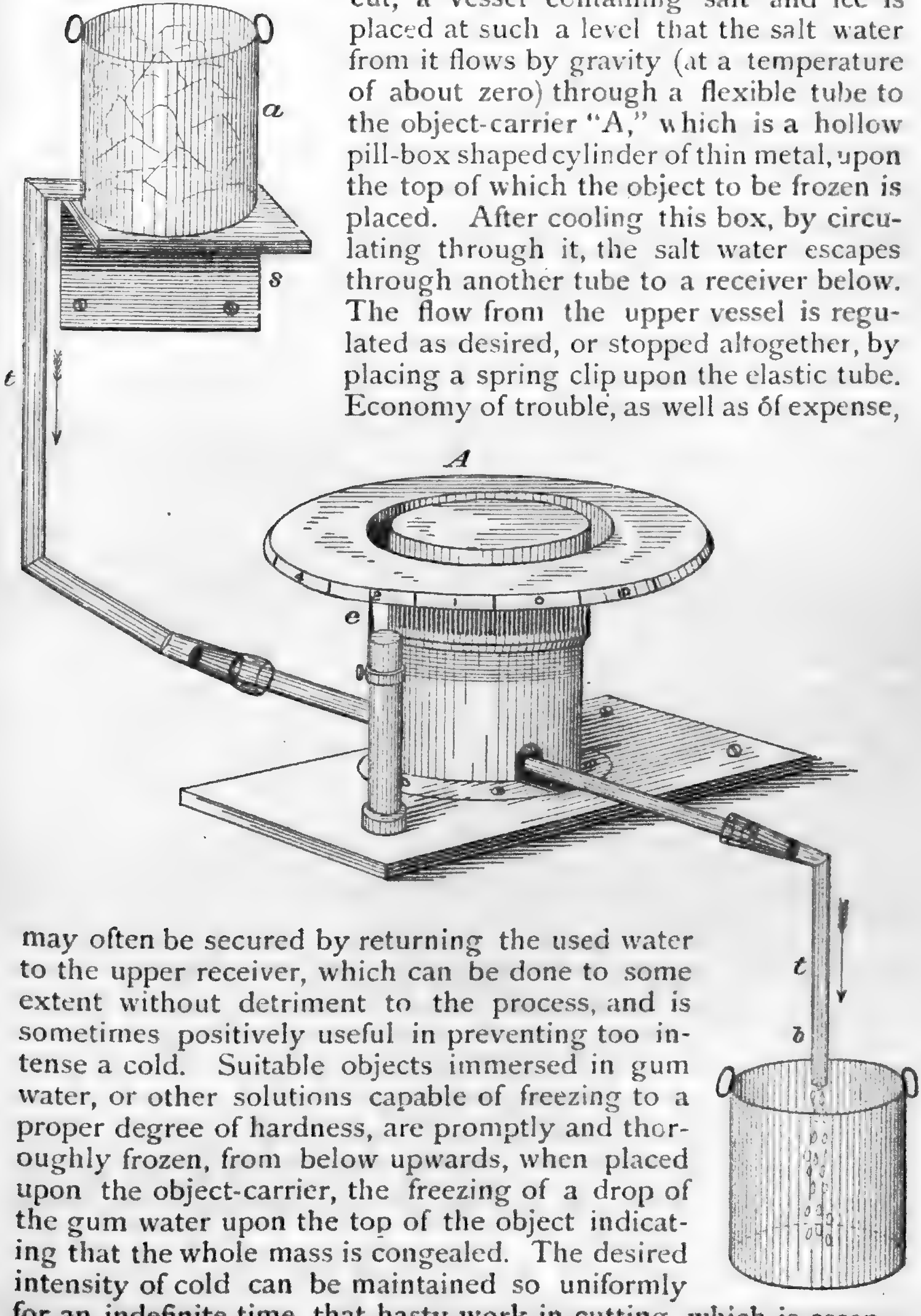
MICROSCOPY.[1]

Taylor's Freezing Microtome.—All who are familiar with the exquisite sections of soft tissues, sometimes cut by the various freezing microtomes, and at the same time have had experience of the troubles, uncertainties and delays (if not dangers) of pack-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

ing ice and salt in little spaces close to the object, or pumping the spray of rhigolene or ether, will be glad to welcome a contrivance fitted to give the best results in cutting frozen tissues with uniformity, certainty and ease. The microtome recently contrived by Thomas Taylor, M.D., of the Department of Agriculture, at Washington, seems able to accomplish this. As shown by the cut, a vessel containing salt and ice is placed at such a level that the salt water from it flows by gravity (at a temperature of about zero) through a flexible tube to the object-carrier "A," which is a hollow pill-box shaped cylinder of thin metal, upon the top of which the object to be frozen is placed. After cooling this box, by circulating through it, the salt water escapes through another tube to a receiver below. The flow from the upper vessel is regulated as desired, or stopped altogether, by placing a spring clip upon the elastic tube. Economy of trouble, as well as of expense, may often be secured by returning the used water to the upper receiver, which can be done to some extent without detriment to the process, and is sometimes positively useful in preventing too intense a cold. Suitable objects immersed in gum water, or other solutions capable of freezing to a proper degree of hardness, are promptly and thoroughly frozen, from below upwards, when placed upon the object-carrier, the freezing of a drop of the gum water upon the top of the object indicating that the whole mass is congealed. The desired intensity of cold can be maintained so uniformly for an indefinite time, that hasty work in cutting, which is essen-



tial to the best work of many freezing microtomes, and the characteristic advantage of some of the best of them, is not required. The cutting knife is supported upon a circular plate, which screws up and down around the object, the extent of its motion, and the consequent thickness of the section to be cut, being indicated by a pointer near its graduated edge. The best of workmanship is required in this screw, but it can be made so firm and yet so easy as to give excellent work. It is evident that the Biscoe form of knife-carrier could be easily adapted to this instrument by those who prefer it. The standard size of the instrument cuts sections up to one inch wide, and costs $15.00, or with rubber tubes, clips and tin pail, $15.50. A special size is being made for cutting much larger sections, which will probably cost about $20.00. The instruments can be obtained from A. R. Taylor, 328 Massachusetts avenue, Capitol Hill, Washington, D. C.

Relation of Aperture and Power.—In the Journal of the Royal Microscopical Society, Professor Abbe gives an elaborate and exhaustive mathematical demonstration of the apertures useful for various powers. His conclusions favor extreme angles for high powers, economy of aperture for medium powers (the loss of penetration, working distance, &c., in superabundant aperture being always a disadvantage greater than the possible benefit), and considerable latitude for low powers, where a surplus aperture of 100 per cent. higher than that required for delineation, may be useful for illumination. A similarly conservative position was taken by Dr. Wm. B. Carpenter, in his able and highly appreciated address on the subject, at the Montreal meeting of the A. A. A. S. He preferred moderate angles for most purposes, even for high powers, and wholly condemned the fashion of attempting, by unduly high angle, to force a low power objective to do the work of a high one. Such a lens will resolve tests, but its use is trying to the eyes. It is useless to spoil a good one inch by trying to make it a poor one-fourth. On the other hand, Mr. Geo. E. Davis, in a lengthy editorial in the *Northern Microscopist*, urges the use of much higher angles than would be admitted by Professor Abbe's theories, and he would only select low angles when cheapness was obligatory. His ideal series is a 2 inch of 20° or more; a 1 inch of 35° or 40°, with a working distance of 0.40 inch; a ½ inch of 66° or 70°, working distance 0.10 or 0.12 inch; a ¼ inch of 100°, and higher powers as required. He claims that objectives by Tolles, Beck, Ross, and Wray, stand reduction of aperture by means of the iris diaphragm shutter remarkably well, though those of Zeiss, made from the formulas of Professor Abbe, do not. (Conf. discussion at Manchester, Mic. Soc., in the *Northern Microscopist*, Vol. 2, pp. 284-291.)

Visibility of Fine Rulings.—Professor W. A. Rogers, in a paper before the A. A. A. S. considers Mr. Fasoldt first in the art of micrometric ruling, since the death of Nobert; but his plates as high as 100,000 to the inch, have not been photographed, and the resolution of 152,000 to the inch, though believed by some, has not been proven. Single lines $\frac{1}{50000}$ of an inch wide are readily seen by the naked eye, and those one-third as wide may be seen without the microscope. Lines too fine to be seen singly with the microscope can be seen and resolved if ruled close together in bands.

Cutting Sections of Coal.—The discussion in the English journals as to the correctness of the assertion in the Micrographic dictionary, that coal can be softened by soaking in a solution of carbonate of potash, sufficiently to be sliced with a razor, has ended with the concession that it is lignite, and not coal, that can be so prepared. The use in the dictionary of the word coal, in this special and not usual sense, has caused many and perplexing failures to experienced workers as well as to beginners.

Microscopical Diagnosis.—Under this title, Professor Charles H. Stowell, of the university of Michigan, has brought out an octavo volume of 250 pages. The book, which is published by Geo. S. Davis, of Detroit, at $3.00, is well printed and freely illustrated with wood cuts and lithographs. Its character is not well indicated by its name. It consists of a collection of essays upon a variety of subjects, having in many cases little relation to each other, and no special connection with the technical subject announced in the title. Part I, of 93 pages, relates (with the exception of the chapter on starch, which seems to belong to Part II) to medical microscopy, with especial reference to questions of diagnosis. It is the portion which gives name to the book, and after an introductory chapter on the instrument, treats of blood, epithelium, sputa, etc., muscle, urinary deposits, parasitic diseases of the skin, tumors, starch, and staining of blood. The chapters upon urinary deposits and tumors are particularly full, the former being illustrated by eight lithographs, very carefully and accurately drawn by Mrs. Stowell. Part II, of 118 pages, is a series of excellent studies in vegetable histology by Mrs. Stowell, the objects selected being of medicinal or economical importance, and the observations having frequent reference to the question of adulterations. By far the most prominent and interesting portion of this Part, is the "Study of Wheat," reprinted from the *American Miller.* The other chapters of this part relate mostly to medicinal plants, and were originally produced in various journals. When supplemented, as proposed by Mrs. Stowell, by a series of similar studies of the more important medicinal plants, this collection will become a treatise of great importance and interest. Part III is the series of very instructive and popular papers on the preparation and mounting of microscopic objects, originally published by Wm. H. Walmsley in *The Microscope*. It forms a convenient appendix to the volume.

THE HOUSE-FLY AS A CARRIER OF CONTAGION.—This subject, which has attracted some attention of late, was discussed by Dr. Thomas Taylor, of Washington, at the Montreal meeting of the A. A. A. S. Having noticed a species of anguillula within the proboscis and abdomen of dissected flies, he undertook a series of experiments to determine whether the house-fly might not be a carrier and distributor of germinal virus of various kinds. The suction tube of the fly was found by measurement to be of sufficient diameter to admit of taking up the spores of cryptogams, trichina, the eggs of anguillula, or even the anguillula themselves. Thirteen specimens of anguillula were found in the proboscis of a single house fly, and sixteen acari in the thorax of another. Furthermore, flies fed with the spores of the red rust of grasses, mixed with sugar, swallowed it freely, and also carried about the spores attached to the hairs on their limbs. The fact that by far the greater part of the spores were consumed, and digested without germinating, suggested to the author that the flies might thus be destroyers of microscopic germs as well as disseminators of them. Dr. Leidy made similar observations some years ago.

RECENT MICROSCOPICAL PAPERS:—

Micro-organisms from Rainwater, Ice, and Hail. (Discussing the question of Bacteria in the air and as a cause of disease.) R. L. Maddox, M.D., in *Journ. Royal Mic. Soc.*, Vol. II, p. 449.

Simple method of determining Angular Aperture. Ernst Gundlach, in *Am. Month. Mic. Journ.* Vol. III, p. 176.

Development of the Planula of *Clava leptostyla* Ag. J. H. Pillsbury (Montreal Meeting A. A. A. S.), in *do.* p. 181.

A New Thericola. Dr. A. C. Stokes, in *do.* p. 182.

The Microspectroscope. Romyn Hitchcock (at N. Y. Mic. Soc.), in *do.* p. 183.

New Constant Pressure Injection Apparatus. Professor Wm. Libby, Jr. (at A. A. A. S.), in *do.* p. 187.

Physiology of Variable Apparent Magnification by the Microscope. W. LeConte Stevens (at A. A. A. S.), in *do.* p. 189.

Some Vegetable Poisons. (Observations and Experiments in regard to Bacteria in poisonous plants). Professor T. J. Burrill (at A. A. A. S.) in *do.* p. 192.

Proboscis and Labial Palps of the Oyster. H. J. Rice, in *The Microscope*, Vol. II, p. 117.

Occurrence of Red Snow in Hertfordshire. R. B. Croft, R. N., in *North. Microscopist*, Vol. II, p. 249.

Life Histories and their Lessons. Rev. W. H. Dallinger, in *do.* p. 263.

Spiders; their Structure and Habits. William Horner, in *Journ. Postal Mic. Soc.*, Vol. I, p. 63, etc.

Photo-micrography. (Popular description of apparatus and methods.) Harry Barker, in *do* p. 75.

Foraminifera; How to Prepare. Charles Elcock, in *do.* p. 25 and 139.

(Etiology of Tuberculosis. (A full and excellent summary of Koch's observations and experiments upon the Bacteria of tuberculous disease.) Wm. F. Whitney, M.D., 16 pp., Cambridge, 1882. Reprinted from *Boston Med. and Surg. Journ.*

Communicable Diseases. (A popular account of the germ theory of disease. Geo. E. Blackham, M. D., in *The Bistoury*, 1882, p. 163.

Alternation of Generations among the Uredines. Charles B. Plowright, in *Sci. Gossip*, 1882, p. 196.

SCIENTIFIC NEWS.

— *Nature* for Sept. 28th, publishes, in full, a translation of the eloquent address of Professor Haeckel, at the Eisenach meeting of the German naturalists and physicians. After paying tribute to Darwin's theory of natural selection and the wide influence it has exerted on human thought, also giving his personal impressions of Darwin, when he first visited him in 1866, he then endeavors, and with good success, to prove that Goethe was an evolutionist. Haeckel then gives very full credit to the views of Lamarck, whose merits have been quite kept in the dark by some English Darwinians. "We cannot," says Haeckel, "but regard it as a truly tragic fact, that the 'Philosophie Zoologique,' by Lamarck, one of the greatest productions of the great literary period in the beginning of our century, met, from its outset, with but extremely little attention, and in the course of a few years was utterly forgotten. Not till Darwin, fifty years later on, breathed new life into the transformation theory therein established, was the buried treasure again brought into the light of day, and we cannot now but describe it as the completest representation of the theory of development prior to the time of Darwin."

Haeckel's monistic views, as he states them in this address, appear to be nearly identical with the agnosticism of Herbert Spencer—"that purest monistic form of faith," says Hæckel, "which attains its climax in the conviction of the *unity of God and nature.*" The further advances we make in the knowledge of nature — "the more we approach that unattainable, ultimate ground—the purer will be our idea of God."

Haeckel then explains his views, uttered five years ago, as to the teaching of Darwinism in the lower schools, which had been misunderstood. "It stands to reason with these words I could not mean to claim that Darwinism should be taught in elementary schools. That is simply impossible. For just like the higher mathematics and physics, or the history of philosophy, Darwinism demands a mass of previous knowledge which can be acquired only in the higher stages of learning. Assuredly, however, we may demand that all subjects of education be treated according to the *genetic method*, and that the fundamental idea of the development theory, the *causality of phenomena*, finds everywhere its acknowledgment.

— We have to announce the death of the Hon. B. B. Redding, State Fish Commissioner of California, a patron of science, and himself possessed of no small scientific attainments, who died suddenly of apoplexy at his residence in San Francisco, on the morning of August 21st. Mr. Redding was born at Yarmouth, Nova Scotia, in 1824, and was the son of the U. S. Consul at that place. In 1849, he started for California in the brig *Mary Jane*, and after some interesting experiences in the Galapagos, reached San Fransisco, and proceeded to the gold mines. As a miner he was not cuccessful, but was soon elected to the Assembly, became editor of the *San Joaquin Republican*, and associate editor of the *Sacramento State Journal*, bought the latter paper; was in 1856, elected Mayor of Sacramento, and in 1863, was Secretary of State. From 1868 to his death, he was the land agent of the Central Pacific Railroad, and for several years was a Regent of the California State University.

Readers of the NATURALIST must remember his contributions to science in this Magazine, and all who knew him personally, can testify to his kindness and courtesy, as well as to his interest in everything that tended toward the development of the resources of his adopted State.

— As we go to press we are in receipt of the news of the death, on Nov. 20th, of Dr. Henry Draper, of New York, of pleurisy. Both the friends of science and the personal friends of Dr. Draper, have in his death cause of the deepest regret. Dr. Draper's devotion to science, fortunately sustained by a very helpful marriage, has been well known. His amiable character endeared him to his associates.

— The California Academy of Sciences has recently received the gift of a large collection of birds and a small number of mammals, all finely mounted specimens, including cases for the same. This present was made by Mrs. Crocker, of Sacramento, widow of the late Judge E. B. Crocker, who was much interested in natural history, especially ornithology. The collection embraces many very rare forms, and cost several thousand dollars.—*R. E. C. S.*

—Natural History is making great strides in Australia. The Biological Station at Sydney has now been completed. It is to be in part maintained by the Royal Society of New South Wales, the Royal Society of Victoria, and the Australian Biological Association. The station has been built mainly through the exertions of Baron Miclucho Maclay, the distinguished Russian naturalist and explorer.

— Professor Cope recently procured a full-grown gorilla from the Ogobai river. It was shipped in a tierce of spirits, and arrived in good order.

—Professor W. B. Carpenter lectures this winter at the Lowell Institute on Deep Sea Soundings and on Automatism in man and animals.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES, March 21.—Professor Cope characterized the *Condylarthra*, a group of Ungulates, found in the lowest horizon of the Eocene of the

United States. Having bunodont teeth, and five toes on each foot, they are the most generalized of the sub-order, but have left no unchanged descendants.

The Rev. H. C. McCook described some interesting variations in the forms of the nest of *Epeira strix.* The ordinary nest of this spider, when in open wood or field, is a rolled leaf fastened by adhesive threads. A second form consists of two leaves lashed together; a third of small holes in wood or stone, lined with web; a fourth (one example found) was a silk-lined cavity in a ball of sawdust, made by the carpenter ant; a fifth, or rather a whole series of variations was exhibited by a colony domiciled among fallen timber; a sixth form was a cavity in a bunch of parasitic moss; and a seventh is that made when the spider weaves her orb on the exposed portions of human habitations, and consists of a stiff cylinder of silk lashed strongly to the surface. This form is taken only in new buildings, which afford no crevices. In view of these adaptations to the environment, the spider must be credited with no small degree of intelligence.

March 28.—Professor H. C. Lewis gave the analysis of *Helvite* from the mica mine near Amelia Court House, Va. The result differs from the usual analysis of Helvite, which has not previously been found in America.

April 18.—Professor Kœnig described some crystals of orthite from the mica mine, at Amelia Court House, Va.

May 2.—Professor Leidy called attention to *Filaria wymani*, an entozoan that takes up its residence in the brain of the darter, *Plotus anhinga.* Professor Wyman found this worm in seventeen out of nineteen birds examined, coiled up on the back of the cerebellum between the arachnoid and pia mater, from two to eight or more in each bird. The specimen exhibited by Dr. Leidy had a single worm enclosed between the two laminæ of the dura mater in the interval of the cerebrum and cerebellum.

Numerous specimens of *Ascaris spiculigera* were also exhibited, obtained from the stomachs of *Plotus anhinga*, *Graculus dilophus*, *Pelecanus trachyrhynchus* and *P. fuscus.* Dr. Leidy exhibited a specimen of the irregular phosphatic nodules, probably coprolites of a zeuglodont or cetacean, brought from Ashley river, S. C., to be manufactured into a fertilizer; and also a quartzite water-rolled pebble with a groove round the middle like that of the stone hammers found in the ancient copper mines of Lake Superior.

Mr. Meehan gave an account of the supposed reasons why *Thuja occidentalis* gained the name of Arbor Vitæ, and suggested that the tree might be the "Annedda," a decoction of which saved the lives of Cartier's band in 1534. The Annedda is usually identified with the white spruce (*Abies alba*), from the young tops and leaves of which, according to Rafinesque, the Indians obtained a spruce beer, that was one of their famous remedies for scurvy.

BOSTON SOCIETY OF NATURAL HISTORY, Oct 4, 1882.—Mr. F. W. Putnam gave an account of recent explorations of several ancient shell heaps on the coast of Maine; and Mr. W. O. Crosby spoke of the origin and classification of joint-structures.

Oct. 18.—Dr. C. C. Abbott gave an account of his last year's researches into the history of palæolithic man in the Delaware valley; and Mr. S. Garman shows some "Antelope Medicine" of the Ogalallas.

Nov. 1.—Papers by Mr. Wm. M. Davis, on the structural value of the trap ridges of the Connecticut valley, and by Mr. W. O. Crosby, on the Elevated coral-reefs of Eastern Cuba were read. Professor Zirkel's paper on the Mineralogy of the fortieth parallel survey, postponed from the last meeting, was also read.

BIOLOGICAL SOCIETY OF WASHINGTON, Oct. 27.—Dr. W. S. Barnard made a communication on Ectoparasitic Trematodes; Mr. W. P. Conant described two cases of snake-bite in Massachusetts; and Mr. Frederick W. True spoke of the cinnamon bear, with exhibition of a specimen.

NEW YORK ACADEMY OF SCIENCES, Oct. 16.—The following papers were read: On the genesis of the Crystalline iron ores, by Dr. Alexis A. Julien; Note upon a new and remarkable Eurypterid from the Catskill group, by Professor D. S. Martin.

Oct. 23.—The following papers were read: Notes on the Cretaceous marl-belt of New Jersey, by Dr. N. L. Britton; On the origin of the crystalline ores of iron, by Professor J. S. Newberry.

APPALACHIAN MOUNTAIN CLUB, Oct. 11.—An address was delivered by Maj. Jed. Hotchkiss, of Staunton, Va., entitled "The Appalachian Mountains of the Virginias." Mr. John Ritchie, Jr., gave some notes on Mt. Stinson, Rumney, N. H.; and Mr. W. O. Crosby read notes on Elevated pot-holes near Shellburne Falls.

NATIONAL ACADEMY OF SCIENCES.—The annual autumn meeting of this body commenced in New York, at Columbia College, on Nov. 13th, and continued four days. The following is a list of the papers read:

1. Mean annual Rain-fall. Elias Loomis.
2. On white Phosphorus. Ira Remsen.
3. On the general equations of Optics, as derived from the electro-magnetic theory of Light. J. Willard Gibbs.
4. On an improved form of standard Daniell Cell. George F. Barker.
5. On complex inorganic Acids. Wolcott Gibbs.
6. On a modified form of solar Eye-piece for use with large apertures. Charles A. Young.
7. On Triassic (?) Insects from the Rocky mountains. Samuel H. Scudder.
8. Explanations on presenting a copy of the first ten numbers of the author's Celestial Charts. C. H. F. Peters.
9. Lists of Errors in Star Catalogues. C. H. F. Peters.

10. Remarks on the Structure of the present Comet. C. H. F. Peters.
11. On a method of studying the laws of Contrast quantitatively. O. N. Rood.
12. On the Heat of the Comstock lode. G. F. Becker, by invitation.
13. Topographical effects of Faults and Landslides. G. F. Becker, by invitation.
14. Prepartion of Cyanin from Chinoline. C. F. Chandler.
15. On the place of the Echeneididæ in the system. Theo. Gill.
16. On the existence in both hemispheres of a terrestrial dry zone and its cause. A. Guyot.
17. On so-called eruptive Serpentines. T. Sterry Hunt.
18. On a Sphereometer for measuring the radii of curvature of lenses of any diameter. Alfred M. Mayer.
19. On a graphical method of representing the errors of a screw. Alfred M. Mayer.
20. On a simple experimental demonstration of Ohm's law. Alfred M. Mayer.
21. On the Fauna of the Puerco Eocene. E. D. Cope.
22. On the Permian genus Diplocaulus. E. D. Cope.
23. On the physical conditions under which Coal was formed. J. S. Newberry.
24. Effect of Magnetism on chemical action. Ira Remsen.
25. On Sinapic acid. Ira Remsen.
26. On the total solar Eclipse of May 6, 1883. Charles A. Young.
27. Physical and geological character of the sea bottom off our coast, especially beneath the Gulf Stream. A. E. Verrill.
28. On the origin of the carbonaceous matter of bituminous Shales. J. S. Newberry.
29. On the meridian Photometer. E. C. Pickering.
30. On the microscopic structure of some of the Brachiopoda, with reference to their generic relation. James Hall.
31. On the logic of relations and on the determination of the figure of the earth by the variations of gravitation. C. S. Pierce.
32. On the supposed Human Footprints recently found in Nevada. O. C. Marsh.

Ontario Entomological Society.—A meeting of this society was held recently in Montreal during the session of the A. A. A. S. After the transaction of the routine business, the president, Mr. Wm. Saunders, of London, Ontario, delivered his annual address, in which he referred to the general prevalence of the Hessian fly in the province of Ontario, during the past season, inflicting a loss on the agricultural community estimated at several hundred thousand dollars, and called attention also to the relative abundance of parasites among the insects now maturing. The Phylloxera was referred to, and the discovery of the root-inhabiting type injuring the vines in several portions of the province, a form of the insect which until within the past few weeks was not known to occur within the province. Several other interesting points were taken up in reference to the occurrence of some rare insects and new habits acquired by others. The short first crop in Ontario, a result, by many, attributed to insect agency, was shown to be due to other causes, some reference was also made to the recent dissemination of insects destructive to fruit in California, and the energetic measures being adopted there to suppress them.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The following is a list of the papers read in the microscopical section:

SECTION G—MICROSCOPY.

On angular aperture in relation to biological investigation. Wm. B. Carpenter.

Demonstration of the Bacillus of tuberculosis. W. Osler.

The third corpuscular element in the blood. W. Osler.

The development of blood corpuscles in the bone-marrow. Wm. Osler.

Note on the Microcytes of the blood and their probable origin. W. Osler.

Plant cells and living matter. Louis Elsberg.

Histology of uterine fibroid tumors. Henry O. Marcy.

Some vegetable poisons. T. J. Burrill.

A study of the problem of fine rulings with reference to the limit of naked eye visibility and microscopic resolution. W. A. Rogers.

On a new form of dry mounting. W. A. Rogers.

The house-fly considered in connection with the distribution of infectious and contagious poisons. Thomas Taylor.

A new economic freezing microtome for section-cutting, with new mechanical devices. Thomas Taylor.

On the epidermis of Marsipobranchs. A. H. Tuttle.

Notes on some of the peculiarities incident to the diseases of fruits. D. P. Penhallow.

Notes on the present status of sanitary inspection, with special reference to the examination of water and air. Romyn Hitchcock.

A filtering wash-bottle especially adapted to the use of the histologist. C. E. Hanaman.

Development of Cilia in the planula of *Clava leptostyla*. J. H. Pillsbury.

AMERICAN GEOGRAPHICAL SOCIETY, Nov. 17th.—Mr. Paul B. DuChaillu delivered a lecture on his journeys in Norway, Sweden, Lapland and Northern Finland.

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THE SEVENTEENTH VOLUME OF THE AMERICAN NATURALIST.—In closing the Sixteenth volume of the AMERICAN NATURALIST, we would call the attention of our subscribers to the increased number of pages in this volume, which contains more reading matter than any previous volumes. From the papers now in hand, and those in preparation for the next year, it is believed that volume *Seventeen* will at least equal in general interest as well as in value for the special student, those of the past years.

Our thanks are due to our friends and contributors who have, by their voluntary labors, made the magazine what it is.

We would respectfully invite working naturalists to send us early notices of new discoveries as well as items of general scientific interest, and ask our friends to call the attention of all who are in any way interested in natural history to our magazine, which is designed to be an aid and stimulus in their studies and field work.

We would again ask our exchanges to specially notice the December NATURALIST, and to send marked copies containing such notices to the editors.

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