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THE

AMERICAN NATURALIST

VOL. XXVII. July, 1893. 319

SOME CORRELATIONS OF ONTOGENY AND PHYLOGENY IN THE BRACHIOPODA.

BY C. E. BEECHER.

The parallelism between the ontogeny and phylogeny in the Brachiopoda has been worked out in numerous instances.[1] To illustrate these, some more or less familiar genera may be taken as characteristic examples.

Lingula has been shown by Hall and Clarke (Pal. N. Y., Vol. VIII, 1892) to have had its inception in the Ordovician. In the ontogeny of both recent and fossil forms, the first shelled stage has a straight hinge line, nearly equal in length to the width of the shell. This stage may be correlated with the more ancient genus *Paterina*, from the lowest Cambrian. Subsequent growth produces a form resembling *Obolella*, a Cambrian and Lower Silurian genus. Then the linguloid type of structure appears at an adolescent period, and is completed at

[1] C. E. Beecher. Development of the Brachiopoda. Part I, Introduction. Am. Jour. Sci., Vol. XLI, April, 1891.

Development of the Brachiopoda. Part II, Classification of the Stages of Growth and Decline. Am. Jour. Sci., Vol. XLIV, August, 1892.

Development of Bilobites. Am. Jour. Sci., Vol. XLII, July, 1891.

Revision of the Families of Loop-bearing Brachiopoda. Trans. Conn. Acad. Sci., Vol. IX, May, 1893.

Deslongchamps e. Etudes critiques sur des Brachiopodes Nouveau ou peu connus, 1884.

Fischer and Œhlert. Brachiopodes: Mission Scientifique du Cap Horn, 1882–1883. Bull. Soc. Hist. Nat. d'Autun, vol. v, 1892.

maturity. Thus, *Lingula* has ontogenetic stages corresponding to (1) *Paterina*, (2) *Obolella*, and (3) *Lingula*, of which the first two occur as adult forms in geological formations older than any known *Lingula*.

Paterina represents the prototype of the Brachiopods. It shows no separate stages of growth in the shell, is found in the oldest fossiliferous rocks, and corresponds to the embryonic shelled condition (protegulum) of the class.

The genus *Orbiculoidea* of the Discinidæ first appears in the Ordovician and continues through the Mesozoic. The early stages in the ontogeny of an individual are, as in *Lingula*, first a *Paterina* stage, followed by an *Obolella* stage. Then, from the mechanical conditions of growth, a *Schizocrania*-like stage follows, and complete growth results in *Orbiculoidea*.

The elongate form of the shell in *Lingula* as well as in many other genera is determined by the length of the pedicle and freedom of motion. The discinoid, or discoid, form of *Orbiculoidea* and *Discinisca* among the Brachiopods, and *Anomia* among Pelecypods, is determined by the horizontal position of the valves, which are attached to an object of support by a more or less flexible, very short organ, a pedicle or byssus, without calcareous cementation. This mode of growth is characteristic of all the discinoid genera, but as already shown, the early stages of Paleozoic *Orbiculoidea* have straight hinge lines and marginal beaks, and in the adult stages of the shell the beaks are usually subcentral and the growth holoperipheral. This adult discinoid form, which originated and was acquired through the conditions of fixation of the animals, has been accelerated in the recent *Discinisca*, so that it appears in a free swimming larval stage. Thus, a character acquired in adolescent and adult stages of Paleozoic species through the mechanical conditions of growth, appears by acceleration in larval stages of later forms before the assumption of the condition of fixation which first produced this character.

The two chief subfamilies of the Terebratellidæ undergo complicated series of metamorphoses in their brachial structure. Generic characters in this family are generally based upon the form and disposition of the brachia and their supports. The highest genera in one subfamily, which is austral in distribution, pass through stages correlated with the adult structure in the genera *Gwynia, Cistella, Bouchardia, Megerlina, Magas, Magasella,* and *Terebratella,* and reach their final development in *Magellania* and *Neothyris.* The higher genera in another subfamily, boreal in distribution, pass through metamorphoses correlated with the adult structures of *Gwynia, Cistella, Platidia, Ismenia, Mühlfeldtia, Terebratalia,* and *Dallina.* The first two stages in both subfamilies are related in the same manner to *Gwynia* and *Cistella.* The subsequent stages are different except the last two, so that the *Magellania* structure is similar in all respects to the *Dallina* structure, and *Terebratella* is like *Terebratalia.* Therefore, *Magellania* and *Terebratella* are respectively the exact morphological equivalents to, or are in exact parallelism with *Dallina* and *Terebratalia.*

The stages of growth of the genera belonging to the two subfamilies Dallininæ and Magellaniinæ are further correlated in the accompanying tables.

The simplest genus, *Gwynia,* as far as known, passes through no brachial metamorphoses, and has the same structure throughout the adolescent period, up to and including the mature condition. In the ontogeny of *Cistella,* the *gwyniform* stage, through acceleration, has become a larval condition. In *Platidia,* the *cistelliform* structure is accelerated to the immature period, and in *Ismenia* (representing an *ismeniform* type of structure in the higher genera), the *gwyniform* and *cistelliform* stages are larval, and the platidiform represents an adolescent condition. Similar comparisons may be made in the other genera. Progressively through each series, the adult structure of any genus forms the last immature stage of the next higher, until the highest member in its ontogeny represents serially, in its stages of growth, all the adult structures, with the larval and immature stages of the simpler genera. It is evident that in the identification of species belonging to the Terebratellidæ, whether recent or fossil, the strict specific characters

Morphogeny from Gwynia to Dallina.

Periods.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.
Larval	gwyniform ?	gwyniform	gwyniform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform
Adolescent	gwyniform	cistelliform	cistelliform	platidiform	platidiform ismeniform	platidiform ismeniform mühlfeldtiform	platidiform ismeniform mühlfeldtiform terebrataliform
Mature	*Gwynia*	*Cistella*	*Platidia*	*Ismenia*	*Mühlfeldtia*	*Terebratalia*	*Dallina*

Morphogeny from Gwynia to Magellania.

Periods.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.	Stages.
Larval	gwyniform?	gwyniform	gwyniform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform	gwyniform cistelliform
Adolescent	gwyniform	cistelliform	cistelliform	bouchardiform	bouchardiform megerliniform	bouchardiform megerliniform magadiform	bouchardiform megerliniform magadiform magaselliform	bouchardiform megerliniform magadiform magaselliform terebratelliform
Mature	*Gwynia*	*Cistella*	*Bouchardia*	*Megerlina*	*Magas*	*Magasella*	*Terebratella*	*Magellania*

must be given first consideration. Species, therefore, must be based upon surface ornaments, form and color, within certain limits, and genera only upon structural features developed through a definite series of changes, the results of which are permanent in individuals evidently fully adult.

In each line of progression in the Terebratellidæ, the acceleration of the period of reproduction, by the influence of environment, threw off genera which did not go through the complete series of metamorphoses, but are otherwise fully adult, and even may show reversional tendencies due to old age; so that nearly every stage passed through by the higher genera has a fixed representative in a lower genus. Moreover, the lower genera are not merely equivalent to, or in exact parallelism with, the early stages of the higher, but they express a permanent type of structure, as far as these genera are concerned, and after reaching maturity do not show a tendency to attain higher phases of development, but thicken the shell and cardinal process, absorb the deltidial plates, and exhibit all the evidences of senility.

EXPLANATION OF PLATE.

Morphogeny of Magellaniinæ.

The figures in the left hand column, A–H, represent the stages in the ontogeny of the brachial supports in *Magellania*, one of the highest genera of the family Terebratellidæ. In the right hand column are shown the adult, permanent, generic structures, corresponding to the stages of *Magellania*.

Terebratella passes through all the stages from A to G, *Magasella* from A to F, and so on, as far as known for each lower genus.

All figures are drawn of approximately the same length, to facilitate comparison, in consequence the younger stages are much enlarged.

Fig. A.—Early larval brachiopod, without calcified brachial supports, but with circlet of tentacles on lophophore. The *gwyniform* stage.

Fig. A1.—*Gwynia capsula* Jeffreys, a morphic equivalent of larval stage, figure A.

Fig. B.—Later stage of A, showing growth of septum and consequent introversion of edge of lophophore. *Cistelliform* stage.

Fig. B1.—*Cistella neapolitana* Scacchi, showing calcification of loop attached to septum, and other adult features. Morphic equivalent of stage B of *Magellania.*

Fig. C.—Third stage of *Magellania*, with small ring on septum. *Bouchardiform* stage.

Fig. Ca.—Side view of same.

Fig. C1.—*Bouchardia rosea* Mawe, adult, showing ring on septum as in C.

Fig. D.—*Megerliniform* stage of *Magellania.*

Fig. Da.—Side view, showing growth of descending branches as prongs on side of septum.

Fig. D1.—*Megerlina lamarckiana* Davidson, adult form of brachial supports.

Fig. E.—*Magadiform* stage of *Magellania*, showing completion of descending branches.

Fig. E1.—*Magas pumilus* Sowerby, the Cretaceous prototype of this structure.

Fig. F.—*Magaselliform* stage, showing union of descending and ascending branches.

Fig. F1.—*Magasella cumingii* Davidson.

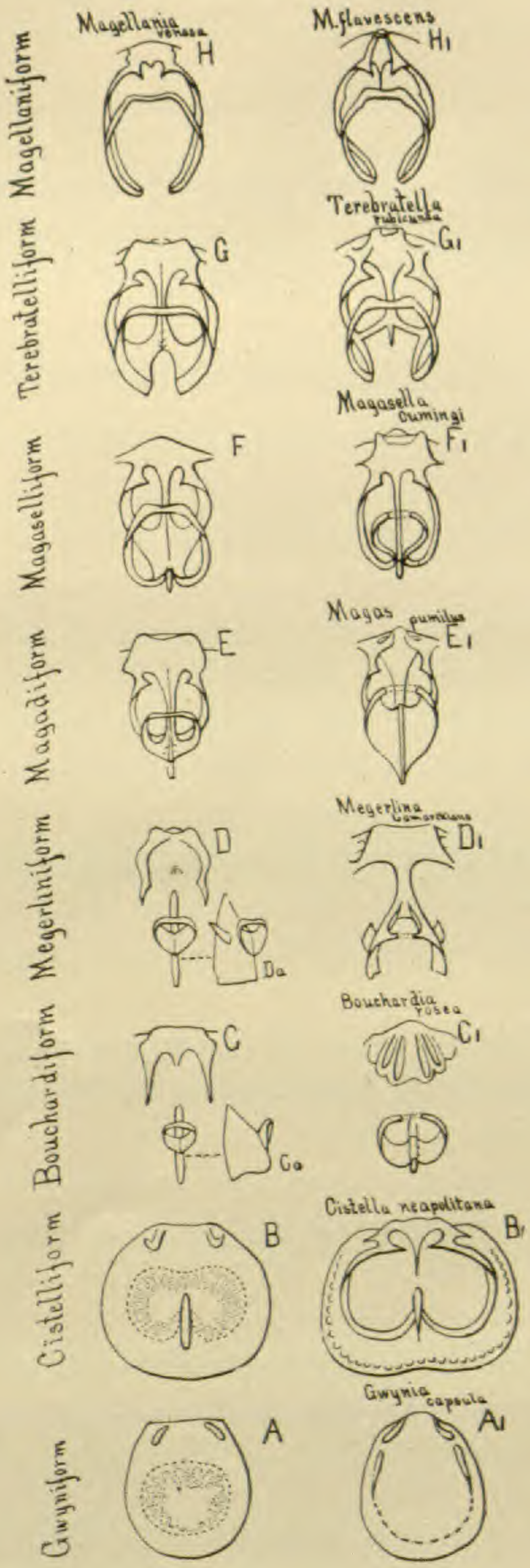
Fig. G.—*Terabratelliform* stage, representing the finished type of structure in *Terebratella dorsata.*

Fig. G1.—*Terebratella rubicunda.* Morphically equivalent to G, but showing more mature features.

Fig. H.—Final stage of *Magellania venosa*, produced by resorption of the septum and connecting bands of the *terebratelliform* stage.

Fig. H1.—*Magellania flavescens* Lamarck.

PLATE XV.



Parallelism in Brachiopoda, (**Magellania series.**)

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

BY CLARENCE BLOOMFIELD MOORE.

(*Continued from February Number, 1893.*)

(*Third Paper.*)

TICK ISLAND (VOLUSIA COUNTY).

Tick Island can be reached by entering Lake Dexter at its union with the St. John's (see map with the first paper of this series), and continuing across it and along Spring Garden Creek, a distance of about four miles in all, until a landing is reached on the southern side of the creek. The island was entirely unknown in connection with scientific research until visited by the writer in February, March and April, 1891. Other visits were made in January, 1892, January and March, 1893; in all twenty-two days have been devoted to the shell heaps and burial mound on Tick Island, with a large party of assistants; but so interesting is the place, and so extended the remains left by a race now passed from sight that much still awaits a thorough investigation.

In connection with many acres of shell deposit is an interesting burial mound of sand, described by the writer in the AMERICAN NATURALIST, issues of February and July, 1892. Thirty feet south of the great burial mound is a small mound, six feet in height and 180 feet in circumference, composed of fragments of shell mingled with sand, so closely packed that a pick is necessary for the work of excavation. The mound is covered with palmettoes whose roots, closely intertwined, lend an additional difficulty to the work of the explorer. As to the nature of this mound the writer is undecided.

Somewhat over 100 yards distant from the great burial mound in a northeasterly direction is a crescentic, or rather a bean-shaped, shell heap 573 feet in length, with a maximum breadth of base of 233 feet. The height is somewhat irregular, averaging about eight feet from the surrounding level, though the shell deposit is found sunk deep into the marshy soil. Excavations at various points yielded nothing of interest.

SHELL RIDGES, TICK ISLAND.

About a quarter of a mile south of the bean-shaped shell heap lie acres of shell ridges inadequately investigated by the writer. Upon one of these ridges are the remnants of a live oak, now destroyed by fire, but growing at the time of the writer's first visit and then measured by him. Taken at a point five feet from the base the circumference was sixteen feet or twenty-three feet, three feet from the base over projecting knots. At a distance of twelve feet from the trunk of this tree an excavation, 7 ft. by 4 ft., converging to a depth of 9 ft., was made. After 1 ft. 6 in. of humus, shell was reached. From the start fragments of pottery were found in great abundance, the ornamented outnumbering the plain. It was rude and thick in character, made from clay through which vegetable fibre, destroyed in the process of baking, had left minute canals. To overcome a too porous character, it had been, previous to baking, thinly coated with clay on the outside. The clay contained no admixture of pounded shell or of gravel, which is rarely if ever met with in the shell heaps of the St. John's. The manner of ornamentation mainly consisted of straight lines in various combinations as shown. Many pieces in addition had indentations in connection with lines, as figured by Wyman; while the marking of others consisted of series of concentric circles of increasing size.

At a depth of 7 ft. 6 in.—a depth sufficient to clearly prove its contemporary origin with the shell heap—was found a fragment of ornamented pottery, with a turned lip,[1] the only

[1] By "lip" the writer means a turning out at one point of the upper margin through which fluid may pass, and not a turned rim encircling the pot. Such turned rims are by no means uncommon. It is taken for granted that Professor Wyman meant to express the same idea in the use of the word "lip."

specimen of the sort ever met with by the writer in a shell heap of the St. John's (Fig. 1). Professor Wyman says ("Fresh Water Shell Mounds of the St. John's River, Florida," page, 53): "the mouth of the vase is generally flaring, is seldom contracted; we have seen no instance in which there were signs of a neck, and only one in which there was anything like a turned lip. This was from Bartram's Mound, and was found on the surface where it had been thrown out in digging up an orange tree. The depth of the hole from which it came was such that it must have been superficial, and may have been brought there by the more recent inhabitants. This view is confirmed by the fact that the stamped ornaments were of a different pattern from anything found elsewhere in the mounds, consisting of a series of short parallel ridges instead of squares." Bartram's Mound, or Little Orange Mound, is on the west side of the St. John's, opposite the entrance of Lake Dexter, and is not over five miles distant from Tick Island.

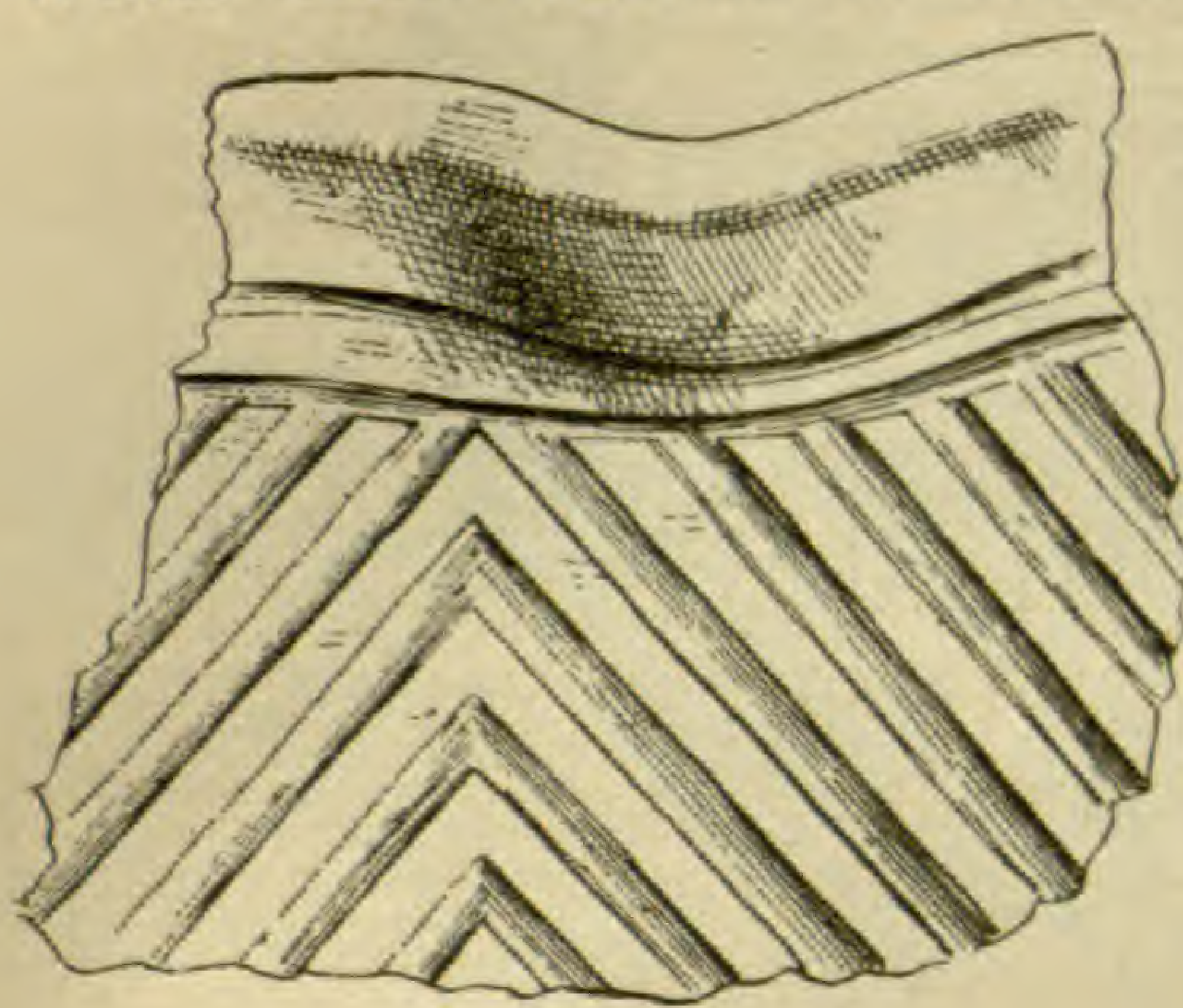
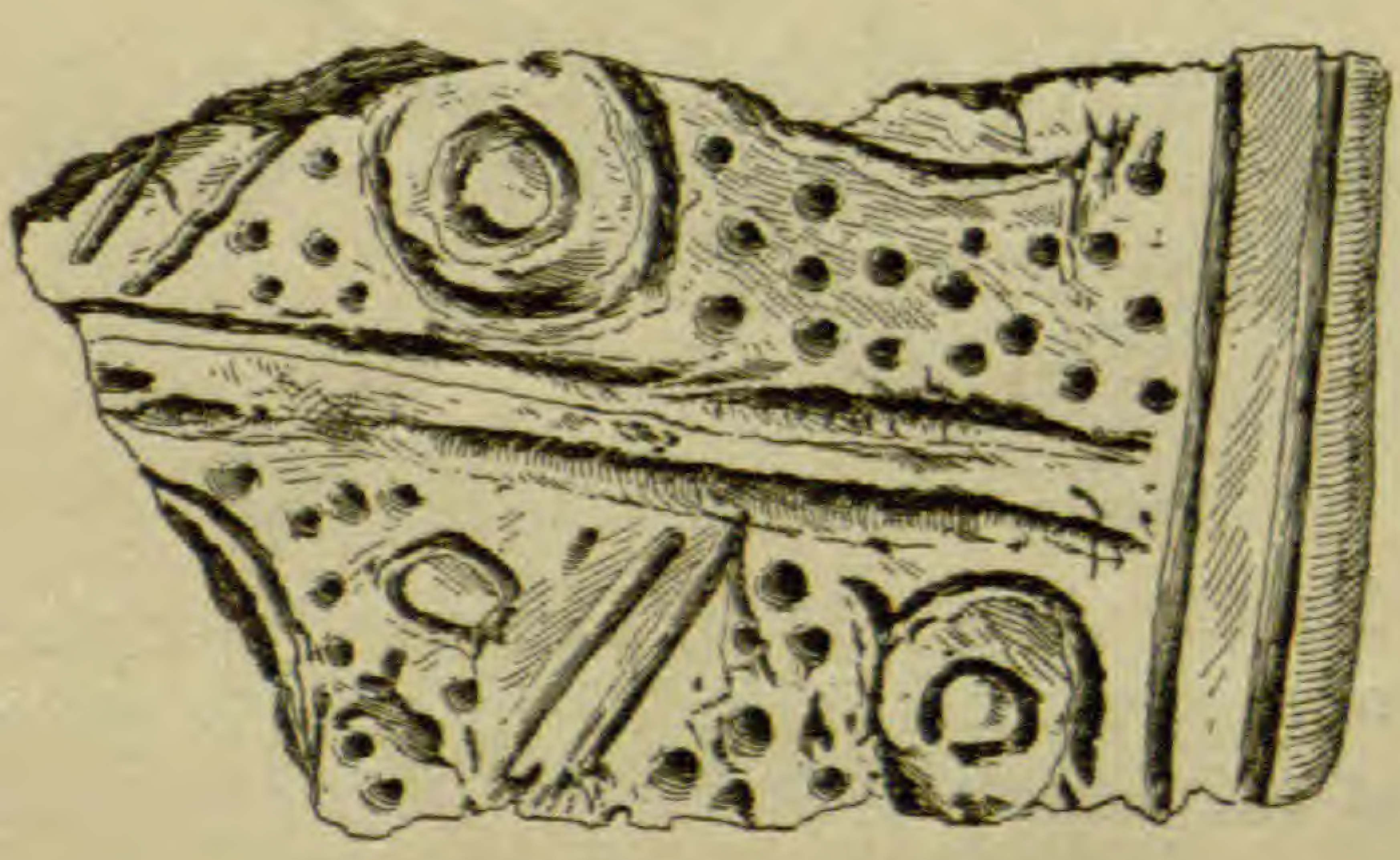


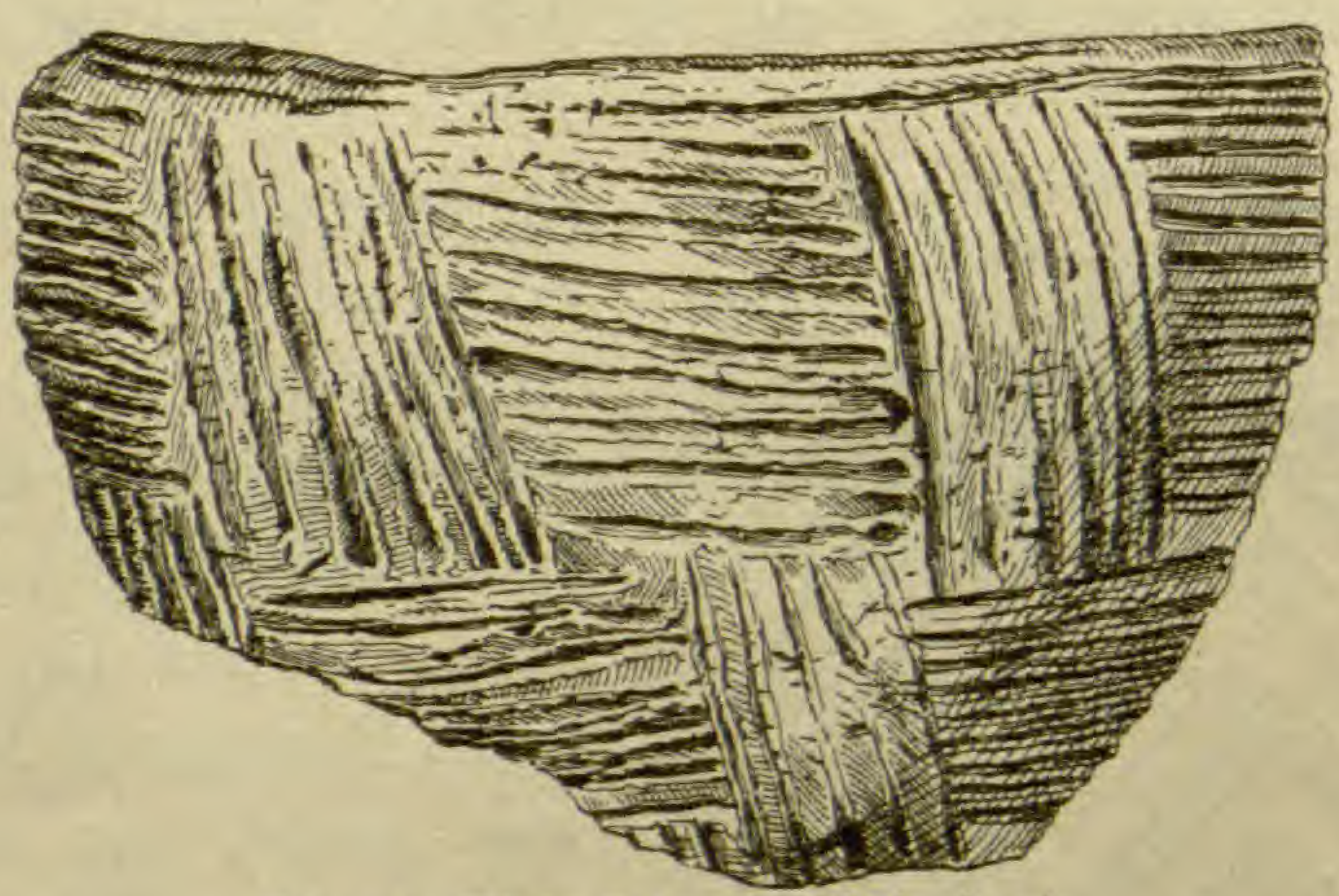
Fig. 1.
Lipped pottery, Tick Island. (Actual size.)

A number of other excavations, some of larger size, yielded



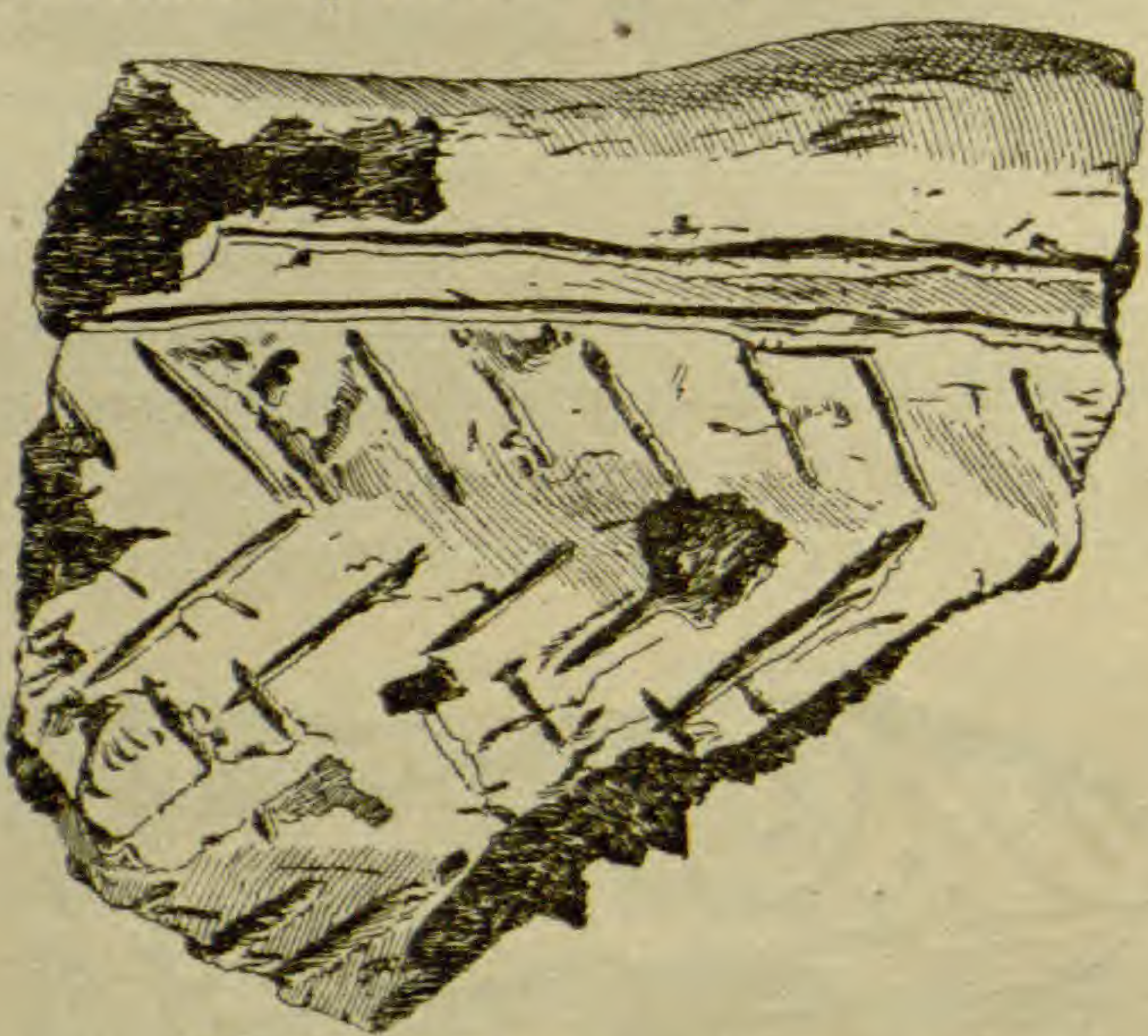
Sherd, Tick Island. (Actual size.)

abundant sherds of like quality and pattern. Tick Island and Orange Mound, to which reference will be made later, are richer by far in number of sherds and in variety of pattern than any other shell heaps of the St. John's explored by the



Sherd, Tick Island. (½ size.)

writer who, it may be said, has not confined himself to localities hitherto unexplored, but has carefully gone over those previously described by Professor Wyman, and has (January,

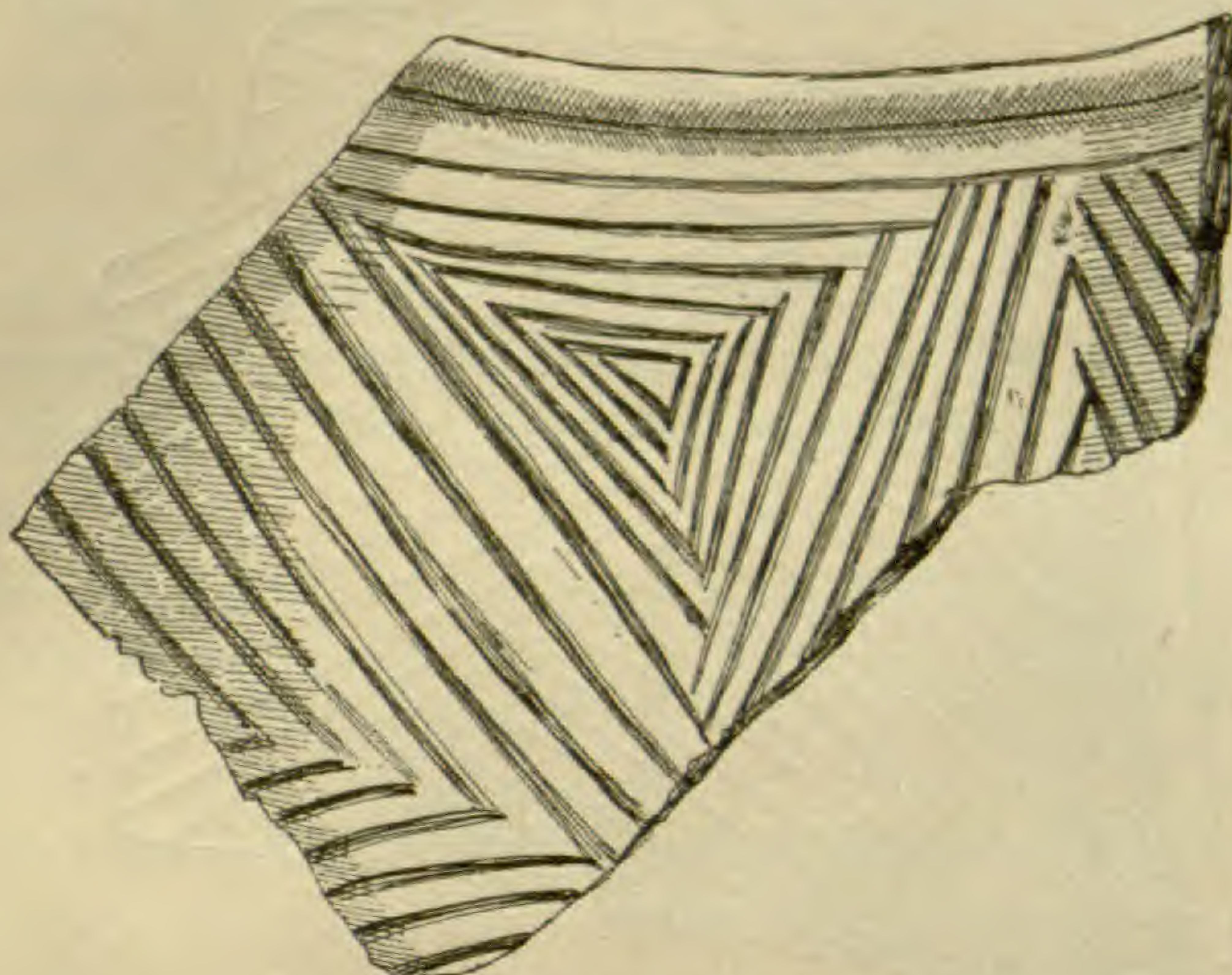


Sherd, Tick Island. (Actual size.)

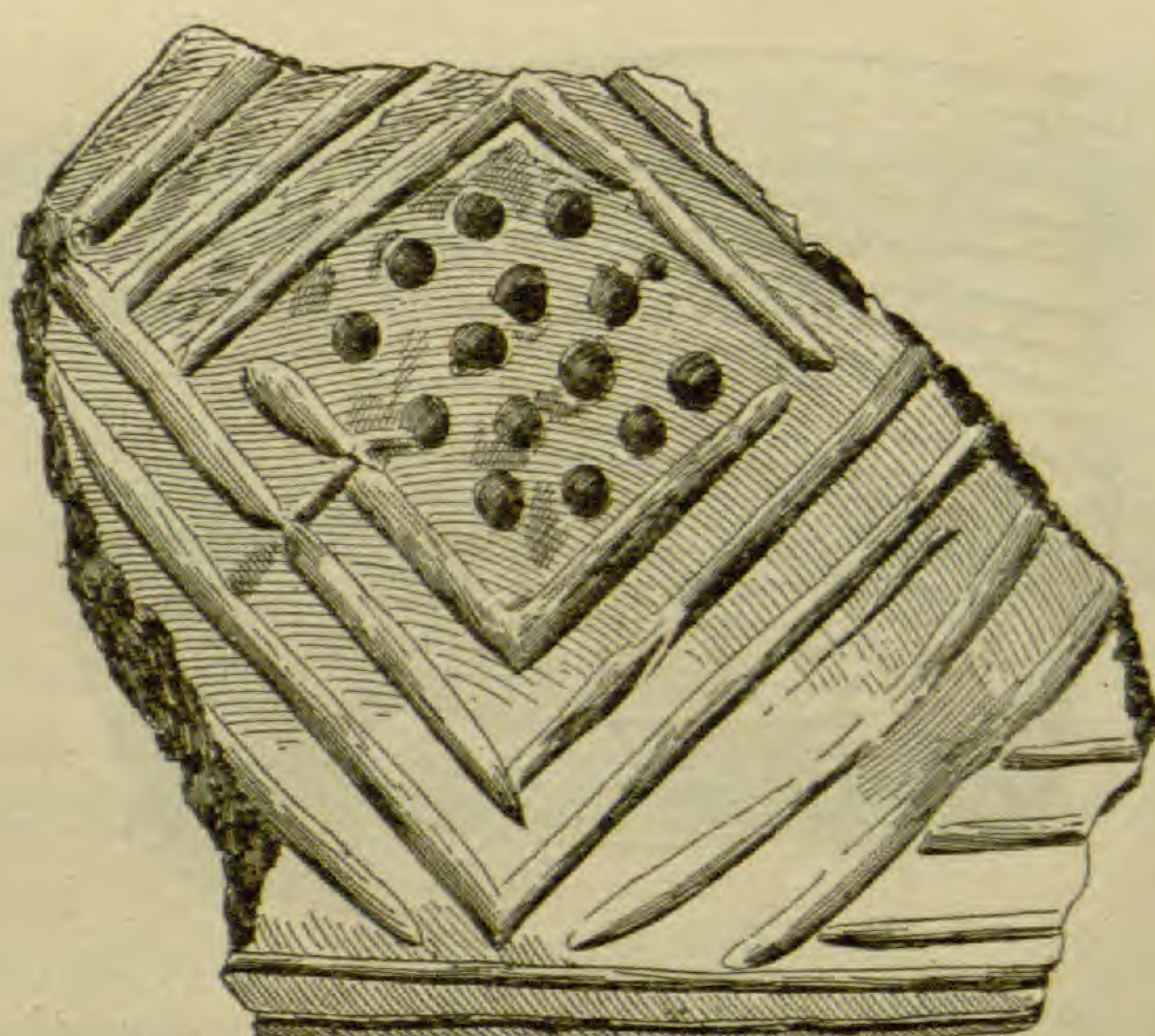
February, March, April, 1893) extensively explored others previously unreported not included in the list given with the first paper of this series.

SHELL HEAP NEAR ECONLOCKHATCHEE CREEK (ORANGE COUNTY).

In the prairie about two miles south of Lake Harney, and nearly a mile distant from the west bank of the St. John's, is a large shell heap covered with palmetto, oak, mulberry and other trees, from many of which hang trailing vines. It

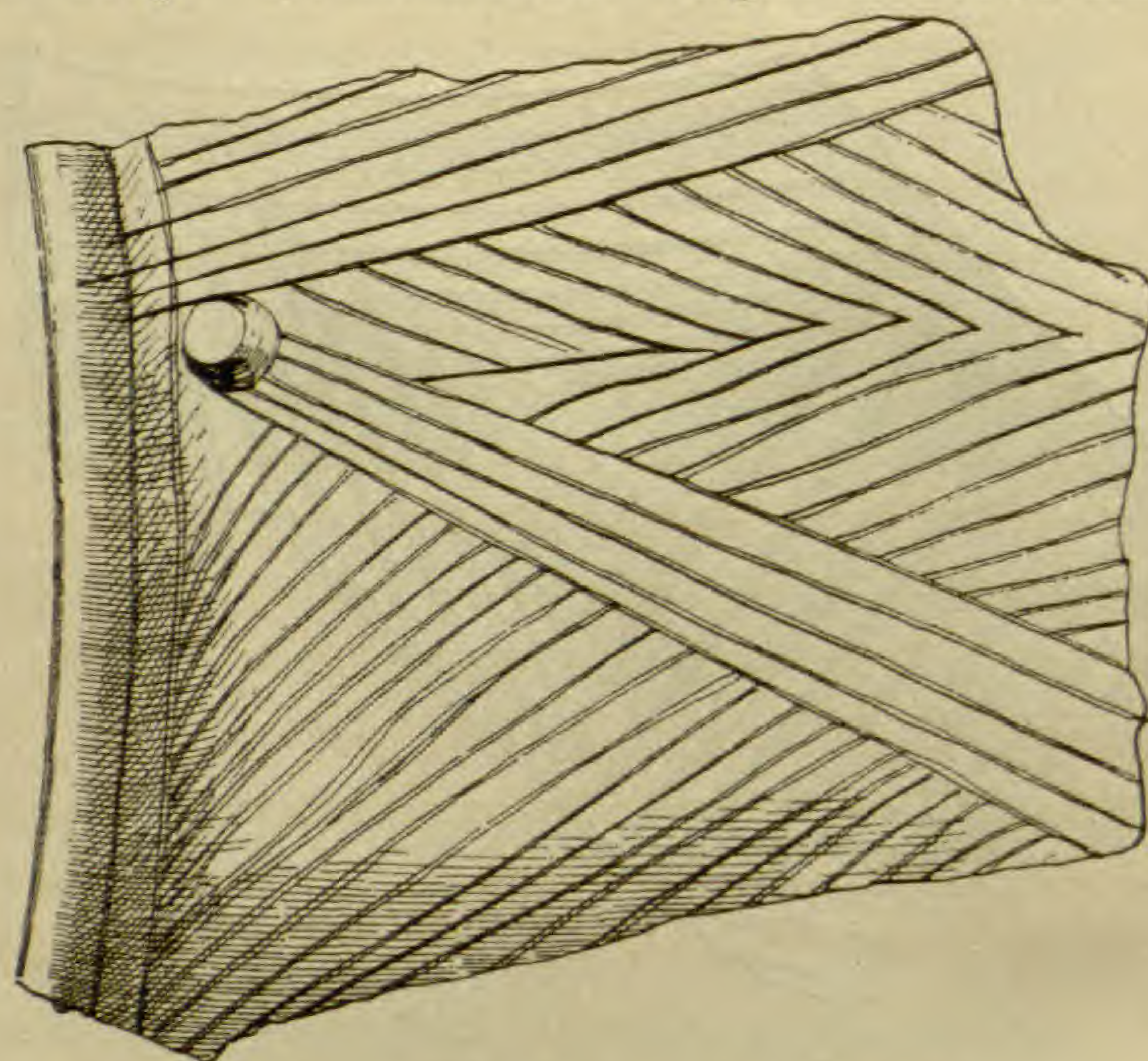


Sherd, Tick Island. (⅗ size.)

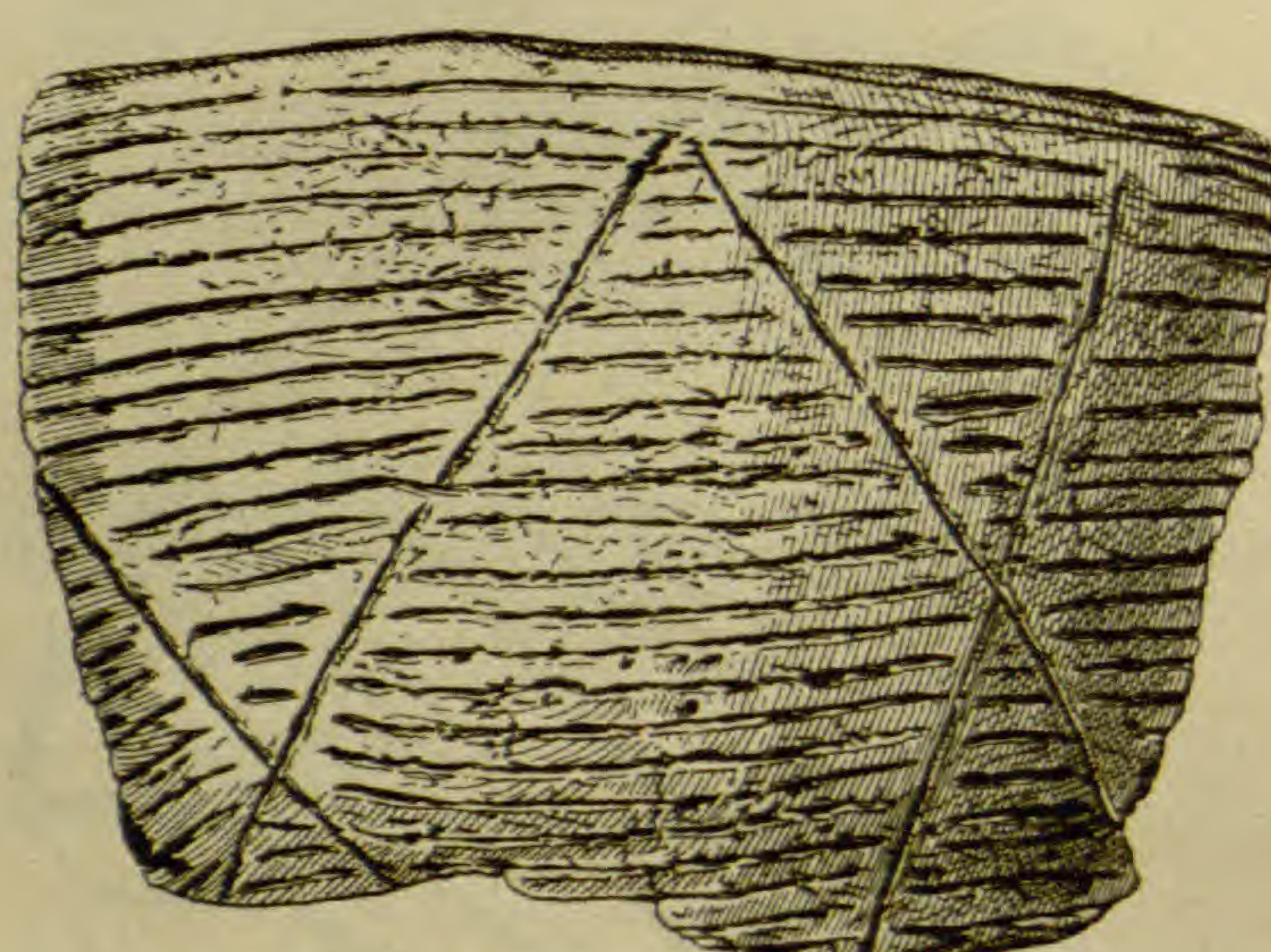


Sherd, Tick Island. (Actual size.)

looms like an island in the prairie which in wet weather becomes a marsh. By ascending the winding Econlockhatchee, it is possible to tie up within three hundred yards of the shell heap. Its maximum height is about six feet near



Sherd, Tick Island. (Actual size.)



Sherd, Tick Island. (½ size.)

the center, from which point it slopes in every direction toward the surrounding prairie.

Excavation I.

At the apex of the mound a hole, slightly converging, 6 ft. by 4 ft. by 7 ft. deep, was dug. Beginning at a level one foot from the surface and continuing through a layer two feet in thickness, were numerous human bones. These bones were broken into fragments and lay at random throughout the entire stratum. Some were found immediately upon a fire-place, and at least one of these human bones showed marks of fire. They were treated in respect to breakage as were the bones of lower animals found with them, and the areas of fracture were of the same dark brown color as the rest of the bone. The bones were so scattered that any estimate as to the number of bodies represented would be impossible, but fragments of at least four crania were met with. Few fragments of bone were in condition for measurement. The average lateral diameter of three portions of tibiæ was 59.9% of the average antero-posterior diameter. As stated in previous papers, these measurements were taken just where the nutrient artery enters the bone. Of three humeri one was perforated.

Composition of the Mound at Point of Excavation.

(*a*) 1 ft.—Sand and powdered shell, containing pottery, plain and ornamented, with fragments of bones of edible animals.

(*b*) 2 ft.—Sand, powdered shell and a slight admixture of shells. Numerous fragments of human bones were found throughout this layer, in association with fragments of animal bones, among which was half the lower jaw of a dog and faeces of animals. At the bottom of this layer, though not covering the entire area, was a fire-place. Absolutely no pottery in this stratum.

(*c*) 1 ft. 6 in.—Ampullariæ, paludinæ and uniones, with slight admixture of sand. No pottery and no bones of animals.

(*d*) 2 ft. 6 in.—Mixture of sand and shell. No remains of any sort.

In the upper layer were found a small piece of chipped chert, a fragment of a rude implement of bone and a rude disc of shell, rough at the margin and perforated in the center, having a diameter of 1¼ inches and a thickness of ¼ inch.

In the Report of the Bureau of Ethnology, 1880–1881,

Plate XXVII, fig. 2, an almost exact counterpart of this shell disc is given, with the exception that the perforation is larger and irregular. It is described as one of the stages in the manufacture of shell fish-hooks by the Indians of California; but as fish-hooks of any material are not found in the mounds of the St. John's this disc may be considered a discoidal bead.

A second excavation on the east side of the mound showed, as before, pottery in the upper layer and none in those below. Six fragments of bone were met with, of which two were human.

In this shell heap the hypothesis of burials, even of disconnected bones, would seem untenable, as absolutely nothing found in association with them pointed to interments. A portion of the remains of this probably cannibalistic feast can be seen at the Wagner Free Institute, Philadelphia.

The finding of a bone belonging to the dog is entirely novel in the shell heaps of the St. John's. Professor Wyman's searches yielded no canine remains[2] nor has the writer hitherto upon any other occasion found, to the best of his knowledge, any portion of the skeleton of the dog in the river mounds. Wyman was aware of no evidence to show the presence of domestic dogs on the river in early times,[3] and cites Le Moyne's list of animals supposed to have been seen by the French[4] (1565), from which the dog is omitted. On the other hand, Cabeça de Vaca, Treasurer of the expedition of Pamphilo de Narvaez (1527), found dogs[5] among the natives during his wanderings along the coast of northwestern Florida, and in other portions of his journey. He makes no comment as to their origin, as he doubtless would have done had they been pointed out as curiosities, and it is hardly reasonable to suppose that, at so early a period, their derivation can have been from a European source. The bones of dogs are reported from a shell heap at Tampa.[6] The writer learns how-

[2] "Fresh Water Shell Mounds of the St. John's River, Florida," page 80.

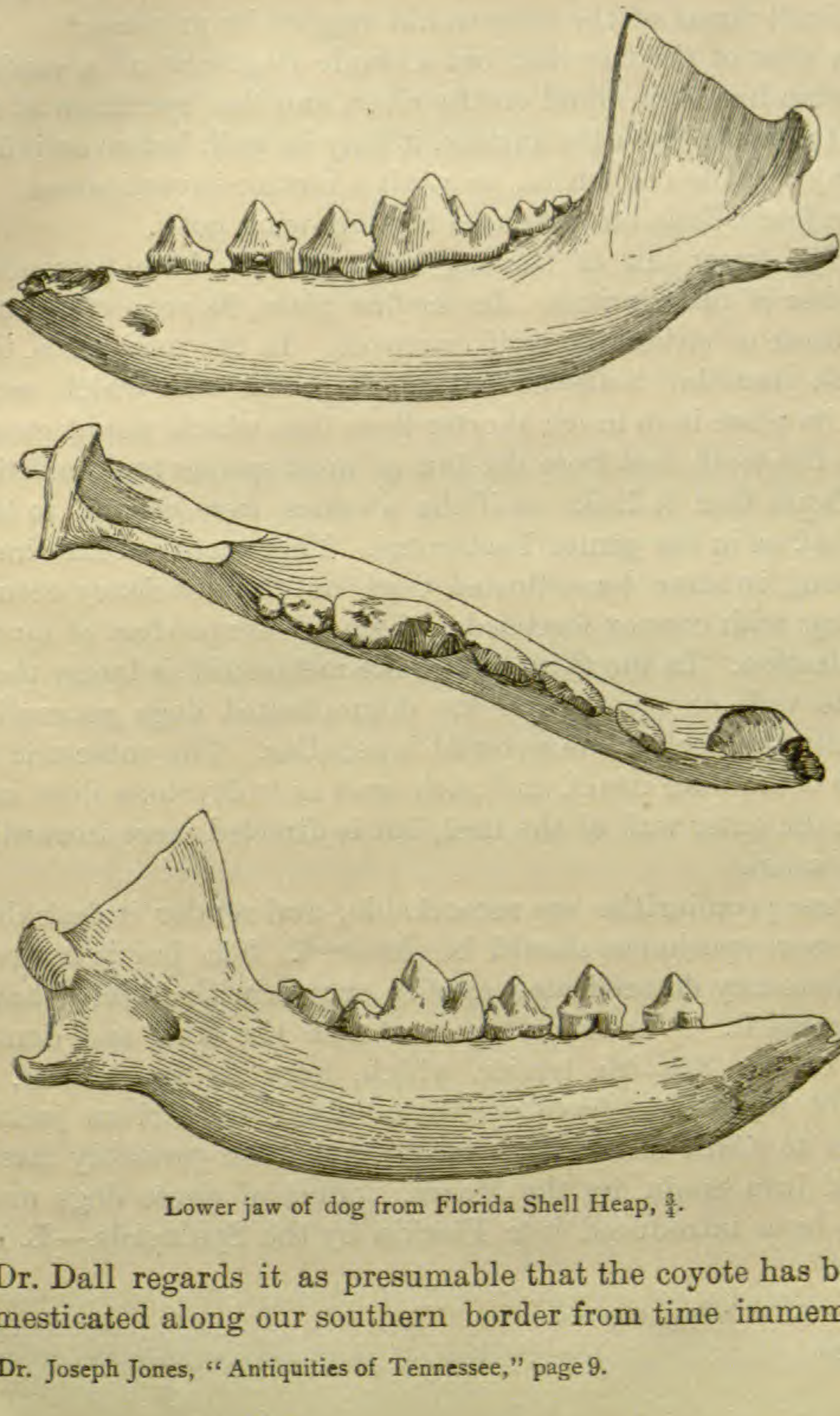
[3] Loc. cit.

[4] Loc. cit.

[5] "The Narrative of Alvar Nunez Cabeça de Vaca," translated by Buckingham Smith, Washington, 1851, page 41, et al.

[6] "Tampa Sunland and Tribune," Nov. 18, 1876.

ever that this discovery was superficial. De Soto, who landed at Tampa, had numerous fierce dogs, and found great quantities of dogs among the Indians of Georgia. Bones supposed to be of the dog are in the stone graves of Tennessee.[7]



Lower jaw of dog from Florida Shell Heap, ¾.

Dr. Dall regards it as presumable that the coyote has been domesticated along our southern border from time immemor-

[7] Dr. Joseph Jones, "Antiquities of Tennessee," page 9.

ial, though perhaps as an occasional curiosity in many tribes, rather than a usual companion. During nine years exploration he found one dog's skull in an Aleutian shell heap, a prehistoric deposit, and only one.[8]

The dog has never yet been found fossil in Florida, though the fossil fauna of the state would suggest its presence.[9]

In view of the fact that but a single fragment of a canine skeleton has been found on the river, and that specimen at no great distance from the surface, it may be well, before arriving at any definite conclusion, to await a farther investigation.

Professor Cope has prepared the following note.

"The lower jaw of the dog found by Mr. Moore presents a number of peculiarities. In the first place, its proportions are not those of either the wolf or coyote. In the next place, the fourth premolar is absent and the short diastema which occupies its place is so much shorter than that which would result were the tooth lost from the jaw of most species and varieties of Canis, that it looks as if the absence were normal to the animal, as in the genus Tomarctus. This tooth is sometimes wanting in some domesticated dogs, but the deficiency occurs in dogs with convex foreheads, which are the product of much civilization. In the third place, the metaconid is larger than in the wolf or coyote, and the domesticated dogs generally. Finally the heel of the sectorial is peculiar. The entoconid is more conic than usual, and such crest as it develops does not form the outer wall of the heel, but is directed more inwardly than usual.

These peculiarities are remarkable, and render it desirable that more specimens should be obtained. The jaw is not referable to any domesticated species or race with which I have compared it. I, however, have not seen the skull and dentition of the Spanish terrier, which, from its appearance, I should suppose to have originated from an African jackal allied to *Canis mesomelas*, and to have been probably introduced into Spain by the Moors. Some of these dogs may have been introduced into Florida by the Spainards.—E. D. Cope."

[8] Dr. W. H. Dall, private letter.

[9] Cope.

PLATE XVI.

Cache, Long Bluff.

ORANGE MOUND (ORANGE COUNTY).

This interesting mound is reached by turning to the west from the river into a lagoon, and continuing about 500 yards after leaving the channel. In a straight line it is ten miles south of Lake Harney, but so devious is the river that three times that number probably would not be an overestimate of the distance by boat, by which means alone can access to the mound be had. Le Baron (Smithsonian Report, 1882, page 102) refers to Orange Mound. He made no investigations and puts the height at forty feet; probably a misprint for fourteen, its maximum altitude. His other dimensions are likewise faulty.

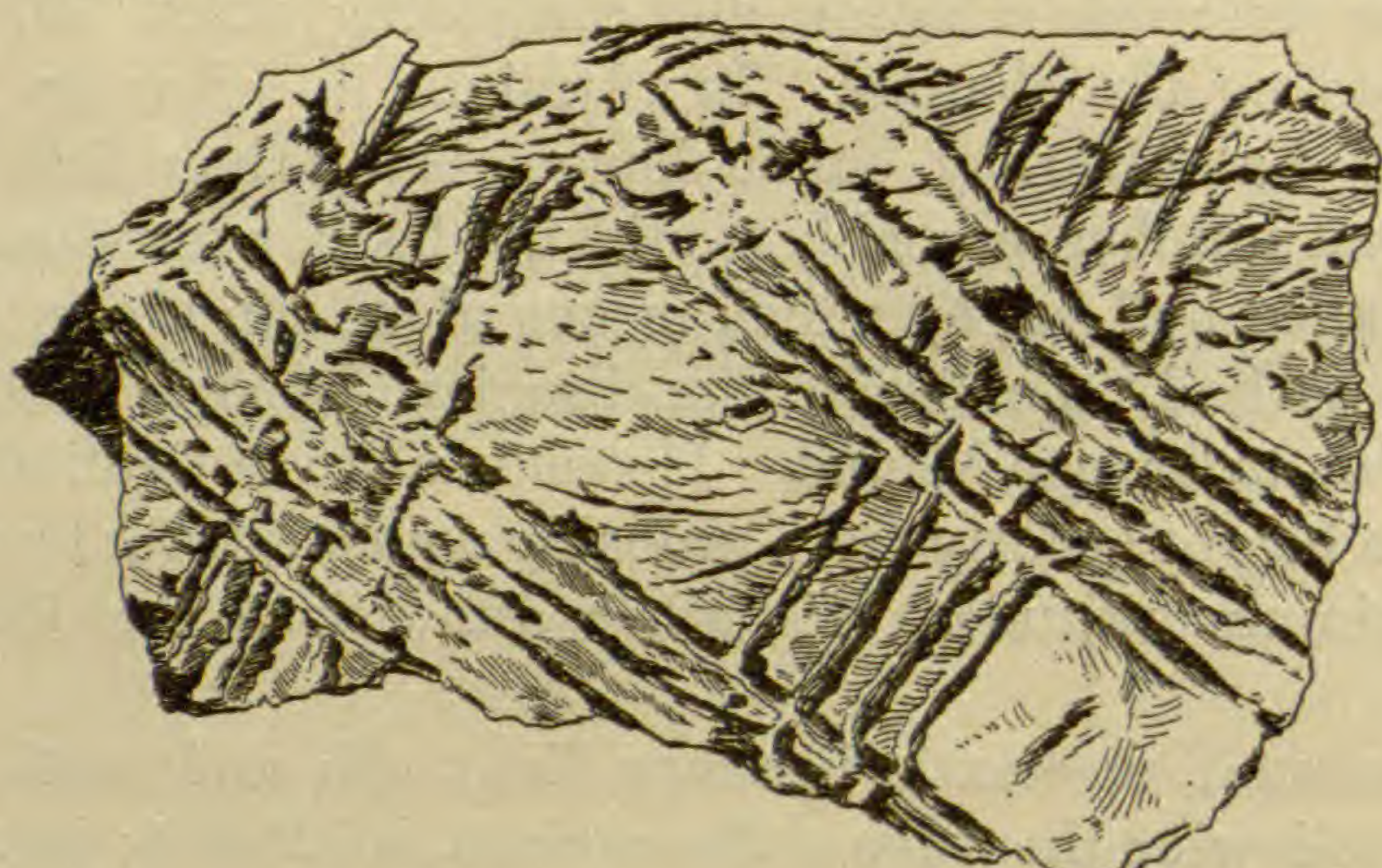
The mound, crescentic in shape, lies north and south. Its length, following the ridge of the crescent, is 560 feet; its maximum width 260 feet. It slopes on every side toward the water and offers usually a secure retreat for numerous large hard-shell turtles which visit it to deposit their eggs. By cutting off their escape to the water, the crew of the writer's boat in one morning secured five, and doubtless the aborigines in the same manner obtained this staple article of diet.

The mound has been under cultivation for the growth of cane, and a tumble-down shed, where once an old caldron stood, is very picturesque, shadowed by towering palmettoes and flanked by a tropical growth of bananas.

Surface pottery is abundant, both plain and stamped in squares. It is of fairly good quality and probably has no connection with the builders of the shell heap. Orange Mound was visited by the writer a number of times during the winter of 1891 and photographs secured; but February 7, 8, 9, 1892 and two days of the winter of 1893 were devoted to serious excavations.

Excavation I.

About the center of the mound at its highest point, 12½ ft. by 8 ft. by 15 ft. deep, converging. The first foot was through a layer of loam filled with pottery of the variety seen on the surface. At a depth of one foot was found a shell chisel, small and perfect. The next three feet consisted of ampullariæ loosely thrown together, with a slight admixture of sand. Many of these shells were of extraordinary size, among



Sherd, Orange Mound. (Actual size.)

them being found specimens far surpassing all previous records known to science. At a depth of 1½ ft. were clearly defined traces of a fire-place. Through the layer of ampullariæ and in the succeeding stratum, consisting of one foot of brown sand, mingled with ampullariæ, unionidæ and paludinæ, pottery was abundant, thick and coarse in character, with a certain percentage decorated with lines.

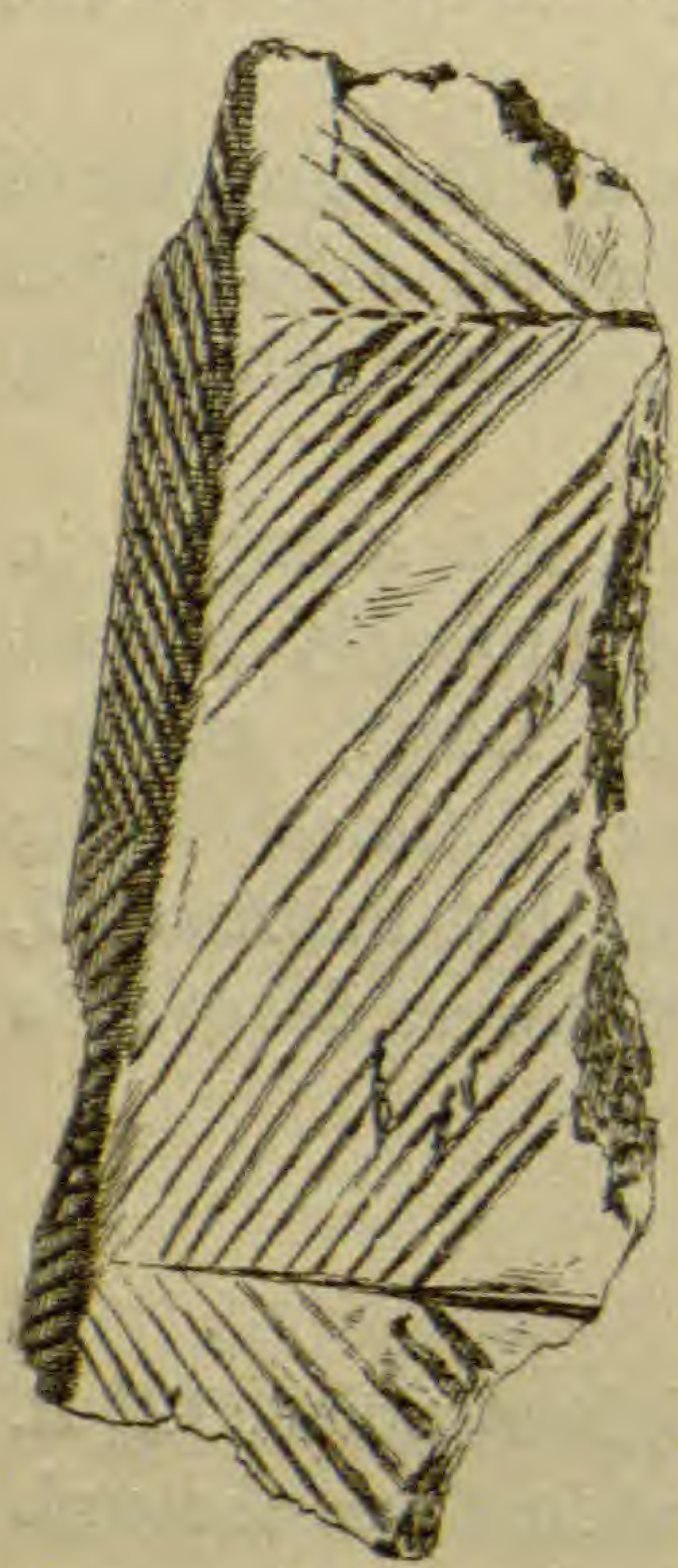


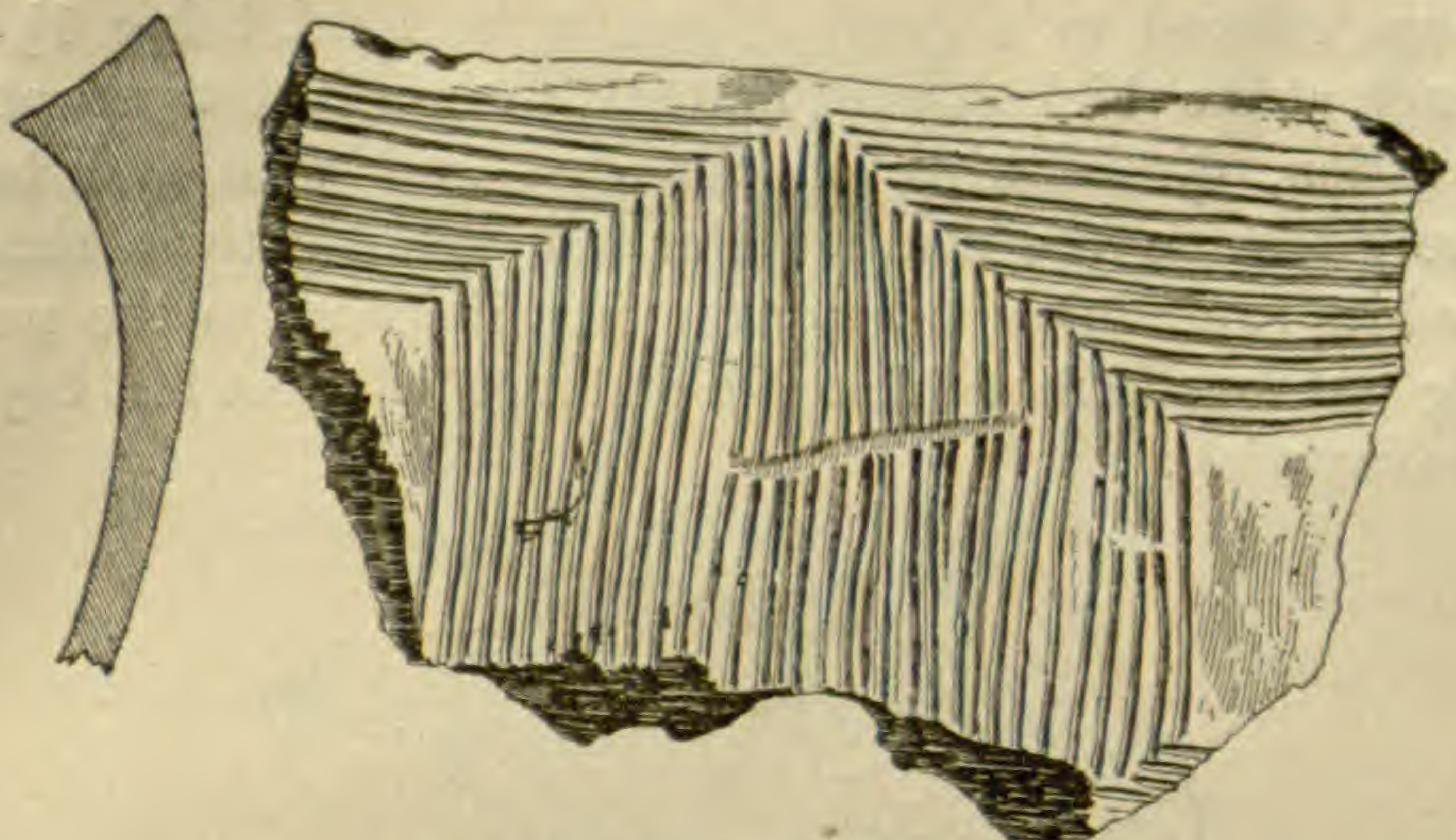
Fig. 2.
Orange Mound. (½ size.)

In its method of manufacture, namely, the admixture with the clay of vegetable fibre, which subsequent heat had destroyed, leaving the material porous in character, it resembled the pottery of the shell ridges at Tick Island and of some other deposits of the river, some sherds being so much as .7 inch in thickness. The patterns varied considerably as to the arrangement of lines, and in certain ones decorations appeared on the upper margin of the rim (Fig. 2).

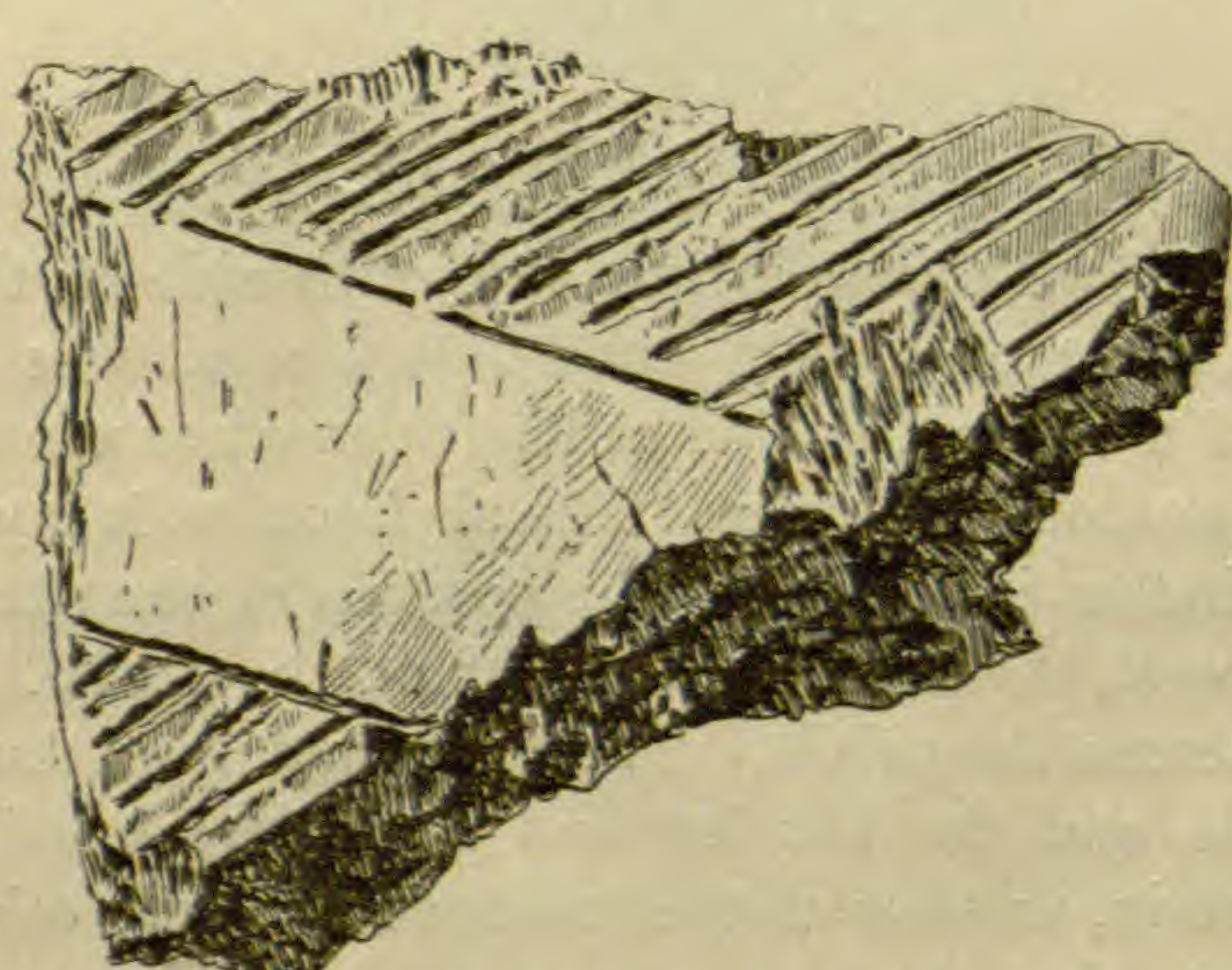
Some fragments with inverted rim were

thickest at the top, the general thickness being .6 inch, thickness of rim 1.2 inches.

At a depth greater than five feet not a fragment of pottery was encountered. Fire-places were found at varying depths, while throughout the entire excavation bones of the turtle,



Sherd, Orange Mound. (½ size.)

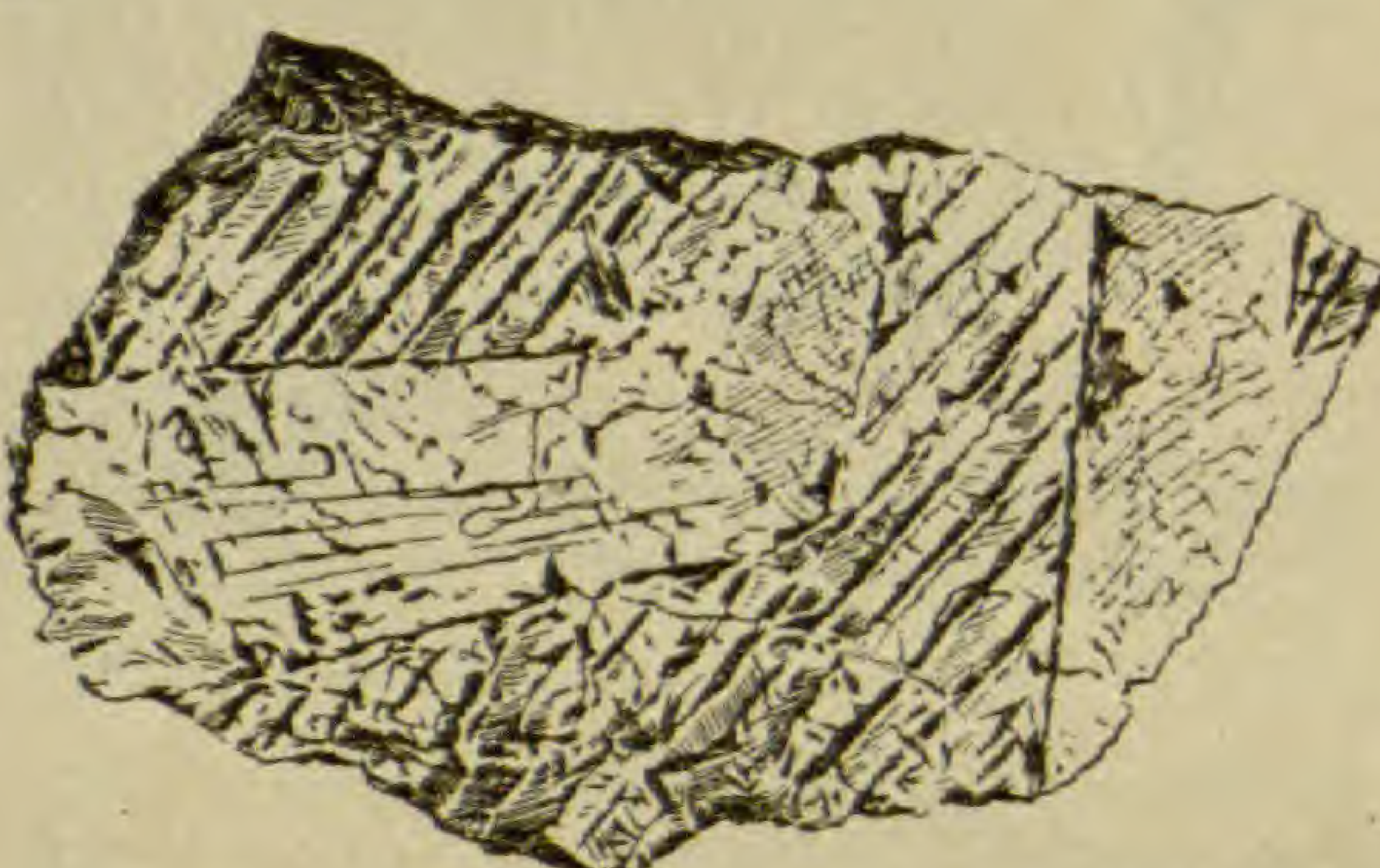


Sherd, Orange Mound. (Actual size.)

deer, alligator and other edible animals were met with. At a depth of 4½ feet, in a layer of brown sand, with a percentage of shell intermingled, strongly reminding the writer of the brown sand layer in the Tick Island burial mound,[10] a num-

[10] AMERICAN NATURALIST, February and July, 1892.

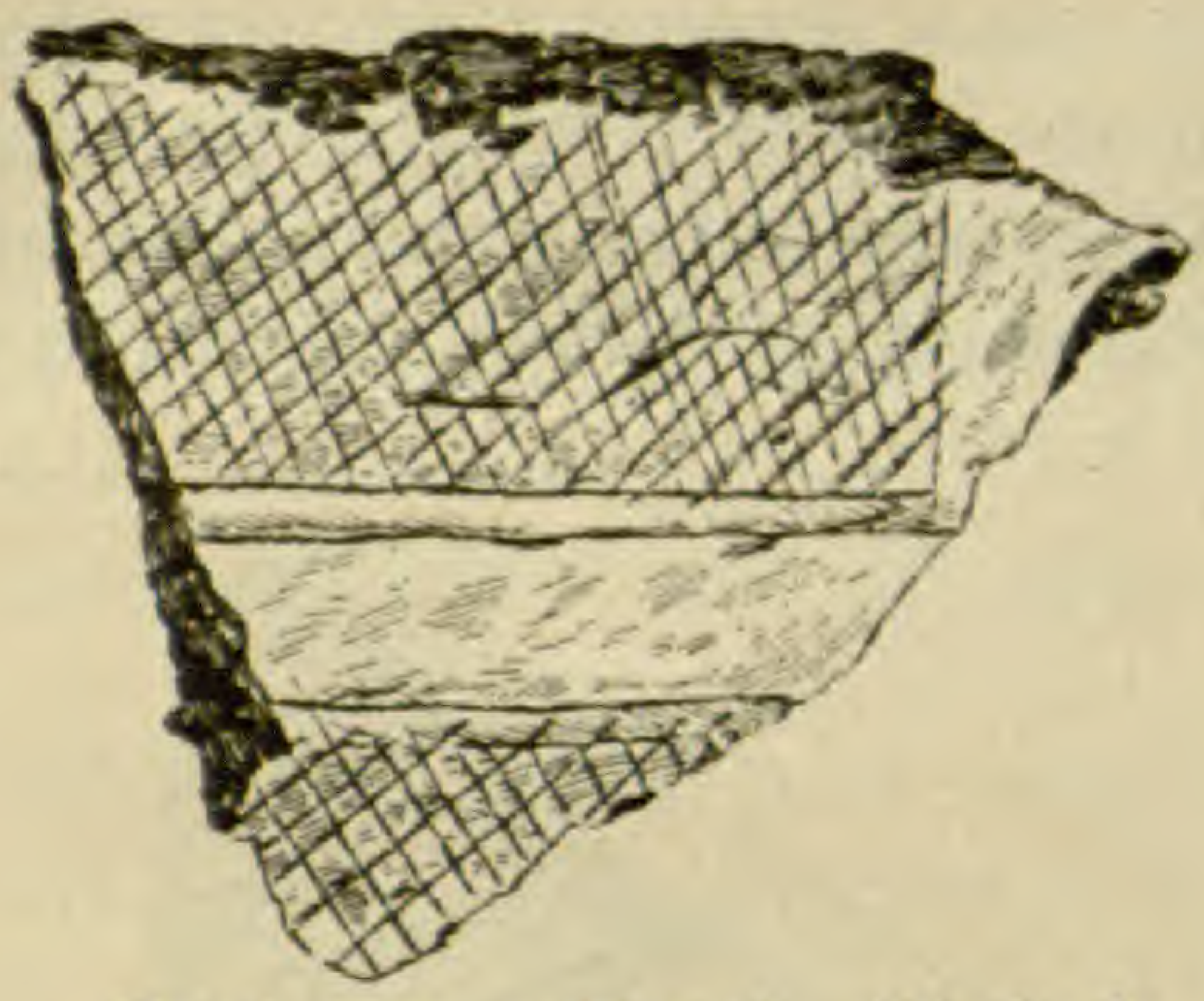
ber of human bones were encountered. They were somewhat disturbed by the digging but were neither crushed nor broken as are the bones of the shell heaps, and it was evident that interments had taken place. Below the bones was a layer of pure white sand, so common in the burial mounds. This stratum seemed to a great extent to be local, being 1½ feet through at the thickest part, namely, the northwest part of the excavation, diminishing on the east and west and being entirely lost on the south. Further investigations showed the white sand layer to decrease in thickness to the north, being but four inches thick at a distance of three feet beyond the excavation.



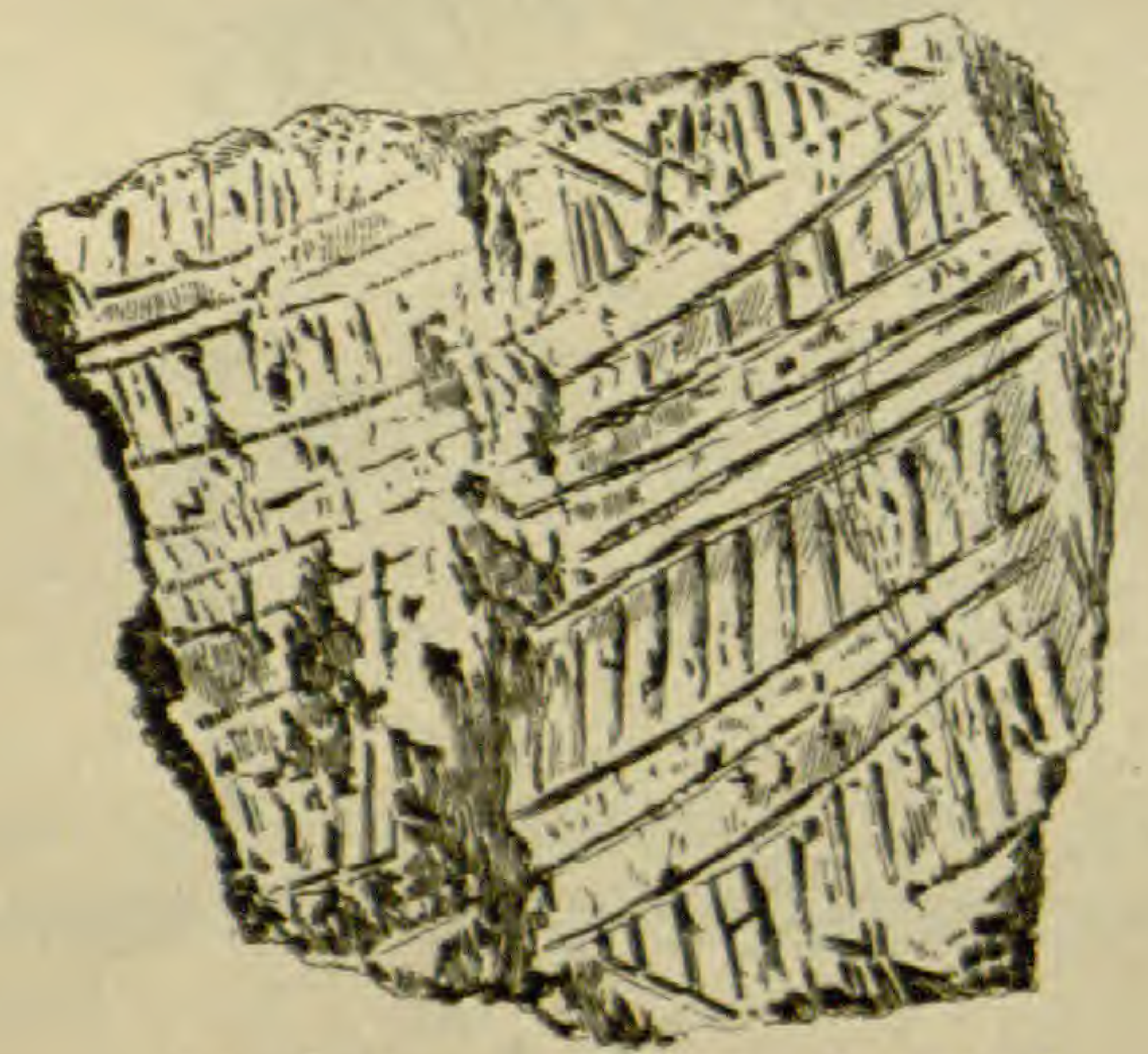
Sherd, Orange Mound. (½ size.)

By digging with trowels into the south side of the excavation, in a layer of almost pure brown sand was found the skeleton of a woman, buried at length in a horizontal position in perfect anatomical order. The skeleton as it lay measured 5 feet, 1½ inches in length. The position of the skull was 10° south of west, the feet pointing 10° north of east. The fore-arm lay across the pelvis. The body had been buried upon its left side and the left leg and arm were missing. It is almost certain, in view of the presence of every other bone of the skeleton, that these members, extending somewhat from the body, unlike the right arm and leg, were thrown out by the spades prior to troweling into the side of the excavation. The skull was somewhat crushed. The femur was 14½ inches in length (tape); the humerus was not perforated. The tibia in lateral diameter was 58.2% of the fore and aft diameter, showing decided platycnemism.

About one foot south of this burial on a line with the ribs was found what was probably a burial of the kind so well known in some of the sand mounds of the river and of the coast, where the body, previously exposed to the ele-



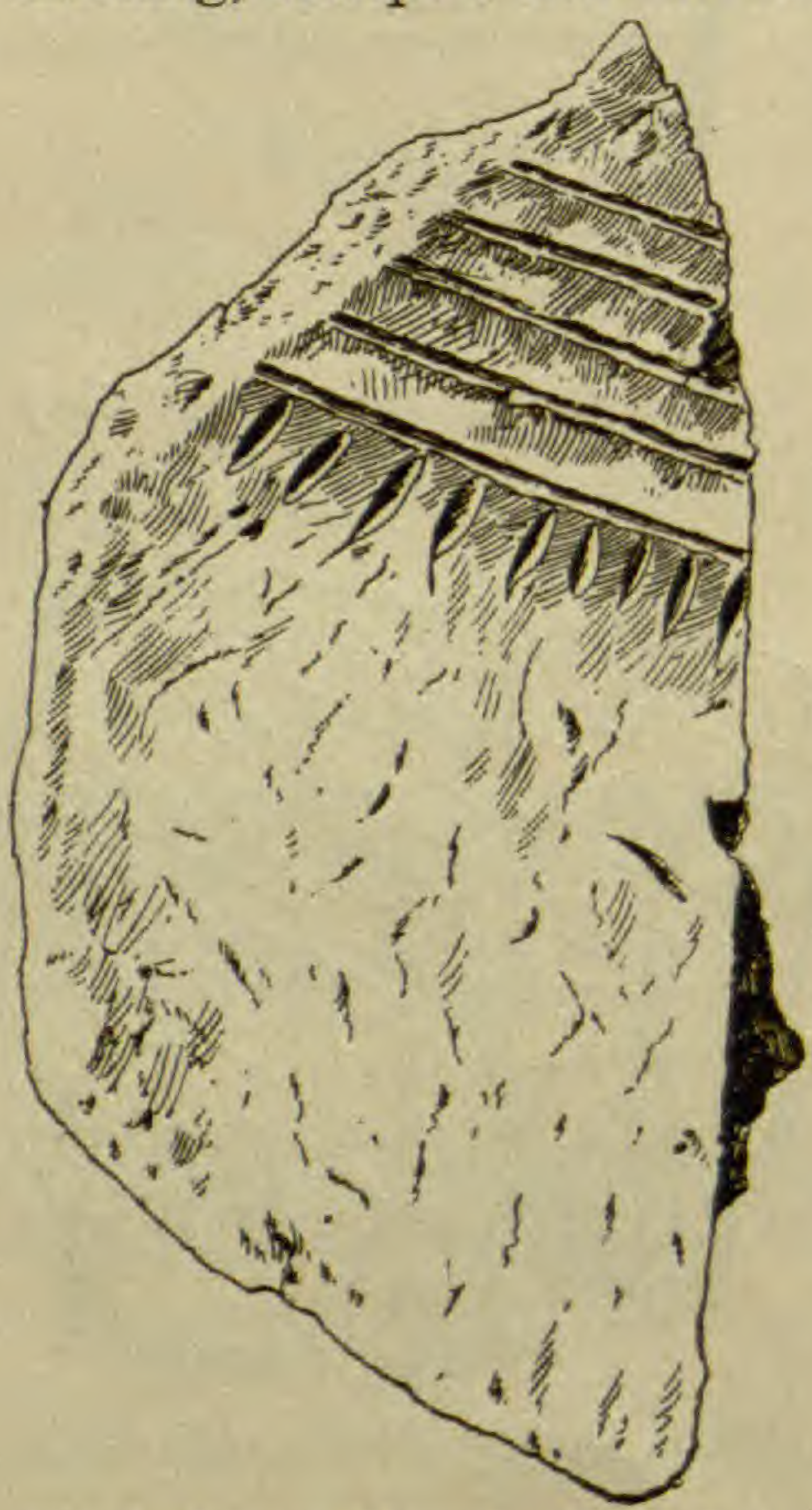
Sherd, Orange Mound. (½ size.)



Sherd, Orange Mound. (½ size.)

ments, is denuded of flesh before burial. As a rule, the larger bones are placed in a bundle horizontally and are surmounted by the skull. In this case the cranium lay below the bones. Above it in immediate association were the larger bones of the body. The lower jaw lay about six inches from the upper jaw to one side with the teeth turned away. A few vertebræ were beneath the head, while two heel bones were with the bundle. Upright by the skull was a femur belonging to another body. All these bones were badly decayed being in a far worse condition than those of the skeleton at length.

To return to the main excavation. Below the layer of white sand were two feet of brown sand and shell intermingled, and beneath this was a stratum 2 feet 9 inches in depth composed of crushed shells with a very slight admixture of sand. At a depth of 8 feet were more human bones disarranged by the digging. At a depth of 8½ feet a cranium was found, with bones of the face missing, except a half of the lower jaw. In



Sherd, Orange Mound. (Actual size.)

association were bones of the lower animals. At the same level as the skull, and where they might be looked for, in anatomical order were pelvis, femur, tibia, fibula and foot bones complete. A femur lay somewhat apart. It is possible that this femur, not in association with the pelvis or with the tibia which was found lying across the first tibia in anatomical order, may have been separated from the skeleton by the shifting of sand caused by trampling in earlier stages of the mound.[11] Between the skull and pelvis lay decaying fragments of ribs. It is probable that the missing arm bones extending upward were those inadvertently disarranged by digging half a foot above.

At a depth of 8½ feet immediately below the bones was a layer two feet, nine inches in thickness, consisting of the ordinary crushed shell of the shell heaps, with fire-places, bones of the lower animals, etc., as ordinarily found. Nothing of further interest was met with.

Diagram of the northern side of this excavation is appended.

A number of other excavations were made in various portions of the mound. No pottery was met with below 5½ feet anywhere near the center of the mound, though near the margin—probably a later deposit—pieces were found at a depth of seven feet. Eighty-eight feet from the first excavation on the northern slope of the mound seven feet below the surface was found a portion of a rude spear head of red chalcedony, 1½ inches in length. In this excavation the glandina truncata was comparatively numerous, some thirty or fourty specimens being present. This land shell is of infrequent occurrence in the mounds.

Of the four humeri found during the first excavation not one was perforated. The three tibiæ exhumed in a condition for measurement had an average of 58.0 per cent lateral diameter as compared to the antero-posterior diameter. No crania were saved.

To those interested in the archæology of Florida, the result of the investigation conducted at Orange Mound must be regarded as of considerable importance. It will be remembered that to the present time no conclusive evidence has been secured, assigning to any sand mounds of the river an origin contemporary with the shell-heaps. That burials took place at Orange Mound in a regular stratified mound of sand is beyond the shadow of a doubt, and that the burial mound was not made upon an abandoned shell-heap, perhaps long

[11] This shifting of bones is not uncommon according to Topinard, Revue d'Anthropologie, 1886, page 742.

Section of North Side of Excavation.

Orange Mound, Fla.

Scale- ½" = 1'.

after the eaters of shell-fish had passed away, is irrefutably shown by the three feet of ampullariæ piled above. It must therefore be admitted that the aborigines of the shell heaps, in one instance at least, interred their dead in a sand mound in every respect similar to many burial mounds of the St. John's, and the writer considers it so unlikely that the stratified burial mound met with in the center of the great shell-heap at Orange Mound is an isolated case in respect to the method of sepulture of the eaters of shell-fish that at least the erection of some of the sand mounds of the river by the men who piled up the shell-heaps would seem to be strongly indicated.

LONG BLUFF (ORANGE COUNTY).

This bluff on the west bank of the St. John's lies directly on the water's edge. It is separated from a large shell-hammock by a quarter of a mile of marsh. This southerly portion probably is considered a part of the Bluff, or at all events has no distinctive name. Long Bluff, unlike most of the shell-deposits south of Lake Harney, is not composed entirely of shell and does not appear to owe its origin solely to the debris of the meals of the aborigines, but consists of sand through which is a sprinkling of shells. It is perfectly level and if cleared of the dense mass of palmettoes which shade it, would be termed a shell-field.

A Cache.

About midway in the northern portion of the Bluff an excavation, the point for which was selected at random, was made, 1½ feet through the sandy loam, with here and there an occasional shell. Beneath was a hard conglomerate of sand and shell, mostly uniones, about four inches in thickness, necessitating the use of the pick. Underneath the shell layer was a pure white sand, continuing to water level. At a depth of eight inches in this sand, or 2½ feet beneath the surface, by good fortune, was found what was probably a cache of one of the earlier Indians. In a space no larger than a man's hat, in actual contact, lay six chisels or scrapers of shell, each of a different size, 8 inches, $4\frac{1}{4}$ inches, 3 inches, $2\frac{1}{4}$ inches, 2 inches, $1\frac{3}{4}$ inches, in length, respectively; one shell gouge; one spiral instrument for cutting or polishing, $6\frac{1}{2}$ inches in length, made from the columella of the fasciolaria; four bone awls; one curved awl of bone, 4 inches in length; one sandstone hone or whetstone; a large number of the smaller bones of edible animals. (See Plate XVI.)

In order to ascertain whether these relics marked the site of a burial, the excavation was continued until a trench, 15 ft. by 4 ft., 3 in. by 3 ft. to 4 ft. deep, was dug. At a depth of 8 inches from the surface an arrow head was found, and during the course of the digging another hone, an oyster shell and several pieces of lined pottery were met with. There were, however, absolutely no indications of a burial. The chisels were perfect, with one exception, the hone showed no marks of use, and the points of the awls were intact. These relics therefore, are not the debris of the shell heaps, and their number precludes the possibility of an unintentional deposit. With no human bones in association, a cache would seem to be indicated, although the presence of unworked animal bones—unless to serve as material for implements—is difficult to explain.

In the southern portion of the Bluff a number of small excavations were made. Fragments of human bone, with broken bones of edible lower animals were met with.

NOTES ON MARINE LABORATORIES OF EUROPE.

BY BASHFORD DEAN.

In every country the Marine Laboratory has become a need of the student of biology. During his winter studies in the university it serves to provide him with well-preserved material, often with living forms which he may himself prepare according to his wants; in summer it gives him opportunity to see and collect his study types and utilize with profit and without physical discomfort abundant material relating to his studies. To the investigator, the Marine Laboratory has become, in the broadest sense, a university. He may there meet the representative students of far and wide, fellow workers, perhaps, in the very line of his own research, and must himself, unknowingly, teach and learn. He finds out gradually of recent work, of technical methods which often happen most pertinent to his present needs. He may carry on his work quietly and thoroughly; his works of reference are at hand; he has the most necessary comfort in working—the feeling of physical rest, untroubled by the rigid hours of demonstrations and lectures.

The importance of the work of the Marine Laboratory has been keenly appreciated in foreign countries, and it is noteworthy how large a number of the original researches is at present conducted at, or upon material from these distributing centers of biology. At the present day the entire coast line of Europe has become dotted with zoological stations great and small, grown out of the resources granted by societies, private individuals or governments—perhaps by the combined efforts of all. It was a matter of great interest to the present writer during recent visits, to find how thoroughly the Marine Laboratory system abroad had become a part of every grade of biological work. The student in a small university in the interior of France receives his first lessons from material sent regularly from Roscoff or Banyuls—he examines *living* sponges, hydroids, lucernarians, pennatulids, beroës, *Loxosoma*, *Coma-*

tula and *Amphioxus*. In Munich, hundreds of miles from the sea, is another example. Professor Richard Hertwig, by the aid of material from Naples, demonstrates the larval characters of ascidians, or the fertilization of the egg of the sea urchin. Every group of European universities seems to have centralized its marine biological work in a convenient locality, and this branch of their needs is supported, and is well-supported, even in countries whose financial resources are most limited. The importance of this work is felt to such a degree that it is not from reasons unselfish that universities have united in their support of a station like that of Naples. This has become literally an emporium, cosmopolitan, bringing together side by side, perhaps not unnaturally, the best workers of many universities whose observations upon the best material, sharpened by discussion and criticism, are certainly tending to become the most accurate and the most fruitful in their direction and results.

It is most singular that foreign countries are unquestioningly liberal in the support of *pure* biology, and in the work of marine stations the tendency is becoming less and less on the part of money-givers to ask how many fish will be hatched to become food material. Public interest has been gradually coming to be directed to the general laws and the problems of life and heredity. This has well been a hopeful sign, and the European biologists are not backward in emphasizing the importance of their studies. Professor de Lacaze-Duthiers does not hesitate even to propitiate the practical Cerberus, reminding him how often 'facts have been found at every step of science which were valueless at their discovery, but which, little by little, fell into line and led to applications of the highest importance—how the observation of the tarnishing of silver or the twitching leg of the frog was the origin of photography and telegraphy—how the purely abstract problem of spontaneous generation gave rise to the antiseptics of surgery.'

In the present paper it may prove of interest to examine briefly the condition of a few of the biological stations of Europe.

I.—France.

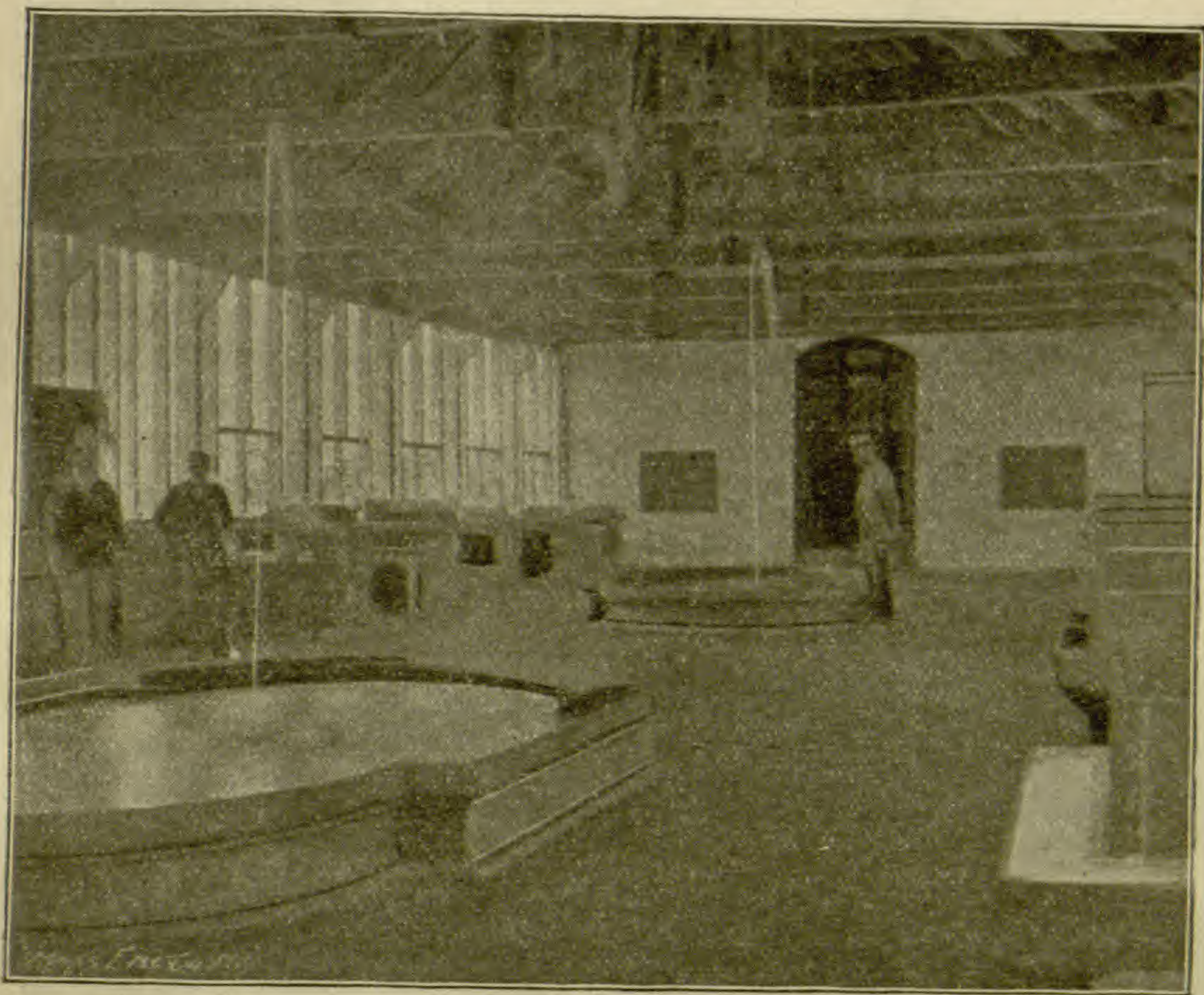
The extended sea-coast has ever been of the greatest aid to the French student—along the entire northern coast the channel is not unlike our Bay of Fundy in the way it sweeps the waters out at the lunar tides. The rocks on the coast of Brittany, massive bowlders, swept and rounded by the rushing waters, will at these times become exposed to a depth as great as 40 feet. This is the harvest-time of the collector; he is enabled to secure the animals of the deep with his own hand, to take them carefully from the rocky crevices where they would ever have avoided the collecting dredge. From earliest times this region has been the field of the naturalist. It was here that Cuvier, during the Reign of Terror, made his studies on marine invertebrates which were to precede his *Règne Animal.* The extreme westernmost promontories of Brittany have, for the last half century, been the summer homes of de Quatrefages, Coste, Audouin, Milne-Edwards and de Lacaze-Duthiers. Coste created a laboratory at Concarneau, but this has come to be devoted to practical fish culture, and is, at the present day, of little scientific interest. It is owing to the exertions of Professor de Lacaze-Duthiers of the Sorbonne, that the two governmental stations of biology have since been founded. The first was established at Roscoff, in one of the most attractive and favorable collecting regions in Brittany, and has continued to grow in importance for the last twenty years. As this station, however, could be serviceable during summer only, it gave rise to a smaller dependency of the Sorbonne in the southernmost part of France, on the Mediterranean, at Banyuls, which had the additional advantage of a Mediterranean fauna.

To these French stations should be added that of Professor Giard, at Wimereaux near Boulogne, in the rich collecting funnel of the Straits of Dover; that of Professor Sabatier at Cette, not far from Banyuls, a dependency of the University of Montpelier; that of Marseilles and the Russian station at Ville-Franche, near the Italian frontier. An interesting station in addition, is that at Arcachon near Bordeaux, founded by a local scientific society, and having at its command the collecting resources of a small inland sea, famous for its oyster culture. Smaller stations are not wanting, as at the Sables d'Olonne.

At Roscoff the laboratory building looks directly out upon the channel. In its main room on the ground floor, work places are partitioned off for a dozen investigators; this on the one hand leads to a large glass-walled aquarium room, seen in

FRENCH MARINE STATION AT ROSCOFF, BRITTANY.
(From photograph by author, July, 1891.)

the accompanying figure, while on the other opens directly to adjoining buildings which include lodging quarters, a well-furnished library and a laboratory for elementary students. Surrounding the building is an attractive garden which gives one anything but a just idea of the barrenness of the soil of Brittany. From the sea wall of the laboratory one looks out over the rocks that are becoming exposed by the receding tide. A strong enclosure of masonry serves as a *vivier* to be used for experiments as well as to retain water for supplying the laboratory. The students are, in the main, those of the Sorbonne, and are under the direction of Dr. Prouho, their *maitre de conférences.* They are given every opportunity to take part in the collecting excursions, frequently made in the laboratory's



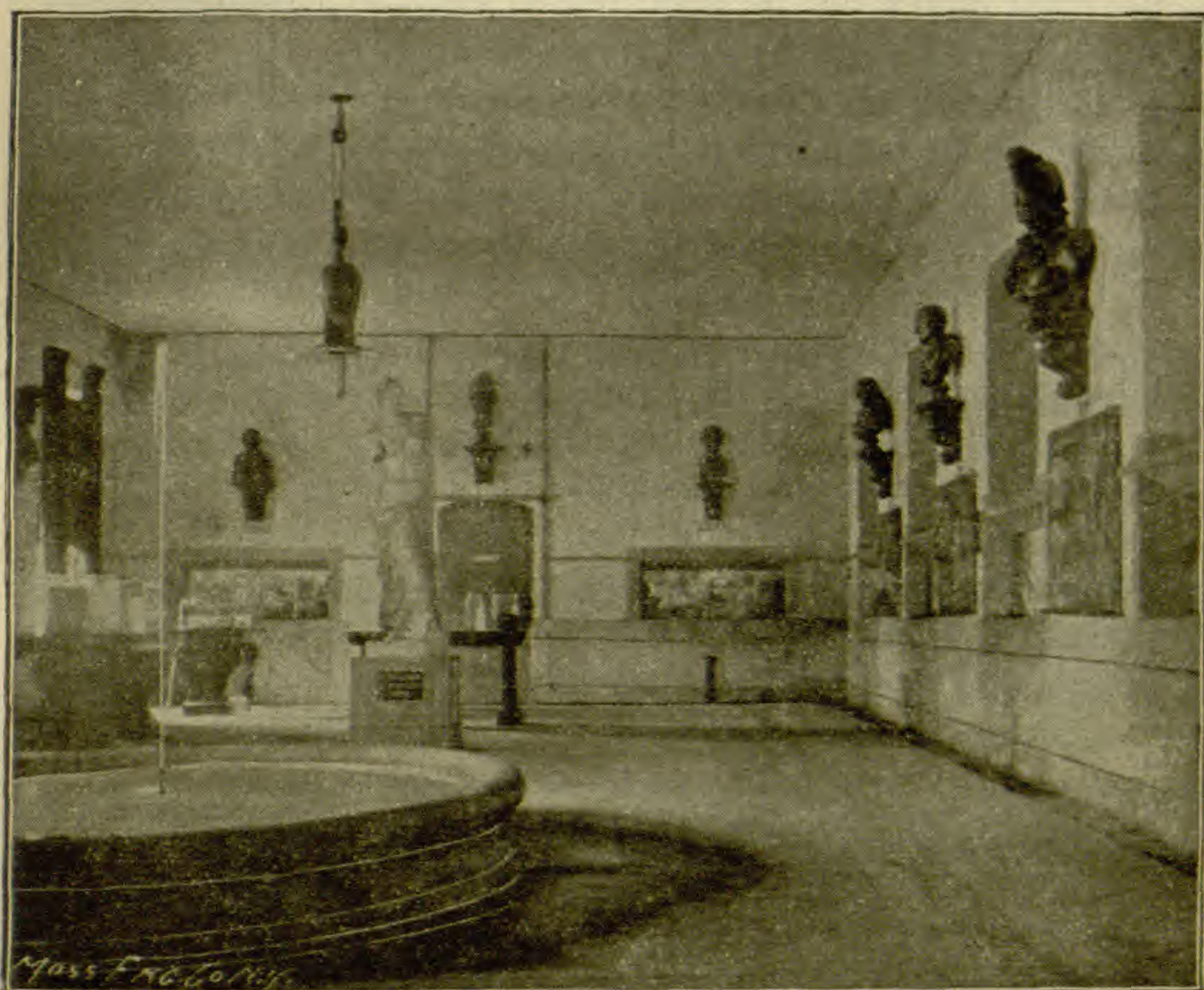
ROSCOFF. INTERIOR OF AQUARIUM ROOM.
(July, 1891.)

small sailing vessels, among the rocky islands of the neighboring coast. Strangers, too, are not infrequent and are generously granted every privilege of the French student. Liberality is one of the characteristic features of Roscoff. The stranger who writes to Professor de Lacaze-Duthiers is accorded a work place which entitles him gratuitously to every privilege of the laboratory—his microscope, his reagents, even his lodging-room should a place be vacant. It seems, in fact, to be a point of pride with Professor Lacaze that the stranger shall be welcomed to Roscoff, and upon entering the laboratory for the first time, feel as much at home as if he had been there a week. He finds his table in order, his microscope awaiting him, and the material for which he had written displayed in stately array in the glass jars and dishes of his work place. So, too, he may have been assigned one of the large aquaria in the glass aquarium room—massive stone-base stands, aërated by a constant jet of sea water.

He finds a surprising wealth of material at Roscoff, and his wants are plentifully and promptly supplied.

FRENCH MARINE STATION AT BANYULS-SUR-MER.
(Oct., 1891.)

At Banyuls, the second station of the Sorbonne, the buildings are less imposing than those of Roscoff. It is a plain, three story building facing the north, at the edge of the promontory which shelters the harbor of Banyuls. The vivier is in front of the station, behind is a reservoir cut in the solid rock—receiving the water of the Mediterranean and distributing it throughout the building. On the first floor is a large aquarium room lighted by electricity, well-supplied with tanks and decorated not a little with statuary donated by the Administration of the Beaux-Arts. The bust of Arago occupies an



BANYULS-SUR-MER. INTERIOR OF AQUARIUM ROOM.
(Oct., 1891.)

important place, as the laboratory has been named in his honor. The suit of a diver, as may be seen in the adjoining figure, indicates at a glance the different tactics in collecting required by the slightly falling tides of the Mediterranean. The wealth of living forms in the aquaria shows at once by variety of bright colors the richness of southern fauna. Sea lillies are in profusion, and are gathered at the very steps of the laboratory. The work-rooms of the students are on the second floor, equipped in a manner similar to those of Roscoff. The director of this station is Dr. Fréderic Guitel. It is usual during the holidays at fall or winter, for the entire classes of the Sorbonne to spend several days in collecting trips in the neighborhood. The region, with its little port, is famous for its fisheries, and one in especial is that of the Angler, *Lophius*, a fish that would not be regarded as especially dainty on our side of the Atlantic.

The station on the Straits of Dover, at Wimereaux, has earned a European reputation in the work of Professor Giard. It is but a small frame building, scarcely large enough to include the advanced students selected from the Sorbonne. The laboratory is, in a way, a rival of Roscoff, and it is noteworthy that its workers seem to make a point of studying the laboratory methods of the German universities.

The marine laboratory of Arcachon, one of the oldest of France, was built in 1867 by the local scientific society, and was carried on independently until the time of the losses of the Franco-Prussian War. Its management was then fused with that of the faculty of medicine of Bordeaux, with whose assistance, aided by that of a small subsidy from the government, the work of the institution is carried on. Arcachon, in itself, is a most interesting locality near Bordeaux. It has become a summering place, noted for its pine lands and the broad, sandy *plage*, picturesque in summer with swarms of quaintly dressed children, the local head-dress of the peasant mingling with the latest toilets from Paris. Here and there is to be seen that accompaniment of every French watering place, the goat boy in smock and berret, fluting to his dozen charges who walk in a stately way before him. The Bay of Arcachon is a small, tranquil, inland sea, long known for its rich fauna. In large part it is laid out in oyster parks which constitute to no small degree the source of wealth of the entire region. Shallow and warm waters seem to give the marine life the best conditions for growth and development. The laboratory is placed just at the margin of the water. It includes a dozen or more work places for investigators, well supplied with aquaria, a library on the second floor, a small museum containing collections of local fauna, including numerous relics of Cetaceans that have found their way into this inland sea. A small aquarium room, opened to the public, is well provided with local forms of fishes, and like that of Naples, is eagerly visited. Those who are entitled freely to the use of the work places are instructors in French colleges, members of the Society, and all the advanced students from the colleges of the State. For other students, work place is given upon the payment of a fee whose amount is regulated each year by the trustees. As at Roscoff, material is plentifully supplied.

The Zoological Station at Cette is a direct annex of the University of Montpelier, and it has been gladly learned that the present temporary building is to be replaced by one of stone, which will enable Professor Sabatier to add in no little way to the working facilities of his students. The region, in every essential regard, is similar to that of Banyuls.

The station at Marseilles is devoted in great part to questions relating to the Mediterranean fisheries, and owes, in a measure, its financial support to this practical work.

The station at Ville Franche is essentially Russian. An account of this with figures has recently been published (Russian text) in Cracow. The station itself is well known through the work of Dr. Bolles Lee, and it is here that Professor Carl Vogt has been a constant visitor.

II.—England.

The laboratory at Plymouth is quite a recent one, first opened in 1888 with a building which is, in many regards, hardly second to Naples. This locality was found well suited for the needs of an extensive marine station. Opposite Brittany it takes advantage of the same extremes of tide, and the rocky Devonshire coast affords one of the richest collecting grounds. The situation of the building is a remarkable one; it stands at one end of the famous Hoe of Plymouth—a broad, level park whose high situation looks far off over the channel. At the rear of the building are the old fortifications of the town. As shown in the adjoining figure, the building is, at the ends, three storied. On the ground floor is the general aquarium room, well-supplied with local marine fauna, and open to the public. The laboratory proper is upon the second floor, divided into eleven compartments, the work places of the students. A series of small tanks passes down the middle of the room. In the western end are the library,

BRITISH MARINE LABORATORY, PLYMOUTH.
(August, 1892.)

the museum, the chemical, photographic and physiological rooms. In the eastern are the living quarters of the director. The water supply of the laboratory is contained in two small reservoirs directly between the building and the fortifications. Each reservoir contains 50,000 gallons, and the water supply is carried throughout the building by gas engines. Tidal aquaria are in constant use for developmental studies of marine fishes. The collecting for the laboratory is aided by a 38-foot steam launch.

The present support of the station is not, unfortunately, as generous a one as might be desired. The station is obliged to consider in the work of its director matters relating to public fisheries and is only enabled by this means to secure governmental assistance. The building itself was constructed by the efforts of the Marine Biological Association of the United Kingdom, under whose auspices the present work is being carried on. The efficiency of the laboratory is in no little way hampered in its purely scientifie work. The investigators' tables are occupied by any founder of the Association, or his representative, by the naturalist or institutions who have rented them. The subscription price per year of an investigator's place is 40 pounds, but tables may be leased for as short a time as a month. The laboratory provides material for investigation and the ordinary apparatus of the marine laboratory, excluding microscopes and accessories. The use of the larger tanks of the main aquarium is also permitted to the working student. The work of the laboratory includes investigation of fishery matters, the preservation of animals to supply the classes of zoology in the universities and the formation of type collections of the British marine fauna. The naturalist of this station has been, for a number of years, Mr. J. T. Cunningham, whose experiments upon the hatching of the Sole have here been carried on.

Other British marine stations are those of Liverpool and St. Andrews, north-east of Edinburgh. The work of these stations is only in part purely biological; the practical matters of fisheries must be considered to insure financial support. In addition to these there are several stations, notably one south-east of Edinburgh, and another, recently equipped, on the Isle of Man.

At St. Andrews, Professor MacIntosh has studied the questions relating to the hatching and development of the North Sea fishes. Its situation upon the promontory leading into the Firth of Forth seems to have been especially favorable for the study of the North Sea fauna—the locality, moreover, is far enough northward to include a number of boreal forms. The importance of St. Andrews is at length better recognized, and a substantial grant from the government will enable a large and permanent marine station to be here constructed. The facilities for work have, up to the present time, been

DUTCH ZOOLOGICAL STATION AT THE HELDER.
(Fig. from Tijdschr. d. Ned. Dierk. Vereen, 5 Juli, 1890.)

somewhat primitive—a simple wooden building single storied, has been partitioned off into small rooms, a general laboratory, with work places for half a dozen investigators, a director's room, aquarium and a small out-lying engine house with storage tanks. The laboratory owns a small sail-boat to assist in the work of collecting.

HOLLAND.

Holland, in the summer of 1890, opened its zoological station in the Helder, a locality which, for this purpose, had long been looked upon with the greatest favor. There is here an old town at the mouth of Zuyder Zee, the naval stronghold of Holland, a station favorable for biological work on account of the rapid running current which renews the waters of the Zee. The station was founded by the support of the Zoological Society of the Netherlands, whose valuable work by the contributions of Hubrecht, Hoek and Horst, has long been known in connection with the development of the oyster industry of Holland. The work of the Society had formerly been carried on by means of a portable zoological station which the investigators caused to be transplanted to different points along the East Schelde, favorable on account of their nearness to the supplies of spawning oysters. The present station at the Helder is situated directly adjoining the great Dyke, a small stone building illustrated in the adjacent figure, two stories, surrounded by a small park. In itself the laboratory is a model one—the rooms are carefully finished and every arrangement has been made to secure working conveniences. A large vestibule leads directly into two laboratory rooms, and by a hallway communicates with the large, well-lighted library, and the rooms of the director. The aquarium room has, for convenience, been placed in a small adjacent building. The director of this station is Professor Hoek, and the President of the Society is Professor Hubrecht. Among others present at the opening of the building may be mentioned, van Bemmelen, Weber, Vosmaer, van Rees, Heinsius, Oudemans and Horst.

EVOLUTION AND DICHROMATISM IN THE GENUS MEGASCOPS.

By E. M. Hasbrouck.

(*Continued from page* 533, *Vol. XXVII.*)

The accompanying tables show the colors of the young produced by parents of known character as to plumage.[1] It will be readily seen that red birds breed either all red, all gray, or both; that reds and grays breed either all red, all gray, or both; while gray birds, as previously stated, invariably breed true.[2] Now to one at all familiar with the theory of reversion to ancestral characters, the perfect harmony between the two theories is self-evident. Take now, the pigeons, which are descended from a parent of bluish color, with certain bars and other markings, and when any breed assumes by simple variation a bluish tint, these bars and other marks invariably reappear; call the two color phases of the common screech-owl species; call the various breeds of pigeons, some of which have bred true for centuries, species; compare these and how exactly parallel are the two cases.

Lastly: the widely accepted theory of the transmission of acquired characters comes to my assistance. Take, for example, the great similarity at certain periods between the plumages of the various ducks, which would indicate that the common ancestor of the duck family was of a dusky color, or, better still, an example of to-day. The young of the genus *Merula* has the breast spotted as in the genus *Turdus*, while that of the adult is plain. Now, one of the grounds upon which this genus is based is, that were the adults spotted, instead of belonging to the genus *Merula*, they would belong

[1] The question mark in the third column signifies that the number of young were not given.

[2] Considerable uncertainty was manifested by some contributors as to what constituted a young, gray bird, they giving the gray down as such, and, while great care has been taken to avoid all such data, it may be well to call attention to possible error.

Table Showing Color of Young Produced by Gray Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Owego, N. Y.	?	All gray.	J. Alden Loring.
2	Hamilton, Ohio.	?	All gray.	Geo. Harbron.
3	Salineville, Ohio.	4	All gray.	Wm. A. Savage.
4	Sioux City, Ia.	?	All gray.	Dr. Guy C. Rich.
5	Providence, R. I.	5	All gray.	Chas. E. Doe.
6	Racine, Wis.	3	All gray.	Dr. P. R. Hoy.

Table Showing Color of Young Produced by Red Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Portland, Conn.	5	Red, 3; Gray, 2.	Jno. H. Sage.
2	Lockport, N. Y.	1	All red.	J. L. Davidson.
3	Oakdale, N. C.	?	All red.	Robt. J. Thompson.
4	Odin, Ill.	?	All red.	C. B. Vandycook.
5	Rockford, Ill.	6	Red, 4; Gray, 2.	J. E. Dickenson.
6	Hamilton, O.	?	All red.	Geo. Harbron.
7	Grinnell, Iowa.	?	All gray.	Lynds Jones.
8	Grinnell, Iowa.	?	All gray.	Lynds Jones.
9	Argentine, Kansas.	3	Red, 2; Gray, 1.	Geo. E. Stilwell.
10	Bell, Ky.	6	"Part red, Part gray."	Carrington C. Bacon.
11	Providence, R. I.	2	Red, 1; Gray, 1.	H. A. Cash.
12	Beaufort, S. C.	?	Gray, 2; Rest red.	Walter Hoxie.
13	Beaufort, S. C.	?	Red, 1; Rest gray.	Walter Hoxie.
14	Washington, D. C.	3	All red.	C. W. Richmond.
15	Cambridge, Mass.	3	All red.	Wm. Brewster.
16	Madison, Wis.	4	All red.	Chas. F. Carr.
17	Racine, Wis.	4	All red.	Dr. P. R. Hoy.
18	Jefferson, Wis.	5	Red, 3; Gray, 1; Intermediate, 1.	Ludwig Kumlien.
19	Charlestown, W. Va.	5	Red, 4; Gray, 1.	B. W. Mitchell.

Table Showing Color of Young of Gray and Red Parents.

NO.	LOCALITY.	NUMBER OF YOUNG.	COLOR.	AUTHORITY.
1	Astoria, L. I.	4	All red.	Franklin Bennet.
2	Toronto, Canada.	5	Red, 2; Gray, 3.	James R. Thurston.
3	Argentine, Kansas.	3	Red, 2; Gray, 1.	G. E. Stilwell.
4	Argentine, Kansas.	2	Both red.	G. E. Stilwell.
5	Manhattan, Kansas.	3	All red.	D. E. Lantz.
6	Versailles, Ky.	?	All gray.	L. O. Pindar.
7	Attleborough, Mass.	4	All gray.	H. A. Cash.
8	Cambridge, Mass.	4	All red.	Wm. Brewster.
9	Giddings, Texas.	?	All gray (*mccallii ?*).	J. A. Singley.
10	Strafford, Vt.	?	Red, 2; Remainder gray.	Chas. P. Collins.
11	Fayette, Mo.	4	Gray, 2 (2 died).	J. W. Kilpatrick.
12	Jefferson, Mo.	4	Red, 2; Gray, 2.	Ludwig Kumlein.

to *Turdus;* it being claimed that *Merula* has been evolved from and is one plain above *Turdus,* and that the spotted breast of the young robin is a transitory inheritance of the acquired markings of the rest of the thrush family. If this be so, then, as all screech-owls are gray in the down, from which those destined to be red, *afterwards* acquire their plumage at the first moult; does it not follow that the aboriginal bird was gray, whose prominent and characteristic markings are reproduced in every brood of young? While on the other hand, if the down of young birds were *red,* from which the gray birds appeared after the moult, the whole theory would be overturned, but it is hardly necessary to state that this is not the case; and the fact that gray birds are extremely rare in some regions, and wholly wanting in others, seems conclusive proof that the gray form is gradually becoming extinct over certain areas.

He who believes that each variety of pigeon known to fanciers has been independently created, and that the various color phases exhibited by individuals of the same species are without meaning and without purpose, will probably assert that each species has been created with a tendency to vary both under nature and under domestication, each in its own particular manner, so as often to become marked like other species of the same genus, and that a species has been created with a strong tendency to produce young not the color of their parents, but other forms closely connected. To admit this view seems, as Darwin aptly says, "To reject a real for an unreal, or at least for an unknown cause. It makes the works of God a mere mockery and deception," and "I would almost as soon believe with the old and ignorant cosmogonists that fossil shells had never lived, but had been created in stone so as to mock the shells living on the seashore." While, on the the other hand, both geology and palæontology plainly proclaim that old forms have been supplanted by new and improved forms of life, the product of "variation" and the survival of the fittest.

Part II.

CAUSES AND INFLUENCES.

The close relationship existing between various branches of science, is, perhaps, nowhere more clearly shown than in the present field of research. Four distinct causes have been found appearing to influence the condition of the screech owls, each of which has an evident bearing upon the other, and the whole forms such a chain of evidence that its truth can hardly fail to be apparent.

These causes or influences are—

1. Humidity.
2. Temperature.
3. Acquired characters.
4. Forest areas.

These will be treated separately under their respective headings and in the order given, while a careful examination of the maps will show their bearing upon the distribution of the color phases of the screech-owl.

A.—Influence of Humidity.

It has been conclusively shown by Allen[3] that humidity is one of the main influences governing the local variations of color in individuals of the same species, and that the distribution of the light colored races is strictly coincident with the regions of mean minimum rainfall, while the dark forms are confined mainly to regions of meăn maximum rainfall. Naturally enough, its effect is greatest during the breeding season, and with the present species the months of March, April, May and June may be considered as the period during which the young would be most under its influence; accordingly, map 3 has been constructed upon the mean of the data for these four months.

The shaded area designates that region where the mean humidity is 70 and over, while localities having less are unshaded. Now it will be seen that to a very great extent the grays are confined to those areas where the humidity is the

[3] Bull. Mus. Comp. Zool. II, 1871, 240–241.

greatest, while on the other hand the reds are distributed over the less favored parts of the country. Along the Atlantic and Gulf coasts, this humid belt corresponds very closely with the pine belt on map No. 5 (although narrower on the Atlantic slope). Here the distribution of the color phases fails to correspond with either the pine or the humid belt, although it does so perfectly with the temperature zones (see map No. 4), while in the northern part of the United States and in Canada the similarity is very great. Unfortunately, no data exist for the little strip extending down the Alleghanies, but as mountanious regions are, as a rule, exceedingly humid, particularly when heavily wooded, there is little doubt but that when data is collected for this region, it will show a narrow strip reaching from New York State to the neighborhood of eastern Kentucky, when the similarity between color distribution, humidity, temperature and forest areas will be nearly complete.

The whole subject of dichromatism as regards *Megascops*, may be considered a special case of the general subject of darker colored species inhabiting humid areas. The red form can be assumed to be a more highly colored form of the gray, and the same is true of *Megascops* as a whole in which the various subspecies—*floridanus*, *mccallii*, *kennicottii*, *bendirei*, *maxwelliæ* and *trichopsis*—are representative of the dark and light forms respectively of the humid and arid regions, and in *Megascops asio* proper, the gray may be taken as the form inhabiting humid areas, while the red phase represents the lighter colored forms of the drier region.

B.—Influence of Temperature.

According to Verrill and Allen,[4] the most potent of all influences in the distribution of color is temperature, which, in the case of birds, is greatest during the breeding season, and as in the case of humidity, map No. 4 is based upon the data for the months previously mentioned. Now, by reference to map No. 4, it will be seen that there are three belts or zones of temperature corresponding to the distribution of the red and gray phases of the screech-owl—the one reaching from Charleston, S. C., to

[4] N. A. Fauna, No. 3, p. 26.

central Texas having a mean temperature of 65° Fahrenheit and upward for the months mentioned; another on the north, extending from New Brunswick to Central Dakota, 45° Fahrenheit and *less*, marking the distribution of the gray form, while the intermediate territory lying between the isotherms of 45° and 65° covers nearly the entire area inhabited by the reds. Just *how* this influence is exerted it is, of course, impossible to say, but that there is an apparent relation is evident from a comparison of maps 2 and 4, while maps 2, 3, 4 and 5 show that on the northern and southern borders all influences combine to produce the existing conditions.

In comparing the northern belt, where a *minimum* degree of temperature exists coincident with the gray phase with the southern, where a *maximum* degree is found also coincident with the same phase, the question arises—Why, in one portion of the country, is a low temperature and in another a higher temperature conducive to a given phase? and the problem is a knotty one. Future investigations may show that some cause or causes, still unknown, exist along the Atlantic coast, but the probabilities are that humidity is the dominant factor in the subject under discussion.

C.—Influence of Acquired Characters.

In attempting to ascertain the causes influencing the condition of *Megascops*, one of the foremost things to be considered is the peculiar distribution of sex as regards color. Leaving the intermediates out of the discussion, as being an evident attempt on the part of nature to fashion a form midway between the two color phases, it will be best to consider only the gray and red.

Out of the total of 3600 birds which furnished data for this paper, 646, scattered over the entire territory, show the following relation of color to sex. It will be seen that the number of gray males far outnumber the red males, while the number of red females outnumber the gray females four to one. This is scarcely a fair average for the whole, as it must be borne in mind that the numbers cover *all* of the territory inhabited by the three forms—*asio, floridanus* and *mccallii*—and conse-

Table Showing Relation of Color to Sex.

(Based on 646 birds scattered over entire area.)

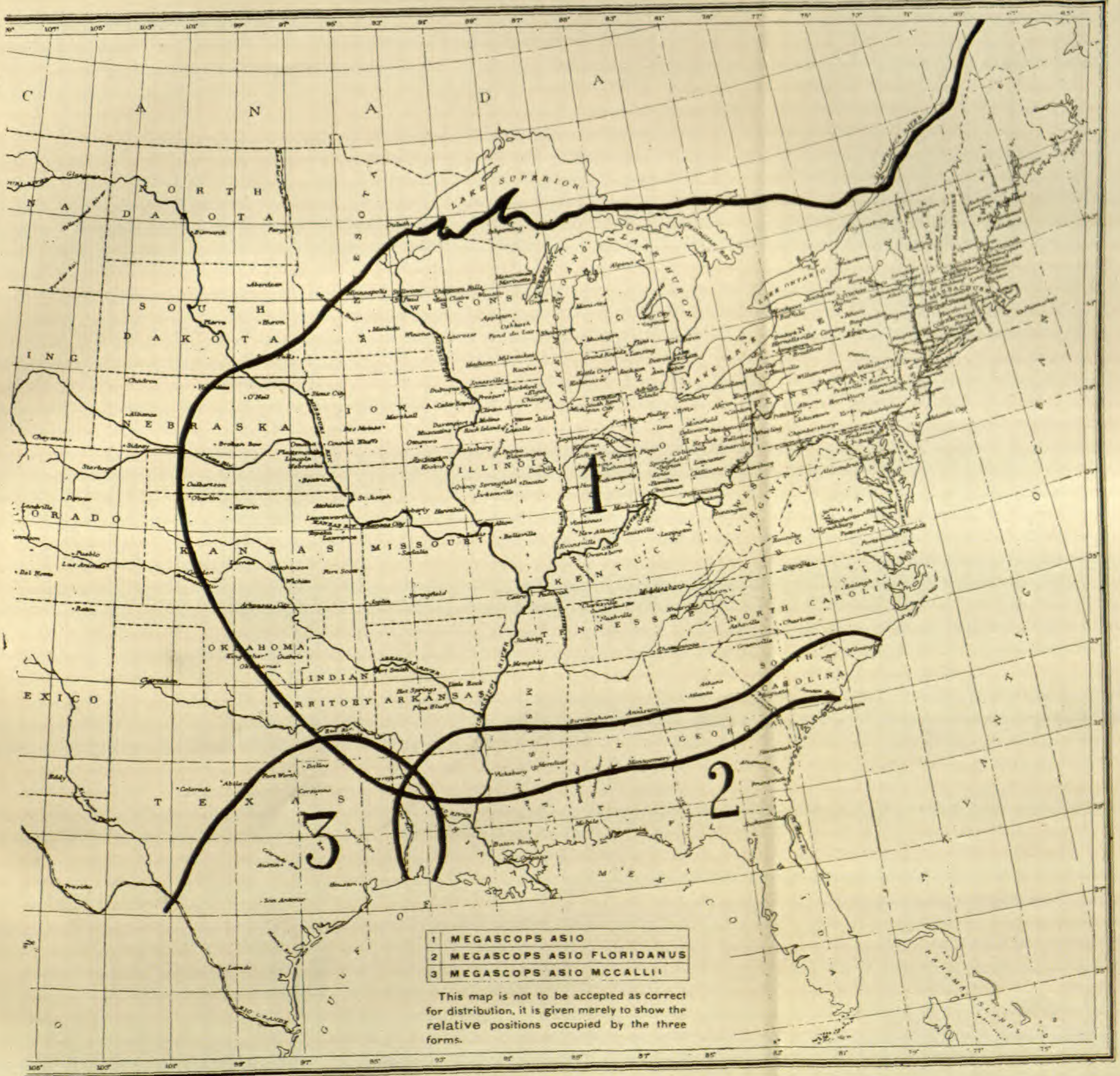
Gray.		Red.	
Male.	Female.	Male.	Female.
183	73	93	297

quently include the figures from those localities where the red and gray respectively are the only forms known. Now it will be seen that the red birds are much more numerous than the grays—the total number being 390 as against 256 of the gray, and if the influence of the exclusive red and gray regions on this average be considered, the proportion for the mixed areas will be somewhat increased. As a consequence, in that region shown on map 2, where red and gray birds are intermingled, with red in the majority, the reason is at once apparent why red and gray birds, or two red birds, are so often found mated, and so seldom a pair of grays.

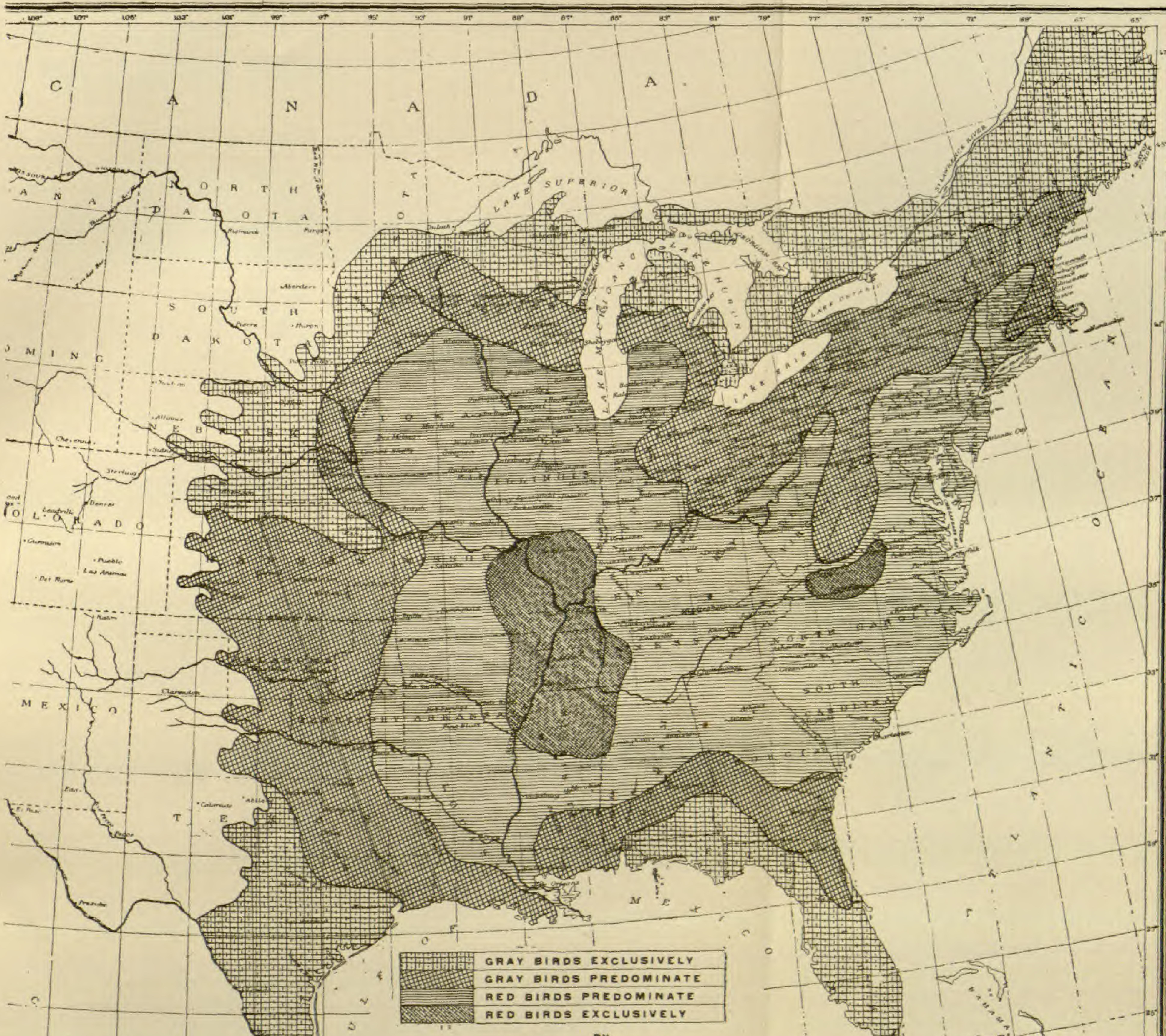
Granting now that the red birds are most numerous, does it not follow that the fewer the grays in any given region, and therefore the farther removed each generation of red birds from the parent stock, *in just such ratio will the tendency to revert to ancestral characters decrease?* It has been shown by Darwin[5] that in the struggle for existence, only those forms survive that are best fitted for the existing conditions of life to which they may be exposed, and, as a result, forms unfitted leave few progeny, and eventually become extinct. It will be shown farther on why the gray form is not fitted for those regions in which the red is now so greatly in the majority; accordingly, it becomes evident that where the red males and females already so greatly outnumber the gray, it requires but an indefinite lapse of time for .the existence of the latter form to be forever terminated in certain sections.

[5] Origin of Species, 69.

MAP I.

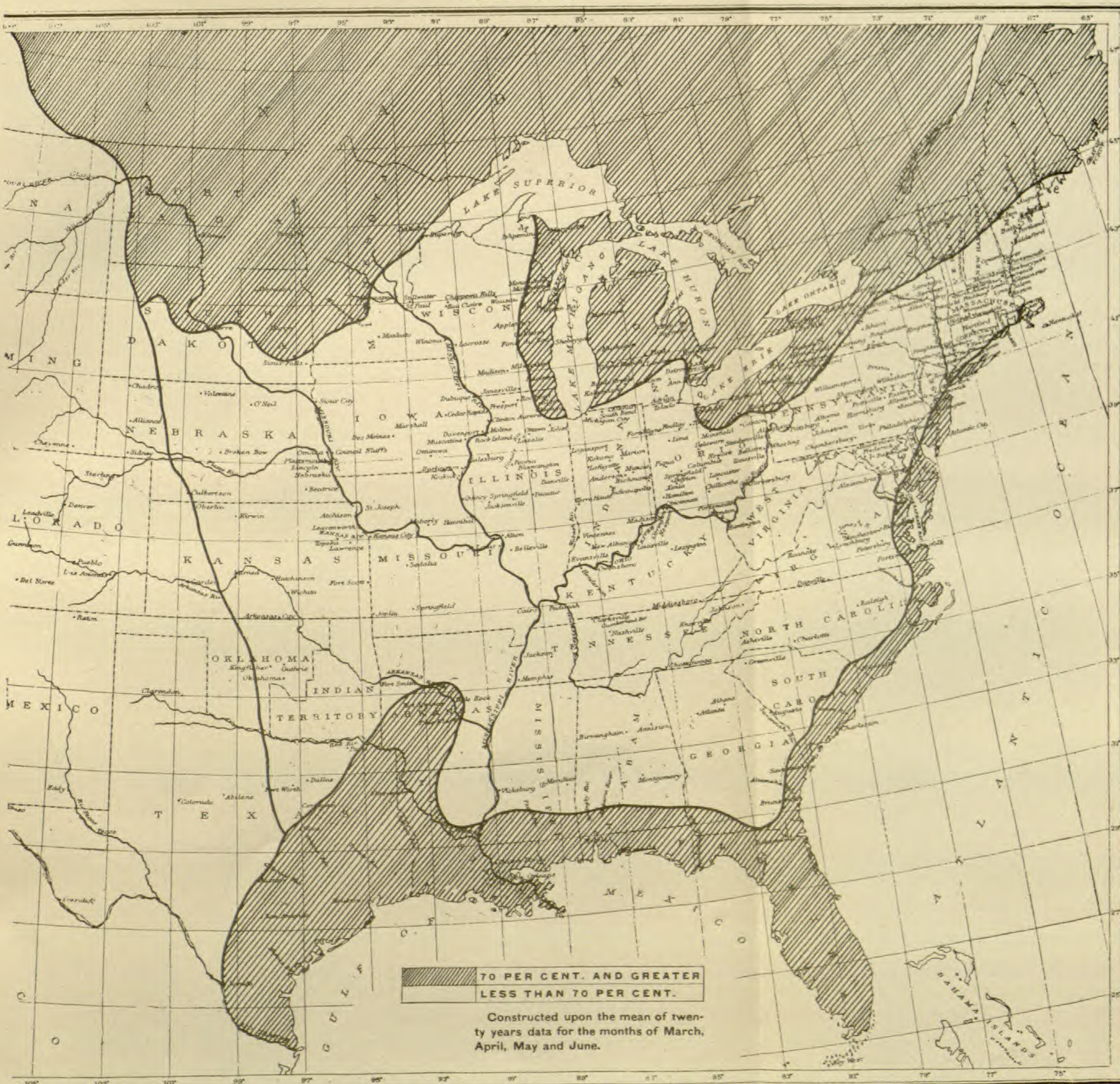

1 MEGASCOPS ASIO
2 MEGASCOPS ASIO FLORIDANUS
3 MEGASCOPS ASIO MCCALLII
This map is not to be accepted as correct for distribution, it is given merely to show the relative positions occupied by the three forms.
1
2
3

MAP II.



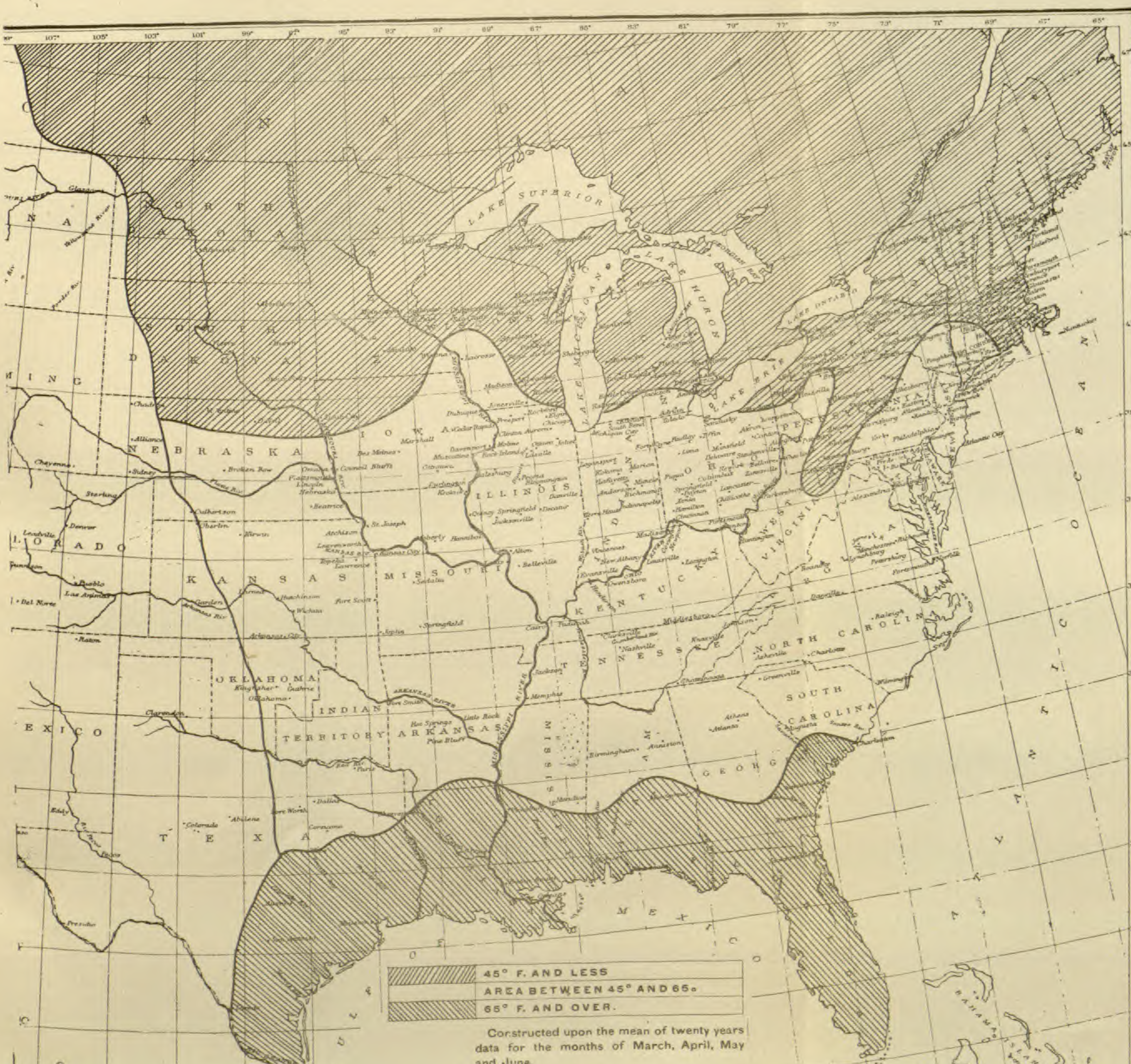
CANADA
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
COLORADO
ILLINOIS
NORTH CAROLINA
SOUTH CAROLINA
GRAY BIRDS EXCLUSIVELY
GRAY BIRDS PREDOMINATE
RED BIRDS PREDOMINATE
RED BIRDS EXCLUSIVELY
BY
E. M. HASBROUCK

MAP III.



70 PER CENT. AND GREATER
LESS THAN 70 PER CENT.
Constructed upon the mean of twenty years data for the months of March, April, May and June.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
NEBRASKA
KANSAS
IOWA
MISSOURI
ILLINOIS
KENTUCKY
TENNESSEE
GEORGIA
TEXAS
MEXICO
INDIAN TERRITORY
OKLAHOMA

MAP IV.


45° F. AND LESS
AREA BETWEEN 45° AND 65°
65° F. AND OVER.
Constructed upon the mean of twenty years data for the months of March, April, May and June.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO
NEBRASKA
KANSAS
MISSOURI
ILLINOIS
IOWA
KENTUCKY
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
OKLAHOMA
INDIAN TERRITORY
ARKANSAS
TEXAS

MAP V.

Reproduced from IX Vol. X Census.

D.—Influence of Forest Areas.

In speaking of the two color phases, the terms "reds" and "grays" have been used, and when applied in their broadest sense, refer to the predominating colors, and consequently to those areas in which either color is in the majority. On map No. 2, the light and dark areas represent respectively the territory in which the red and gray phases predominate. Map No. 5 shows the predominating distribution of the two great divisions of our forest trees—deciduous and coniferous—the lighter shade indicating the region where the conifers are in the majority, and the darker the deciduous. Now, by a comparison of the two, it will be seen that the distribution of the color phases of the screech-owl coincides, to a large extent, with the distribution of the coniferous and deciduous forests. This similarity of distributions between fauna and flora was so striking, that to ascertain whether or not there was any real connection between the two, a similar state of affairs was looked for, and found in the case of the tawny owl (*Strix aluco*) of Europe. This bird furnishes a somewhat parallel case to that of *Megascops*, as in England, where it is stated that the forests are largely deciduous—Yarrell writes[6] that red is the predominating color, while in Scotland, coniferous as a whole, Mr. John A. Harvie-Brown informs me that the reverse is the case.[7] Coniferous forests in the eastern part of the United States have a grayish cast, and the point to be brought forward is that where the general aspect of the forest growth is gray, gray birds are found. As an instance, in the South where the forests are largely bald cypress (*Taxodium distichum*), and covered with a profusion of Spanish moss, the whole country is decidedly gray, and here the gray birds are almost the exclusive form known.

[6] History of British Birds, 4th Ed., I, 153.

[7] On the Continent, in Europe, it appears to be a pretty-well established fact that the red birds are females, and the grays males, which is a remarkable state of affairs when compared with existing conditions on the British Isles.

With the screech-owl, of 55 pairs known to have been actually mated, 39 males and 28 females were red, while 27 males and 24 females were gray, showing that *Megascops* is in no way approaching the condition of *Strix*.

There are at least three places on the map where this similarity of distribution is wanting, as, for example, the deciduous region extending from central New York southwestward through Ohio and northern Indiana, where gray birds predominate, also the territory along the Atlantic coast most decidedly coniferous where red birds are found, and the western boundary of the species from north to south, where little or no timber occurs, and when found is mostly deciduous, and where gray is the predominating color. With these exceptions the similarity is remarkable, while the discrepancies are in a measure compensated for by the hygrometric conditions existing in the localities mentioned.

Conclusions.

From the foregoing it is evident that the red phase is confined mainly to *Megascops asio* (I am speaking of it as a whole), which, on its northern border, merges into the gray phase; that the southern gray belt incompasses *floridanus*, while in eastern Texas the few red specimens of *mccallii* that are known have been taken from the extreme north-eastern portion of its range, which is influenced both by humidity and temperature (see maps). Again this distribution of color corresponds very closely to the life areas—the gray phase of the Florida form in the South occupying a major portion of the Austroriparian; the red phase of *asio* proper conforming very closely to even the outlines of the Carolinian, while the gray phase is equally identical with the Alleghanian.

It is worthy of note that the gray phase of *Megascops asio* is boreal in its affinities, and that where a gray phase of *asio* is found that is not boreal, it is recognized as a subspecies.

Now if *floridanus* (gray) is separable from *asio* just north of it (red), it seems highly probable that *asio* (red) will some day be separated from the gray phase on the north. It has been shown that as regards the two phases of *asio*, certain areas are inhabited exclusively by reds, certain ones exclusively by grays, while still others are inhabited by a mixture of the two, and that three forms (*floridanus* and two color phases of asio proper) inhabit, as a whole, entirely distinct areas. No one will deny that all of the forms of *Megascops* are descended from a common ancestor, and if through climatic or environmental conditions they have become subspecifically differentiated in various localities, I see no reason to doubt that in like manner under the influence of humidity, temperature, acquired character and forest area, which will be felt for countless generations to come, that the species now known as *Megascops asio* will one day be separated into species and subspecies—the former represented by the original gray, and the latter by the more modern red.

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WARD, H. B.—On *Nectonema agile* Verrill. Extr. Bull. Harvard Mus. Comp. Zool., Vol. XXIII, 1892. From the author.

WHITE, D.—A New Taeniopteroid Fern and its Allies. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

WHITTLE, C. L.—Some Dynamic and Metasomatic Phenomena in the Metamorphic Conglomerate in the Green Mountains. Extr. Bull. Geol. Soc. Am., Vol. IV, 1893. From the Society.

WRIGHT, G. F.—Reply to Professor Chamberlain's Criticism on Extra-Morainic Drift in the Susquehanna, Lehigh and Delaware Valleys.

Wright, H.—Report on Native Birds of Hauturn Island, New Zealand.

RECENT LITERATURE.

A Popular Botany.[1]—This pretty book professes to enable one who has never studied botany to have a "bowing acquaintance" with the common wild flowers, certainly a most laudable undertaking. The author appears to have fallen largely under the baleful influence of the old-fashioned teachers of botany, characterized not inaptly by the line she quotes from Emerson—

"And all their botany is Latin names"

which may account for the impression she has that a scientific arrangement or even a "key" must be repellant to the amateur, or "bristling with technical terms and outlandish titles." This book is an honest effort to bring some knowledge of plants nearer to the non-botanical man and woman who may have a natural love of the flowers of the wayside and fields.

At the opening of the book are a few pages devoted to the explanation of terms, in which we find what is so common in popular works—that many of the definitions do not define. There is a woful mixing up of physiological with structural definitions, which must prove as troublesome to the amateur who has a horror of technical terms which "bristle," or of titles which are "outlandish." How much help will the reader get from this definition?—"The Stamens are the fertilizing organs of the flower." Some of the definitions are good enough, and will, perhaps, serve their purpose.

The "Flower Descriptions" are grouped under six heads, viz.: White, Yellow, Pink, Red, Blue and Purple, Miscellaneous. This part is pretty well done, and includes descriptions and many good illustrations of the more striking common flowers of the region within one or two hundred miles of New York City. The provincialism of the book is shown in its title, where the flowers of this limited region are called "*our* common wild flowers," and again on page X, where we find the expression, "this side of Chicago," which makes one ask where is "this side?" The title should be changed so as to restrict the book to the New England and Middle States, in which region it will be a useful book for amateurs. The author should remember that there are "common wild flowers" and multitudes of people who admire them in the South, upon the prairies and plains, in the Rocky Mountains, and in the States of the Pacific Coast. "Our common wild flowers" is an

[1] "How to Know the Wild Flowers." A guide to the names, haunts, and habits of our common wild flowers, by Mrs. William Starr Dana; illustrated by Marion Satterlee; small, 8vo, 298 pp. New York: Charles Scribner's Sons, 1893.

expression with a very different meaning in different parts of the country.—CHARLES E. BESSEY.

Two Text-Books of Physiology.[2]—The State of Indiana has gone into the business of loaning its name as endorsing certain text-books, which are published as the " Indiana State Series." These two books, by Professor Jenkins, now of the Leland Stanford University, belong to the series. Of the advantages and disadvantages of such a course, much might be said; but for this we have no room aside from the remark that in our opinion the disadvantages far outweigh the greatest advantages gained—the publication of the books at reasonable rates, the prices of the two volumes being fixed by law at thirty and sixty cents respectively.

Dr. Jenkins has done his work well in both volumes, the "Advanced" work being the better of the two—the " Primary " being too old in its style for the students for which it is intended. In each work there is a freshness of style and a logical arrangement which please us, and the greatest fault we can find with the work is the insertion of " review questions " which were doubtless demanded by the publishers (we might say parenthetically that Professor Martin's otherwise excellent " Human Body, Briefer Course," is damaged by the same operation.) Especially admirable is the treatment of the use of alcoholic stimulants, narcotics, and the like. There is no lurid description of the drunkard's stomach, no intemperate use of adjectives, but rather a plain, common-sense view of the matter which will be as effective as the more extravagant statements so common in the suppression of intemperance. In short, we regard these books as among the very best for schools of the grammar and high school grades, and can but wish that they might supplant, in other States than Indiana, the trashy works so commonly in use.

Calderwood on Mental Evolution.[3]—This octavo of 350 pages is written with the object of harmonizing the modern doctrine of evolution or physical continuity, with the doctrine of non-continuity of mental evolution, so far as regards man. The author endeavors to show that while the physical structure of man may have been the result of an evolutionary process, his mind presents too great a differ-

[2] O. P. Jenkins. Primary lessons in human physiology. Indianapolis, 1891, pp. 211.
O. P. Jenkins. Advanced lessons in human physiology. Indianapolis, 1891, pp. 318.

[3] Evolution and Man's Place in Nature, by Henry Calderwood, LL.D., Professor of Moral Philosophy in the University of Edinburgh. Macmillan & Co., 1893.

ence from that of any of the lower animals to permit us to believe in its origin by a similar process. He regards mind properly so-called, as restricted to man, asserting that animals possess "sensible discrimination" only, while man possesses "rational discrimination." He thus defines the latter power.[4] "Negatively, intelligence is non-sensible discrimination, a distinguishing of difference to which sensibility is unequal. Positively, intelligence is discrimination of the meaning of sensible impressions." This kind of intelligence Dr. Calderwood denies to the animals below man. Few or no naturalists familiar with animals will concur in restricting Dr. Calderwood's intelligence as here defined, to man. It is certain that a great many, if not the majority, of animal species "discriminate" to varying degrees, "the meaning of sensible impressions. Had the author desired a more certain criterion of difference between the animal and the human mind, it seems to us that he would have found it more surely in the capacity of the production of the concept, though it does not seem certain that this grade of mental action is entirely restricted to man.

The grade of mental activity displayed by animals can not, however, be excluded from the realm of mind. Indeed, when reduced to its lowest terms, mind appears as sense impressions, and it ceases only with the disappearance of consciousness. Such at least is the comprehensive definition which may be set off in contrast with no mind, or the realm of pure physical energy. Of course such a definition is not acceptable to the advocates of the non-continuity of mental evolution.

In accordance with the latter view, Dr. Calderwood does not admit that intelligence is related to physical structure (p. 178), although many convincing proofs to the contrary can be found in the annals of brain pathology. He regards passion and not intelligence as the active guide in animal evolution. He regards instinct (pp. 179–187) as not intelligence in any form. He closes with an eloquent defense of Christianity, as though the doctrine of the continuous evolution of intelligence conflicted with it.

It seems to us that in making comparisons between the minds of men and animals, we learn most by using the lowest types of man. Comparisons between the latter and the highest types of men are also very instructive. If the continuity of mental evolution has been interrupted, some interruptions during human evolution might be found as well as prior to it.

Dr. Calderwood's book is interesting as showing what can be said on the non-evolutionary side of psychology. There is much of interest in it, but we do not find his reasoning conclusive.—C.

[4] P. 151.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Norian Rocks of Canada.—Professor F. D. Adams of McGill College, Canada has published a memoir on the Norian or Upper Laurentian rocks of Canada.[1] This memoir is the result of five seasons' field-work conducted for the Geological Survey of Canada, supplemented by a laboratory investigation of the rocks constituting the Norian series. According to Professor Lawson, two important results of Mr. Adams' work are first, the clear recognition, as plutonic eruptive formations, of rock masses, which, being petrographically and geolographically units, have each an enormous extent. These are the Norian mass, which occupies nearly 1000 square miles; and the Saguenay mass, which is about six times that area. These masses, which may be termed batholites, are characterized by a distinct type of rock known as anorthorite.

The second important result is the immense simplification effected in Archaean geology in the Canadian territory. (Science, May, 1893.)

The Caudal Fin of Ichthyosaurian Reptiles.—In discussing the recent advances in knowledge of the Ichthyosaurian reptiles, Mr. R. Lydekker refers as follows to an important paleontological discovery which confirms Sir Richard Owen's conclusions that the Ichthyosauri possessed a caudal fin.

"From the circumstance that nearly all their skeletons found in the English Lias have a dislocation in the vertebræ of the tail, Sir Richard Owen was led many years ago to the conclusion that the Ichthysaurs were furnished with an expanded fin at the end of the tail, and that the weight of this fin caused the fracture in question. In the present year, there has been discovered in the Lias one of these reptiles, in which the outline of the fleshy parts is completely preserved, and which proves the existence of a caudal fin of still larger dimensions than Owen supposed to be the case. This interesting specimen is described by Dr. Fraas (*Neue Jahrbuch f. Mineralogie,* 1892, pp. 87-90). We already knew that in the paddles the fleshy part was extended much behind the bony skeleton; but the new specimen shows us that, in addition to the tail-fin, the Ichthyosaurs had a triangular fin on the middle of the back, behind which was a crest of horny excrescence compared to those of the crested newt. The tail fin is vertical and nearly symmetrical

[1] Ueber das Norian oder Ober-Laurentian von Canada. Stuttgart, 1893.

externally, although the backbone runs downward to terminate in its lower lobe. In this respect the fin has the same general aspect as in the Sharks, except that in the latter the backbone runs into the upper lobe. It shows, indeed, as Dr. Fraas remarks, how closely analagous is the form of Ichthyosaurs to fishes." (Natural Science Vol. I, 1892.)

New Fossil Fishes from the Upper Lias.—Continuing his studies of the fossil fish from the Upper Lias of Cement of Vassy of the Youne, M. Sauvage describes and figures three new species; *Leptolepis affinis* Sauvage, *L. antissiodorensis* Sauvage, and *Pholidophorus gaudryi* Sauvage. The first resembles *L. constrictus* Egerton, but differs from that species by having the preopercular strongly striated, a longer body, more numerous vertebræ, and the ventral fins further back. *Polidophorus gaudryi* is very close to *P. bechei* Ag. and *P. onychius* Ag., it has, however, a longer head, and the scales not so elevated and less numerous than either of these species. It may be identical with *P. dorsalis* Ag., but the description of that species is too meager to allow full comparison. (Bull. de la Soc. d'Hist. Nat. d'Autun, 1892.)

Affinities of Ichthyornis.—Dr. R. W. Shufeldt has published a tabular comparison of the anatomical points of *Ichthyornis dispar*, *Rhynchops nigra* and *Sterna macrura* to show that while in some minor characters *Ichthyornis* seems to come nearer the Gulls than it does the Terns, on the whole it possesses more in common with our now existing Rhyncopidæ than with the Sterninæ. This is most apparent in the cranium; in the large skull compared with the rest of the skeleton; and in certain characters in the vertebral chain and pelvis. (Journ. Anat. and Physiol. Vol. XXVII.)

Cretaceous Formations of Mexico.—Mr. R. T. Hill has recently shown that the Mountain Limestone so widely distributed throughout Mexico is the southern continuation of the Comanche Series of Texas, and is therefore of Lower Cretaceous age instead of Upper Cretaceous and Paleozoic, as has been asserted. The author has recognized the three prominent stratigraphic divisions of the Comanche Series in Mexico as in Texas, and is confident that when the whole region is studied more detailed resemblances of horizons will be observed.

The true Upper Cretaceous is characterized by shallow deposits of ferruginous limestones, clays, sand and lignite. The beds occur in the northeastern border States of Chihuahua, Coahuila and Tamaulipas, and are at least 5000 feet thick. The subdivisions of this series are not distinctly differentiated. The Dakota horizon has no true representative, but the Benton shales and clays with the typical *Inoceramus problematicus* and *Scaphites* occur near Juarez and in El Paso, Texas. The chalky beds of the Niobrara sub-epoch are missing, and the whole of the Niobrara. Pierre is apparently represented by thinner ferruginous clays and impure limestones marked by a commingling of the characteristic fauna and the *Exogyra ponderosa* of the Southern States. The Eagle Pass beds, correlated by White with the Fox Hill stage grade into the Laramie, and the latter into the Eo-Lignitic beds of the Southern States, the whole having a unity of littoral lithological features indicating that the Upper Cretaceous and basal Eocene from the Dakota to the Claiborne inclusive was a continuous epoch of sedimentation, without any serious interruption of continuity until toward its close, and deposited at a marine base level now occupied by the eastern masses of the Rocky Mountains and eastern Sierra Madre. (Am. Journ. Sci., Vol. XLV, 1893.)

On a new Musteline from the John Day Miocene.—In striking contrast to the Tertiary formations of Europe, those of North America have yielded but very few mustelines. From the White River beds only the problematical genus, *Buncelunus* Cope, the systematic position of which is quite uncertain, has so far been obtained, and the John Day beds have hitherto yielded no members of the family. For this reason, even scanty fragments are of importance. Among the collections of the Princeton expedition of 1889 is a mandibular ramus containing only $\underline{p2}$ and $\underline{p3}$, but displaying the alveoli of the other teeth, which was found in the John Day beds at Silver Wells, Oregon. It is obvious at the first glance that this jaw cannot be referred to any genus of carnivores hitherto known from the John Day, and though the absence of the characteristic teeth renders the framing of a generic definition very difficult, yet it is possible to so define it as to make identification of other specimens easy.

Parietis gen. nov., Dental formula $C_{\frac{1}{1}}$ $P_{\frac{4}{4}}$ $M_{\frac{3}{3}}$. $\overline{p2 \text{ and } 3}$ small very low, but relatively thick, massive, obtusely pointed and with a cingulum around the entire crown; enamel coarsely wrinkled. Molar alveoli decreasing in size from 1st to 3rd; $\overline{m3}$ implanted by a single fang. *P. princeous* sp. nov. Mandible short but thick and heavy, with a larger mental foramen beneath $\underline{p2}$ and a smaller one beneath $\overline{p3}$, $\overline{P1}$ very small and inserted by one root. Size small. Length of molar-premolar series: M. ·032. Length of $\overline{p2}$, ·005: Width of $\overline{p2}$ ·003. Length of alveolus of

$\overline{m1}$ ·007 : of $\overline{m2}$ ·005. Depth of jaw beneath $\overline{p3}$ ·010. The character of the premolars suggest those of *Inercytherium*, but *Parietis* was no creodont, the molar alveoli clearly showing the presence of one sectorial and two tubercular molars, and the whole appearance of the specimen is musteline. Of the European genera *Stephanodon* von Meyer, appears to be most like *Parietis* but differs in many particulars, e. g. in having but two lower molars.—W. B. Scott, *Geological Museum, Princeton, N. J.*, May 24, 1893.

The Mammals of the Deep River Beds.—The Tertiary beds of the Deep River, Montana, were discovered by Grinnell and Dana in 1875. These observers recognized two distinct horizons in the formation, which they called respectively "Miocene" and "Pliocene," without attempting a more exact correlation. In 1878, Cope referred the formation to the base of the Loup Fork, but afterward regarded it as a distinct epoch (Ticholeptus beds), intermediate between that formation and the John Day.

The Princeton expedition of 1891 made extensive collections in the Deep River Valley, and the examination of these has brought to light some interesting new forms, upon which the following preliminary notes are founded. A full description, with figures, is in preparation.

The beds contain, as Grinnell and Dana pointed out, two very distinct faunas, the older one of which is equivalent to the John Day, and the newer to the "Ticholeptus beds" of Cope. The lower strata, from a few very small exposures, yielded numerous specimens of the following forms: *Cynodesmus thooides* gen. et. sp. nov.; *Steneofiber montanus* sp. nov.; *Cœnopus* sp.; *Miohippus annectens?* Marsh; *M. anceps?* Marsh; *Mesoreodon chelonyx* gen. et. sp. nov.; *M. intermedius* sp. nov.; *Poëbrotherium* sp.; *Hypertragulus calcaratus* Cope.

The upper beds, from which alone Professor Cope's collections appear to have been obtained, contain a very different fauna. The following list is made from a comparison of Professor Cope's material with that gathered by the Princeton party: *?Canis anceps* sp. nov.; *Chalicotherium* sp.; *Aphelops fossiger* Cope; *Miohippus* sp.; *Anchitherium equinum* sp. nov.; *Desmatippus crenidens* gen. et sp. nov.; *Protohippus sejunctus* Cope; *P. (Merychippus) insignis* Leidy; *Merychyus zygomaticus* Cope; *M. pariogonus* Cope; *Merycochœrus montanus* Cope; *Cyclopidius simus* Cope; *C. emydinus* Cope; *C. incisivus* sp. nov.; *Pithecistes brevifacies* Cope; *P. decedens* Cope; *P. heterodon* Cope; *Protolabis* sp.; *Procamelus* sp.; *Blastomeryx borealis* Cope; *B. antilopinus* sp. nov.; *Mastodon proavus* Cope.

Cynodesmus gen. nov.—Dentition like the microdont forms of *Canis*, but with the skull structure of the more ancient genera. Cerebral hemispheres small, not overlapping the olfactory lobes or cerebellum, with fewer and simpler convolutions than any of the recent *Canidæ*. Post-glenoid foramen concealed or absent.

C. thooides sp. nov.—Dentition microdont; deuterocone of $\frac{p4}{}$ relatively large; face short and cranium long; small frontal sinuses present; mandible non-lobate; size medium.

This genus represents the direct canine ancestor which the John Day beds have hitherto failed to yield. Found by O. C. Mortson in the lower strata.

? Canis anceps sp. nov.—A fragment of mandible containing $\overline{p4}$, $\overline{m1}$ and $\overline{m2}$ agrees well with *C. brachypus* Cope, except for its smaller size and more slender jaw. The lower sectorial is nearly as long as in that species (as 17 : 19), but the depth of the mandible is much less (as 21 : 30.) The primitive character of the sectorial renders the generic reference uncertain. Upper beds.

Steneofiber montanus sp. nov.—This species is most like the *S.* (*Castor*) *peninsulatus* Cope from the John Day of Oregon, but the upper molars (except $\frac{m3}{}$) have but two fossettes, both of which are anterior to the enamel inflection. In the lower molars the antero-posterior diameter of the crown exceeds the transverse. Found by C. C. Jefferson in the lower beds.

The name *Anchitherium* has been much too extensively applied to American equines. The following table will show the generic distinctions in the Miocene forms of this group which appear to be justified by present knowledge.

I. *Teeth brachyodont.*

A. Conules of upper cheek teeth well-marked; posterior transverse crest not reaching the outer wall; external cusps moderately concave or flattened; anterior pillar of lower teeth distinctly marked.

1. No cement present.

a. Incisors without enamel pits — *Mesohippus* Marsh.
b. Upper incisors with enamel pits. — *Miohippus* Marsh.

2. Cement on cheek teeth.

Posterior transverse crests of upper teeth confluent with the external wall. — *Desmatippus* gen. nov.

B. Conules of upper cheek teeth much reduced, and external cusps deeply concave; posterior transverse crest confluent with outer wall; anterior pillar of lower teeth reduced and on one or more teeth absent. No cement; incisors with pits. *Anchitherium.*

II. *Teeth hypsodont.*

1. Antero-internal cusp of upper teeth confluent with transverse crest. *Protohippus* Leidy.

2. Antero-internal cusp separate from transverse crest. *Hipparion* de Christol.

Desmatippus gen. nov.—Molars and premolars short crowned, the valleys more or less filled with a thin deposit of cement. In the upper series the posterior transverse crest is connected with the outer walls and sends forward a process which extends nearly to the anterior conule. Inner cusps of lower teeth expanded so as to narrow entrances to the valleys. Median inner cusps (a, a′ of Rütimeyer) much more distinctly separated than in the older genera.

D. crenidens sp. nov.—Posterior transverse crests of upper cheek teeth sinuous; limbs elongate and slender; size moderate.

This interesting new equine very satisfactorily fills the gap between *Miohippus* and *Protohippus.* The type specimen was found by I. Benet in the upper strata of the Deep River.

Anchitherium equinum sp. nov.—Size equal to that of *A. aurelianense,* but with teeth relatively larger; lower incisors without enamel pits; humerus with bicipital tubercle and double bicipital groove.

This is the first American species of *Anchitherium* in the restricted sense in which that name is here employed. It was found by Mr. Benet in the upper beds.

Mesoreodon gen. nov.—Skull and dentition very much as in the John Day genus *Eporeodon* but with "adaptive" names, the 3d metacarpal articulating with the trapezoid and excluding the 2d from the magnum.

M. chelonyx sp. nov.—Metapodials rather short and stout, ungual phalanges trowel-shaped and pointed.

This is the most abundant animal of the lower beds, and nearly all parts of the skeleton are known. Two very curious features are the presence of a rudimentary clavicle and of an ossified thyroid cartilage of the larynx. The type was found by O. C. Mortson.

M. intermedius.—Metapodials slender and elongate, and ungual phalanges like those of *Merychyus.* Lower beds.

Cyclopidius incisivus sp. nov.—Like *C. simus,* but having two small incisors in each premaxillary; the latter bones also of a different shape from those of the former species. Found by R. A. Stevenson in the upper beds.

Blastomeryx antilopinus sp. nov.—Size decidedly smaller than that of *B. borealis* Cope, and ribs of external crescents on upper molars less prominent. Found by O. C. Mortson in the upper beds.

Besides the new forms here enumerated excellent materials were found of species already named, including some nearly complete skeletons, which will be fully described in the memoir now in preparation.

W. B. Scott.

Geological Museum, Princeton, N. J., June 9, 1893.

Conditions of Erosion beneath Deep Glaciers.—Mr. N. S. Shaler has published a paper on the conditions of Erosion beneath deep glaciers, based upon a study of the Boulder Train from Iron Hill, Cumberland, R. I. The author advances an hypothesis of pressure melting to account for unexplained peculiarities of glacial movement, such as sudden variations of a temporary nature in the position of the ice, and the movement of the ice in the direction of the glacial flow over surfaces of slight inclination. It also accounts for the small amount of erosion often traceable in the central parts of a glaciated district, and explains the phenomena exhibited by drumlins or lenticular hills. (Bull. Harv. Mus. Comp. Zool., Vol. XVI, 1893.)

Paleozoic.—Mr. Whiteaves has published a list of 16 gasteropods found in the Trenton limestone of Manitoba, of which, one *Loxonema winnipegense,* is new. The new species is of interest on account of its close similarity to some of the most typical Jurassic species of *Pseudomelania.* (Can. Rec. Sci. April, 1893).—A new fungus, *Incolaria securiformis,* is reported by Mr. H. Herzer. It was found under the bark of a Sigillaria imbedded in the Zoar limestone of Tuscarawas Co., Ohio and represents a new genus. (Am. Geol. June, 1893). A new fern from the Coal Measures of Henry Co., Missouri, is described and figured by Mr. David White in the Bull. Geol. Soc. Amer., 1893 under the name *Tæniopteris missouriensis.* According to the author the new species presents a striking combination of tæniopteroid and alethopteroid characters.

Mesozoic.—Mr. N. H. Darton has defined a thin series of arenaceous deposits lying between the Potomac and Severn formations, to which he gives the name Magothy formation. Its stratigraphic position places it in the early Cretaceous. (Ann. Journ. Sci. 1893). Mr. P. B. Brodie reports the discovery of fossil fish and labyrinthodonts in the Green Gritty Marls, immediately overlying the Red Marls of the Upper Keuper in Warwickshire. The fish are represented by scales, numerous large and small spines of cestracionts, and the palatal teeth of *Acrodus keuperinus;* the labyrinthodonts, by fragments of bones only. (Quart. Journ. Geol. Soc., May, 1893.)

Cenozoic.—Mr. Lydekker has described and figured three new Cetaceans:—*Zeuglodon caucasicus* characterized by its small size; *?Platanistidæ*, represented by an associated series of four cervical, and the first dorsal, a lumbar, and a caudal vertebra; *Iniopsis caucasica*, which has maxillary fossæ of the Inia type. The fossils in question were found in Eocene strata of the Caucasus Mountains. (Proceeds., London, Zool. Soc., Nov., 1892).—Mr. J. S. Diller has published evidence to show that the Shasta-Chico series in California and Oregon is the result of continuous sedimentation, and that there is a faunal break in Oregon between the Chico and the Tejon. (Bull. Geol. Soc. Am., Vol., 4, 1893.)

Mr. E. T. Dumble reports a bed of Volcanic Dust in Texas. Its stratigraphic position is in the brown-coal series of the Fayette beds, and, if the correlation of these beds be correct, of Miocene age. (Trans. Texas Acad. Sci., 1892.)

BOTANY.

The Plants of the Bahamas, Jamaica, and Grand Cayman.—Professor A. S. Hitchcock's paper on this subject, which appeared in the Fourth Annual Report of the Missouri Botanical Garden, is very interesting, inasmuch as it not only catalogues a large number of species, but in addition discusses at some length some of the problems connected with insular floras. The following are some of the author's conclusions.

"It would seem to the writer that the ordinary methods of dissemination would account for the flora of the Bahama Islands without calling in the aid of hypotheses founded on ancient land connection. There are probably no more endemic species than would be found if all the islands were at present connected. It seems hardly reasonable to suppose that Watling's, Crooked Island or Inagua have ever been connected with Cuba or any of the other islands, yet the flora of these have about the same relation to Cuba as do the islands of the Bahama bank. From the table it will be seen that the flora comes from the south, that it is essentially Cuban and that this flora has also established itself in the extreme southern part of Florida, where it is found only on the most recent formations. Climatic conditions undoubtedly prevent any great extension to the north, but most of the plants would probably extend further north than they do, were they not brought into competition with an established flora. On the other hand very few plants from the Southern States have found their way to the Bahamas, and those that have are mostly such as are of wide distribution in the Tropics and hence just as probably came from the south as from Florida.

"Again, the facilities for distribution, the ocean currents and the prevailing winds, are from the south to the north. The Gulf Stream not only tends to bring plants from the south but quite effectually prevents any from drifting from Florida to the Bahamas. The current is so strong that the occasional northers would be more than counteracted, while the easterly winds are favored. What is true of the Gulf Stream to the west of the Bahamas is also true of the Equatorial Current to the east. Distribution by birds is apparently of little importance or we should find more plants with pulpy fruits brought from Florida. Maritime plants are easily distributed by currents as their seeds are not injured by the salt water, and furthermore, as stated by Hemsley and Wallace, when cast ashore they find a suitable place for germination, while many other seeds although transported fail to be placed in a favorable situation. I collected several beans of *Gigalobium scandens* on various beaches, but the plant had not gained a foot-hold as its habitat is the dense woods of the larger islands. But the bulk of the flora of the Bahamas is either maritime or such as would, under favorable conditions, be likely to pass through the salt water ordeal successfully. The islands are all low and probably most of the species are found within the influence of the sea."

The Saprolegniaceæ of the United States.—The monograph of the Saprolegniaceæ of the United States, prepared by Dr. J. E. Humphrey, and published by the American Philosophical Society, is a notable contribution to the botany of the lower plants. It occupies eighty-six quarto pages of text, and is illustrated by seven large plates. The author first discusses the group in general, giving much attention to the non-sexual and sexual reproduction, and bringing out many interesting facts. He confirms the statement of DeBary and others that the so-called sexual reproductive organs are morphologically sexual, though not physiologically so in all cases.

The second part of the paper is occupied with descriptions of the genera and species. Seven genera are known to occur within our limits, viz: *Saprolegnia*, with seven species; *Pythiopsis*, with one species; *Achlya*, with eight species; *Aphanomyces*, with two species; *Dictyuchus*, with one species; *Leptomitus*, with one species; *Apodachlya*, with one species. A number of other species are described, of which as yet no specimens have been found in the United States. A bibliography of 110 titles is given, of which but five are by American authors. The plates add much to the usefulness of the paper, and should make the study of these much less difficult than heretofore.

Dr. Humphrey recommends the following method of cultivating these plants. "The most prolific source of supply is water containing green algæ, and the best subsistance is afforded by insects, such as common house-flies or meal-worms. For material, a handful of algæ may be taken from the stream, pond or pool in which they are growing and placed in a collecting bottle or other vessel, which will protect them from drying. In the laboratory, these are placed in a vessel of water from the public or private water supply, and the culture insects are thrown upon its surface. This collection of a mass of algæ without water, except that retained by the mass, reduces the bulk of specimens, which is of importance when they are taken at a distance from the laboratory, and largely excludes aquatic organisms which might make trouble in the cultures; while experience shows that the zoöspores and oöspores of the *Saprolegniaceæ* are carried with the algæ to a large extent. * * * The insects used may be freshly killed, and their chitonous covering should be broken as little as possible; but I have found that for winter cultures, when fresh insects are not readily available, an excellent substitute may be found in dead house-flies, collected in the fall and kept dry and exposed to the air, but protected from dust. Since the dry surfaces of insects are not readily wetted by water, it has proved useful to moisten them, whether fresh or dried, with alcohol, and then soak them in water for a few minutes to remove the alcohol. They will then, when thrown into the culture vessel, sink until their bodies are mostly below the surface, and so present a much larger area to the swimming zoöspores of *Saprolegniaceæ* than if dry and floating largely above the surface."

The publication of this paper will certainly stimulate the more general study of these interesting aquatic fungi.

CHARLES E. BESSEY.

ZOOLOGY.

A Deformity Inherited.—An account is given in a medical journal by Dr. M. L. Holbrook of a case of deformity transmitted through three generations to both sexes. It appeared first in a person named M. B. Wadsworth, born in Connecticut about the year 1800. It consisted in the absence of the three middle metacarpal bones and phalanges of each hand, and also the absence of the three middle corresponding bones, the metatarsal and phalanges of each foot, together, of course, with the absence of the toes and fingers and that part of the foot and hand belonging to these bones. The remaining parts lay nearly side by side like fingers, and the movement was partly from side to side like claws, rather than a grasping movement, like that of a perfect hand. This man was very able bodied, and worked at farming and laying stone wall, and lived to be about sixty years of age. He married, moved to Ohio and being a neighbor of my parents, I knew him well. He had two children, S. and W. with whom I was intimate, and both inherited the deformity. In the oldest one, however, there seemed to be an attempt on the part of nature to restore the missing parts by producing one double finger on each hand, and a foot partly restored, but the restoration was so imperfect as to really make the deformity worse. This son died in early manhood and left no family. The second son, W., was nearly like the father in both hands and feet. He is still living, married, and has had four children. The first is a man, grown and is not deformed. The second, a girl, now about eighteen years old, is as bad as the father. The third, a son, not deformed. The fourth, a daughter, now dead, was like her father.

As to the cause of this strange deformity we have no absolute knowledge. One story current in the family is that the mother of the original case was frightened at a lobster before the child was born. There is another family belief concerning the cause that is worth relating. It is that the mother received a severe nervous shock from a vicious horse, which had chased her with open mouth and tried to get hold of her with his teeth after she had taken refuge under a wagon. The mental shock may have produced an arrest of development in the unborn child. (Herald of Health, Oct., 1892).

Preliminary Note on the Relationship of the Species Usually United under the Generic Name Sebastodes.—On the Pacific coast of temperate North America, a large number of species of viviparous Scorpaenidae are found. They range all the way from tide water to a depth of 1600 feet, from Cerros Island to Alaska. They are most abundant on the coast of California, about 30 species being known from San Diego and a like number from Monterey. In size, they vary from 1 lb. to 30 lbs.

The species have been variously grouped as forming one genus by Jordan & Gilbert, as forming two by Jordan, and as forming four by Gill. Jordan & Gilbert, in their Synopsis, arranged the species known to them according to the greater or less prominence of the spiniferous ridges of the skull. In examining the skulls of a number of them, one of us several years ago, noticed that in a number of species, the parietals meet over the supra-occipitals, while in others they are separated, and the supra-occipital is exposed above for its whole length.

A more recent examination of a larger series of skulls, tended to show that, if we admit the relationships pointed out by Jordan & Gilbert, this greater or less development of the parietals is of no significance. A more thorough study has, however, convinced us that the species with united parietals are related and that the relationships pointed out by Jordan & Gilbert are at fault.

The value placed on such a cranial character as the union or non-union of the parietals need not be defended here. It may only be mentioned that in *mystinus* which for other reasons we considered the hub to which the other groups proposed here are related as spokes, the parietals are united in 8 out of 10 specimens. The variation of this character in *mystinus* but confirmed our view that it is the radiating point.

Leaving the parietals, the next prominent characters are the development or non-development of certain cranial spines and ridges. These spines are found in all stages from minute points to comparatively huge spines. The variation in size for this reason, if there were no other objections, cannot be utilized for determining generic relationship. The spines are very regularly arranged and in any given species certain ones are always present. (Individual variations should of course be expected in this character as in every other if a sufficient number of specimens are examined). The *constancy* of the presence of certain spines in a given species warrants the use of the presence or absence of these spines in the different species in determining their true relationship. This relationship is usually borne out by a number of subsidiary characters. Considering the constancy of the spines, reinforced by subsidiary characters, we have divided the species usually united under the generic name *Sebastodes* as follows:—

a. Parietals meeting above the supra-occipital.

b. Jaws equal; head narrow above; high and prominent cranial ridges ending in spines; preocular, supraocular, tympanic and parietals present. Scales usually very strongly ctenoid; accessory scales numerous; suborbital stay directed obliquely downward and backward; second anal spine much heavier than, and at least as long as the third; body short and deep, back arched; mouth very large; head heavy. All known species with cross bands.

SEBASTICHTHYS Gill.

*nigrocinctus, serriceps, rubrivinctus, diploproa.**

bb. Lower jaw much projecting; head broad, the skull usually convex; cranial ridges when present low; gill-rakers very long and slender; scales usually smooth, few if any accessory scales. Suborbital stay little if at all oblique.

c. Parietal ridges ending in spines; preocular, supraocular and tympanic spines well developed. Peritoneum black.

d. Postocular spine present. Second anal spine usually stronger and longer than third. Symphyseal knob strong, projecting forward. Dorsal low. (Peritoneum black, mandibles and maxillary scaled.)

ACUTOMENTUM[1] E & B.

[1]Type *A. ovalis* (Ayres).

*melanostomus, ovalis, rufus, *alutus, macdonaldi* n. sp. nov.= *S. proriger* E. & G. not of J. & G.

dd. Postocular spine not developed.

We have not been able to examine the two species (entomelas and atrovirens) and cannot vouch for their position.

cc. Parietal ridges not ending in spines.

e. Preocular spines well developed. Supraocular and tympanic spines sometimes present. Interorbital wide, convex. Peritoneum black. Approximated edges of sub-opercle and inter-opercle frequently ending in spines. PRIMOSPINA[2] E. & B.

[2]Type *P. mystinus* (J. & G).

The only species (*mystinus*) is the most variable species of the group.

ee. Preocular without spine, skull smooth, without spines. Peritoneum usually white SEBASTOSOMUS Gill.

*flavidus, serranoides, melanops, *ciliatus.*

aa. Parietals separated by the supra-occipital.

f. Cranium with parietal ridges only. Lower jaw much projecting, entering the profile; a prominent symphyseal knob directed forward. Head broad, convex. Interobital convex, nearly smooth. SEBASTODES Gill.

paucispinis, goodei.

* Species marked with an asterisk have not been examined in reference to the characters utilized.

ff. Cranium with many ridges, all ending in spines.

g. Postocular and tympanic spines both present. Interopercle and subopercle without spines. Lower pectoral rays normal.

h. Coronal spines; nuchal spines, a spine below, another in front of eye. * *matzubarae* with this species we are not acquainted.

hh. No coronal spines SEBASTOMUS Gill.

miniatus, pinniger, levis, aereus, constellatus, umbrosus*, rosaceus, rhodochloris*, gilli*, rupestris*, eos, chlorostictus*, ruber* rufus.*

gg. Postocular spine wanting.

i. Coronal spines none. PTEROPODUS E. & B.[1]

Species with normal pectoral rays, (living off the bottom) *saxicola*, proriger† *, brevispinis*, elongatus, sinensis.*

Species with lower pectoral rays thick (living on the bottom) *zacentrus*, maliger, caurinus, vexillaris, rastrelliger, nebulosus, carnatus, chrysomelas.*

ii. Coronal spines present. AUCTOSPINA E. & B.[2]

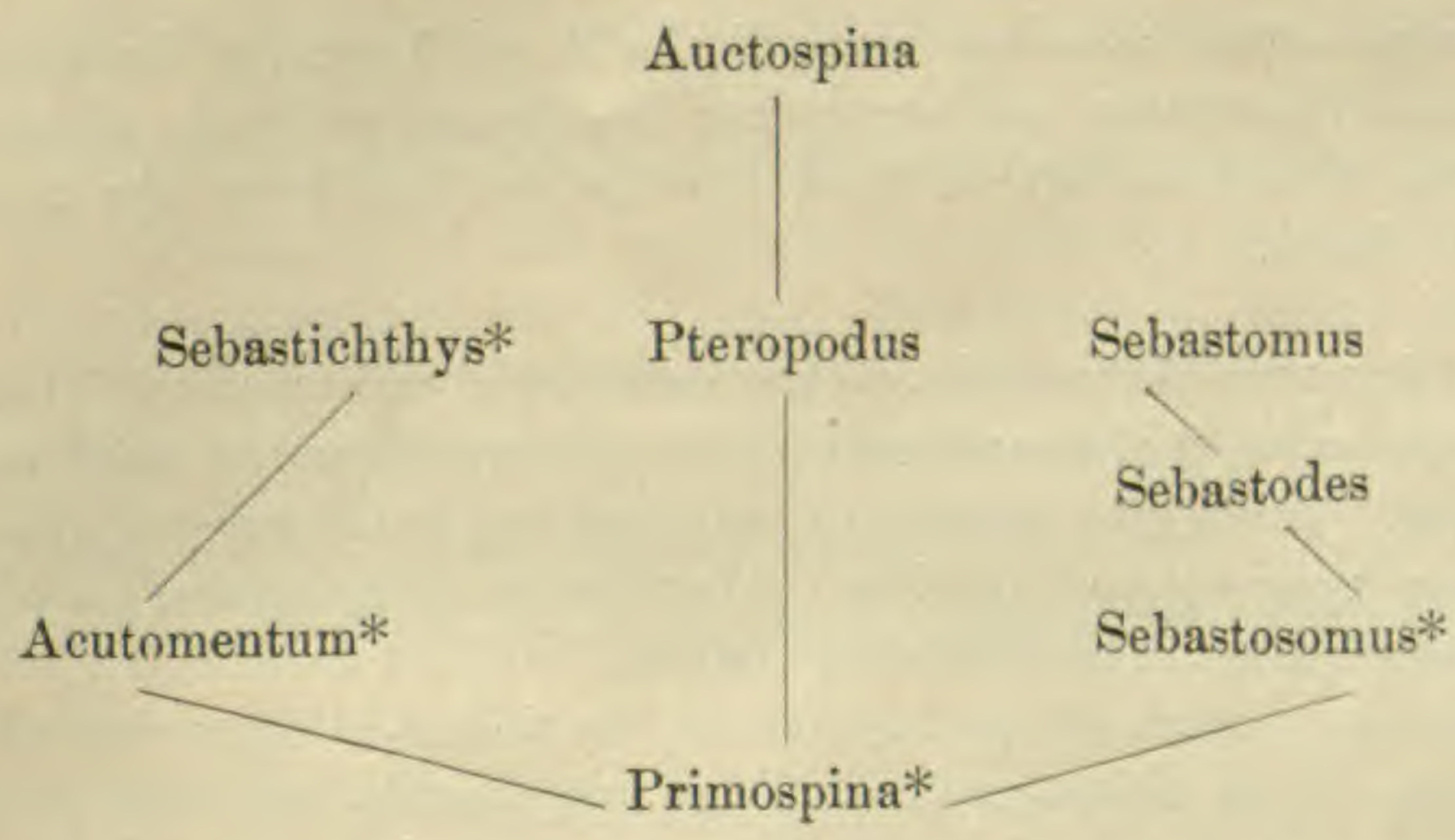
aurora, auriculatus.*

† The specimen described by E. & E., Proc. Cal. Acad. Sci. (2) III, 15, 1890, is a species distinct from *proriger.*

The inter-relationship of these genera is complex. It may be represented by the following diagram where the genera with the united parietals are followed by an asterisk.

[1]Type *P. maliger* (J. & G).

[2]Type *A. auriculatus* (Girard).



A revision of the Pacific Scorpaenidæ will be included in my "Viviparous fishes of the Pacific Coast."—C. H. EIGENMANN and C. H. BEESON.

Batrachians of British India.—The total number of Batrachians known at the present time from British India, including the Malay peninsula, comprises 147 species; of these, the Indian Museum possesses specimens of 103 distributed as follows; Ecaudata 99, Caudata 1, Apoda 3. (Sclater's List of Batrachians of the Indian Museum, 1892).

Washington and British Columbian Orinthology.—A resumé of the birds observed in British Columbia and Washington during the spring and summer 1892, is given by Mr. S. N. Rhoads in the Proceeds. Phila. Acad., 1893. To the combined lists of Mr. Chapman and Mr. Fannin, the author adds 21 species that came under his own observation, making the list of species now known from that region number 326. Descriptions of 11 new species observed appear in the Auk for January, 1893. Four specimens of a new variety of *Parus hudsonicus* were obtained in British Columbia, near Field. The new form, *P. hudsonicus columbianus*, is larger and darker than *hudsonicus*, with a much larger bill, and with the throat patch jet black instead of brownish-black.

Zoological News. Hemichorda.—Prof. W. E. Ritter presents in Zoe[3] a popular study of Balanoglossus in which few new facts concerning the larvæ are brought out. Professor Ritter puts in a request for evidence of the existence of Balanoglossus on the Pacific coast.

[3]Zoe iii, 187, 1892.

Fishes.—Evermann has revised[4] the North American Suckers of the genus Pantosteus and recognizes the species *plebeius*, *virescens*, *generosus*, *discobolus* and a new species *jordani* from the upper Missouri Basin.

Reptiles and Batrachia.—Cope catalogues[5] eight species of Batrachia, 5 of turtles, 8 of lizards and 13 of snakes collected in northwestern Texas. The region appears to be interesting as the meeting ground for several geographical districts. The absence of Sceleporus from the collections is due to the absence of timber.

Davenport records the persistence[6] of the right root of the subvertebral artery in an alligator 28 cm. long, and figures two cases of the persistence of the ductus botalli in the same animal.

Mammalia.—At a meeting of the London Zoological Society, M. Tegetmeier exhibited the feet of some Australian rabbits to show an adaptation which is gradually being brought about to a new mode of locomotion. The rabbits are becoming climbers, and often ascend trees in their search for food ; their feet are growing slighter and the claws longer and sharper. (Revue Scientifique, Mar. 1893.)—Mr. G. S. Miller reports that *Zapus insignis*, hitherto known only from New Brunswick and Nova Scotia, is locally common in the eastern United States. As the original description was based on three specimens faded by grease and age, he redescribes the species in the Proceeds. Biol. Soc. Washington, April, 1893.

Notes on the Classification of the Cryptodira.—In the June number of the AMERICAN NATURALIST, 1890, I have given a classification of the Testudinata, distinguishing four sub-orders—*Amphichelydia*, *Pleurodira*, *Cryptodira*, *Trionychia*.

To-day I shall give a more detailed classification of the living forms of the Testudinata belonging to the Cryptodira.

CRYPTODIRA.

No free nasals, a parieto-squamosal arch present or absent; descending processes of prefrontals connected with vomer; stapes in an open groove, of the quadrate or covered by the quadrate behind ; pterygoids narrow in the middle, without wing-like lateral expansions, separating

[4]Bull. U. S. Fish Comm. 1892, p. 51, 1893.

[5]Proc. Phila. Acad. 1892, p. 331.

[6]Bull. Mus. Comp. Zoology xxiv, no. 2, 1893.

quadrate and basisphenoid; epipterygoid free or not free; dentary bones united. Cervical vertebræ with rudimentary transverse processes in front of vertebra; the posterior cervicals with double articular faces; sacral ribs well-developed and connected with centrum and neuroids. Pelvis free from plastron and carapace. Epiplastra in contact with hyoplastra; entoplastron oval, rhomboidal or T-shaped, a more or less complete series of peripheralia more or less connected with the ribs.

I.—CHELONIOIDEA.

A parieto-squamosal arch; no foramen palatinum between palate and maxillary; articular faces between the sixth and seventh cervical plane; nuchal with a distinct process on the lower side for the articulation with the neuroid of the eighth cervical; no lateral processes of nuchal. One biconvex cervical vertebra.

1. *Cheloniidæ.*

Skull with descending processes of parietals; limbs paddle-shaped; claws one or two. *Chelonia, Thalassochelys, Caretta, Lepidochelys.*

2. *Dermochelyidæ.*

Skull without descending processes of parietals; limbs paddle-shaped; no claws. Bony carapace dissolved into numerous mosaic-like pieces. *Dermochelys.*

II.—CHELYDROIDEA.

No parieto-squamosal arch; a foramen palatinum between palate and maxillary; articular faces between the sixth and seventh cervicals not plane; nuchal without lower process, but with more or less strong lateral process underlying the peripherals; one biconvex cervical; a complete series of inframarginals.[1]

1. *Dermatemydidæ.*

Frontals not excluded from orbit; maxillary without connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron. Number of neuralia incomplete; the posterior pleurals not meeting in median line. *Dermatemys.*

2. *Chelydridæ.*

Frontals excluded from orbit; maxillary without connection with quadratojugal; squamosal in connection with postfronto-orbital; meso-

[1] Some species of *Kinosternon* excepted.

gastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron. Number of neuralia complete; posterior pleurals meeting in median line. *Chelydra, Macrochelys.*

3. *Staurotypidæ.*

Frontals excluded from orbit; maxillary in connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 10; an entoplastron; number of neuralia incomplete; posterior pleurals meeting on median line. *Staurotypus, Claudius.*[1]

4. *Kinosternidæ.*

Frontals excluded from orbit; maxillary in connection with quadratojugal; squamosal without connection with postfronto-orbital; mesogastroid reduced; number of peripherals 10; no entoplastron; number of neuralia incomplete; posterior pleurals meeting on median line. *Kinosternon, Aromochelys, Goniochelys.*

III.—PLATYSTERNOIDEA.

No parieto-squamosal arch; a foramen palatinum between palate and maxillary; articular faces between sixth and seventh cervical not plane; nuchal without lower and without a lateral process; two biconvex cervicals; a complete series of inframarginals. Skull of the type of the Chelydroideae.

Platysternidæ.

Frontals excluded from orbit; maxillary in connection with quadratojugal; jugal excluded from orbit; squamosal connected with postfronto-orbital; mesogastroid well-developed, separating completely entopubes and entoischia; number of peripherals 11; an entoplastron; number of neuralia complete. *Platysternum.*

[1] In *Claudius* the post-orbital arch is exceedingly slender; the parietal sends down a process behind the postfronto orbital to join the jugal. The zygomatic arch is also very slender, but three times as broad as the postorbital; the interorbital arch is one and a half times the diameter of the orbit. The lower jaw is strongly hooked, with the symphysis larger than the diameter of orbit. Upper jaw with a small but distinct hook, each maxillary with a very sharp lateral hook. Lower side of skull as in Kinosternon; palate not forming a part of the alveolar surface, the posterior nares not bridged over by palate and vomer as in Staurotypus. Pterygoids without any ecto-pterygoid process.

IV.—TESTUDINOIDEA.

No parietosquamosal arch; a foramen palatinum between palate and maxillary; articular faces between sixth and seventh cervical not plane; nuchal without lower process; two biconvex cervicals; an incomplete series of inframarginals; squamosal not connected with postfronto-orbital.

Emydidæ.

Quadrate open behind; number of phalanges of second and third toe of hind foot more than two; peripherals of bridge without median processes interlocking with rib-ends; rib-ends in a groove of the peripherals.

Testudinidæ.

Quadrate closed behind; number of phalanges of second and third toe of hind foot never more than two; peripherals of bridge with median processes interlocking with rib-ends.

—G. Baur, *University of Chicago.*

Two New Species of North American Testudinata.— The following species of Graptemys have been described:

1. *Graptemys geographica*, Les. 1817.
2. *Graptemys pseudogeographica* (Les. MSS.), Holbrook, 1842.
3. *Graptemys oculifera*, Baur, 1890. Science, No. 405, pp. 262–263.
4. *Graptemys kohnii*, Baur, 1890. l. c.

GRAPTEMYS PULCHRA spec. nov.

For some years I have been acquainted with two specimens of a *Graptemys* preserved at the Smithsonian Institution. Both specimens were collected by Dr. T. H. Bean in Montgomery, Ala., and bear the number 8808. One of these is mentioned in Yarrow's Catalogue (Bull. U. S. Nat. Mus., No. 24, 1883), as "*Malacoclemmys geographicus.*" In 1891 I received a skull and a very large living specimen from Mr. G. Kohn, of New Orleans, La., of the same species.

The coloration of the skull and neck distinguishes this species at once from all the others. The whole space between and behind the orbits is characterized by a continuous yellow figure, which sends backward on each side behind each orbit a strong process of the same color.

The head resembles that of *Graptemys kohnii*, but is more slender. The symphysis of the lower jaw is longer and the nose projecting. In all the skulls examined the jugal is excluded from the orbit, a character not seen in the other species of *Graptemys* or *Malaclemmys*. The form of the carapace is very close to *Graptemys kohnii;* the dermal shields are very thin. It is the largest form of *Graptemys*, the shell reaching a length of over 170 mm. in straight line. The color of the shell is light olive with yellow marks on the marginals, the plastron is yellow, with some darker marks. Types: No. 8808. Smithsonian Institution, Washington, D. C. Two not full-grown specimens, collected by Dr. T. H. Bean at Montgomery, Ala.

The genus *Malaclemys*, with the single species *M. centrata* (Bosc. MSS.) Latreille, 1801, is distinguished from *Graptemys* by the lower jaw, which is pointed and not rounded in front, and also by the condition of the quadratojugal and maxillary. In *Malaclemys* the quadratojugal is extensively united with the maxillary; in *Graptemys* these elements are separated by the quadratojugal. The peculiar character of the jugal in *Graptemys pulchra* may perhaps justify the creation of a new genus for this species. I have given to the common "Diamond-back" the name *Malaclemmys centrata* (Bosc. MSS.) Latreille, 1801. The name *M. terrapin* Schoepff, 1793, cannot be used. The same name (*Testudo terrapen*) was given by Bonnaterre in 1789 to the *Trachemys rugosa* Shaw, 1802, of Jamaica. Already in the year 1788, however, Gmelin introduced the name *Testudo palustris* for the Jamaica tortoise; I therefore use the name *Trachemys palustris* Gmelin for the Jamaica tortoise, and that of *Malaclemmys centrata* (Bosc. MSS.) Latreille for the "Diamond-back."

KINOSTERNON LOUISIANÆ spec. nov.

Shell much like *K. pensilvanicum*, but more elongated. Skull different; the lateral hook in the middle of the maxillary very much developed and very sharp; median hook on symphysis not so strong; postorbital arch stronger than in *K. pensilvanicum*. Lower jaw very strong, ending in a sharp point; symphysis of lower jaw larger than vertical diameter of orbit. A yellow-orange stripe from snout over upper part of orbit along neck, one from the angle of the mouth. Four barbels, two just behind the symphysis near together and two farther behind more separated. Limbs and neck olive gray; a few yellow spots on top of the posterior part of head; webs more developed than in *K. pensilvanicum*. Lower jaw with greyish-yellow dots and lines. The whole coloration is very much like that in *Aromochelys tristycha* Ag., which is found together with *K. louisianæ*. seen from above these two animals resemble each other very much. They belong to different genera, but have about the same specific characters.

I have received many specimens of this species through the kindness of Mr. Gustave Kohn, of New Orleans, La. This species is the representative of *K. pensilvanicum* in Louisiana. I have never received a specimen of *K. pensilvanicum* from this locality, and believe that all the specimens which have been described as *K. pensilvanicum* from this State belong to *K. louisianæ.* Type specimen, No. 15527, Smithsonian Institution, from New Orleans, La.

—G. BAUR, *University of Chicago.*

Further Notes on American Box-Tortoises.—In Science, of April 3, 1891 (Vol. XVII, No. 426), I have given the osteological characters of three of the American Box-Tortoises: *Terrapene major* Ag., *T. carolina* L., and *T. ornata* Ag.

Through the kindness of Mr. Gustave Kohn, of New Orleans, La., I have received lately three living specimens of *T. triunguis* Ag. (*C. cinosternoides* Gray, Boul.) Besides I have received a specimen of *T. mexicana* Gray, for which I have to thank Dr. A. L. Herrera, Director of the National Museum, Mexico. Both these forms proved to be very interesting. I give now osteological characters of all the forms of Terrapene.

TERRAPENE MAJOR AG., 1857.

Quadratojugal well-developed, forming a complete zygomatic arch; cervicals long; upper branch of scapula considerably longer than inner branch (endo-scapula); digits with well-developed webs.

Number of phalanges in fore-foot, 2 3 3 3 2; in hind foot, 2 3 3 3 2.

Southern States. Locality of type, Mobile, Ala.

TERRAPENE CAROLINA L., 1766.

Quadratojugal rudimentary, only connected with quadrate; cervicals shorter than in *T. major* Ag.; upper branch of scapula somewhat longer than inner branch (endo-scapula), but not so long as in *T. major*; digits slightly webbed.

Number of phalanges in fore-foot, 2 3 3 3 2 or 2 3 3 2 2; in hind foot 2 3 3 3 2.

Eastern States to Indiana.

TERRAPENE MEXICANA GRAY, 1849 (*Onychotria*).

Quadratojugal rudimentary, only connected with quadrate; cervicals probably as in *T. major;* upper branch of scapula as in *T. major.* No web between the digits and only three claws in the hind foot.

Number of phalanges in fore-foot, 2 3 3 2 2; in hind foot, 2 3 3 3 1.

Mexico.

This species is readily distinct from *T. triunguis* by its oval tectiform carapace. *The additional vertebral shield between the fourth and fifth, seen in both the British Museum specimens, is present also in the specimen received from Dr. Herrera.* .

TERRAPENE TRIUNGUIS AG., 1857.

Syn. *Emys kinosternoides* Gray.

Quadratojugal rudimentary, only connected with quadrate; cervicals somewhat shorter than in *T. major*; scapula as in *T. major*; no web between the digits, and only three claws in the hind foot. Shell as in *T. carolina* L.

Number of phalanges in fore-foot, 2 3 3 2 2 or 2 3 3 2 1; in hind foot, 2 3 3 2 1.

Louisiana, Arkansas, Indian Territory, Mississippi, Georgia.

TERRAPENE ORNATA AG., 1857.

Quadratojugal absent; cervicals very short; upper branch of scapula of the same length as inner branch (endo-scapula); digits without distinct web.

Number of phalanges of fore-limb, 2 2 2 2 2; of hind limb, 2 3 3 3 1.

Central States. Type from Upper Missouri, Iowa.

—G. BAUR, *University of Chicago.*

ENTOMOLOGY.[1]

Spiders collected in New Mexico and Arizona.—Among some spiders sent to Professor G. W. Peckham, of Milwaukee, a year or two ago, the following species of Attidæ was found.

Habrocestum hirsutum Peckham. This species was originally described from Oregon. The specimens sent were collected at Las Cruces, New Mexico.

Professor Peckham wrote that there were several other species of Attidæ in the sending, but that they were immature and could not be determined.

Some spiders sent to Dr. Geo. Marx, about the same time, were identified by him as follows. They were all collected at Las Cruces.

Pholcus n. sp. A very interesting one.

Lathrodectus n. sp.

Filistata capitata Hentz.

Ocyale n. sp.

Misumena rosea Keys.

Scytodes thoracica Latr.

Hamataliva grisea Keys.

Loxosceles unicolor Keys.

Dictyna sedentaria Keys.

Dr. Marx wrote that the last five species were of much interest, and mostly very rare.

Recently a lot of spiders was sent to Mr. Nathan Banks, including all that had been collected since the above sendings, both in New Mexico and Arizona. He has reported on them as follows.

The following are from north-eastern Arizona:

Tetragnatha laboriosa Hentz. ♂ and ♀.

Steatoda corollata Linn. ♀.

Misumena vatia Clerck. ♀ and young.

Olios giganteus Keys. Young.

Pardosa n. sp. ♀.

Phidippus sp. ? Young ♀. Mr. Banks writes that "this is probably *arizonensis* Peck., but the ♀ has not been described."

Dendryphantes retarius Hentz. ♀.

Dendryphantes octavus Hentz. ♂ and ♀.

[1] Edited by Dr. C. M. Weed, New Hampshire College, Hanover, N. H.

Dendryphantes sp. prob. new. ♀. Mr. Banks writes that "this is near *octavus* Hentz, and may be only a variety, but cannot decide without the ♂."

Eris barbipes Peck. Mr. Banks writes that this species "has not been recorded from the United States. It was described from Mexico."

The following are from southern New Mexico, mostly near Las Cruces:

Thanatus coloradensis Keys. ♂ and ♀.

Lathrodectus mactans Koch. Young.

Steatoda corollata Linn. ♂ and Young.

Pholcus n. sp. ♂ and young.

Filistata capitata Hentz. ♂.

Epeira trivittata Keys. ♂ and ♀.

Trochosa sp.? Young.

Marptusa californica Peck. Young.

Astia sp.? Young.

Eurypelma steindachneri Auss. ♂.

Ariope riparia Hentz. ♀.

Lycosa n. sp. ♂. This specimen was collected in the Organ Mountains. It is in all probability the same as the common form here, which is called the "tarantula."

A solpugid, found in southern New Mexico, was also included in the sending to Mr. Banks, and was determined by him as *Datames pallipes* Say.

Mr. Banks, in conclusion, writes as follows concerning this fauna: "Your fauna seems to have a Colorado tinge, with forms from California and the Gulf States. A number of the species run across from Texas to southern California."

The above list makes a showing of twenty-five species of Araneina from the south-western region, which, though small, is a material contribution to the knowledge of this fauna.—C. H. TYLER TOWNSEND.

Lepidopterous gall on Bigelovia.—On June 21, 1892, elongate flower-bud like galls were found on *Bigelovia graveolens*, near Galls Spring, New Mexico. Several which were opened on that date showed within what appear to be lepidopterous larvæ. The latter were reddish in color, somewhat the color of codling moth larvæ. More galls were found, June 22, west of Apache Spring, New Mexico. One of these which was opened showed two very small larvæ within.

Gall. Length 19 mm.; greatest width, 5 mm. Resembling an elongate flower-bud in shape and appearance, elongate pyriform with a stem-like portion about as long as the body of the gall, the whole appearing to be formed of a widened leaf or large stipule of the plant with the edges meeting and grown together, forming an elongate cavity inside, the basal stem portion narrow and more or less cylindrical, gradually thickening at body which is swollen. Stem clothed with fine white wooly fibers on the outside, the body light greenish and not so thickly wooly. Several narrowed and elongate leaves of the plant are grown to the outside of the body, springing from the stem and running longitudinally to tip of gall. These apparently reveal the mode of formation of the gall, which is, if I am not mistaken, formed of a number of the elongate leaves of the plant grown together, the edge of one to the edge of the next. The stem portion is not hollow but solid. The larvæ live in the hollow body of the gall.

Described from one specimen. The larva which was found within this gall shows no traces of thoracic or other legs, but possesses a large and distinct head with strong jaws. I infer that it is lepidopterous.—C. H. TYLER TOWNSEND.

North American Locusts.—Mr. Lawrence Bruner publishes[2] a valuable paper on "The More Destructive Locusts of America North of Mexico." A considerable number of species are treated of, full descriptions being given together with notes on preventive measures. Many new illustrations appear, four of which are reproduced on the accompanying plate, where *a* represents *Acridium frontalis* from Kansas; *b. Dendrotettix longipennis*, the "Post-oak Locust" of Texas *c. Melanoplus robustus* also of Texas; and *d*, the large green Bush-locust (*Acridium shoshone*) which occurs in many of the Southwestern States.

Entomological Notes.—The sixteenth of the admirable series of Reports of Observations of Injurious Insects by Miss Eleanor A. Ormerod of England has recently appeared. Its most distinctive feature in the way of illustrations consists of a number of plates, from photographs, of injuries to turnips and cabbages caused by eel-worms and slime fungi.

Mr. H. F. Wickham is spending the summer collecting insects and other specimens in the region of the West Indies. He is with a party from the Iowa State University.

Dr. A. S. Packard has recently published two important papers on Heterocera. One deals with "The life-histories of certain moths of the

[2] U. S. Dept. Ag., Div. Ent. Bull., No. 28.

family Cochliopodidæ, with notes on their spines and tubercles"[3] and the other records the author's "Studies on the transformations of Moths of the family Saturniidæ[4]". In both papers the armature of the caterpillars is carefully described, and many figures are given.

Professor C. H. T. Townsend formerly of the New Mexico Agricultural College announces that after June 1, 1893 his address will be: C. H. Tyler Townsend, Curator of Museum, Institute of Jamaica, Kingston, West Indies.

Mr. James Fletcher has favored us with a copy of his "Evidence before the standing Committee of the House of Commons on Agriculture and Colonization" for the session of 1892. It is a careful discussion of the economic value of entomological study.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—May 17.—The following paper was read: Dr. Clarence J. Blake—Out of Darkness into Light; or The Education of a Blind Deaf-Mute.

—SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—May 20.—The following communications were read: Dr. V. A. Moore—The Distribution of Pathogenic Bacteria in the Upper Air Passages of Domesticated Animals; Professor C. V. Riley—Some Further Notes on Yucca Pollination; Professor B. W. Evermann—The Ichthyologic Features of the Black Hills; Dr. W. H. Dall—New Forms of Fossils from the Old Miocene of the Gulf States; Dr. C. Hart Merriam—Biology in our Colleges; Dr. C. Hart Merriam—Facts of General Biological Interest Resulting from a Study of the Kangaroo Rats.

FREDERICK V. COVILLE, *Secretary.*

Anthropological Society of Washington.—May 9.—The following papers were read: Common Errors in Regard to Indian Language, Mr. J. N. B. Hewitt; Primitive Belief in a Future State: a Comparative Study, Mr. H. E. Warner; The Pivot Point in Modern History: Andrew Palaeologus at Barcelona, Col. F. A. Seely; Fourth Centenary of the Discovery of America, at Madrid, 1892, Dr. Thomas Wilson.—WESTON FLINT, *Secretary.*

[3] Proc. Amer. Philos. Soc. v. XXXI, pp. 83–108.

[4] Proc. Am. Acad. Arts and Sciences, 1893, pp. 55–92.

The Agassiz Scientific Society of Oregon met Wednesday, May 10, at 8 P. M., in the Botanical Laboratory of the Agricultural College. The principal paper of the evening was by Professor Dumont Lotz on "Food Adulterants."—F. L. WASHBURN, *Sec.*

SCIENTIFIC NEWS.

—THE entire Leidy collection of Parasites, property of the Biological Department, University of Pennsylvania, has been placed in the hands of Dr. C. W. Stiles for revision. Dr. Stiles intends to publish a descriptive catalogue of this collection, together with a descriptive catalogue of eight other collections now in his possession.

—THE Smithsonian Institution has taken an American table at the Naples Station for three years. Dr. Stiles will publish the correspondence between Secretary Langley and himself relating to the table, in the form of a report to the signers of the memorial presented to the Institution, in a later number of the NATURALIST.

THE next meeting of the Australian Association for the Advancement of Science will be held in Adelaide, South Australia, commencing on September 25, 1893.

The Association has now been in existence since 1888. Four meetings have been held, viz :—

In September, 1888, at Sydney—President, H. C. Russell, C. M. G., B. A., F. R. S., Government Astronomer, N. S. W.

In January, 1890, at Melbourne—President, Baron F. von Mueller, K. C. M. G., Ph.D., F. R.S.

In January, 1891, at Christchurch—President, Sir James Hector, K. C. M. G., M. D., M. D., F. R. S.

In January, 1892, Hobart—President, His Excellency, Sir Robert Hamilton, K. C. B.

The meeting in Adelaide will be presided over by Ralph Tate, F. L. S., F. G. S., Professor of Natural Science at the University of Adelaide.

Since its commencement the Association has grown steadily, and now numbers about 900 members. The work is divided into sections as in the British Association, whose rules on most points have been closely followed.

The meeting of next year will last about a week, during which time the Sections will meet daily for the reading and discussion of papers. During the week there will be various short excursions to places of interest, and some evening entertainments. After the meeting one or two longer excursions will be arranged.

At the time fixed for the meeting, South Australia will be at its best. There is no better time at which to visit Australia than when spring is merging into summer. To naturalists, this time of year is specially attractive, and these may be reminded that at the meeting of the Association they will come into contact with men of like tastes from all parts of Australia.

Should visitors wish to prolong their trip, they will do well to visit during the months of October and November the principal objects of interest in the mainland, and in December, January and February to pass on to New Zealand and Tasmania.

Table of Contents of the North American Review for June, 1893.—THE LESSON OF THE NAVAL REVIEW, by the Hon. Hilary A. Herbert, Secretary of the Navy; Who are the Greatest Wealth-Producers? W. H. Mallock; How to Check Testamentary Litigation, Surrogate Ransom, of New York; Disappearing Dickensland, Charles Dickens; A Look Ahead, by Andrew Carnegie; Police Protection at the World's Fair: I. By the General Superintendent of the Chicago Police—II. By the Chief of the Secret Service, World's Columbian Exposition; Thirty Knots an Hour to Europe, Professor J. H. Biles, Designer of the "Paris" and the "New York:" Reform of the Drink Traffic, the Rev. W. S. Rainsford, D. D.; The Financial Outlook, by the Hon. W. Bourke Cockran. *Notes and Comments.*—Christ as an Orator, T. Alexander Hyde. A Farmer's View of Free Coinage, Newton F. Bunnell; The Art of Living Two Hundred Years, William Kinnear; Inebriety from a Medical Standpoint, Dr. E. F. Arnold.

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VOL. XXVII. August, 1893. 320

THE SPORE-FORMING SPECIES OF THE GENUS SACCHAROMYCES.

J. CHRISTIAN BAY.

In his monograph on the *Saccharomycetaceae* [*Saccardo*: Sylloge Fungorum omnium hucusque cognitorum, Vol. VIII, page 916–22.] *J. B. de Toni* enumerated 31 species of the genus *Saccharomyces* Meyen upon which the family is based by *Reess* in the year 1870, when it was separated from the *Ascomycetes*. Since *De Toni's* monograph was published, our knowledge of this important family, among which very important culture plants are found, has been widely broadened, mainly by the investigations of *Emil Chr. Hansen*, so that several species may be added to those already known. But further *De Toni*, in his monograph, has given no notice to the species described and figured by *Hansen*, nor to the extensive literature based upon these. We find in the " Sylloge " species as *Saccharomyces ellipsoideus* Reess, *S. conglomeratus* Reess, *S. Pasteurianus* Reess, and the description of the species is based solely upon the morphology of the cells. In fact, for the description not only reliable morphological but purely physiological characters of these fungi have been used and must to a certain extent be used. *Reess* and other mycologists before *Hansen* and his school have taken in consideration for the description almost solely the morphological characters of the cells; but we may easily observe that the form and size, etc., of the cells have very little to do with the species question. The latter depends much more upon the number of spores found in the cells, the conditions for the spore-formation, and the effect upon the various kinds of sugar. As therefore *De Toni's* monograph can not pretend to give a correct account of the species known up to date, I have tried to bring together the forms in which a formation of spores has been found, with description of the various stages in their development. A later number of this series, materials for a monograph on the alcoholic fermentation, will contain the literature in full.

Fungaceae. Linné, Gen. 1737, page 327.

SACCHAROMYCETACEAE. Reess.

M. Reess: Botanische Untersuchungen ueber die Alkoholgaehrungspilze, 1870. Winter: Die Pilze (in Rabenhorst's Kryptogamenflora)I, 1, page 68. *Blastomycetes* Frank: Leunis Synopsis, Botanik, III, page 595.

Genus: *Saccharomyces.* Meyen.

Meyen: Wiegmann's Archiv. Vol. IV. 2, page 100, 1838. Reess, l. c. Winter, l. c., page 69. Joergensen, Die Mikroorganismen der Gaehrungsindustrie, 1890, page 123. Saccardo, Sylloge, VIII, page 916 [De Toni.]. Ludwig: Lehrbuch der niederen Kryptogamen, 1892, page 210.

All species unicellular, often adhering together, forming a false mycelium. Hyphae or regular mycelia never occur. Cells circular, oval, or ellipsoid, often rectangular. *Habitat:* Causing the conversion of glycose into alcohol and carbonic acid, and a few other products, most of the species are always found in fermenting fluids. Some species are found in other places, most of these, however, have not been observed forming spores. Further investigation must determine the true nature of the latter; probably some of them belong to the Torula-forms in the sense of Pasteur. Owing to the general feeling that the Saccharomyces are characterized mainly by their faculty of spore-formation, I took up only these forms in the present synopsis.

Propagation by buds. This is the general way of propagation. Where a vigorous conversion of sugar is caused by the Saccharomyces, an equal rapidity of the budding is always observed.

Propagation by spores. In all of the species mentioned here a spore-formation has been traced and investigated, and many species are based upon the conditions for this formation, which *Hansen* has found constant in all the forms described and studied by him.—Form of spores round or oval, in one species, "hat-formed;" their number 1–10 or more. Appearance various in the various species, also transparency. Spores invariaably endogenous.

Appearance of the colonies. When cultivated in a 10 per cent. beer-wort-gelatine the colonies appear as round or oval, white macroscopic spots, the outline of which is even in some, uneven in other species.—Cultivation for spore-formation, see *Hansen:* Meddelelser fra Carlsberg-Laboratoriet. Vol. II, page 152; *Holm* and *Poulsen,* ibidem page 218. (Compte Rendus, etc., Carlsberg. II, page 97; *Holm and Poulsen,* ibid, page 141.) 1886–88.—For the formation of a top-vegetation see each single species.

1. *Saccharomyces cerevisiae I.* Hansen.

Hansen, l. c. II, page 67; Plate I, fig. 1; Pl. III, fig. 1–3. - Sacch. cerevisiae Meyen (ex parte) Wiegm. Arch. IV, page 109; Reess Unters. page 81; Pl. 1, fig. 1–17; Pl. II, fig. 1–6. Winter: Pilze. I, 2, page 69, and fig. Joergensen Mikroorg. 1890, page 124. Ludwig, l. c. page 215.

Torula cerevisiae Turpin: Mém. de l'Académie XVII, 1840, page 93; Plate I- , Comptes Rendus de l'Acad. Vol. VII, 1838, page 369 (without plates.), Liebigs Annalen XXIX, page 93. Kuetzing: Journal fuer prakt. Chemie Vol. XI, page 387, 1837, and plate.—Cryptococcus cerevisiae Kuetz.: Phycol. gener. page 148, 1843; Cryptococcus cerevisiae Kuetz, Species Algarum, page 146, 1849.—Hormiscium cerevisiae Bail in Flora 1857, page 417. Pasteur: Ann. d. Phys. et de Chim. LXII, page 332–426. id. Etudes sur la bière, page 185–192, 1876. Garnier: Ferments et Fermentations Paris, 1888, page 75.

This form and many varieties of it is common in breweries. The specific form gives a top-fermentation. Cells 2, 5 μ–6μ; the young culture gives mainly round and slightly oval, or ellipsoid cells. Spore-formation found: Maximum: 36°–37° C., minimum 11°–12°C. The first trace of spores at 25° C. found in 23 hours, at 15° C. in 72 hours. Number of spores generally 1–4, of round shape and of strong reflecting power.

In giving a key to the determination of the species, it seems best to select the occurrence of spore-formation by 25° and 15°, not only because this is most instructive but also because these temperatures are used for examination of the yeast in the breweries, the physiological yeast-analysis; another reason is that it enables the investigator to keep two thermostates at the points 25° and 15° as long as the investigation lasts. The very best apparatus for these investigations is, of course, the Panum thermostate, described by Pedersen in Meddelelser fra Carlsberg-Laboratoriet, Vol. I, page 48–52, 1878, or by Panum in Nordisk medic. Arkiv. Vol. X, No. 4.

This species and its varieties, which are cultivated for constant use in brewing establishments are known as "cultivated yeasts," the other forms, which cause "sickness" in the product, being commonly called "wild yeasts." In these cultivated forms, the spores are very refractive, compared with the other forms, and their spore-forming cells often display a singular formation of a thick wall which divides the cell into various parts, each of these containing a spore. This "wall" is very refractive and consists of the protoplasm of the cell, pressed in between the walls of the spores. But the same formation may also appear as a result of the spores being pressed against each other. Occasionally there is a real formation of a wall, when the spores cannot be separated, and then the cell turns out to be a kind of a sporangium.

A superficial layer of cells which we will call top-vegetation occurs at 3°–5° C. never after 7–10 days at 20–22° C. This kind of vegetation generally gives cells of a singular shape.

Among the many varieties found in breweries all over the world all cannot be sure to give the same results; but the question of variation has still to be debated.

2. Saccharomyces Pastorianus I. Hansen.

Hansen, l. c. II, page 68; Plate I, fig. 2; Pl. V, fig. 1–3.—S. Pastorianus Reess, l. c. page 83; Pl. II, fig. 11–13 (ex parte.). Winter, l. c. page 70. Saccardo, l. c. page 917. Pasteur: Etudes sur la bière, 1876, page 150, fig. 128, Pl. X–XI, page 171–75, fig. 33–37, Pl. XII (ex parte.). Garnier, l. c. page 78. Joergensen, l. c. page 127. Ludwig, l. c. page 215.

Often found in the cellars where the fermentation of the beer takes place; it gives a bottom- fermentation. A young culture in beer-wort gives round and oval, sausage-formed cells; the spores are formed at 27°, 5 in 24 hours, at 15° in 50 hours, maximum being at 29°, 5–30°, 5, minimum at 3°–4°. Number of spores 1–5, commonly 5–10 are also found, their diameter being 1.5–5μ.

Top-vegetation does not occur at 34°, but in 8–15 days at 20°–22°; it gives cells of irregular shape, long, sausage-formed, as well as small, round and oval cells. Gives the beer a very bitter taste.

3. Saccharomyces Pastorianus II. Hansen.

Hansen, l. c. page 69; Pl. I, fig. 3; Pl. V, fig. 1–3. Other references under the preceding species (ex parte.). Joergensen, l. c. page 129. Ludwig, l. c. page 215.

Common in the air in the brewery, consequently often found in the fermenting beer. Cells round or long oval. Spore-formation: 25° in 25 h., 15° in 48 h. Maximum 27°–28°, minimum 3°–4°. Spores like those of the preceding, wall-formation sometimes found.

Gives a weak top-fermentation. Top-vegetation gives, when the culture is young, a large number of small, round or oval cells, when old, we find long, irregular shaped forms; not found at 34°, at 20°–22° in 8–15 days.—Gelatine-cultures give round, even-edged colonies.

4. Saccharomyces Pastorianus III. Hansen.

Hansen l. c. II, page 70, Pl. II, fig. 1; Pl. VI, fig. 1–3. See preceding. Joergeusen, l. c. page 130. Ludwig, l. c. page 216.

Found causing a peculiar disease in the yeast. Gives a well marked bottom-fermentation. Cells long, oval and ellipsoid. Spore-formation: 25° in 28 h., 15° in 35 h. Max. 27°–28°; Min. 4°. Top-vegetation never found at 34°, occurs in 9–12 days at 20°–22°, the culture giving, when old, very irregular, almost thread-shape cells.—Gelatine-culture has round colonies with fringed edges.

5. *Saccharomyces ellipsoideus I.* Hansen.

Hansen, l. c. II, page 71; Pl. III, fig. 2; Pl. VII, fig. 1–3.
S. ellipsoideus Reess, l. c. page 82; Pl. III, fig 1–7. Pasteur, l. c. page 242, fig. 58. Joergensen, l. c. page 132. Ludwig, l. c. page 216. [" Wine-yeast."]

Found on the surface of grapes. Cells round, oval, ellipsoid; gives bottom-fermentation. Spore formation: 25° in 21 hours. 15° in 45 h.; maxim. 30°, 5–31°, 5; minim. 7°, 5. Top-vegetation gives always round and oval, scarcely long and irregular cells, does not occur at 38°, but at 20°–22° in 10–17 days.

5. *Saccharomyces ellipsoideus II.* Hansen.

Hansen, l. c. II, page 71; Pl. II, fig. 3; Plate VIII, fig. 1–3. Reess, Pasteur loci cit. Joergensen, l. c. page 135. Ludwig, l. c. page 216.

Found together with S. Pastorianus III in diseased yeast. Gives sometimes top-, sometimes bottom-fermentation. Cells similar to those of S. ellipsoideus I. Spore-formation: 25° in 27 h., 15° in 70 h. Max. 33°–34°; min. 8°.—Young top vegetation gives round and oval cells, occurs never at 40°, at 20°–22° in 4–6 days; the old vegetation has long cells, and a mycelium-like appearance.

7. *Saccharomyces Marxianus.* Hansen.

Hansen: Annales de Micrographie, 1888, Nr. 2–3, page 3, l. c. page 222, Joergensen, l. c. page 136. Ludwig, l. c. page 219.

Found on grapes. In beer-wort it gives a number of elliptic, egg-formed cells, and later small colonies of mycelium-like growth. Spores not easily formed, the latter being generally round or slightly oval, but often kidney-shaped. Top-vegetation scarce. On gelatine a "false" mycelium is often formed.

8. Saccharomyces exiguus. Hansen.

Hansen: Annal. d. MicrVogr. 1888, Nr. 2–3, page 5; l. c. II, page 225. [Reess, l. c. page 82; Pl. II, fig. 7–8, and Hansen, l. c. I, page 227. (ex parte.)]. Saccardo, Sylloge, VIII, page 917, 1889. Joergensen, l. c. page 136. Ludwig, l. c. page 220. Winter, Pilze, I, page 70 (ex parte.).

Probably a distinct species. In beer-wort good development and often formation of a "yeast-ring." Cells 2–5μ, round and oval, scarcely long.—Found in press-yeast. Spores rare, top-vegetation seldom occurs. No mycelial growth in fluids.

9. Saccharomyces membranaefaciens. Hansen.

Hansen: Ann. d. Micr., l. c. page 6; l. c. II, page 225. Saccardo, l. c. page 918. Joergensen, l. c. page 137. Ludwig, l. c. page 220.

Found on decaying elm-roots. Gives in beer-wort abundant top-vegetation of oval cells. Spores easily formed both in cultures in fluid and in spore-cultures. Gelatine-cultures show reddish colonies, the substratum being slowly liquefied.

10. Saccharomyces Ludwigii. Hansen.

Hansen, Centralbl. f. Bakteriol. u. Paras. V, page 638, 1889; Meddel. III, page 62, 1891. Joergensen, l. c. page 138. Ludwig, l. c. page 218.

Found in "Schleimflüsse" of oak-trees. Cells elliptical, flask-formed, or long and irregular shaped. On gelatine a mycelium is developed, with branches and septa. Cultures in fluids give spores abundantly. Power of variation great, some forms easily giving spores, while others do not. Germination of spores peculiar; see Hansen, Medd. III, page 62–70. 1891.

11. Saccharomyces anomalus. Hansen.

Hansen, l. c. III, page 71. Ludwig, l. c. page 219.

In impure yeast from brewery and on grapes. Cells round and oval, rarely long. Spores formed both in the bottom-yeast and in the top-vegetation, they are " hat-shaped," a form not occurring in any other species.

12. Saccharomyces Hansenii. Zopf.

Zopf: Berichte der Deutschen bot. Gesellschaft, Vol. VI, page 94–97; 1889, with figures.

Found in cotton-dust. Spores 1–2 in each cell, ball-formed, diam. 2–4μ. This species does not give rise to alcoholic fermentation, but it brings fermentation in a solution of saccharose, dextrose, lactose, galactose, maltose, mannit, dulcit, and glycerin, converting these sugars and the glycerin into oxalic acid, the latter being found at the bottom of the solution as calcium oxalate when the fermentation is at an end.

13. Saccharomyces Joergensenii. Lasché.

Lasché: Der Braumeister, Vol. V, page 242–245. Chicago, 1892; and Zeitschrift f. d. gesammte Baruwesen, Munich 1892. With figures.

Found in "temperance-beer." Cells 2.5–5.5μ. Spore-formation: 26° in 20 h., 25° in 17 h., 12° in 4 days. Maxim. 28°–30°, Min. 8°: " wall "-fermation in the spore-forming cells scarce. Causes no disease in the beer. Gelatine-cultures give a " false mycelium."

[*14. Saccharomyces conglomeratus.* Reess.

Reess, l. c. page 82; Pl. II, fig. 14–16. Winter, l. c. page 70. Saccardo, l. c. VIII, page 917. Joergensen, l. c. page 140.

Cells 5–6μ. Typical forms appear with more than one bud on the propagating cell. It is hardly a distinct species, because such forms often are found in old cultures by Hansen, Will, and other investigators,[1] mainly in top-vegetation.]

15. Saccharomyces albicans. Reess.

Reess; Sitzungsberichte d. phys. med. Gesellschaft Erlangen. 1877. Winter, l. c. page 72.

[1] For example, see Will's figures.

Oidium albicans Robin (Histoire naturelle d. vég. parasit. page 488; pl. I, fig. 3–7.)

Cells round and oval, found in the mouth of small children. Number of spores one. Has been considered the same as Sacch. mycoderma (Mycod. cerevisiae) which forms no spores and therefore is probably no Saccharomyces.

16. Saccharomyces Reessi. David.

David: Annalen der Oenologie IV, page 223, 1878.

Found in wine-fermentation. Cells form three spores. Almost unknown.

17. Saccharomyces galacticola. Pirot. and Rib.

Pirotta and Riboni: Studii sul latte, page 14, pl. VI, fig. 6; pl. XVII, fig. 1, 1879.

Occurs in "fermenting" milk where it forms smaller rows, sometimes a short mycelium. Cells with 2–4 spores.

18. Saccharomyces I of Will.

Will: Zeitschrift f. d. gesammte Brauwesen. No. 7–8. 1891.

In beer; the taste of the product becomes very much affected. Cells oval or of a pastorian form. The top-vegetation has long cells and a "false mycelium," when old. The old bottom-yeast forms short rows, similar to those cultivated varieties which give top-fermentation. Spore-formation: 25° in 14, 5 h.; 15° in 41 h. Max. 41°; min. 4°–5°. Top-vegetation: 41° never; 22°–23° in 4–6 days. "Conglomeratus"-forms (see No. 14) figured.

19. Saccharomyces II of Will.

Will l. c.

Habitat as the preceding form. Spores: 24°, 5–25° in 31 h.; 15°–15° 5 in 74 h.; diam. 2–4μ, number: 1–4. Max. 32°; min. 0°, 5–1°. Top-vegetation found, often developing into the formation of a yeast-ring.

20. Saccharomyces minor. Engel.

Engel: Les ferments alcooliques, 1872. Arcangeli: Nuovo giorn. bot. Ital, 1888, page 303. Joergensen, l. c. page 139.

Sphaerous cells, diam. 6μ. Short rows. Spore-forming cells 7–8μ; spores 2–4, diam. 3μ.

21. Saccharomyces Ilicis. Groenlund.

Groenlund: Zeitschr. f. d. gesammte Brauwesen, 1892, page 289, with fig., and Videnskabelige Meddelelser f. d. naturhist. Foren. i Kjoebenhavn, Vol. LIV, page 5, 1893.

Found on fruits of Ilex aquifolium. Cells round, similar to Sacch. cerev. I. Spore-formation: 25° in 22 h., 15°. 5 in 3 days. Max. 36°–37°; min. 9°. 5.—Bottom-fermentation. Top-vegetation found after 122 or 165 days in the temperature of the room, in sunlight after 93 days. Gives the beer a disagreeable, bitter taste.

22. Saccharomyces Aquifolii. Groenlund.

Groenlund, l. c., page 297; Vid. Medd., page 9.

On Ilex-fruits. Cells larger than those of the preceding. Spores: 25°, 5–26°, 5 in 29 h.; 16° in 3½ days. Max. 27° 5–28°, 5; min. 10°–10°, 5. Gives the beer a sweet-bitter taste. Top-fermentation.

Concluding Remarks.

If we were able to trace the *Saccharomycetaceae* back into their history, we should be able to form an opinion with regard to their origin. But, for the present time, there is no reason whatever for regarding these organisms as a form of some fungi of higher organization which have been subject to a one-sided evolution. We have never seen a *Saccharomyces* develop into anything but a *Saccharomyces.*

The term "fermentation" is hardly to be used any more. Originally, in the sense of *Liebig,* it meant the conversion of carbo-hydrates into products of a lower combination, terminating in the formation of CO_2 and H_2O, by means of the life-activity of lower organisms (the theory of vitality). Now, however, it is also applied to the *conversion of proteid substances* by means of a life-activity. Since the enzymes have been found and studied, it would be more proper to speak of the conversion of such and such matter into certain products

I. THE CONDITION OF THE SPORE-FORMATION AND OF TOP-VEGETATION.

Temp. °C.	S. cerevisiae I.		S. Pastor I.		S. Pastor II.		S. Pastor III.		S. ellips. I.		S. ellip, II.	
	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.	Spore-f.	Top-veg.
40.°												0.
38.										0.		—
37	0; 29 h.											
35											0.	
34		—; max.		0.		0.		0.		—	—; 31 h.	
32									0.			
31				0.					—; 36 h.			
30	Opt. 20h.			—; 30 h.					—23 h.			
29			—; 27 h.		0.		0.				Opt.; 22 h.	
28				—	—; 34 h.	—	—; 35 h.	—				
27			Opt.; 24 h.									
25	—; 23 h.		—; 24-26 h.		Opt.: 25 h.		Opt.; 28 h.		—; 21 h.	—; 10-17 d.	—; 27 h.	—; 4-6 d.
20-22		7-10 d.		—; 8-15 d.		—; 8-15 d.		—; 9-12 d.		—; 15-30 d.		—; 8-10 d.
13-15		15-30 d.		—; 15-30 d.		—; 10-25 d.		—; 10-20 d.				
11	—; 10 d.	—; 10 d.										
9	0.											
8							—; 9 d.				—; 9 d.	
7										—		
5		0.		—		—		—		0.		—
4			— } 14 d.		— } 17 d.		0.		0.		0.	
3			— } 14 d.		— } 17 d.							
2				0.		0.		0.				0.
0.5.					0.							

0 signifies no growth.
— signifies that the process takes place.

h. hours.
d. days.

II. ACTION OF THE SPORE-FORMING SACCHAROMYCES ON DIFFERENT KINDS OF SUGAR.

	$C_6H_{12}O_6$	Invert sugar formed and the invertin fermented.	$C_{12}H_{22}O_{11}$	Maltose.	Lactose.
S. cerevisiae I. S. Pastorianus I–III. S. ellipsoideus I–II. S. Ilicis; S. aquifolii.	0.	—	—	—	0
S. Marxianus; S. exiguus. S. Joergensenii; S. Ludwigii.	0.	—	—	0.	0.

0 signifies no fermentation; — signifies a fermentation.

III. SIZE AND NUMBER OF SPORES.

No.	Spores.		No.	Spores.	
used above.	Diameter.	Number.	used above.	Diameter.	Number.
1	2,5–6μ.	1– 5.	12		
2	1,5–5μ.	1–10.	13	1–2,5μ.	2–4.
3	2–5μ.	1– 7.	14		
4	2–4μ.	1–10.	15		1.
5	2–4μ.	1– 4.	16		3.
6	2–5μ.	1– 4.	17		2–4.
7	2–4μ.		18	1,5–5μ.	1–5.
8	2–4μ.	2– 3.	19	2–4μ.	1–4.
9			20	3.	2–4.
10		1– 8.	21		
11		2– 4.	22		

through the life-activity of this or that organism, or enzyme, and this mode of expression would also indicate more about the process than the terms fermentation or putrefaction are able to do.

The names yeast or yeast-fungi ought to be used exclusively on the species of Saccharomycetes, not including the mycoderma (cerevisiae and vini—Saccharomyces mycoderma), Torula, and those of the moulds which give either no fermentation or a fermentation (conversion of glucose) with a large per cent. of alcohol. And, finally, the genus Saccharomyces should comprise only the spore-forming species.

Missouri Botanical Gardens, May, 1893.

NOTES ON THE MARINE BIOLOGICAL LABORATORIES OF EUROPE.

By Bashford Dean,
COLUMBIA COLLEGE, NEW YORK.

PART II.

Naples.

The Stazione Zoologica at Naples during the past twenty years has earned its reputation as the center of marine biological work. Its success has been aided by the richness of the fauna of the Gulf, but is due in no small degree to careful and energetic administration. The director of the station, Prof. Dohrn, deserves no little gratitude from every worker in science for his untiring efforts in securing its foundation and systematic management. Partly by his private generosity and partly by the financial support he obtained, the original, or eastern building was constructed. Its annual maintenance was next assured by the aid he secured throughout (mainly) Germany and Austria. By the leasing of work tables to be used by representatives of the universities, a sufficient income was maintained to carry on the work of the station most efficiently. A gift by the German government of a small steam launch added not a little to the collecting facilities.

Attractiveness is one of the striking features of the Naples station. It has nothing of the dusty, uncomfortable, gloomy air of the average university laboratory. Its situation is one of the brightest; it has the gulf directly in front, about it the city gardens, rich in palm trees and holm oaks. The building itself rises out of beds of century plant and cactus, like a white palace; the fashionable drive-way alone separates it from the water's edge. In full view is the Island of Capri, to the eastward is Vesuvius,—a bright and restful picture to one who leaves his work for a five minutes stroll on the long, covered balcony which looks out over the sea.

The student, in fact, knows the Naples station before he visits it, although he can hardly anticipate the busy and profitable stay that there awaits him. He has received the circular from the Secretary of the laboratory while perhaps in Germany, when he secured the privilege of a table. He is told of the best method of reaching Naples, the precautions he must take to secure the safe arrival of his boxes and instruments. He is told to send directions as to the material he desires for study; he is notified of the supplies which will be allowed him, and of the matters of hotels, lodging and bank-

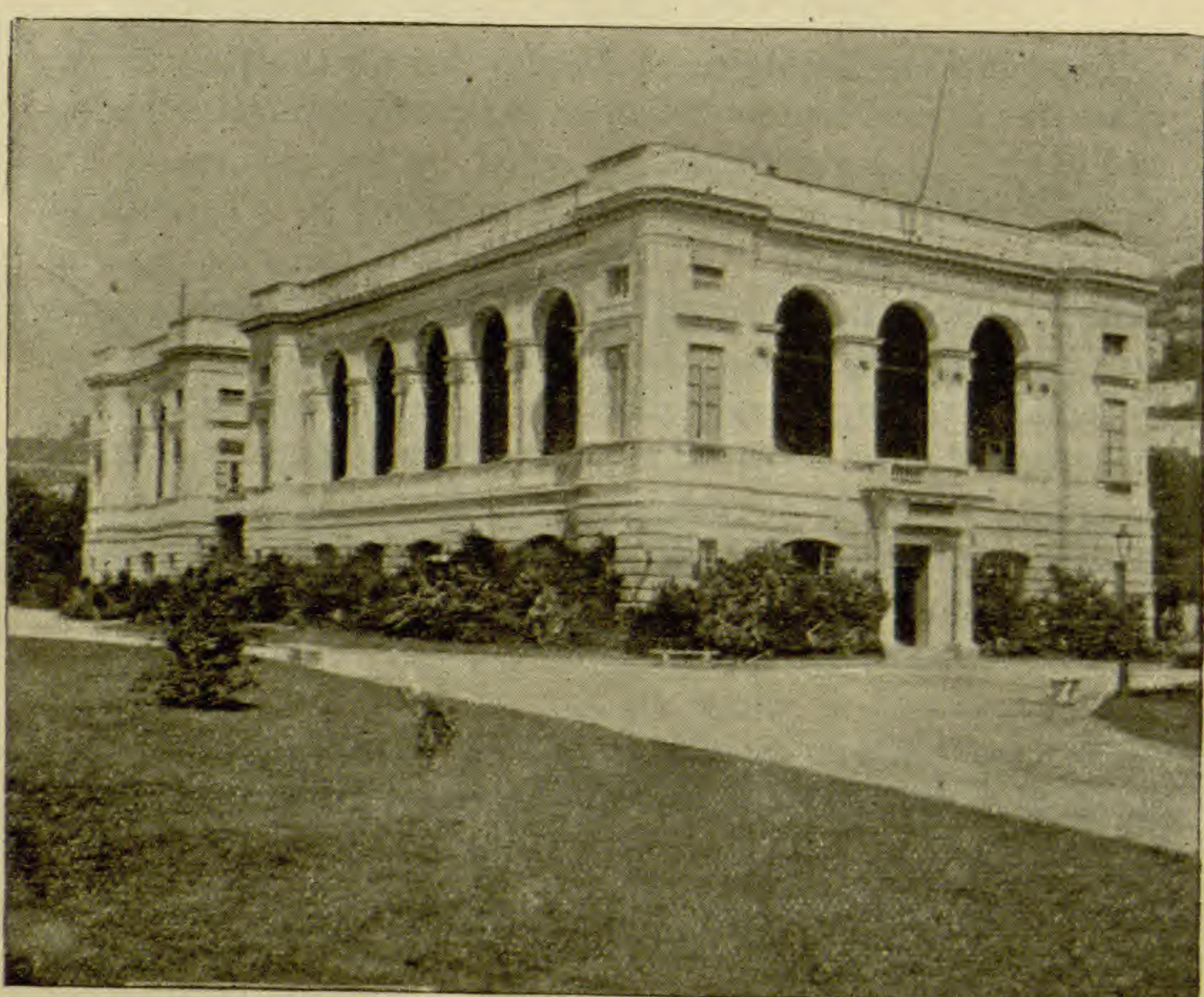


FIG. 1.
Stazione Zoologica of Naples. From view taken by writer, June, 1891.

ing, necessary even to a biologist. At the first sight of the building he is impressed most favorably, and it is not long before he comes to look upon his work-place as his particular home, open to him day, night and holidays. He likes the general air of quietness,—in no little way significant of system in every branch of the station's organization; his neighbors are friendly and he feels that even the attendants are willing, often anxious to give him help.

At present the station at Naples consists of two buildings; the first shown in the foreground in the accompanying figure (Fig. 1), is the older, the main building, behind it is the newly built physiological laboratory. In the basement of the main building is the aquarium, well managed, open to the public, and eagerly visited. Passing into the aquarium room from the main entrance, one descends into a long, dark, concreted room, lighted only through wall-tanks brilliant on every side with the varied forms of life. There are in all about two dozen large aquaria embedded in the walls of the sides and of the main partition of the room. The water is clear and blue. The background in each aquaria, built of rock work, catches the light from above and throws in clear relief the living inmates. The first tank will perhaps be full of star fish and sea urchins, bright in color, often clustered on the glass each with a dim halo of pale, threadlike feet. In the background may be a living clump of crinoids, flowering out like a garden of bright colored lilies. In a neighboring tank, rich with dark colored seaweeds, will be a group of flying gurnards, reddish and brilliantly spotted, feeling cautiously along the bottom with the finger-like rays of their wing-shaped fins. Here too may be squids, delicate and fish-like, swimming timidly up and down; perhaps a series of huge triton snails below amid clustered eggs of cuttle fish. In another tank would be a bank of sea anemones with all the large and brilliant forms common to southern waters. Here may be corals in the background and a forest of sea fans in orange, red and yellow, with a precious fringe of pink coral, flowering out in yellow starlike polyps. There may again be a host of ascidians, delicate, transparent, solitary forms, the lanky Ciona, the brilliantly crimson Cynthia and huge masses of varied, compound forms. Swimming in the water may be chains of Salpa and occasionally a number of Amphioxus, the latter, as they from time to time emerge from the sandy bottom, flurry about as if with sudden fright, quickly to disappear. Variety is one of the striking characters of neighboring tanks. In one, brilliant forms will outvie the colors of their neighbors, in another, the least obtrusive mimicry will be exemplified. The stranger has often to examine carefully before, in the seemingly empty tank, he can determine on every side the living forms whose color characters screen them effectively. Thus he will see sand-colored rays and flounders, the upturned eyes of the curious star-gazer almost buried in the sand, a series of mottled crustaceans wedged in a rocky background, an occasional crab wandering cautiously about, carrying a protective garden of seaweeds on his broad back; odd sea horses posing motionless, mimicing the rough stems of the seaweeds. In the larger tank sea turtles float sluggishly about; and coiled amid broken earthern jars, are the sharp-jawed murrys, suggestive of Roman dinners and of the cultural experiments of Pollio. Aëration in the aquaria is secured effectively by streams of air which are forced in at the water surface and subdivide into bright clouds of minute silvery bubbles. The tanks are cared for from the rear passage-ways; attendants are never seen by visitors and constant attention has given the aquaria a well earned reputation. Descriptive catalogues with figures enable the stranger to better appreciate the aquarium.

To the remainder of the building strangers are not admitted. A marble stairway leads from the door of the aquarium to a loggia which opens into the territory of the students. A long pathway of grating extends across the open center of the building,—whose skylight top admits the light to the aquarium below. On the one hand is the main laboratory room, on the other the library and separate rooms intended for more fortunate investigators. One enters the main laboratory, passes a wall of student aquaria and sees a series of alcoves formed by low partitions, each work place with its occupant, his apparatus, his books, his jars,—altogether often a picture not of the utmost tidiness. A small iron staircase leads to a gallery which gives a second tier of work places and doubles the working capacity of the room. Here, side by side, will be representative workers from universities of every country of Europe.

The library room adds not a little to the attractiveness of the Naples station. It is a long room, and, as shown in

(Fig. 2), is adorned with frescoes in a truly Italian style. It looks out into a long loggia with view of the sea and Capri, where the student is wont to promenade or retire in after lucheon hour with easy chair and book. The working library is of the best and is sure to contain the results of

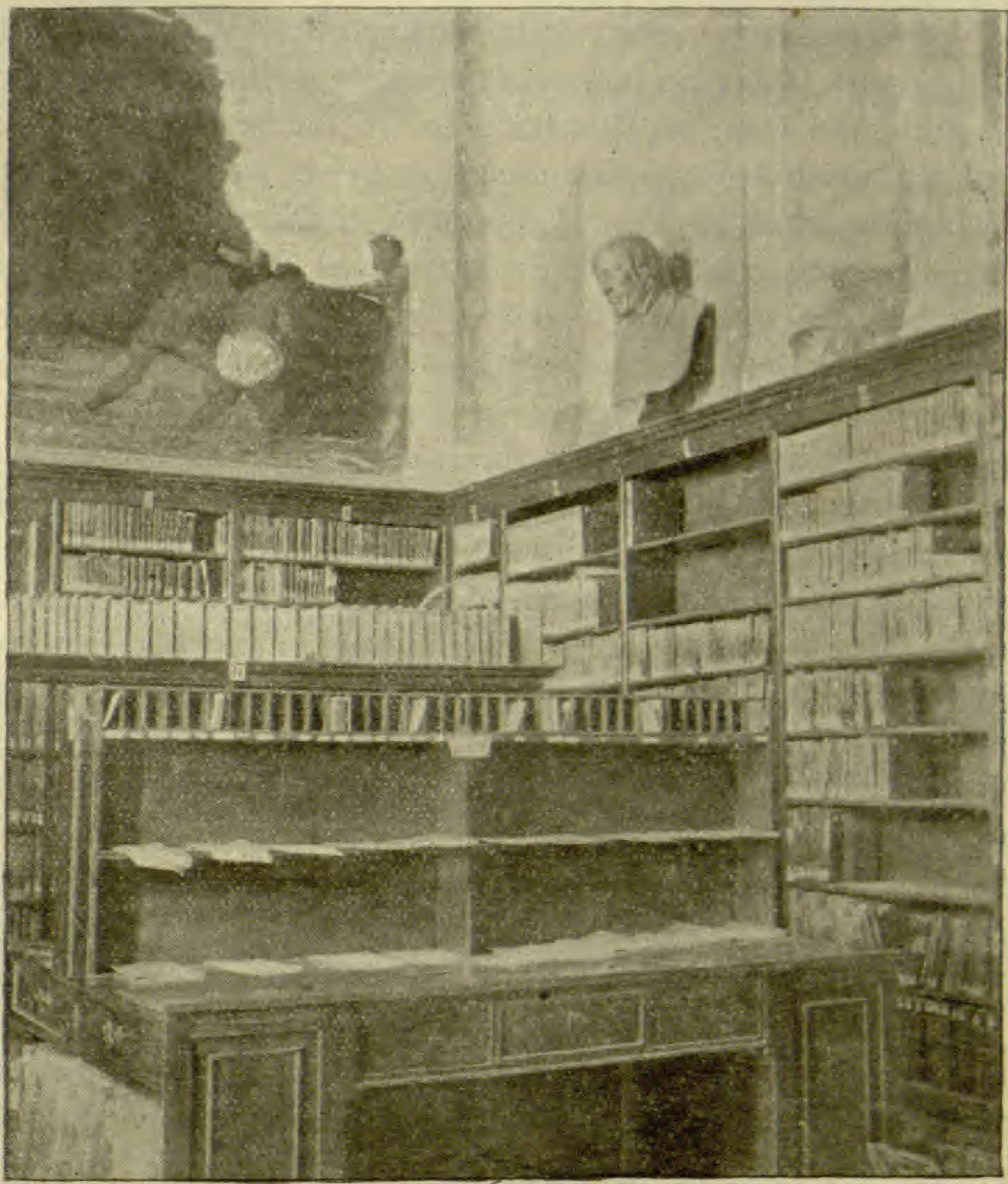


FIG. 2.

Naples. Corner of north end of Library: Photographed by writer, May, 1891.

the most recent researches. The desk shown in the figure is one on which each day is to be found the latest publications. In the upper pigeon holes are the cards prepared for each investigator on his advent to Naples; with these he replaces the volumes which he has taken to his work place. Every division of the laboratory is carefully organized and is under the charge of a special assistant. Prof. Hugo Eisig, the assistant director, has taken the welfare of each student under his personal charge, and it is not until the end of his stay that the visitor recognizes how much has been done for him.

There is no more interesting department of the station than that of receiving and distributing the material. Its headquarters is in the basement of the physiological laboratory, and here Cav. Lo Bianco is to be found busy with his aids and attendants amid a confusion of pans, dishes and tables, encountering the Neapolitan fishermen who have learned to bring all of their rarities to the station. The specimens are quickly assorted by the attendants; such as may not be needed for the immediate use of the investigators are retained and prepared for shipment to the universities throughout Europe. The methods of killing and preserving marine forms have been made a most careful study by Lo Bianco and his preparations have gained him a world wide reputation. Delicate jelly fish are to be preserved distended, and the frail forms of almost every group have been successfully fixed. The methods of the Naples station were kept secret only until it was possible to verify and improve them as it was not deemed desirable to have them given out in a scattered way by a number of investigators.

Lo Bianco has made the best use of the rich material passing daily through his department, and has been enabled to prepare the most valuable records as to spawning seasons and as to larval conditions. He knows the exact station of the rarest species, and it seems to the stranger a difficult matter to ask for a form which cannot be directly or indirectly procured. It adds no little to the time saving of the student to find each morning at his work place, the fresh material which he has ordered the day before, and there is usually an embarrassment rather than a dearth of riches.

A collecting trip often occurs as a pleasant change from the indoor work of the investigator. An excursion to Capri may be planned; the launch will be brought to the quay near the station and the party will embark. The collecting tubs are soon scattered over the deck and filled with the dredge contents. Some of the passengers are quickly at work sorting out their material, this one seizing brachiopods, another compound ascidians, another sponges. Others will wait until the surface nets have been brought in and the contents turned into jars. All will depend upon Lo Bianco as an appellate judge in matters of identification.

Many Americans have availed themselves of the privileges of Naples and the former lack of support of an American table needs little comment. Of those who have hitherto visited Naples not less than three-quarters have been indebted to the courtesies of German universities. At present, of the two American tables, one is supported by the Smithsonian Institution, the other by gift of Mr. Agassiz.

The entire Italian coast is so rich in its fauna that it is due perhaps, only to the greatness of Naples, that so few stations have been founded. Messina has its interesting laboratory well known in the work of its director, Prof. Kleinenberg. The Adriatic, especially favorable for collecting, has at Istria a small station on the Dalmatian coast, and at Trieste is the Austrian station.

TRIESTE.

Trieste possesses one of the oldest and most honored of Marine Observatories, although its station is but small in comparison with that of Naples, Plymouth or Roscoff. Its work has in no small way been limited by scanty income; it has offered the investigator fewer advantages and has therefore become outrivalled. During a greater part of the year it is but little more than the supply station of the University of Vienna, providing fresh material for the students of Professor Claus. Its percentage of foreign investigators appears small; its visitors are usually from Vienna and of its university.

Trieste is in itself a small but busy city, growing in active commerce. Its quays are massive and bristle with odd shaped shipping of the Eastern Mediterranean. Its deep and basin like harbor affords a collecting ground as rich as the Gulf of Naples.

The station has been located at a quiet corner of the harbor, just beyond the ledge of the lighthouse. Its building is somewhat châlet-like, situated on a small, well wooded knoll, as seen in the adjacent figure (Fig. 3). About it are trellis covered grounds enclosed by high walls, and separated from the harbor only by the main roadway of the quays. One enters the laboratory garden through a large gateway and passes into a

Fig. 3.

Marine Station at Trieste. From photograph received recently from Dr. Graeffe.

court yard whose outhouses disclose the pails and nets of the marine laboratory. Perhaps an attendant will here be sorting out the captures which a bronze-legged fisherman has just brought in.

A library and the rooms of the director, Dr. Graeffe, are close by the entrance of the building. In the basement is the aquarium room.—somewhat dark and cellar like; its tanks small and shallow, their inmates representing especially stages of Adriatic hydroids and anthozoans. On the second story are the investigators' rooms, large, well lighted, looking out over garden and sea. Near by is a museum of local fauna, rich in crustaceans and in the larval stages of Adriatic fishes.

GERMANY, NORWAY, RUSSIA.

The German universities have contributed to such a degree to the building up of the station at Naples that they have hitherto been little able to avail themselves of the more convenient but less favorable region of German coasts. The collecting resources of the North Sea and of the Baltic have perhaps been not sufficiently rich to warrant the establishment of a central station. On the side of the Baltic, the University of Kiel, directly on the coast, may itself be regarded a marine station. At present the interest in founding local marine laboratories has, however, become stronger. At Plön, at a corner of the North Sea not far from Flensburg, is established a small station under the directorship of Professor Zacharias,—and the first number of its contributions has recently been published. In addition the newly acquired Heligoland has become the seat of a well equipped Governmental station, under the directorship of Dr. R. Heincke. The island has been long known as most favorable in collecting regions, and its position in the midst of the North Sea fisheries gives it especial importance.

Norway like Germany is strengthening its interest in local marine laboratories. During the past year (1892) it has succeeded in establishing two permanent stations, one near Bergen,—the other south of Bergen an outjutting point of the North Sea almost westward of Christiana. The former is interested especially in matters relating to the North Sea fisheries, and is supported partly by the contributions of a learned society and partly by a subsidy from the government in view of its relation to the practical fisheries. The second and smaller station is devoted almost exclusively to research in morphology. It is a dependency of the University of Christiana and is under the directorship of one of its professors, Dr. Johan Hjört.

With the richest collecting resources these new stations may naturally be expected to yield most important results.

Russians have ever been most enthusiastic in marine research, and their investigators are to be found in nearly every marine station of Europe. The French laboratory on the Mediterranean at Ville Franche, as has previously been noted, is supported essentially by Russians. At Naples they are often next in numbers to the Germans and Austrians. The learned societies of Moscow and St. Petersburg have contributed in no little way to marine research. The station at Sebastopol on the Black Sea, has become permanent, possessing an assured income. That near the Convent Solovetsky on the White Sea, though small, is of marked importance. It is already in its thirteenth year. Professor Wagner of St. Petersburg, has been its most earnest promoter as well as constant visitor. He in fact caused the Superior of the Convent to become interested in its work and secured a permanent building by the Convent's grant; he was then enabled by an appropriation from government to provide an equipment. Its annual maintenance is due to the Society of Naturalists of St. Petersburg. The matter of the appointment of a permanent director for the summer months is now being agitated. The station Solovetskaia is said to possess the richest collecting region of the Russian coasts. It is certainly the only laboratory which has at its command a truly Arctic fauna.

The following list of papers relating to marine laboratories was kindly sent the writer from Naples by Mr. H. B. Pollard.

Arcachon (Bulletin of the Scientific Society.)

Berichte v. d. Ver der. biol. Stat. Sebastopol. Russian text.

Brunchorst, Die biol. Meerestat. 1st. Bergen. Plate and plans.

Buissent, Les Stations Zool. du Bords de la Mer. Rev. de Ques. Scien. Brussels, 1889.

Dohrn, Aus Vergang. u. Gegenwart der Zool. Stat. in Neapel, Deutsche Rundschau, XVIII, h. II, Pactel, Berlin, 1892.

Fausseck, Station biologique "Solovetskaia." (1892.)

Herdman, Annual reports of Liverpool M. B. Station on

Puffin Island. Dobb & Co., Liverpool, 1890–91.

Hoyle, Scot. M. Stat. and its work. J. of M. B. Ass. II.

Korotheba, (The laboratory at Ville Franche, Russian text.) Cracow, 1892.

Lacaze Duthiers, Les Lab. maritimes de Roscoff et Banyuls en 1891. Rev. Exp. de Biol. 1892.

Les Stations Zoologiques, L' Aquarium des Sables d' Olonne, La Nature, 16 Annèe, 1 sem. 1891.

McIntosh, St. Andrew's Marine Laboratory. J. of M. B. Ass, II.

Mitsukeori, The Mar. Biol. Stat. of the Imp. Univ. at Misaki, J. of Col. of Scien. of Japan. Tokio. V. I.

Nederlandische Dierkundige Vereein Zool. Stat. Tijdschr. d. Ned. Dier. Ver., with figure, 1890.

Petersen, Danske Biol. Stat. Rep. Copenhagen Schule. 1892.

Pouchet, Rapport. sur la Laboratoire de Concarneau, 1886.

Prince, St. Andrew's Mar. Lab. Eng. Ill. Mag. p. 70. 1889.

Vogt, Les Laboratoires de Zoologie maritimes, Rev. Scient. Paris, 1876.

Vogt, Zool. Stat. Die Gegenwart. 26 Bd. 1884.

Von Lendenfeld, Die Zool. Stat. in Trieste. Oes. Ung. Revue, 7 Bd. 1889.

Zacharias, Forschungsberichte aus der Biol. Stat. zu Plön, Friedländer, Berlin, 1893.

Since the above was in print, Prof. Lönnberg has given the writer many interesting details in regard to the Swedish Zoological Station on the west coast near the city of Gothenberg.

The Station has up to the present, under its founder and late director, Prof. Loven, admitted no foreigners.

Its three original buildings, a laboratory and two dwelling houses, were constructed about fifteen years ago by a gift of Dr. Regnell of Stockholm. It is at present maintained by a small subsidy from the government. Dr. Hjalmar Theel, in charge of the museum at Stockholm, has recently been appointed its director. The laboratory is itself a wooden building, with aquaria rooms, and on the second story with the separate work places of the investigators. The students are mainly from the University of Upsala.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

BY CLARENCE BLOOMFIELD MOORE.

(*Continued from July Number*, 1893.)

(*Fourth Paper.*)

MULBERRY MOUND (ORANGE COUNTY).

By referring to the map accompanying the first article of this series,[1] the reader will see that Mulberry Mound lies on the west bank of the St. John's, just north of the river's exit from Lake Poinsett. Rising abruptly from the water's edge the mound offers the only solid footing for miles around, and upon it the otter hunter on his way up and down the stream finds a welcome refuge. This island mound has been under cultivation in former years, but when visited (February, 1892, and February, 1893) was covered densely with vines, shrubbery and sugar-cane. In all, eight days were spent in investigation with a party of eight workers. The mound extends from S. S. E. to N. N. W. The length of base is 285 feet; its maximum breadth 120 feet; its maximum height from water level at a low stage of the river is 15 feet, 6 inches. Shell continues to an undetermined depth. The mound is unstratified, as a whole, and is composed mainly of uniones with a large admixture of sandy loam, containing occasional ampullariæ and paludinæ.

At no part of the mound investigated by the writer was there any evidence of the presence of loose masses of shell comparatively unbroken. Abandoned fire places were found at every depth. Upon the surface is a stratum of loam and sand from 1½ feet to 2½ feet in thickness. This layer is probably a formation subsequent to the abandonment of the mound by the eaters of shell-fish, and all articles found

[1] AMERICAN NATURALIST, Nov., 1892.

therein cannot with certainty be attributed to the period of the formation of the shell heap.

To the north of the shell heap is a small burial mound which, through its immediate association with the shell heap, is of the greatest interest. To it a number of additional days were devoted.

Of all the shell heaps of the St. John's, Mulberry Mound most richly rewards archeological research. So distant is the nearest solid ground and so contracted were the quarters of those who raised the shell heap that every article cast away or lost during certainly a very long period is contained within an area a mere fraction in comparison to that of many shell heaps of the lower river.

On the summit of Mulberry Mound, not far separated, three excavations were made: 10½ x 7 x 12 feet deep; 12 x 7½ x 10 feet deep; 16 feet, 8 inches by 14 feet, 5 inches by 16 feet deep. All these excavations were subsequently increased in size by the use of the pick upon the sides.

Pottery.

While the sherds found throughout the excavations were of good quality and ornamented fragments of pottery were found even below water level, yet in numbers and in variety of design they by no means compared with the fragments of ruder material so plentifully met with in other shell heaps of the river and notably at Tick Island and at Orange Mound. No sherds were encountered of that coarse and porous material showing original intermixture of vegetable fibre save two or three specimens at the very base of the mound. At a distance of 8½ feet from the surface was a fragment of pottery, colored a bright red, and three other sherds similarly decorated were encountered in various stages of the excavations. While pottery of this character is of frequent occurrence in the sand mounds its discovery is not on record hitherto in the shell heaps of the river. Pottery with stamped decoration, so common on the surface along the St. John's, was fairly abundant in the upper portion of the mound, while specimens were met with at unusual depths, one sherd thus decorated being found at a distance of 10 feet from the surface. As a rule, the ceramic ornamentation consisted of incised lines, several of novel pattern. One specimen showed interior decoration, the outer surface being plain. Another had been scratched upon the surface subsequent to the completion of the pottery (Fig. 1).

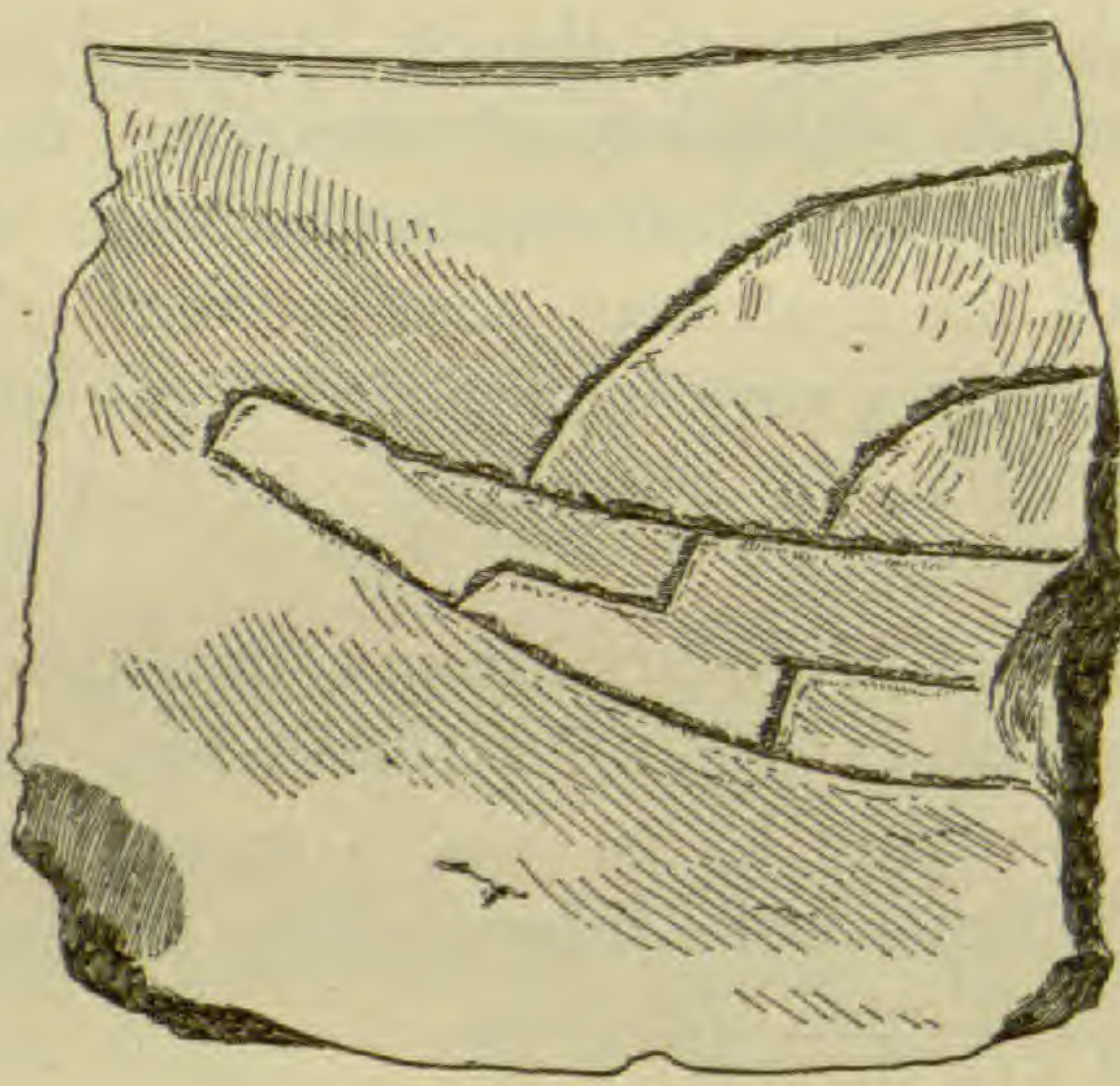


Fig. 1. (Full size.)

Three feet from the surface, in excavation 3, a vessel was uncovered, uninjured, with the exception of a small chipping from a portion of the rim. The material was of inferior quality. Its decoration varied, consisting of lines and dots in various combinations. The body of the bowl was plain. Its diameter at the mouth which was irregular but nearly circular, was from 8¼ inches to 7¾ inches. Its height was 4 inches. Its average thickness of material was .3 of an inch. In form it resembled a bowl, a common shape in the sand mounds.

Various partially broken vessels were found unornamented and presenting no peculiarity. One contained a mass of unbaked clay.

Nine and a half feet from the surface was found what at the time was considered a fragment of a large bead of pottery (Fig. 2), and not until two similar and more complete objects were met with in the adjoining burial mound (Figs. 3 and 4) was the conclusion arrived at that it was a portion of a tobacco pipe.

It will be remembered that the absence of pipes from the shell heaps was emphasized by Professor Wyman, and the writer, in upward of eighty shell heaps carefully explored, has heretofore found nothing indicating the use of tobacco by the eaters of shell fish, though pipes have been taken by him

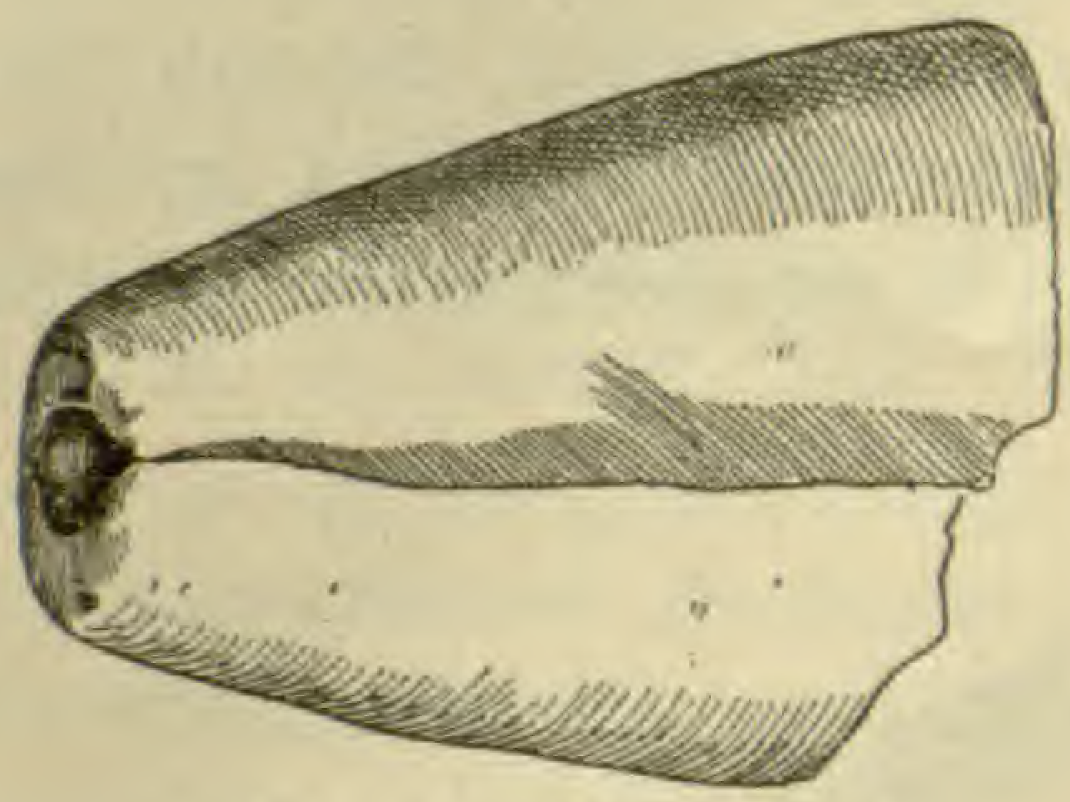


Fig. 2. (Full size.)

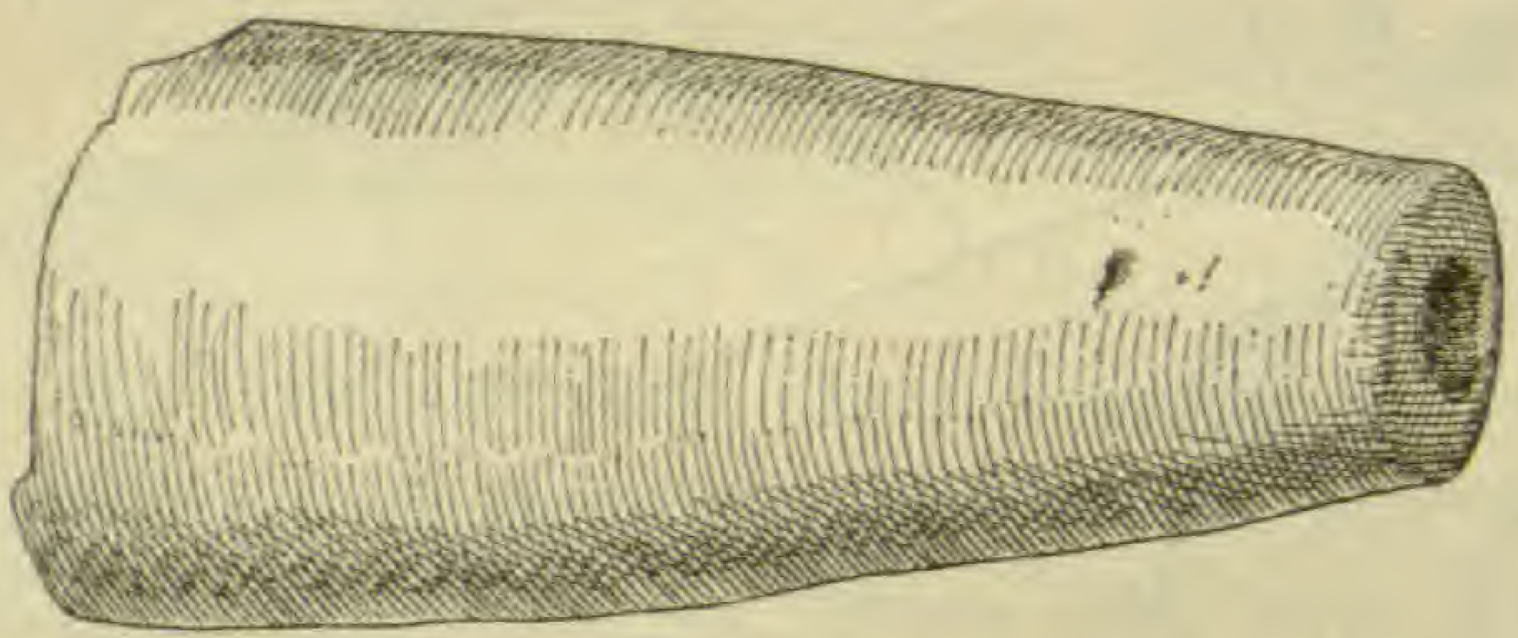


Fig. 3. (Full size.)

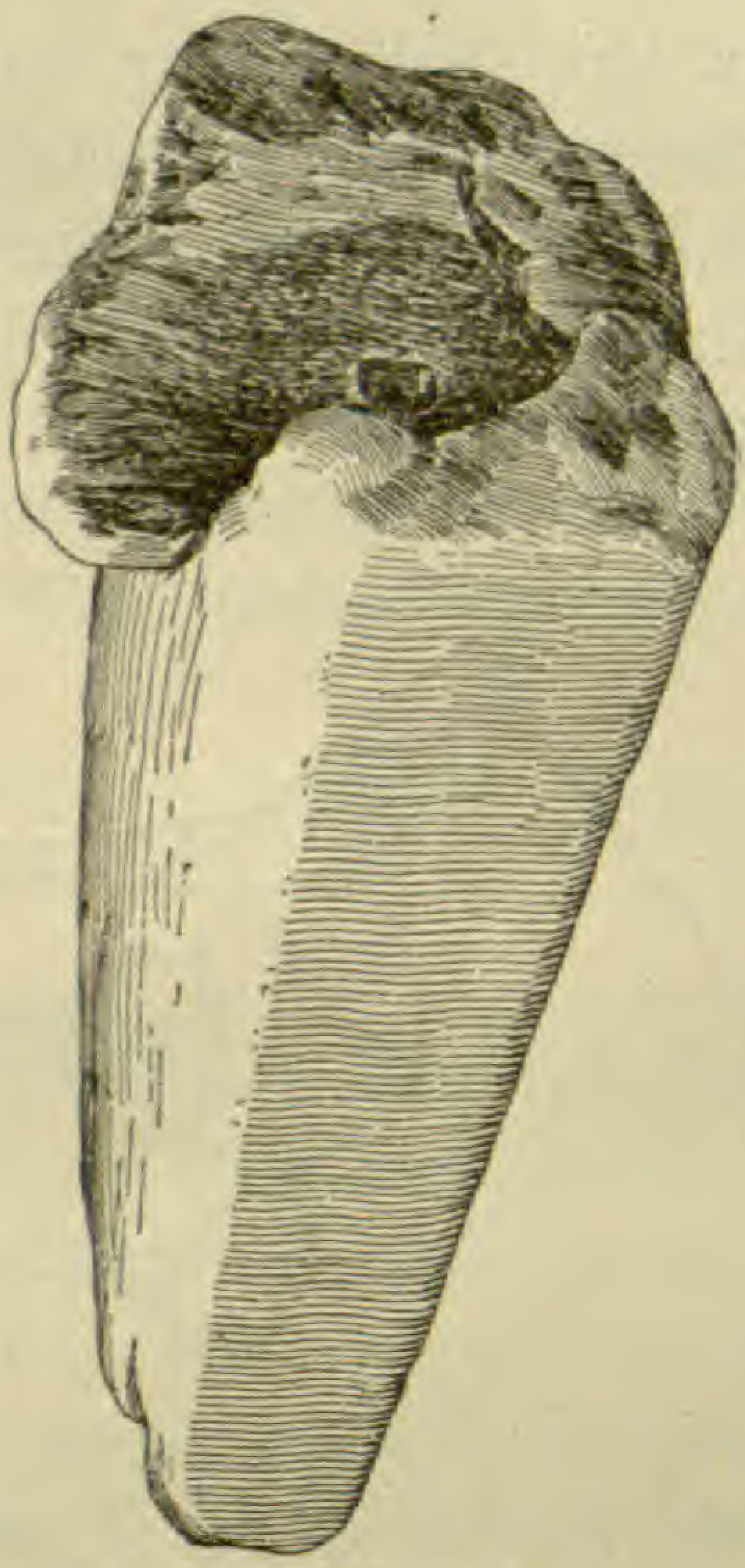


Fig. 4. (Full size.)

from the burial mounds. A careful comparison, however, of the figures given herewith should convince the most skeptical that all three are fragmentary parts of vessels used in the smoking of tobacco, and such is the opinion of Professor Haynes who has made a careful examination of the specimens.

During the excavation a mass of baked clay was found bearing the imprint of human fingers.

At a depth of 2½ feet was found a mass of clay about six inches in height, unbroken, resembling half the cast of a pot. It is quite evident that whatever its use may have been, clay could readily have been moulded around it when placed with one of similar proportions.[2]

[2] It is possible that the masses of clay referred to by Squier and Davis (Ancient Monuments of the Mississippi Valley, page 149) were of similar character.

An Attempt at Delineation.

At a depth of 10 feet from the surface two pieces of pottery in immediate association were thrown out in the same shovelful of debris. An investigation showed the fragments, which were covered with the soot so frequently found upon the sherds of the shell heaps, to belong to the same vessel, though the fracture was contemporary with their abandonment in the mound. Upon them was rudely cut a representation of the human figure (Fig. 5).

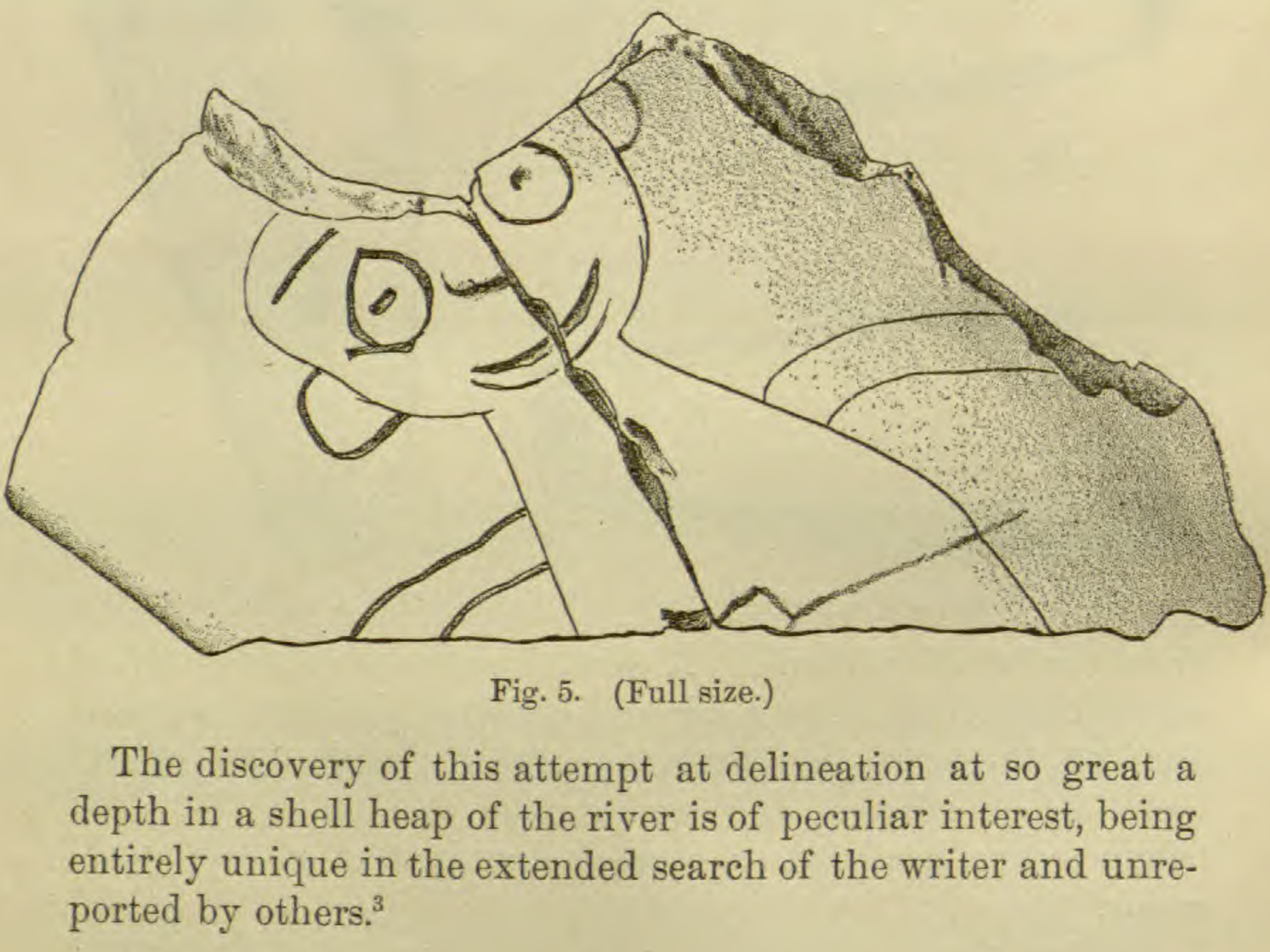


Fig. 5. (Full size.)

The discovery of this attempt at delineation at so great a depth in a shell heap of the river is of peculiar interest, being entirely unique in the extended search of the writer and unreported by others.[3]

Bone.

Upward of ninety implements of bone, many of which were somewhat fragmentary, were met with in the three excavations. As the depth of the excavations increased implements were found in an inverse ratio. Awls and piercing

[3] This aboriginal attempt at delineation may be seen at the Wagner Free Institute, Philadelphia.

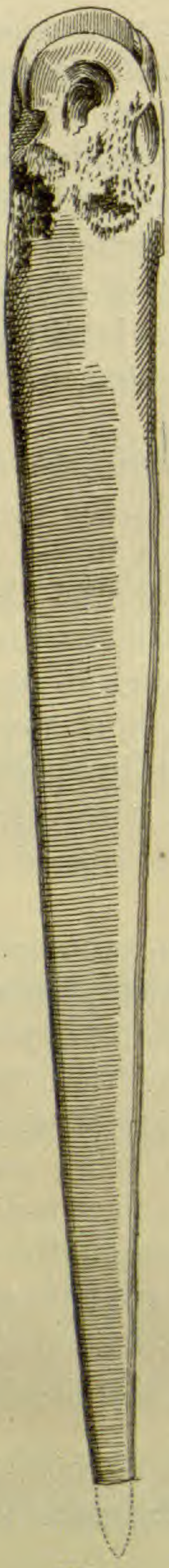
implements were numerous. One foot and five feet from the surface were two-pointed implements resembling daggers, respectively 6¼ inches and 7¼ inches in length (Figs. 6 and 7). Piercing implements of bone of this size are not mentioned by Wyman, nor have they been met with by the writer in any other shell heap of the St. John's, though in the burial mound at Tick Island was found a carefully fashioned pointed instrument of human bone 9¼ inches in length, circled at the blunt end by an incised line. On one side were three perforations extending longitudinally below. These long stilletto-shaped implements of bone are not uncommon in other localities. Professor Haynes is of the opinion that they were used in the weaving of baskets.

At a depth of four feet was an implement, in shape resembling a shuttle (Fig. 8), hitherto unreported in connection with shell heaps in the river.

Two slender pins with lined ornamentation around the heads (Fig. 9), 7 inches and 8.2 inches in length, both discovered at a depth of three feet from the surface, though in separate excavations, were found intact, while throughout were numbers of small piercing implements two inches in length and over fashioned from the long bones of small carnivores with the articular portion remaining (Fig. 10). The core of a stag horn was lined with eight parallel circles.

A curious implement, 2.3 inches in length, was exhumed, made from a solid bone, unidentified, having a maximum diameter of 1 inch, polished at the base and drilled to a depth of .9 inch, the cavity diminishing slightly in size from the margin of the orifice inward. The opposite end was beveled on one-half to a central ridge, the other portion being cut down as if to connect with the cavity below. Two longitudinal parallel lines were on either side, while a longitudinal ridge spread out at the upper portion, forming a triangle of which the margin of the top formed the base. Unfortunately a series of figures would be required to represent this curious object.

A portion of the head of a piercing implement, 1⅜ inches in length was beautifully decorated with lines. Exposure to



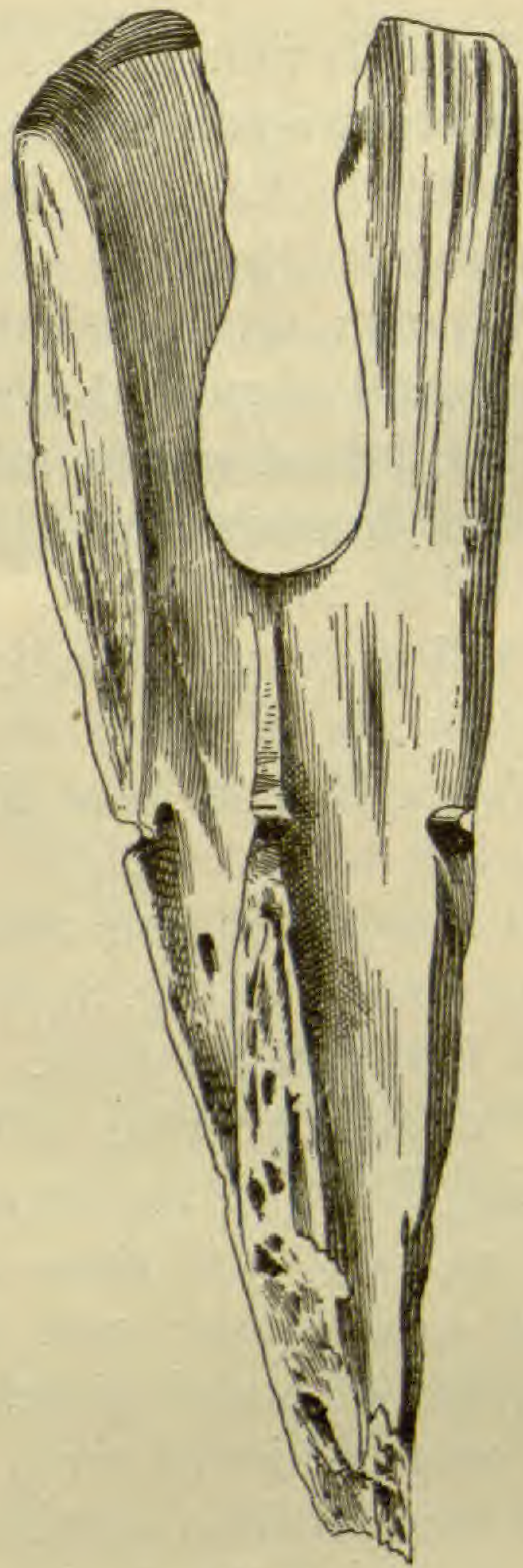



Fig. 8.


Fig. 6. Fig. 7. Fig. 9. Fig. 10. Fig. 11.

Implements of Bone. (All full size.)

fire had colored it black and given to the surface a brilliant polish (Fig. 11).

Stone.

Just below the surface loam was a portion of a celt of slate, 2½ inches in length, polished and with ground cutting edge. Its depth does not identify it positively with the shell heap. 1½ feet from the surface was found a "sinker," or pendant ornament,[4] 2⅝ inches in length, rimmed at either end for suspension (Fig. 12). This interesting relic cannot positively be attributed to the period of formation of the mound. It is probable that later Indians cultivated the mound which, moreover, within recent years has been ploughed to facilitate the planting of sugar-cane.

Two feet from the surface a round sandstone hone was met with.

At a depth of 4½ feet was brought to light a celt of polished shale of rude workmanship, with the portion farthest from the cutting edge roughened, probably for insertion into a socket (Fig. 13). This find is extremely interesting, being the tfirs on record of an implement of polished stone found in a shell heap of the St. John's at a depth to justify the belief as to an origin contemporary with the heap. Among other articles of interest brought to light were a sandstone hone, grooved through the sharpening of pointed implements, and a flat piece of coquina.

At a depth of 14 feet, 8 inches from the surface was found a lance head of fine chert, 3.6 inches in length, thin and of graceful pattern, while 8 inches above were two lance heads of chert, one of beautiful design, barbed and having the base of the tang concave, fully as graceful in design and in finish as any stone point met with on the surface. Its length was 3.8 inches.

Its companion was of coarse yellow chert, with a length of 4.14 inches, and had a natural defect through crystallization of the material. It was of ruder workmanship. The great rarity of implements of stone in the shell heaps was commented

[4] Positive identification as to material has been found impossible without mutilation of specimen.

upon by Wyman, and the writer during his investigations has had no grounds to differ from Professor Wyman's opinion. The discovery of lance points at such a depth and of such graceful pattern is entirely without precedent. Specimens of the rude and thick arrow points ordinarily found in the shell heaps will be figured in a later paper.

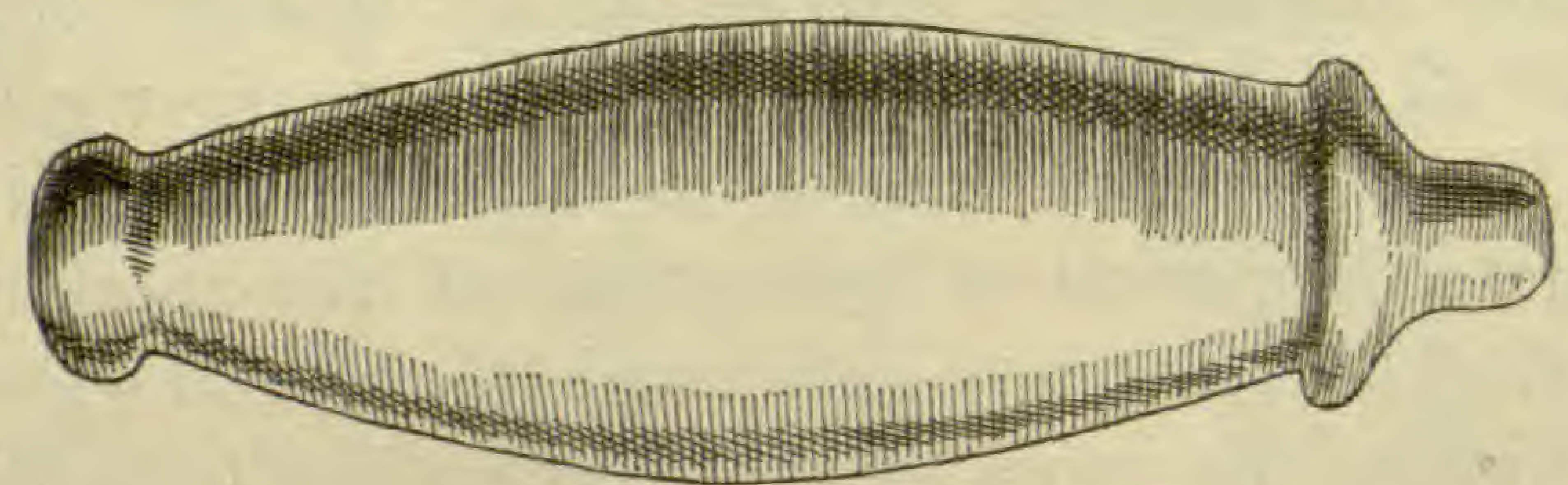


Fig. 12. (Full size.)

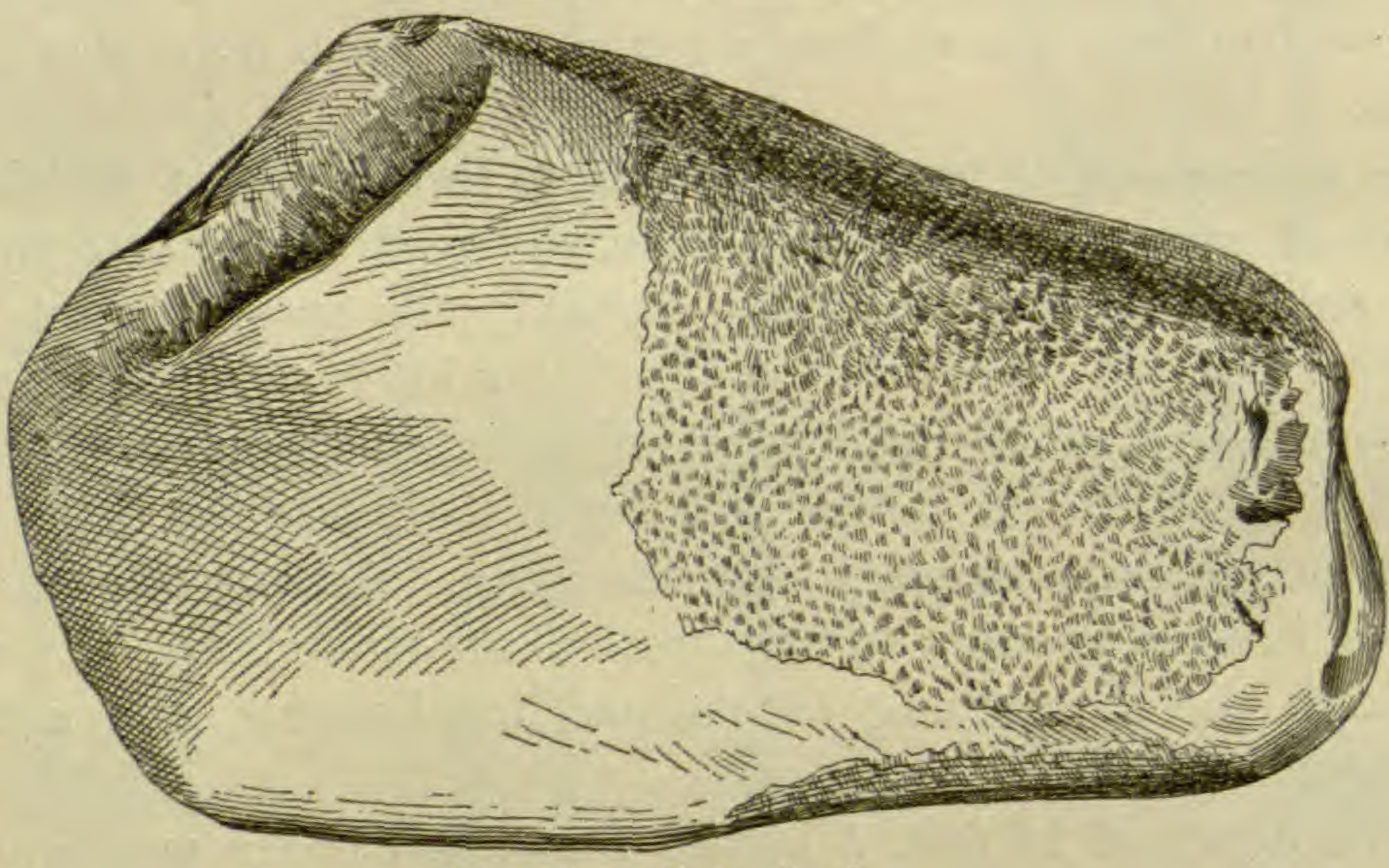


Fig. 13. (Full size.)

Throughout the excavations were found a number of pieces of red hematite, the largest being $3\frac{1}{2}$ x $2\frac{5}{8}$ x 2 inches. This mineral was largely used as coloring matter in several of the burial mounds, notably at Mt. Royal where the whole upper stratum is dyed with it.

Shell.

As in the case of implements of bone, so of shell it may be said that Mulberry Mound among all the shell heaps of the St. John's has furnished the richest results to the archeologist.

At every depth were found gouges and scrapers of shell, many unbroken, and columellæ of fasciolaria, one 10½ inches in length. Two and a quarter feet and five feet below the surface were found two drinking cups, formed from fulgur *perversum*, with portions of the side and the inner whorls removed, a form common enough on the surface and in the burial mounds, but very unusual at any depth in the shell deposits. Curiously enough, similar drinking cups wrought from the conch are in use to-day by the side of springs in some of the sea-board southern states.

Piercing Implements of Bone.
Mulberry Mound (full size).

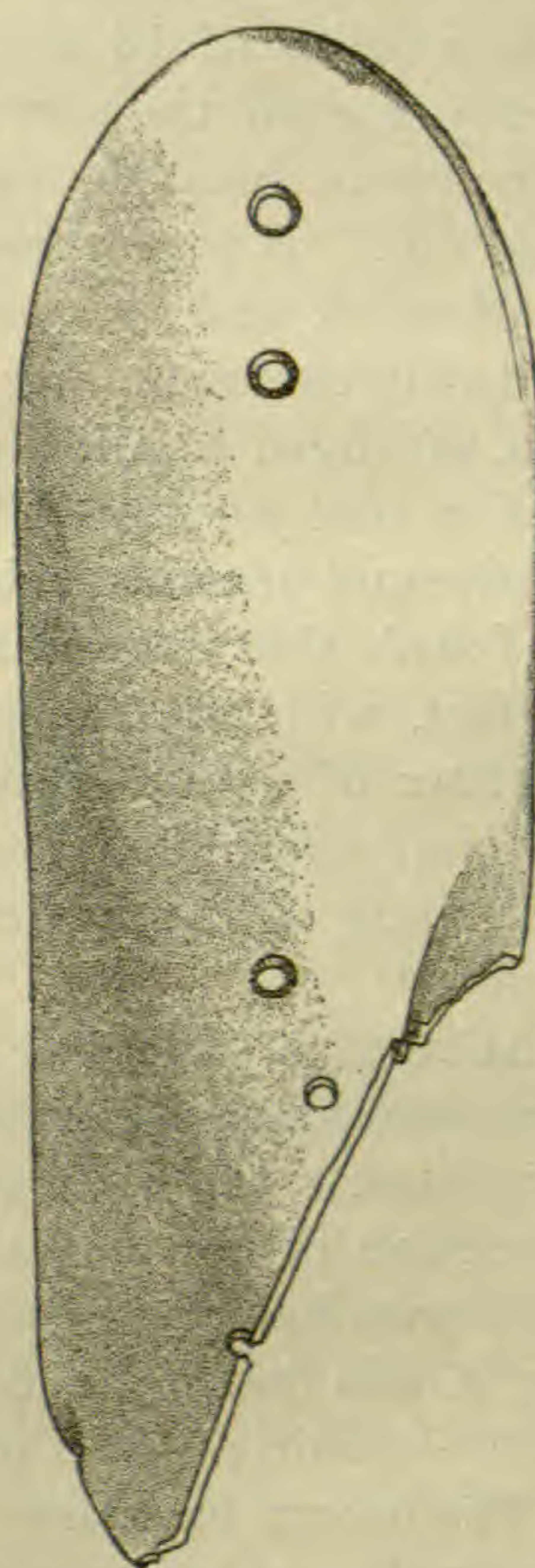


Fig. 14. ⅔ size.

Ten feet from the surface in perfect condition was a beautiful chisel fashioned from the lip of *strombus*.

Five feet from the surface was found a *cardium*, unbroken, but giving evidence of wear upon the edge, and having a portion of the shell between the ridges removed. A *pecten*, without wear or work upon the edges, is figured in the annual report of the Bureau of Ethnology, 1880–1881, Plate XXI, Fig. 3. This particular shell is described as having served among the Indians as a receptacle for paint, and as coming from Santa Barbara, California. It is possible that the "cockle shell" from Mulberry Mound may have been used for the lining of pottery. At all events, the two central ridges could be put to such a purpose.

At a depth of 13 feet, 8 inches was found a portion of a gorget of shell, the part recovered being 6.04 inches in length, 2 inches in breadth, with an average thickness of .12 inch (Fig. 14). It bore three perforations for suspension or for attachment, and two smaller ones along the line of fracture, evidently corresponding with similar ones on the missing portion, arranged to allow of repair by binding, a method common at that period. The discovery of a gorget or any object of personal ornamentation is so unusual in a shell heap of the St. John's that particular stress deserves to be laid upon it. In fact, with the exception of one longitudinally perforated phalanx of a deer, from Salt Run (Marion Co.), no articles of personal adornment have been found by the writer in any shell heap of the St. John's beyond the limits of Mulberry Mound.[4]

At various distances from surface, one even so deep as 11 feet, were found six fulgurs, five of the species *carica* and one *perversum*. All were ground at the beak, and all with the exception of one carica, were perforated. Three of the species *carica* had single perforations below the angle and involving it, and one on the body whorl between the angle and the suture within an inch of the aperture.

The fulgur *perversum* had a small round perforation above the angle and two, one ¼ inch, the other ⅝ inch, below. These perforations were considerably larger than the one above. The finding of the perforated fulgurs at so great a depth in a shell heap will, with other matters relating to these perforated shells, be referred to in Note A.

Human Remains.

Eleven feet from the surface, in immediate association with fragmentary bones of the lower animals, lay a portion of the shaft of a human femur 3¾ inches in length, with old breaks at either end; a portion of the shaft of a tibia, broken in excavation; two right heel bones, somewhat crushed; two bones of the toe; a fragment of a radius with old break, and a portion of rib. Five feet east of these remains lay a fragmentary portion of human femur, showing no recent fracture, while at the same level, but four feet distant, in the southeast corner of excavation 3 lay a fragment of femur; an ulna in two portions, old break; a small fragment of lower jaw and a piece of femur with old longitudinal split. At about the same level in the northwestern portion of the excavation, apparently entirely isolated, was the upper half of a human ulna. In view of the scattered and broken condition of these bones and their association with the bones of animals used for food together with the fact that an almost contiguous burial mound offered a means of sepulture, it seems unlikely that these human remains are other than refuse left over from a cannibalistic repast. Never elsewhere on the St. John's has the writer come upon human remains in this condition at a depth from the surface greater than 3 feet, and in his introductory paper, written previous to a second visit to Mulberry Mound, he stated that in view of the numerous cases indicating cannibalism discovered by him along the greater portion of the river where shell heaps exist, at no great depth from the surface, he was inclined to the belief that the custom must have come in at a somewhat late period of the formation of the shell heaps. Subsequent research may prove this supposition unfounded, but for reasons to be mentioned later the presence of human remains in this condition in Mulberry Mound does not modify his previously expressed opinion.

Remains of Lower Animals.

As is the case in the majority of shell heaps, the deer and turtle in Mulberry Mound were found, next to shell fish, to have been the most staple articles of diet. In addition to a number of small fragments unidentified, were found bones of the alligator, of the raccoon, of the turtle, of the black bear, of the red lynx (a jaw), of the catfish and of the gar. Also a curious bone identified by Professor Cope as supporting the dorsal fin in a member of the sheep's head family. The jaw of the red lynx, an animal hitherto unreported in the shell heaps of the St. John's, was submitted to Professor Cope for identification.

Note A.

Perforated Fulgurs.

The fulgur, sometimes termed the busycon, popularly known as the conch, was a shell extensively in use among the aborigines. If specimens of the two species of fulgur most commonly found on the St. John's River are held facing the investigator the shell having the aperture to his right is termed *carica*, to his left, *perversum*. Fulgurs with artificially ground beaks and with circular or oval perforations evenly made are comparatively numerous upon the surface of the territory bordering the St. John's River. They are seldom at a greater depth in the shell heaps than can be reached by the plow. Their superficial position was noticed and commented upon by Wyman (Fresh Water Shell Mounds of the St. John's River, Florida, page 58 and Plate VIII, Fig. 2). They are, however, occasionally found in the burial mounds of sand at depths excluding the idea of an intrusive deposit.[5] With the exception of Mulberry Mound, no shell heap in the writer's

[4] Wyman figures two perforated objects from the shell heaps, and the writer has a considerable number of the phalanges of the deer perforated longitudinally, ploughed up and presented to him by Mr. Charles Dillard of Volusia. He is also indebted to Mr. McAllister of Bluffton, Volusia Co., for the fossil tooth of a shark, perforated laterally, found superficially in the shell deposit at that place.

[5] This is particularly true of the great mound at Mt. Royal, Putnam Co., where in one trench among a number made, no less than 1307 fulgurs were found by the writer. A very small percentage, however, were evenly perforated in the manner of the shells under discussion. The great majority were of the species perversum. Some were unbroken, but the greater number were apparently intentionally mutilated in the manner of mortuary pottery by having a piece roughly knocked out.

investigations has yielded perforated conchs at a considerable depth, and as the territory bordering the St. John's has been carefully searched by the writer, having in mind the investigation of these perforated fulgurs, he is strongly inclined to the belief that the employment of these implements came in at a period subsequent to or approaching the abandonment of the great majority of the shell heaps of the river.

The use of these perforated fulgurs is not determined. Wyman confessed himself in doubt. In "Art in Shell," Bureau of Ethnology, Annual Report, 1880–1881, Professor Holmes figures a perforated fulgur (Plate XXVII) and cites Rau, "Archæological Collection of the National Museum," page 67: "It further appears that the Florida Indians applied shells of the *busycon perversum* as clubs or *casse-tetes* by adapting them to be used with a handle, which was made to pass transversely through the shell. This was effected by a hole pierced in the outer wall of the last whorl in such a manner as to be somewhat to the left of the columella, while a notch in the outer lip, corresponding to the hole, confined the handle or stick between the outer edge of the lip and inner edge of the columella. * * * * A hole was also made in the posterior surface of the spire behind the carina in the last whorl, evidently for receiving a ligature by means of which the shell was more firmly lashed to the handle."

Of scores of perforated fulgurs from the river, examined by the writer, he can recall but two wrought from the fulgur *perversum*. The fulgur *carica* is a more massive shell and better fitted for the rough work than the more slender *perversum* from which shell the drinking cups of the river shell heaps and mounds are fashioned. It is true that a heavy variety of *perversum* is met with on the coast, and that the fulgur *carica* is rarely, if ever, found on the west coast or on the east coast south of Jupiter inlet.[6]

In the coast shell heaps alone is the perforated fulgur *perversum* found to any extent, and this point should be remem-

[6] The Academy of Natural Sciences possesses no fulgurs of the species carica from the west coast. The Smithsonian has one, stated to be from Cedar Keys; its record is not well established.

bered when perforated fulgurs of Florida are under discussion.

In the river shell heaps a very small percentage of perforated shells have a notch in the outer lip, while absolutely none has a perforation in the spire, if we consider the spire to be that portion of the shell surrounding the apex, bounded by the suture. Moreover, a considerable majority of the perforated shells have but one hole, that being in the body whorl between the angle and the suture, from one to two inches to the right of the aperture. A certain percentage of fulgurs have the perforation below the shoulder, or angle, but frequently in such a position that if hafted, the ground beak of the shell would not be at right angles with the handle, and occasionally the perforation is so placed that a handle entering the aperture could not reach it. In other cases, perforations are disproportionately small and oval in shape, unfitted to receive a handle suitable for the rough usage of a war club. In the writer's collection are two good sized fulgurs with perforations .54 inch by .76 inch, and .86 inch by .56 inch. Many perforated fulgurs with ground beaks are of a size to set aside the hypothesis of their employment for any purpose where weight is an important factor. Of these the writer has one weighing but eight ounces, while another is but 2¾ inches in length. Occasionally fulgurs are seen with perforations in the body whorl above and below the shoulder, and it is probable that these are the ones referred to by Rau with a misapprehension as to the location of the spire. Again, other fulgurs are found with a single perforation between the angle and the suture, having two below the shoulder and equidistant from it. A fulgur *perversum* of this character, was taken by the writer from the historic mound at Mt. Royal, Putnam County.

Some fulgurs with ground beaks are imperforate, while others with perforations show grinding or wear where not alone the beak is involved but a portion of the lip. Other shells give evidence of considerable wear on the margin of the perforation toward the upper and lower portion of the shell, showing that the implement was not securely hafted and that it was subjected to continuous use. Others are polished on the spire and body whorl above the periphery as though held in the hand.

From all this it is evident that while certain perforated fulgurs may have served for war clubs the great majority did not. Mr. Douglass, who is so familiar with the east coast of Florida, believes some of them to have served as hoes, and in this he is doubtless right. Probably, as is the case with most aboriginal implements, their use was various.

Conclusions.

At no point in the excavations at Mulberry Mound were whole shells found in any numbers, the heap having grown apparently from the beginning by the slow accretion of refuse from the meals of the few families living upon it and been solidly packed beneath their feet. It is apparent that such should be the case, since solid ground is too far distant to admit of the hypothesis that the mound was made through contributions of others not living upon its immediate surface. That a considerable time was required to pile so great a mass of shell to such a height through the agency of comparatively few there can be no reason to doubt. And yet the writer is convinced that of all the shell heaps investigated by him and by Professor Wyman the shell heap at Mulberry Mound is the most recent, and that it was still in process of formation when many others were abandoned, at least for use as refuse heaps. This belief is based upon the marvelous variety of the implements of bone, so infrequent in the other mounds, and patterns heretofore unreported from other localities on the river. The presence of delicately wrought lance heads near the base; of colored and of stamped pottery at considerable depths; of fulgurs at a distance from the surface; of a carefully made gorget of shell; the discovery of an implement of polished stone, a fact previously unheard of in the river shell heaps, and fragmentary human bones a number of feet from the surface, found only superficially by the writer in numerous other shell heaps, when taken together, argue for Mulberry Mound an origin posterior to other shell heaps of the St. John's hitherto explored. It will be noted, however, that nothing found in this shell heap indicated a knowledge of Europeans or in any way pointed to its formation in post-Columbian times.

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RECENT LITERATURE.

Hawks and Owls of the United States.[1]—This volume is a report on the Hawks and Owls of the United States, by Mr. A. K. Fisher, with reference to the economic status of the various species. Of it Mr. C. Hart Merriam makes the following statement in his letter of transmissal to the Secretary of Agriculture.

"This work was written several years ago, but was withheld from publication until provision could be made for suitable reproduction of the colored illustrations, without which the bulletin would have been of comparatively little value to the class of readers for whose benefit it was specially prepared.

"The statements herein contained respecting the food of the various hawks and owls are based on the critical examination, by scientific experts, of the actual contents of about 2,700 stomachs of these birds, and consequently may be fairly regarded as a truthful showing of the normal food of each species. The result proves that a class of birds commonly looked upon as enemies to the farmer, and indiscriminately destroyed whenever occasion offers, really rank among his best friends, and with few exceptions should be preserved, and encouraged to take up their abode in the neighborhood of his home. Only six of the 73 species and subspecies of hawks and owls of the United States are injurious. Of these, three are so extremely rare they need hardly be considered, and another (the Fish Hawk) is only indirectly injurious, leaving but two (the Sharp-shinned and Cooper's Hawks) that really need be taken into account as enemies to agriculture. Omitting the six species that feed largely on poultry and game 2,212 stomachs were examined, of which 56 per cent contained mice and other small mammals, 27 per cent insects, and only 3½ per cent poultry or game birds. In view of these facts the folly of offering bounties for the destruction of hawks and owls, as has been done by several states, becomes apparent, and the importance of an accurate knowledge of the economic status of our common birds and mammals is overwhelmingly demonstrated."

Fresh Water Algæ and the Desmidieæ of the United

[1] The Hawks and Owls of the United States in their Relation to Agriculture. By A. K. Fisher. Bull. No. 3, Div. Ornith. & Mam., U. S. Dept. Agric., Washington, 1893.

States.[2]—This work of Mr. Stokes has been prepared with special reference to the needs of beginners in the study of Algæ and Desmids, for whom the author believes analytical keys are absolutely essential. Generally speaking an artificial one is more useful than a natural one which involves more or less dissection, ruinous to the specimen, and a knowledge of characters that a beginner does not possess.

The keys offered by Mr. Stokes are founded on the classification in Wolle's Monographs on the fresh water Algæ and Desmids of this country, and references to these works are given for extended descriptions of the species.

Directions for the collection, preservation and mounting of these microscopic plants are given, with a list of the best preserving media in the order of their excellence.

The plate illustrating the genera of Desmids is a valuable adjunct to the work.

Gasteropoda and Cephalopoda of the New Jersey Cretaceous Marls.[3]—This volume, in reality a Monograph of the subject, has been prepared by Professor Robert P. Whitfield for the Geological Survey of New Jersey. It constitutes the second volume of a series which is intended to include descriptions of all the fossil invertebrates found in the New Jersey Cretaceous Marls. The following is a synopsis of the Classified List which accompanies the work:

INVERTEBRATA OF THE NEW JERSEY CRETACEOUS MARLS.

Gasteropoda.

	Genera	Species
Subclass Prosobranchiata		
Order Pectinibranchiata	54	119
Order Scutibranchiata	5	6
Subclass Opisthobranchiata		
Order Tectibranchiata	6	6
Scaphoda.		
Family Dentalium	3	4

[2] Analytical Keys to the Genera and Species of the Fresh Water Algæ and the Desmidieæ of the United States. By Alfred Stokes. Portland, Conn., 1893.

[3] Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. By Robert P. Whitfield. Trenton, 1892.

Cephalopoda.

Order Tetrabranchiata	8	21
Order Dibranchiata	1	1

INVERTEBRATA OF THE NEW JERSEY EOCENE MARLS.

Gasteropoda.

	Genera	Species
Subclass Prosobranchiata		
Order Pectinibranchiata	25	45
Order Scutibranchiata	2	4
Subclass Opisthobranchiata		
Order Tectibranchiata	3	3

Cephalopoda.

Order Tetrabranchiata	2	2

General Notes.

GEOGRAPHY AND TRAVELS.

Europe.—NEUSIEDLER LAKE.—Neusiedler Lake has for some time decreased in capacity, and it is now proposed to drain its remaining waters into the Raab by means of a canal.

RECLAMATION OF THE ZUYDER ZEE.—The March issue of the Geographical Journal contains an account of the engineering works proposed to be executed for the purpose of reclaiming the greater part of the Zuyder Zee. The work is to be carried out in sections, the first of which will fill in a bay north of the broad channel which will be left leading to the city of Amsterdam; while the second will comprise an extensive area south of that channel. The remaining sections will diminish the water area to the eastward. As a dam will be built across the Zee at its mouth the whole of the waters within will be fresh, and will be named the Ysel Meer, from the river of that name. The scheme also provides for the enlargement on their land-fronts of the islands at the mouth of the Zuyder Zee.

THE PONTINE MARSHES.—Capt. von Doncet has brought forward a scheme for reclaiming the Pontine Marshes, which are exceedingly fertile, and capable of producing food for half a million of people. The area is six square miles, but the exhalations from them render sixteen square miles unhealthful, and the present population is only thirty. The projector proposes to cut off by peripheral canals the streams which enter from the surrounding higher ground, and to utilize the existing interior canals, the work of Pius VI. The surface of these marshes is of old soft elastic peat, ten feet thick at the Appian Way, over seventy feet deep at the foot of the mountains; this peat apparently fills an ancient sea area, as beneath it is a layer of clay with shells and sea-sand. Five thousand acres are too low to permit the natural fall to be made available, and much of the area is, after the rains, covered with three feet of water, besides which, springs at the foot of the hills yield one and a half times as much as might be expected to drain into the basin.

Africa.—ASCENT OF THE JUB OR JUBA.—Capt. Dundas has returned safely from what seems to have been a most perilous journey of some 400 miles up the Juba, a river which parts the "sphere of influence" of England in East Africa from that of Italy. The inhabitants of both coasts of this river are the fanatical Mussulman, Somali or Swahili, who resent the coming among them of any European, though some of the coast Somalis seem to have become accustomed to their presence. At the very entrance of the river the natives assembled in great numbers, completely over-awed the crew of Zanzibaris, and gave Capt. Dundas to understand that he could not proceed without leave. The Captain was compelled to go to Mombasa, and enlist the aid of the resident there by whose tact leave was obtained, the Somal chief appropriating a sword and an armchair as a present. At about a hundred miles from the sea a second river channel, trending toward the ocean, south of the mouth known as that of the Juba, enters the latter stream.

New troubles commenced when the territory of the chief of Berbera, within which the unfortunate expedition of Van der Decken came to an end, was reached. Thousands of savages appeared on the banks, and many sprang into the river to seize the little stern wheel steamer. The discharge of a rocket cleared the river, but the danger remained. Accompanied by his interpreter, Capt. Dundas went ashore, and, constantly repeating "Aman" (peace) made his way, spite of the contact of cold spears, into the chief's presence. "We have done you no harm, is it to be 'aman' or not," was the substance of the Captain's speech. The astonished chief hesitated, asked for time to consider, and then sent word that, though he objected to white men, he rather liked the captain. Finally, with some natives on board, the *Kenia* was allowed to proceed, passing by the wreck of Van der Decken's vessel, to some rapids; whence, as the Somals assured Capt. Dundas that important falls existed a few miles higher up, and as the water was shallow, the *Kenia* commenced its return journey.

Capt. Dundas speaks with considerable admiration of the fighting powers and physique of the Somalis, who are attired with a long spear and a stabbing knife, and who guard their women rigidly. Many lighter complexioned Galla, probably slaves, were observed among them.

Dahomey—The end of General Dodd's victorious compaign in Dahomey has been the declaration that all that country is now under French protection, while the districts of Whydah, Godomy, Abomey—Kalavi, with some others, are annexed to France.

Sources of the Nile.—Dr. Bauman's journeys in the district between Lakes Tanganyika and Victoria Nyanza have thrown much light on the ultimate sources of the Nile. Dr. Bauman considers the

Kagera, a small river emptying into the Nyanza, as the true fount of the Nile—its source is esteemed sacred by the Warundi, or natives of Urundi, a thickly populated district lying around the head of Lake Tanganyika.

DEATH OF MSIDI.—The March issue of the Geographical Journal contains a résumé of the conduct and result of various exploring expeditions which have penetrated into the district of Garenganze (Msidi's country) since it was visited by Arnot. The whole of this southeastern part of the Congo State has been leased to the Katanza Company, and no less than five expeditions have reached and explored the upper courses of the Lualaba, Lomaine, and Sankaru, the upper part of which last is called the Lubilash. Lieutenants Paul le Marinel, Delcommune and Capt. W. G. Stairs were the respective commandants of three of these. The most important political event has been the death of Msidi, and the falling to pieces of his ephemeral empire. Having become old and despotic, various chiefs rebelled, and the country became anarchic. Msidi asked for aid from M. Delcommune, but that gentleman wisely refused. During the stay of Capt. Stairs at the capital, Lieut. Bodson was compelled to shoot at and kill Msidi in self-defence, but was at once shot by a chief. Capt. Stairs immediately called the chiefs together, and persuaded them to accept the flag of the Congo State. At this juncture—Captain Dia and his party arrived, and Capt. Stairs, whose health had long been failing, took the opportunity of departing for the coast, but died at Chinde. The flow of water in the Lualaba is much less that in the more eastern Lualaba. Msidi's " empire " about which so much has been written, has therefore endured less than a single generation.

The River Baram and Mt. Dulit, Borneo.—In the Geographical Journal for March, Mr. C. Hose gives an account of a trip up the Baram River to Dulit (5100 feet) and the high lands of Borneo. A map accompanies the account, and one eminence Kalalong is given at 7000 feet, while Mr. Hose states that the extinct summit visible must be nearly 10,000 feet. An amusing incident was the encounter with a musician who was entertaining an assembly by performing upon a flute, *selingut,* with his *nose,* and eliciting notes clearer than those obtaining from the ordinary native flute, *ensuling,* played with the mouth. The musician asserted that when at best, he could draw tears from his audience. The lower part of the Baram, which at its embouchure is three quarters of a mile wide, and which rolls forth a current sufficiently strong to render the sea-water fresh two miles from shore, is flat, with little to note save fine palm-trees. The first real high ground begins

60 miles from the mouth, at Claudetown, the seat of government and centre of trade. Most of the traffic seems to be in the hands of Chinese merchants. At the entrance of the Akar the land is very fertile, and the mountain scenery fine; while at the mouth of the Libbun the scenery on one side consists of lofty table topped elevations of from 5,000 to 8,000 feet, on the other of grassy plains. The object of Mr. Hose's trip was not exploration only, but natural history, and from various points of the flat topped Mt. Dulit he collected many birds and mammals, some of the former new to science. Several tribes; Kayans, Punans, etc., are mentioned, all differing from the Dyaks. The Punans build no houses, but live in the jungle like wild beasts, and are expert with the blow pipe. The Kayans have singular burial customs, and are spiritualists, believing that messages can pass between the dead and the living. When a death occurs in a family, the body is placed in a coffin of soft wood, painted in various hues, and with a lid fastened down with dammar resin, and is kept in the house three months. To avoid too great a nuisance, a long drain of bamboo is thrust deep into the soil, with the upper end in the coffin. After three months a tomb of hard wood, twelve feet from the ground, adorned with figures of men and women, is made, and the corpse is borne to it with much ceremony. The weapons, tools, and cook-pot of a man are buried with him, while with a woman are laid her sun-hat, hoe, and personal adornments, particularly her ear-rings. Cigarettes, to be given to friends in the land of the dead, are always placed with the corpse. The Kayans believe that the dead have different places of abode, according to the manner of their death. Those who die of sickness or old age have a lot in Apo Leggān, much like that on the earth; those who die by accident or in battle have a better lot in Long Jalan; still born children, who have never known pain, are very brave; suicides are miserable in Jan Jokkan, while to those who die by water fall stores of riches in their posthumous residence Ling Yang. It may be remembered by some that recently Mr. Whitehead added greatly to our zoological knowledge of Borneo by his ascent of Kina Balu, from which mountain he brought back a collection that demonstrated the existence of a Himalayan fauna. Mr. Hose has added to these proofs. The district of the Baram River has been detached from N. Borneo, and annexed to Sarawak, now governed by the son of the famous Rajah Brooke.

Mr. H. R. Mill, in an article in the March Geographical Journal seeks to reconcile conflicting ideas respecting the permanence of oceanic and continental areas, by showing that the 1700 fathom line divides the world into two nearly equal areas, the one abyssal, the other continental.

GEOLOGY AND PALEONTOLOGY.

The Moon's Face.—Mr. Gilbert's address as retiring president of the Washington Philosophical Society is an ingenious array of arguments in favor of the impact theory to account for the origin of the features of the moon's face. His hypothesis is, that material constituting the moon once surrounded the earth in the form of a Saturnian ring; that the small bodies of this ring coalesced, first gathering around a large number of nuclei, and finally all uniting in a single sphere, the moon; that the lunar craters are the scars resulting from the collision of the moonlets.

This hypothesis reconciles the impact theory with the circular outline of the lunar craters, and explains the abundance of colliding bodies of large magnitude. The author discusses the probabilities of the formation, according to his theory, of lunar wreaths, central hills, arched inner plains, level inner plains, and the association of inner plains with central hills. He finds his theory adequate to explain all these phenomena, as well as the peculiarities known as furrows, sculpture, rills and rill pits. In regard to the "white streaks" Mr. Gilbert quotes, as in accordance with his own idea, an unpublished suggestion made by Mr. William Würdeman, "that a meteorite (moonlet) striking the moon with great force spattered whitish matter in various directions."

During the growth of the moon, many of the moonlets must have collided with the earth and formed impact craters which have been obliterated by erosion and sedimentation. It is possible the writer suggests, that these collisions imitated not only the differentiation of continental and oceanic plateaus, but the series of geographic transformations of which geologic structure is the record. (Phil. Soc. Washington, Bull. Vol. XII, 1893).

North America during Cambrian Time.—Mr. Charles Walcott's extensive knowledge of the Cambrian system of North America, has made it possible for him to reconstruct the form of the continent during that time. The land area is considered at the inception of Cambrian time, and its history is traced in a broad manner to the closing epoch of the period.

By a form of deductive reasoning from the mode of sedimentation the author first determines an approximate shore line of the ancient pre-Cambrian continent. The geographic distribution of pre-Cambrian land is based upon the evidence afforded by the absence of Cambrian deposits upon known pre-Cambrian rocks; the existence of shore lines during earlier Cambrian time; and the presence of deep-water deposits. The features of the surface of the pre-Cambrian land are indicated by the relation of the known Cambrian and post-Cambrian formations where it is exposed.

Mr. Walcott considers the prevailing view of the geographic distribution and extent of continental area at the beginning of Paleozoic time too restricted. The present Appalachian system was outlined by a broad, high range that extended from the present site of Alabama to Canada, with subparallel ranges to the east and northeast. The paleo-Adirondacks joined the main portion of the continent, and the strait between them and the paleo-Green Mountains opened north into the paleo-St. Lawrence Gulf, and to the south extended far along the western side of the mountains and the eastern margin of the continental mass to the sea that carried the fauna of the Olenellus epoch around to the paleo-Rocky Mountain trough.

It is highly probable that ridges of the Algonkian Continent rose above the sea to the east of the present continent. On the east and west of the continental area the pre-Cambrian land formed a mountain region, and over the interior a plateau existed much as it does to-day.

In late Middle Cambrian time, the Cambrian Sea began to invade the great Interior Continental area and extended far to the north toward the close of the period.

At the close of the Cambrian time the Cambrian Sea had extended over the broad interior continent and had submerged the low ground along the line of the barrier ridges and some portions of the northern nucleal V of the Archean Continent.

Two hypothetical maps based upon columnar sections, and the present knowledge of the distribution of the sediments, represent the continent at the beginning of Lower Cambrian and of Ordovician time. These maps in connection with one showing the relative amount of sedimentation within the typical provinces of North America during Cambrian time, and the theoretic sections across the continent, are valuable adjuncts to the text. (Extr. Twelfth Ann. Rept. Director U. S. Geol. Survey, 1890–91).

Lower Silurian Brachiopoda of Minnesota.—The report of Mr. N. H. Winchell and Mr. Charles Schubert on the Brachiopoda found in the Lower Silurian deposits of Minnesota comprises descriptions of 31 genera and subgenera, to which are referred 94 species and varieties. These latter include 15 that are new to science. Two new families are necessitated by the authors' scheme of classification. Clitambonitidæ to contain Protorthis, Clitambonites, Hemipronites, and Scenidium; and Lingulasmatidæ to contain Lingulaps and Lingulasma.

In a short introduction the authors state that near the top of the Trenton shales new forms are introduced. Near the middle of the Galena the brachiopod horizon is quite distinct from any below it. The fauna of the Hudson River deposits agrees with that of the Cincinnati group of the Ohio Valley. Below the Trenton limestone, but one brachiopod (*Lingula moesii*) is known in the St. Peter sandstone; none in the Shakopee formation, but several in the Lower Magnesian. In the St. Croix formation brachiopods are abundant but mainly of inarticulate species. (Extr. Vol. III. Rept. Minn. Geol. Surv. 1893)

Geological News. General.—Mr. C. S. Du Riche Preller gives as a result of a lengthy investigation of the Tuscan Archipelago that (1) these islands are, geologically and petrographically, closely connected, not only with each other, but with the Maremina Hills on the one hand, and with Corsica and Sardinia, as well as with the Ligurian Alps on the other; (2) that they probably constitute part of a former Tyrrhenian continent; and (3) with few exceptions they are representative of every geological formation from pre-Silurian downward and also include an interesting eruptive series. (Geol. Mag., June, 1893).

Paleozoic.—Mr. N. H. Winchell and C. Schubert have published in quarto form, with profuse illustration, the Sponges, Graptolites and Corals from the Lower Silurian of Minnesota. 9 sponges are listed; 4 Hydrozoa including the doubtful one, *Solenopora compacta* Billings; and 10 Actinozoa, of which 5 are new species. The paper includes a discussion of the systematic position of "Anomaloides" by Mr. E. O. Ulrich, with a proposal to change the name to Anomalospongia. (Vol. III. Final Rept. Minn. Geol. Surv. 1893).

A new species of Discites (*Discites hibernicus*) is described and figured by Messrs A. H. Foord and G. C. Cricks in the Geol. Mag., June, 1893. The shell has not been distorted during fossilization, so that the characters of the fossil can be accurately determined. The specimen was found in the carboniferous limestone near Dublin.

According to Mr. Arthur Hollick the isolated and limited exposures of cretaceous strata on Staten Island indicate a large and continuous bed of similar material throughout the entire area. Mr. White's division of the New Jersey cretaceous strata into marine and non-marine, with the Staten Island Clays referred to the latter division, the author considers no longer tenable. (Trans. N. Y. Acad. Sci. Vol. XI, 1892).

Mesozoic.—The validity of the Wallala beds as a division of the California cretaceous is questioned by Mr. H. W. Fairbanks. This division was made by Drs. White and Becker and comprises a series of shales, sandstones and conglomerates found in Mendocino Co., Cal. and Todos Santos Bay, Lower Cal. The Coraliochama, which White considers the characteristic fossil of the Wallala beds, is abundant in the Chico. Recent fossil finds show also that the fauna of Todos Santos Bay closely resembles the Chico. The general character of to the beds, together with resemblance of fauna, is sufficient evidence Mr. Fairbanks that the Wallala beds and the Chico are synchronous. (Am. Journ. of Sci., June, 1893.

Mr. T. W. Stanton's conclusions in regard to the California cretaceous are substantially the same as those of Mr. Diller. He finds no faunal break in the series of strata that have been referred to the Shasta and Chico formations. A comparison of the Shasta-Chico fauna with that of the Blackdown beds of England, shows that of 46 species figured by Sowerby from those beds, 23 are represented in the Shasta-Chico formations. The age of this fauna, therefore, is not more recent than the Cenomanian. (Bull. Geol. Soc. Am. June, 1893).

Cenozoic.—In discussing the affinities of a fish from the " terrain Bruxellien " described by Dr. Winkler as *Euchodus bleekeri*, M. Raymond Storms agrees with Mr. A. S. Woodward, that the fossil must be referred to Cybium, a genus represented in modern waters by at least a dozen species. (Bull. Soc. Belge de Geol. de Paleont. et d' Hydrol, T. VI, 1892).—At the June meeting of the London Zoological Society an account was given by Mr. Lydekker of a collection of bird bones from the Neocene deposits of St. Alban in the Department of Isère, France. The more perfect specimens were referred mostly to new species; *Strix sancti albani, Palaeortyx maxima, P. grivensis* and *Totanus majori.* Some of the specimens were indeterminable from their fragmentary condition. (Nature, June 15, 1893.)

BOTANY.

The Coming Botanical Meetings at Madison.—In connection with the meeting of the American Association for the Advancement of Science at Madison, Wisconsin, from August 17 to 23, inclusive, there will be much of interest to American botanists. The Society for the Promotion of Agricultural Science meets on the 15th and 16th. Beginning on Friday, the 18th, the Botanical Club will hold daily meetings. The new section of Botany (Section G) of the Association promises to be of unusual interest, inasmuch as the committee on programme has made a special effort to bring out some of the foremost botanists of the country, many of whom have consented to prepare papers. The announcement is made that there will be papers on Morphology, Physiology, Pathology, Systematic and Economic Botany, and special papers on "The Present Status of Botanical Instruction in the Colleges and Universities of this Country," and "The Present Aspect of the Nomenclature Question."

Following all these will come the International Botanical Congress, of which mention was made in the NATURALIST some months ago. The Committee having the matter in hand have issued a circular announcing the congress, as follows:

"An International Botanical Congress will be held at Madison, Wis., U. S. A., beginning August 23, 1893, and continuing three or more days. All botanists are eligible to membership, and are earnestly requested to attend the sessions, so far as possible. A membership fee of two dollars will be required.

"The purpose of the Congress is the presentation and discussion of botanical questions of general interest relating to the advancement of the science. It is expected that the International Standing Committee on Nomenclature, appointed last year at the Genoa Congress, will present its first report at this time. Papers embodying research will not be received, but such papers, whether by American or foreign botanists, may be presented before the Botanical Section or the Botanical Club of the American Association for the Advancement of Science, which holds its annual meeting preceding that of the Congress (August 17 to 24).

"Reduced rates of travel by steamship or railway cannot be provided by the Congress, but special rates can be obtained for the World's Columbian Exposition at Chicago. Madison is reached by several lines of railway from Chicago, and is distant only about four hours.

"It is hoped that societies will send delegates to the Congress. It is requested that all persons intending to be present notify the chairman of the committee of arrangements at as early a date as possible."

The committee, consisting of Messrs Arthur, Bailey, Britton, Campbell, Coulter, Coville, Galloway, MacMillan, Robinson and Underwood promises to issue a programme of the sessions before the meeting. In the meantime further information may be obtained of the chairman, Dr. J. C. Arthur, Lafayette, Ind.—CHARLES E. BESSEY.

Freshwater Algæ.—Dr. A. C. Stokes has rendered a good service to beginners in the study of the fresh water algæ by preparing his little book "Analytical Key to the Genera and Species of the Fresh Water Algæ and the Desmidieæ of the United States." It contains 117 pages of matter, and a plate illustrating the genera. As brought out by the publisher E. F. Bigelow of Portland, Conn., it is a neatly printed, cloth-bound volume, which he sells for the moderate price of $1.25. It merits an abundant sale. The following suggestions taken from the introduction may be useful to beginners:

"Algæ and Desmids are singly invisible to the naked eye. It is only when they occur in large masses that the eye can take cognizance of them. It rarely occurs, however, that the Desmids are so abundantly congregated that they thus obtrude themselves on the observer. When a large quantity has been collected and the vessel placed near a window, they will collect in a green film at the surface of the water on the lighted side, and there become visible in mass. In the ponds and shallows such an occurrence is not common. At times they are found so abundantly that by holding a glass vessel of the water up to the light they may be seen floating about as minute green objects, which the trained eye will recognize and the pocket lens make distinct. But these varieties are among the largest of the forms; according to my experience they are always exclusively confined to the Closteriums. Other large forms, like Micrasterias, at least in the writer's locality, rarely occur in such profusion. To collect the Desmids, therefore, it is necessary to collect by faith. The microscopist can know exactly what he has only when he gets home and examines the water, drop by drop, under the microscope.

"With the Algæ it is different. These are usually visible to the naked eye, as they are almost invariably collected in large masses, floating on the surface, submerged just beneath the surface, or attached in waving tufts or fringes to sticks and stones and other plants in the ponds. The eye of faith is not needed to recognize them. They usually force themselves on the wandering attention of the observing pedestrian in the wayside lanes, beside the ditches and slow brooks. As soft emerald clouds, or graceful streamers floating in the sluggish current, or resting like a green scum on the surface, they are readily seen and easily gathered. No collecting tools are demanded for either Algæ or Desmids, except a dipper of some kind, a common tin dipper is as good as anything, and a few bottles or other vessels to carry the treasures home, and to keep them concealed from inquisitive people; the collecting naturalist must always be prepared for meeting with such persons."

ZOOLOGY.

Zoology of the Lower Saskatchewan River.—Prof. C. C. Nutting's report on Zoological Explorations on the Lower Saskatchewan River is condensed statement of a large amount of information. The expedition was sent out by the Iowa State University, with the primary object of getting a series of birds in summer plumage, and also the downy young. Prof. Nutting, however, got all he could in all directions. Much of the interest of the report lies in the descriptions of the habits of the various animals, either as observed by the party themselves, or told them by the hunters of that region.

In speaking of the geography of the country explored, Mr. Nutting refers to the water system as comparable in extent to that of the Mississippi River. From the Saskatchewan River to the Polar Sea is one inextricable maze of lakes, rivers and marshes, one of the greatest palustral regions in the world, perhaps, and the breeding place of most of our migratory birds.

The region is one of unusual zoological interest, being to a certain extent characterized by an intermingling of eastern and western, arctic and temperate faunæ. The whole region is covered with dense forests of conifers and poplar. The formation is Upper Silurian, and the principal paleontological feature is *Pentamerus decussatus* of which a fine series was secured.

The birds collected, numbering 104 species, were the summer residents of that region, of which 90 per cent are birds included in the avifauna of Iowa.

In regard to the migration of birds, the view held by the writer is that the impulse to migrate comes *from without* and the act is a *conscious* seeking for a more suitable clime, on the part of the adults at least, the young simply following or imitating their elders. There is much to indicate that this stimulus comes in the form of *the wind*.

Only a fragmentary list of the mammals is given. One snake was found, also three frogs and five fishes; but a large number of insects and molluscs were secured. (Bull. Lab. Nat. Hist. Iowa State University Vol. II, No. 3, 1893).

Zoological News. General.—A correspondent of The Naturalist has communicated a curious fact to that Journal. Along the estuary of the Humber River an excavation has been made in a quarry into which the water of the estuary overflows but cannot return to the river. This water is brackish and contains a few sea fish, among which are some whitebait and herring. These fish thrive and reproduce themselves, but are reduced in size and are gradually forming a dwarfed species, especially the herring. These brackish water fish could easily be utilized for pisciculture. Mr. Yarrel reports that the whitebait adapts itself to fresh water where it grows and multiplies almost as well as in the sea, furnishing a table fish which for size and flavor is not surpassed by its salt water relatives. (Revue Scientifique June, 1893).

Invertebrata.—Dr. J. G. de Man has recently published in quarto form full descriptions of 129 species of Decapods found in the Indian Archipelago. Among them the author notes 27 new species and 9 new varieties. They are all classified under 50 genera. Fourteen plates, and a table showing the geographical distribution of the fresh water species accompany the paper. (Zool. Ergeb. einer Reise in Neiderl. Ost. Indien, Zweiter Bd., Leiden, 1892).

According to Dr. M. Weber 112 species of fresh-water crustaceans have been found in the Indian Archipelago, of which 83 are Decapoda, 10 Isopoda, 6 Ostracoda, 5 Cladocera, 4 Amphipoda, 2 Copepoda, 1 Branchiura and 1 Branchiopoda. (Zool. Ergeb. einer Reise in Niederl. Ost. Indien, Zweiter Bd. Leiden, 1892).

Vertebrata.—Mr. J. A. Allen reports 17 mammals and 162 birds collected in northeastern Sonora and northwestern Chihuahua, Mexico, on the Lumholtz Archeological Expedition 1890–92. Of the birds 12 species occur as resident birds within 150 miles of the southern border of the United States. (Am. Mus. Nat. Hist., March, 1893).

A summary of the species of Reptiles and Batrachians of Wisconsin published by Prof. W. K. Higley gives Lacertilia 4, Ophidia 22, Testudinata 13, Anura 8, and Urodela 12. Among the turtles is mentioned *Macrochelys lacertina*, the Loggerhead Snapper which the author says is occasionally found in the Mississippi River as far north as the mouth of the Wisconsin. (Wis. Acad. Sci. and Arts, Vol. VII).

EMBRYOLOGY.[1]

The Sea-urchin egg.—Hans Driesch[2] has recently made an interesting addition to his previous work upon the eggs of *Echinus mricrotuberculatus* and *Sphærechinus granularis* by the aid of an improvement in his methods.

He reaches the conclusion that by operative interference cells of the cleaving egg are made to form entodermal structures though they would normally have formed ectodermal structures.

In his larger paper[3] the author described the peculiar results obtained when eggs are subjected to pressure under a cover glass.

In such eggs the elastic membrane must be ruptured by pressure in order that it may not tend to restore the original spherical shape when the pressure is removed, but when the eggs are compressed sufficiently to break the membrane many of them are irreparably injured. Subsequently he found that if the eggs are shaken for 4 or 5 seconds in a glass the membrane may be removed from all of them without any injury to the eggs. This, however, must be done at the right time, about three minutes after the sperm has been added to the eggs and the membrane is just plainly separating itself from the egg.

These membraneless eggs are subjected to the pressure of the cover glass when they have divided into 4 cells. Under such circumstances they form a disk of 8 cells, since the cleavage spindles now lie horizontally or at right angles to their normal position.

When the pressure is removed the 8 cells divide at right angles to the plate, forming 16 cells in two layers of 8 each; however there are rarely 4 but usually only 2 micromeres formed and these 2 frequently lie out at one side of the double plate, not beneath the cells that formed them. From this double plate of 16 cells there is next formed a double plate of 32 cells. The important point here is that, as the author maintains, no rearrangement of cells takes place but merely a horizontal division of each of the 16 to increase the whole to a double plate of 32, 16 in each layer; yet the cells that gave off the peripherally placed micromeres do divide vertically and thus fill the gap in the lower plate, which would otherwise remain with only 12 cells. These 12 with, the 2 vertically formed ones and the 2 products of the 2 micromeres make up the 16 of the lower plate.

[1] Edited by Dr. E. A. Andrews, Baltimore, Md.

[2] Anatom. Anz., April 8th, 1893.

[3] See THE AMERICAN NATURALIST for February, 1893.

This double plate of 16 cells is the blastula stage, the author affirms, and becomes a complete larva without rearrangement of cells. It follows then that the normal animal pole of the egg is now found as a circular zone of cells about the equatorial periphery of the embryo while the vegetative pole of the normal egg is now represented by two isolated cells, one at each polar region of the entire mass; this is a disk that is becoming spheroidal by the conversion of the central parts which we have called its upper and lower surfaces into the peripheral zone or equator of the sphere.

If the eggs are kept under pressure till 16 cells are formed these are found to be in a single layer. When now this plate of 16 cells is set free and a second division in accomplished there results a double plate of 32 cells having 16 in each layer. This seems almost identical with the above described 32 cell stage and like it may form a complete normal pleuteus larva. As a matter of fact the two 32 cell embryos differ in the important item that cells having homologous positions in the two may have different relationships to the cells near them. Thus in the latter case cells at the periphery overlying one another, one in each layer, are brothers while like-placed cells in the former embryo are cousins. Another difference is that the 2 micromeres of the latter embryo do not divide into 4 equal cells but into 2 larger 2 smaller, as is the case in the normal embryo.

From the above facts, which are illustrated by camera drawings, the author concludes that so fundamental a displacement of cells has been brought about that, first, some ectoderm arises from what would have been entoderm and second, that entoderm arises from what would have been ectoderm. The first conclusion is evident from Selenka's observation that the entodermal invagination is normally opposite the animal pole, or region of micromeres. For if these experiments are credited, the vegetative part of the egg is displaced into two separate sets of cells; later but one digestive tract arises, hence some of these two sets of vegetative cells must have taken part in the formation of ectodermal structures.

If we may assume that the micromeres are a determining influence, or that the entoderm *must* arise opposite them, even in these abnormal specimens, then the entoderm will be formed from a part of the abnormal egg that is purely of the animal pole or normally to form but ectoderm.

Unfortunately the author has no observations upon these interesting stages of the abnormal larvæ and we have no real knowledge of what cells actually form the entoderm.

A Contribution to Insect Embryology.[4]—Under this title Mr. W. M. Wheeler presented to the Faculty of Clark University a dissertation that demonstrates the high ideals attained in Biological work at that institution.

It is sufficient indication of the character of the work to say that it is worthy of the elegant illustration it has found in the Journal of Morphology.

It is chiefly a study of gastrulation, formation of embryonic membranes, nervous system and reproductive organs in the locust, *Xiphidium ensiferum* Scud., though a much broader view is given by illustrations drawn from the author's work upon numerous other insects, notably the Orthoptera.

The eggs of this insect are laid in the willow galls produced by a Cecidomyia. They were hardened in water heated to 80° C. and afterwards kept in 70 per cent alcohol for weeks or months to allow the yolk to shrink from the chorion. Surface views and sections were then prepared by methods but little modified from those of Graber and of Patten.

The blastopore extends nearly the whole length of the germ band and is bifurcated posteriorly in a way strangely suggestive of the "sickel" of the chick embryo. It closes from each end toward the middle or future baso-abdominal region and by a process of "slurred" invagination thus gives rise to the mesentoderm.

In almost all other Orthoptera there is also, the author shows, an invaginate gastrula.

Later a most remarkable migration of the embryo takes place and complicates the difficult subject of the complex embryonic membranes.

Lying first upon the ventral surface of the egg, with its head toward the anterior and sharper end of the egg, the embryo actually sinks down into the yolk and by bending comes to lie upon the dorsal side with its ends reversed, its head toward the posterior or larger end of the egg. The appendages having meanwhile become so well developed that the leaping legs are distinguishable from the others, the embryo moves back into its original position upon the ventral side of the yolk, bending back so that it lies as at first. This second migration, however, is not through the yolk but upon its surface, over the posterior end of the egg.

These peculiar movements of the embryo, which the author would embrace under the term "blasto-kinesis," may, he thinks, be explained as of physiological use. He first shows that the primitive winged

[4] Journal of Morphology, Vol. VIII, No. 1, 1893.

insects probably had eggs with considerable yolk and dense envelopes of chitin. The rapidly growing embryo, feeding upon the yolk must give off waste products that might accumulate in the adjacent yolk. Hence, it would be of advantage if the embryo could move away to yolk not contaminated.

From a comparative view of similar movements in Orthoptera the author infers that the more complete migration movements are primitive and that the more restricted movements have been more recently assumed; while in other groups various stages of disappearance of these blasto-kinetic phenomena have been described.

A classification of the insects based upon these movements and the character of the embryonic membranes would not, the author is convinced, conflict with that of Brauer, though the embryological evidence would tend to subdivide the Orthoptera or raise the value of the families of this group.

These embryonic membranes in Xiphidium are very numerous and complicate the above movements of the embryo, are, perhaps, the cause of the return movement. The serosa covering the entire yolk becomes cut off from the folds, amnion, covering the ventral face of the embryo so that the embryo first sinks into the yolk free from the serosa, which surrounds everything, but carrying with it the amnion. When the return trip begins, however, the amnion is again grown fast to a super-jacent membrane, the indusium, and is ruptured before the embryo can advance. This it does by becoming evaginated from the pouch of the amnion, out of which, also, an amniotic liquid escapes. The reflexed membranes do not form the dorsal surface of the future insect but are thrown off; in fact this is the case, the author thinks, in all insects: the envelopes may be variously absorbed or cast off in different cases, but in all they are to be regarded as specialized organs that have performed their part and are not used again in the formation of the body wall of the insect.

The indusium to which the amnion adheres is a most remarkable organ that first appears as a faint disk of cells anterior to the embryo when the blastopore is open.

Later this plate of cells is for awhile connected with the head lobes of the embryo, which then assumes a clover leaf outline, disappearing when the plate becomes again free.

This plate of cells is grown over by the serosa so that an amnion is formed over it just as over the embryo, the edges of the plate rising up to meet as a thin amnion beneath the serosa. This amnion is cut off from the serosa; it may be called the outer indusium to distinguish it from the thicker disk of cells, the inner or true indusium, lying upon the yolk. The indusium is then a double body lying anterior to the embryo and free. So it is not carried away when the embryo sinks into the yolk but remains and grows in all directions as a double layer between the serosa and the yolk. This double sac externally meets itself on the dorsal mid line of the egg and fuses with itself, inner indusium with inner, outer with outer. Thus the embryo becomes covered in by four cellular membranes; of these the inner indusium also secretes a granular substance and a cuticle.

As to the origin of these structures the author inclines to the mechanical conception regarding the amnion, since the insect may be regarded as sinking down from the surface in its formation much as in the case of some "invaginal disks," heads of cysticercus, the nemertean in the pilidium, etc. The indusium is, however, a structure found only in the Locustidæ, but may be homologized with a solid mass of cells, the so-called micropyle of certain Poduridæ. This micropyle in turn is comparable to the "dorsal organ" of crustaceans which possibly goes back to some sucking disk of some remote annelid-like ancestor.

The author's discoveries regarding the formation of the nervous system form one of the most interesting chapters of the present contribution and add to the evidence for the derivation of insects from annelid ancestors. The first recognized start of the nervous system is when the blastopore is still open and many large clear ectoderm cells are distinguishable in groups amongst the superficial common ectodermal cells. These large nerve-formative cells soon sink beneath the surface and are arranged in four long rows on each side of the blastopore. When that closes a median row is formed between the above four right, and four left rows. From these lateral and median rows of large cells the whole central nervous system is formed, at least all its true nervous substance. These cell rows do not, however, become directly converted into ganglion cells, but disappear, it is thought, after having budded off a mass of daughter cells. Each cell in one of the rows buds off successive cells that form vertical strings of cells; these strings form the thickness of the nerve cord and become the ganglion cells with their nerve processes. The continuous ganglionic mass so formed becomes divided into sixteen successive ganglia which are reduced by fusion to ten.

The brain is directly continuous with the ventral cord and, at least in the middle and posterior of the three regions into which it may be divided, differs from the ventral ganglia chiefly in the lack of the middle row of cells.

Contrary to what would be expected the optic nerve fibres seem to grow out from the brain toward the ommatidia of the eye.

While the author supports the view that the rows of nerve-cord forming cells in insects are homologous with the neural cell-rows of annelids (especially since they are most clearly shown in the oldest winged insects, the Orthoptera) he recognizes the possibility of this being merely a case of precocious segregation.

Another interesting part of the paper deals with the formation of the gonads and the sexual ducts.

The mesoderm is early split up into eighteen pairs of blocks, which become hollow and extend from the region of the definitive mouth to that of the definitive anus, the length of the blastopore. Two pairs correspond to the second and the third division of the brain, the others are in the thorax and abdomen. The first pair send out hollow diverticula into the antennæ; those back of the head send diverticula into the limbs.

In the walls of these hollow mesodermal sacs on the side next the median plane and the yolk, certain large cells become recognizable as the germ cells. These cells are formed, however, in the abdomen in the first to the sixth segments. They are of mesodermal origin, apparently, and first recognized when thus distributed in segmentally arranged clusters in the walls of the mesodermal sacs. In one abnormal case such germ cells occurred also in the tenth abdominal segment. These germ cells fall into the cavities of the mesodermal sacs and multiply by caryokinetic division. The six successive masses of germ cells become connected into one ovary or one testis by the outgrowths of solid diverticula from each sac to the one anterior to it and subsequent fusion.

The sexual ducts arise also from these mesodermal sacs. Thus, while in the head and thorax the diverticula that go to the limbs are converted into their muscles, the diverticula in the abdomen either disappear along with the transitory appendages or else remain as parts of the sexual ducts. In the male the mesodermal diverticula of the tenth abdominal segment remains as the terminal part of the sperm duct. The rest of the duct is formed from a solid ridge on the inner wall of the mesodermal sacs between the tenth segment and the anterior six forming the testis. The ducts then may be regarded as hollow outgrowths of the cœlomic sacs. In the female these diverticula are in the seventh segment, but at the same time there is a pair in the tenth. While the former become the oviducts, the latter, representing the terminal ampullæ of the sperm ducts, ultimately disappear. With the disappearance of most of the abdominal appendages there is still a retention of the posterior ones to form the ovipositor. The author makes out a clear case for the belief that this structure is formed from two or three pairs of real limbs.

The reproductive organs thus show resemblances to those of annelids, not only in the marked metameric character of the gonads, or clusters of cells on the cœlomic walls, but also in the fact that the ducts arise as cœlomic diverticula, since these diverticula may be homologized with nephridia by the aid of the condition of things probably existing in Peripatus.

ENTOMOLOGY.[1]

The Work of the Gypsy Moth Commission.[2]—For the last three years an experiment of great entomological interest has been in progress in the vicinity of Boston. About twenty-five years ago there lived in Medford, Mass., a man who experimented with silk worms of various kinds. Among other species which he had imported from Europe was that known as the Gypsy Moth—an insect that in Germany is very destructive to a great variety of trees and other plants. Some of these insects escaped and began developing in the neighborhood. They continued to multiply for many years until they became a plague to the community. The entomologist of the State Agricultural College was appealed to, and finally the Legislature appropriated $50,000 to be expended under the direction of a Commission appointed by the Governor, "to prevent the spreading and secure the extermination of the *Ocneria dispar* or Gypsy Moth in this Commonwealth." The Commissioners thus appointed remained in office about one year, when the work was turned over to a Committee of the State Board of Agriculture, consisting of Professor N. S. Shaler, Francis H. Appleton and Secretary Wm. R. Sessions. This committee soon called into consultation a number of prominent entomologists, and later appointed Professor C. H. Fernald entomological adviser. Mr. E. H. Forbush was elected director of field work.

Since the time of these appointments additional appropriations have been made and the work of extermination has been vigorously prosecuted. A large force of men has been kept at work fighting the insect in all its stages. The infested area has been accurately determined and every precaution has been taken to prevent its further spread. The results already obtained are very remarkable: where three years ago every green thing was alive with the worms, during a recent visit I had difficulty in finding any. The localities in which the insect is still present in numbers are comparatively few and are receiving so much attention from the director that a year hence they will be still fewer.

An idea of the general methods of work may be obtained from the following extract from the Director's first report: "It was at once seen that the work of crushing out the species would be an arduous task.

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

[2] Reports of the Mass. Board of Agriculture on the Extermination of *Ocneria dispar*, 1892 and 1893.

 [redacted]

Drawn by Joseph Bridgham.

Heliotype Printing Co. Boston.

GYPSY MOTH

For an undertaking of this character and magnitude, men were needed who by nature and training were fitted for the work. A perfect system was imperative. An intimate acquaintance with the country must be acquired. An accurate knowledge of the habits of the insects was a necessity, and constant vigilance an indispensable requisite.

"When field operations were commenced, the eggs of the gypsy moth were the only living form of the pest. The men were carefully trained to recognize and destroy them, and to distinguish between their eggs and those of our native moths. They were taught to observe all evidences of the existence of the gypsy moth, and were requested to secure all information possible in regard to its habits. Each inspector was instructed to make out a daily written report of the work done by himself and his men, and to include in this report his observations on the habits of the insect. Many valuable facts were thus recorded during the season. As the force was organized, each inspector was given a squad of men, and a section, indicated by a map, was allotted him, with instructions to inspect it, and destroy the eggs therein. When eggs were found upon a tree, the tree was marked with white paint and the locality designated upon the map. Special implements for the work were invented as necessity required, and a stock of equipments and materials was gradually accumulated.

"At this time the gypsy moth was supposed to be confined to eight or nine towns. Inspectors were sent out to determine how far it had extended, and soon found small colonies in other towns. It was at once evident that inspection must be continued until the limits of the infested district was determined. This method was followed until the new leaves covering the trees rendered further inspection impracticable. The work was resumed when the caterpillars had nearly reached maturity, was continued after the leaves fell, and is still in progress.

"After the men had received the training and experience without which their work would have been of little value, there remained but six weeks in which to make a hasty inspection of the territory and destroy the eggs. Although the work was thus necessarily hurried and imperfect, yet, in consequence of it, the insects have not since appeared in more than sixty localities where the eggs were found in the spring. The infested towns farthest from the centre were first visited by the men engaged in destroying eggs. The men worked from these towns toward Malden and Medford. Before this work was completed the eggs began to hatch. This rendered thorough work an impossibility. No attempt was made, therefore, in the spring, to complete this work in Malden and Medford, except upon trees on or near the highways.

"Wherever worthless, hollow trees were found infested, they were felled and burned. More than one hundred acres of brush and woodland have been burned over, and everything upon it destroyed. Stone walls in which eggs were laid were thoroughly cleaned by fire. In this way vast numbers of moths and their eggs were destroyed during the season.

"As it was observed early in the campaign that the distribution of the caterpillars was effected largely by their falling from the trees upon teams, an effort was made to destroy all eggs upon trees on or near the highways. Before the hatching of the eggs, many of the large street trees in Malden, most of those in Medford and some in Somerville, were banded with strips of tarred paper. This work was first undertaken in Medford. It was proposed by the selectmen of that town as a means of protecting the street trees from the gypsy moth and the canker worm. It proved a very effective means of preventing the depredations of each of these species. The town furnished the labor and paper for banding the trees in Medford. These strips were kept moist by a regular application of a mixture that the caterpillars could not cross. Great numbers of eggs had been deposited on buildings, fences and other objects near the trees. As soon as the young caterpillars left the eggs, instinct led them to the trees, and, as they crawled upward to find food, many were entangled in the cotton waste under the tarred paper and perished. Many more succeeded in getting upon the paper, and, in cases where they were very numerous, would undoubtedly have bridged the mixture upon the paper with their bodies, until some had passed over. The men employed in applying the mixture from day to day prevented this by killing them with their brushes. Some eggs in the trees which had been missed in the spring doubtless hatched, but most of the caterpillars descended from the tree at one time or another, and were unable to return. This greatly reduced the danger that had seemed imminent in the spring,—that the caterpillars would be distributed in large numbers."

Various other methods of destruction are now being used, and valuable experiments with insecticides are being carried on, chiefly at Amherst in the insectary of the Hatch Experiment Station under the direction of Professor Fernald.

It seems to me after a careful inspection of the work in progress that it is being well done, and that its continuation is a matter of national importance. Should this insect become generally distributed it would be liable to cause enormous losses, and even if European parasites were introduced there would inevitably be fluctuations in numbers which would involve periodical outbreaks. I believe with Professor Fernald that the extermination of the pest is possible, "provided the work be continued for several years with sufficient appropriations to keep the entire territory under careful supervision."

Through the kindness of the Committee the NATURALIST is able to present the accompanying colored plate showing the various stages of the Gypsy Moth. The adult females are represented at Figs. 1 and 2; the adult males at 3 and 4; the pupa, (slightly magnified) at 5; the caterpillars at 6 and 7; the egg cluster at 8, and eggs magnified at 9 and 10.

Mr. Forbush has summarized the habits of this caterpillar as follows; "The gypsy moth feeds only when in the larva or caterpillar state. The length of larval life varies somewhat according to circumstances, but probably averages ten weeks. When the caterpillars are first hatched from the eggs they are light in color, and covered with whitish hairs. In a few hours they assume a dark hue. They usually remain on or near the egg cluster until they change in color, and, should the weather be cold, they sometimes remain for several days in a semi-torpid condition upon the egg clusters. If the temperature is favorable they will search for food before they are twenty-four hours old. If a green leaf be dropped upon a table on which some of the caterpillars have been placed, they will all move towards it and climb upon it. During the first few weeks of their existence they remain most of the time on the leaves, feeding usually on the under side. Their feeding habits are so uncertain that no rule can be given which will apply to all individuals, but as a rule when about half grown they begin to manifest their gregarious instincts. At that time and for the rest of their existence as caterpillars they spend a large part of the day clustered in sheltered situations, and feed principally at night, going up the trees and out on the branches after dark, and returning before daybreak. Where they are so abundant that the food supply is insufficient, they evince much restlessness, and feed in numbers during all hours of the day and night. They may be seen hastening to and fro, both up and down the trees. Those which have fed sufficiently are at once replaced by hungry new-comers, and the destruction of the foliage goes on incessantly.

"At such times the trunks and lower branches of the trees are covered with a moving mass of caterpillars. Hurrying throngs are passing and repassing, and nearly every leaf or denuded stem bears up one or more of the feeding insects. The rustling caused by their movements and the continual dropping of excrements is plainly audible. On tall trees the larger caterpillars appear to crawl to the higher limbs, and they seem to prefer to feed well out toward the end of the branches. They do not feed gregariously except when in great numbers; therefore they seldom strip one branch, as do the larvæ of the *Vanessa antiopa*, but scatter throughout the trees, eating a little from each leaf. Early in the season, when they are small and few in number, their ravages are scarcely noticed; but as they grow larger and more numerous their inroads on the tree decrease the foliage area night by night, until suddenly the leaves appear to have been eaten in a single night, and the tree is stripped."—CLARENCE M. WEED.

ARCHEOLOGY AND ETHNOLOGY.

Eighth International Congress of Americanists, Paris, 1890.—M. De Quatrefages was President, and this was the last public function at which he assisted.

Dr. Brinton was one of the Vice Presidents and presided at one of the meetings. M. Desiré Pector, of Nicaragua, but resident at Paris, was Secretary General. There were four or five hundred adherents, about one-half of whom were in attendance.

The questions for discussion were prepared in advance by the committee and announced to the members by circular. One group was as to the

History and Geography of America.

The first question in that group was that presented in 1875 and discussed at nearly every Congress since; Whether the name "America," given to the Western Continent, was not taken from the chain of mountains of a similar name which form cordilleras between Lake Nicaragua and the Mosquito Coast, rather than from the discoverer, Americus Vespuccius? The affirmative was maintained by Prof. Jules Marcou and M. Lambert de St. Bris. The contrary opinion, to wit:–that the name of America was given at San Die near Nancy, and published by Waldseemüller under his *Cosmographia Introductio* was maintained by MM. Jimenez de la Espada, Dr. Hamy, Desiré Pector, Julio Calcano, and others. At the close of the discussion, the President remarked that after the conclusive communications which they had made in favor of the transmission of the name from Americus Vespucci, the question as to the derivation of the name was forever decided and settled. "And," said he, "I hope that it will never figure on the programme of our future Congresses." The question as to an earlier discovery of America was maintained by Mr. Lambert de St. Bris, who attempted to prove that there had been a voyage of Cabot earlier than that of Americus Vespuccius, and also the legend of one still earlier by Cortereal; but none of these met any favor from the Congress, and on the other hand, were universally denounced as traditions and unsupported by evidence.

Mrs. Shipley (née Brown) entered a paper on the "Missing Records of Scandinavian Discovery," declaring her belief in their existence and attributing their suppression to the authorities of the Roman Catholic Church.

The Scandinavian Discoveries of Greenland, was presented by M. Valdemir Schmidt, while M. E. Beaubois argued in favor of the migrations of the Gaul to America during the Middle Ages. MM. Paul Gaffarel and Charles Cariod presented a history of the Discoveries of the Portuguese in America in the time of Christopher Columbus.

Dr. A. Ernst presented some observations upon the culture of the Banana in America. J. Sylvario Jorrin questioned whether there was an authentic portrait of Christopher Columbus, and Dr. Francisco Henriquez y Carvajal argued that the remains or ashes of Christopher Columbus were not removed from San Domingo to Havana as was intended and believed. In support of this, he presented the inscription of one of the sarcophagi at San Domingo, indicating that it contained the remains of Columbus. This assertion gave rise to discussion in which this inscription was denounced by de la Rada y Delgado as false and bearing evidence of having been made in modern times. The "Ancient Cartography of America" was presented by Mr. Shipley, and M. Gabriel Marcel gave interesting account of the globes in the Bibliotheque Nationale on which the Continents of America were figured.

The next group of questions comprised

American Anthropology.

Dr. Ten Kate supported the thesis of Dr. Virchow at the Seventh Congress, to wit:–that we must definitely renounce the theory of a universal type among the American Aborigines. Dr. Ten Kate declared in favor of a plurality of types in America. He found from Cape San Lucas to the River Gila, a distance of 600 kilometres, the extremes of cephalic forms, the indices varying from .6 to 10.0, although he gives no opinions as to which was the most ancient form. The height, too, varies from one metre and 57 centimetres to one metre and 87 centimetres. Taking into consideration these and all other dimensions, he thought he could distinguish more than one type which may have been primitive. He dissents from the idea of the American Indian being a red-skin, but says that his skin is brown or yellow, and to be accounted for by atmospheric and other influences. Dr. Ten Kate declared his conclusions based upon his experience after having made critical anthropological examinations of a large number of Indians, both individual and in tribes. He is forced to the conclusion that many of them possess distinctive mongolite type characters, yet, while there are certain tribes in the northwest like the Tinneh, are undoubtedly of an Asiatic origin as demonstrated by other than anthropological evidence. He does not at all pretend that this similarity of character springs from Asiatic origin of the North American or that he descends directly from the Mongol. The object is to show the difficulty of determining between hypothesis and fact.

A paper was presented from Mr. Thomas Wilson on the subject of the Paleolithic Age in America. Mr. Wilson presented some of the paleolithic implements found throughout the United States and compared them with Chelléen implements and others of the paleolithic period of Western Europe—called attention to the similarity between the two, and explained at length the radical differences between these and instruments belonging to the Neolithic Age, and announces his conclusion that we may assume the existence of a Paleolithic Period in the United States. He says in a note that, as a working hypothesis, this conclusion is expressed under all reserve and subject to future discoveries; that it is intended to stimulate investigators to seek in the sands and gravels of the Quatenary geological Epoch for paleolithic implements, and that despite their want of beauty, to gather and preserve them for the sake of science. No argument is made as to whether they come from glacial or preglacial regions, nor is any attempt made from them to determine the civilization or culture of the Paleolithic Period, nor to find the man who employed or made these instruments.

The Marquis de Nadaillac presented and read an extended review of the evidence on the subject of "The Earliest American." His origin he confesses to be entirely unknown, but he is of the opinion that he occupied the continent of America during the glacial if not during the pre-glacial period, and that he passed through two periods of cold. In saying this, however, he expressly disclaims any attempt to establish a parallel of the glacial periods of America and Europe. His paper was published at length in the *Revue of Scientific Questions* of Brussels in July, 1891, and is not to be found in the report of this Congress. M. l'Abbe La Petitot, in discussing the paper of the Marquis, bore testimony to the quantity of remains of extinct fossil animals belonging to the Glacial Period which were evidences of having been used by the prehistoric man in the manufacture of his implements. Dr. Fernand de Lisle presented an elaborate paper of 30 or 40 pages, on the subject of the artificial deformation of the skull among Indian tribes of the northwest of America. He took the position alleging it to be borne out by anthropometry, and the experience obtained thereby, that the cranial capacity of the flat-head Indian after having been subjected to this artificial deformation, was not reduced in volume; that some of them were found to be of extreme capacity of 1625 centimetres, and that, consequently, there would be no reduction of brain-power; also he said this deformation being artificial, was individual and not transmitted by heredity.

Dr. Hamy gave a description of the Cliff Dwellers of the Sierra Madre.

Dr. Leon and Mr. Pinart occupied the attention of the Congress with descriptions of Dental Deformations among the Pre-Columbian Tarasques and the Indians on the Isthmus of Panama. Dr. Leon remarks that these Indians do not possess wisdom-teeth, and he attempts to account for it by a supposed want of virility evidenced by their being without hair on any part of their body, and their beard rudimentary. He found that they also were without canine teeth—being replaced by small molars. Their skulls were deformed artificially. He cited an ancient work *The Relacion de Mechuacan* which stated that the Indians with the round head and of natural form, were not considered brave in battle. M. Pinart remarked that among the Indians of the Isthmus of Panama, the incisor teeth were filed to a point, giving them a saw-tooth appearance. Among the females, on their arrival at womanhood, the canine tooth on the upper left hand side was broken out as a sign that they were fit for marriage.

Dr. P. Ehrenreich described his various voyages among the Aborigines of Brazil in 1884–5 and 1887–9, and presented before the Congress a collection of photographs he had taken.

Dr. J. Vilanova described a fossil man found by M. Carles in the valley of the river de la Plata, associated with or near to a skeleton of a Megatherium in the Pampean formation, which corresponds in its characteristics with the European Lehm. Dr. Vilanova has studied the question of fossil man in times of high antiquity, as probably no other Spaniard and but few others in all the world have ever done.

Dr. J. Deniker, Librarian of Histoire Naturelle at Paris, was charged by his Government with a scientific mission to Cape Horn, which he visited in 1882–3. He gave to the Congress a resume of his investigations under the title of Fuegien Anthropology. He first mentions the difference in appearance between the inhabitants of Tierra del Fuego and the Archipelago of Magellan. He describes the type which is based upon his measurement of more than a hundred living Fuegians. He remarks their striking analogy with the prehistoric skulls found by Lund at Lagoa Santa in Brazil, and by Roth at

Pontimilo, Argentine Republic. His conclusions are:–first—the existence in South America of a race or a variety of the American Race, of small height, meso- or dolichocephalic, nose concave—often retroussé in the root—large below, with prominent eyebrows shaped like lozenges, large mouth, etc. Second:—This race occupied in times of high antiquity a large part of South America, principally that south of the Amazon. Third:—At the present time, this same race in a more or less pure state reduced to a few tribes dispersed a long ways from each other, meaning the Fuegians at the extreme south of the Continent and the Botocudos much farther north on the headwaters of the Amazon. Fourth:—They are found isolated in small tribes disseminated throughout Brazil, Bolivia, Peru and Chili. Fifth:—That this race presents a striking contrast to the Patagonian and with several others of the ancient tribes. Sixth:—That it is probable that most of the indigenous population of South America are the issues arising from a mixture of the three races—the Fuegians and Botocudos, who are short in height and with dolichocephalic index,—the Patagonians who are tall and brachycephalic, and the Araucans Carabs who are small and brachycephalic, and possibly others unknown.

The group of questions under the head of Archeology was about equally divided between the United States and Central America. Mr. S. B. Evans investigated the claims made on behalf of the North American Indian as builders of mounds and other works of antiquity in the United States and Mexico. His conclusion was that the Indians were not the builders of the mounds and earthworks. His paper is an arraignment of the Bureau of Ethnology for having announced this theory. The spirit of his paper may be gathered from the following quotation:—

"The United States Bureau of Ethnology in its capacity as a Governmental department has seen fit to lay the weight of its commanding influence to a theory that all the works of antiquity in the United States are to be referred to the Indians. * * * Everything contrary to the theory they maintain and foster, is characterized as romantic and visionary in comparison with the opinion announced with something like official authority, by the respectable gentlemen who have created a school which might be designated as the Fenimore Cooper School of American Archeology, for the reason that it claims for the Indian more than he would claim for himself. Disciples of this school have met with the experiences usual to those who attempt to adjust facts to pet opinions, and a notable instance is reported in the

Fifth Annual Report of the Bureau, where a distinguished observer, writing under the sanction of his chief, alludes to the manner of Black Hawk's burial, and brings that forth as a proof that Indians built mounds within the historic period."

Prince Poutjatine presented an interesting paper accompanied by specimen illustrations of imprints of textile fabrics on Russian prehistoric pottery, and he brought for comparison, a collection of stamps and imprints similar in decoration and manufacture on prehistoric pottery of the United States of America prepared by Mr. Wilson of Washington, from the United States National Museum. The specimen presented by Prince Poutjatine were the result of excavations made by himself on his own property at Bolgoje, in the Province of Novgorod, midway between Moscow and St. Petersburgh. The similarity between these two sets of specimens from nearly opposite sides of the globe was truly remarkable. Pottery with these imprints of textile fabrics have been found in other parts of Russia—the Provinces of Wladimir and Laroslaw—as is noted in the work of the late Count Ouvaraw in the "Age de pierre en Russia." Prince Poutjatine argued that these facts were evidences of communication between Russia and Siberia with America across the Straits of Bering. To this opinion, however, Mr. Wilson did not agree, because the pottery of the United States thus decorated was not found in that part of the United States approaching Bering Strait.

M. Marcel Daly read an Essay at the Chronologic Classification of Monuments of Prehistoric America, but he presented it as nothing more than a working hypothesis, recommended to investigators for the determination of the truth.

Other papers upon American Archeology were those on Frescos on the Ancient Palace of Mitla, by Dr. Ed. Seler; Archeological Studies in Salvador by Capt. Montessus de Ballore; and Petroglyphs on the Isthmus of Panama and Central America and the Antilles by M. Pinart. He concludes that the art of making petroglyphs was most highly developed in the Antilles especially in Porto Rico, but nevertheless in the Islands of Granada, Guadeloupe, St. Christopher and St. John. He attributes this higher art to that race of prehistoric people who preceded the conquering Caribs. In Cuba, the petroglyphs are rare, and they are not to be found in Jamaica. The ruins of Tialuanaco were explained by M. T. Ber, who presented a photograph of these ruins, which he alleged to be the first ever taken. Interesting among them were huge blocks of stone 20 and more feet long in process of being sawed. The quarry whence they came was well known, and as it was on the borders of the island, the belief was that the blocks were transported on the water by means of rafts.

ETHNOGRAPHY.

The only paper upon this subject relating to the North American Indian, was that by Capt. John G. Bourke, 7th Cavalry, U. S. A., upon the Sacred Hunt of the North American Indian. The author witnessed one while among the Zuñi Indians of New Mexico, which he describes in detail. The "Hunt" was for the purpose of procuring meat to feed the Sacred Eagles of which there were 13 specimens and which furnished the plumage for the various dances and ceremonies. His description included other tribes. He showed a boomerang used by the Zuñi and Moquis. The blade was 20 inches long with a handle 3 inches, the blade was 2½ inches wide, ½ inch thick, bent edgeways 3 inches.

M. Desiré Charnay presented a memoir on the Analogies between the North and Central American civilization and that of Asia. His comparisons were based upon his own experiences in the former countries, compared with those of the latter as described by various authors.

Dr. Seler, of Germany, described Uitzilopochtli the God of War.? He also described some of the arts of the Ancient Mexicans, principally of working stone and making plume ornaments. This subject was continued by a paper by Mrs. Z. Nuttal on Quetzal-apanecaioth or the ancient plume head-dress of the Aztecs. She also presented a feather hat, Mexican or Aztec, the making of which was one of the specialties of the ancient Aztecs. It was seen by Mrs. Nuttal in the Pitti Palace at Florence, and was recognized by her as either the work of an Aztec workman or a reproduction thereof made by a Spanish Artist.

Other papers within this group were Popular Melodies of the Guatemala Indians by M. Raymond Pilet; The Limit to Prehistoric Civilization upon the Isthmus of Panama by M. Pinart; a description of the Antiquities of the Island of Aruba by the same author. M. R. de Semalla described the characteristics of the few remaining Caribs on the Island of Guadeloupe; M. Marcel treated upon the Fuegians at the end of the XVII century as they were reported in some of the unpublished documents of the Bibliotheque Nationale.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The World's Congress Auxiliary of the World's Columbian Exposition of 1893.—Provisional Program.—A Congress of Zoologists will be held, according to previous announcements of this committee, under the auspices of the World's Congress Auxiliary at the Art Institute Building in Chicago, beginning August 28, and continuing until the program of addresses and papers accepted is exhausted.

The present stage of preparation for the sessions of this Congress is shown by the following provisional program, each person whose name is placed against a topic on this list having accepted an invitation to prepare a principal address upon it.

"The History and Evolution of American Zoology and the Status and Tendencies of Zoological Science in America." Dr. G. Brown Goode, Director U. S. National Museum, Washington, D. C.

"The Geographical Distribution of American Animals." Mr. J. A. Allen, Curator of Departments of Mammalogy and Ornithology, American Museum of Natural History, New York.

"The Effect of Glaciation and of the Glacial Period on the Present Fauna of America." Mr. Samuel H. Scudder, Cambridge, Mass.

"Preliminary Account of the Formicidæ of the North American Fauna." Professor C. Emery, University of Bologna, Bologna, Italy.

"Lacustrine Zoology: Methods and General Results of Its Investigation." Professor Dr. F. A. Forel, à la Faculté des Sciences de l'Université de Lausanne, Morges, Switzerland.

"The Plankton of the Muskoko Lakes, Ontario." Professor R. Ramsay Wright, Professor of Biology, University of Toronto, Canada.

"The Origin of the Subterranean Animals of America." Professor A. S. Packard, Professor of Zoology and Geology, Brown University, Providence, R. I.

"The History and Special Features of the Economic Entomology of the United States." Professor J. H. Comstock, Professor of Entomology and General Invertebrate Zoology, Cornell University, Ithaca, N. Y.

"The Special Problems of American Economic Entomology." Dr. C. V. Riley, Chief of the Division of Entomology, U. S. Department of Agriculture, Washington, D. C.

"Undergraduate Courses and Post-graduate Methods in Zoology," Professor E. L. Mark, Hersey Professor of Anatomy, Harvard University, Cambridge, Mass.

"The Zoological Museum." Mr. F. W. True, Curator of Mammals, U. S. National Museum, Washington, D. C.

"Kinetogenesis, or the Relation of Motion to Organic Evolution." Professor E. D. Cope, Professor of Mineralogy and Geology, University of Pennsylvania, Philadelphia, and Editor of the AMERICAN NATURALIST.

"Energy in Relation to Organic Evolution." Professor J. A. Ryder, Professor of Comparative Embryology, University of Pennsylvania, Philadelphia.

"Principles of Bioplastology." Professor Alpheus Hyatt, Curator of the Boston Society of Natural History, Boston, Mass.

"The Cellular Basis of Heredity." Professor E. B. Wilson, Department of Biology, Columbia University, New York City.

"Continuity of Organization the Basis of Heredity, or the Organism and the Cell." Professor C. O. Whitman, Head Professor of Biology, University of Chicago, and Editor of the Department of Microscopy in the AMERICAN NATURALIST.

"Zoological Psychology and the Development of Mind." Professor C. Lloyd Morgan, Professor of Animal Biology in University College, Bristol, England.

"On Zoological Nomenclature." . . . Dr. Charles Girard, Paris, France.

"Zoological Nomenclature as a Means to an End." Dr. Elliott Coues, Washington, D. C.

The committee will be pleased to receive additional titles for this program from members of the Advisory Council of the Congress, or on their recommendation.

Suitable opportunity will be given after the reading of each address for its formal discussion. The committee have respectfully to request that all who intend to take part in the discussion of one or more of the above topics will indicate this fact in advance, at as early a day as may be practicable, to the chairman of this committee.

We have also to request that advance notice of an intention to attend the sessions of the Congress may be given so far as practicable.

S. A. FORBES,
Chairman Committee of Arrangements.

University of Illinois,
Champaign, July 20, 1893.

SCIENTIFIC NEWS.

The large scientific library of the late Prof. J. S. Newberry has been offered as a gift to Columbia College, New York. The collection will be known as the Newberry Library of Geology, being a memorial to Professor Newberry.

A Chair of Geography has been established at the German University of Tübingen. Geography is now taught at nineteen of the twenty-one German Universities, Rostock and Heidelberg being the exceptions.

Mr. R. Bowdler Sharpe is about to publish a Monograph of the Birds of Paradise and the Bower-Birds. This Monograph will be published in six parts, forming one volume imperial folio, uniform with Mr. Gould's Works, price three guineas each part, to subscribers only. On the conclusion of the work, should any copies remain unsubscribed for, the price will be raised to twenty guineas.

International Congress of Zoology.—The permanent Committee which has just been appointed for the International Congress of Zoology is as follows:—

President, M. Milne Edwards (Paris).

Vice-Presidents, { M. Jentink (Leiden), Count Kapinst (Moscow), M. W. Studer (Berne), M. L. Vaillant (Paris).

General Secretary, M. R. Blanchard (Paris).

Secretary, Baron J. de Guerne (Paris).

The permanent Committee propose the following question for the prize of S. A. I. le Tsarévitch, which will be awarded in 1895, at the Congress of Leiden.

A Study of the fauna of one of the great regions of the globe, and the relations of that fauna to the neighboring ones.

The judges will accept works bearing upon either a branch or a class of the Animal Kingdom.

The papers, manuscript or printed since the last Congress, must be written in French and sent before May 1st, 1895, to M. le President du Comité Société Zoologique de France, rue des Grands-Augustins, 7, Paris.

The papers presented will be examined by the following Committee: M. Milne-Edwards (Paris), President, R. Blanchard (Paris), General Secretary, A. Bogdanow (Moscow), Jentink (Leiden), R. B. Sharpe (London), W. Studer (Berne), and V. Zograf (Moscow).

We will publish later an official text of rules in regard to the prizes distributed by the International Congress of Zoology.

The prize given by the Imperial Society of the friends of the Natural Sciences of Moscow, in memory of the International Congress of 1892, *and in honor of Emperor Alexander III.*

RULES.

Article 1.—The Committee on Organization of the International Congress of Anthropology and prehistoric Anthropology, and of Zoology, in session in Moscow in 1892, place at the disposal of the Imperial Society of the friends of Natural Science the sum of 3,500 gold roubles to constitute a perpetual capital in memory of the two International Congresses and of the august kindness which has been accorded them by the Emperor Alexander III.

Article 2.—The interest of this capital shall be used as a prize in honor of his majesty, Emperor Alexander III. This prize shall belong alternately to the Congress of Anthropology and prehistoric Archeology and to the Congress of Zoology.

Article 3.—The value of the prize shall be equal to the interest on the capital for two years. In case there should elapse more than two years between two consecutive Congresses, the interest for the extra years shall be at the disposal of the Society of the friends of Natural Science of Moscow, which will devote it to the prizes distributed at the annual meeting of October 15.

Article 4.—If one of the two Congresses should cease to exist, the portion belonging to it in accordance with the above articles shall revert to the Imperial Society of the friends of Natural Sciences to be distributed by it equally among the prizes given at its annual meeting.

Article 5.—The prize given by the Congress of Anthropology and prehistoric Archeology is awarded by a special Commission nominated for that purpose by the permanent Council of that Congress. The prize given by the Congress of Zoology is awarded in the same way by a special Commission nominated for that purpose by the permanent Council of that Congress.

Article 6.—The prizes may consist of medals or of sums of money.

Article 7.—They shall be distributed at a special meeting while Congress is in session.

Article 8.—The program of the prizes shall be arranged by the permanent Council of each of the two Congresses.

Article 9.—It shall also be the duty of this permanent Council to the the papers presented, to appoint the Professors or the examining Committee to whom the papers will be submitted, and who must return a written report.

Article 10.—Any scientist may compete for the prize, on the condition that he does not belong to the country in which the next session of the Congress takes place.

Article 11.—The President of the Congress must notify the President of the Imperial Society of the friends of Natural Science of the name of the person to whom the prize has been awarded.

Prizes given by the Imperial Society of the friends of Natural Science of Moscow, in memory of the International Congress of 1892, *and in honor of S. A. I. the Grand-Duc Nicholas Alexandrovitch.*

Article 1—The Committee on Organization of the International Congress of Anthropology and prehistoric Archeology, and of Zoology, in session at Moscow in 1892, place at the disposal of the Imperial Society of the friends of Natural Science the sum of 2,000 gold roubles to constitute a perpetual capital in memory of the Congress of Zoology, and of the august kindness which has been accorded to them by the Grand-Duc Nicholas Alexandrovitch.

Article 2.—The interest on this capital shall be used for a prize in honor of the Grand-Duc Nicholas Alexandrovitch. This prize shall belong to the Congress of Zoology.

Article 3.—The value of the prize shall be equal to the interest on the capital for two years. In case there should elapse more than two years between two consecutive Congresses, the interest for the extra years shall be at the disposal of the Society of the friends of Natural Science, which will devote it to the prizes distributed by them during the annual meeting on October 15.

Article 4.—If the Congress should cease to exist, the portion belonging to it in accordance with the above articles shall revert to the Imperial Society of the friends of Natural Science, to be distributed by it equally among the prizes given at its annual meeting.

Article 5.—The prize given by the Congress of Zoology is awarded by a special Committee nominated for that purpose by the permanent Council of that Congress.

Article 6.—The prize may consist of medals or of sums of money.

Article 7.—They shall be distributed at a special meeting while Congress is in session.

Article 8.—The program of the prizes shall be arranged by the permanent Council of the Congress.

Article 9.—It shall also be the duty of this permanent Council to the papers presented, to appoint the Professors or the examining Committee to whom the papers will be submitted, and who must return a written report.

Article 10.—Any scientist may compete for the prize, on the condition that he does not belong to the country in which the next session of Congress takes place.[1]

Article 11.—The President of the Congress must at once notify the President of the Imperial Society of the friends of Natural Science of the name of the person to whom the prize has been awarded.

ERRATA.—In Prof. Scott's paper on, A New Musteline from the John Day River, make the following corrections: Page 658, l. 21, read *Bunœlurus* for "*Buncelunus;*" l. 33 and p. 659, ll. 4 and 6 *Parictis* for "*Parietis;*" p. 658, l. 37, *P. primœvus* for "*P princeous;*" p. 659, l. 2, *Quercytherium* for "*Inercytherium.*"

[1] The next Congress will be held in Leiden, August, 1895; the scientists of Holland are therefore excluded from the next competition.

Special Notice from the Publishers.—Owing to the absence of the Editor the publication of this issue was delayed. We shall always aim to get out each issue promptly on the first of each month, but our editors and authors being so wide-spread we are often delayed a few days in the return of the proofs of articles sent them for revision. With this explanation

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THE PHILOSOPHY OF FLOWER SEASONS.[1]

By HENRY L. CLARKE.[2]

The researches of recent botany have more than once suggested the vague outlines of a truth that, though manifestly requiring investigation, has as yet received but little definite expression. It is:—the philosophy that underlies the association of certain groups and types of flowering plants with certain definite seasons of the year; the principles that will show how this association accords with the "eternal fitness of things."

The subject is of broadly interesting scope, but its treatment requires caution because of the variety of somewhat conflicting considerations involved. Obviously the aim cannot be to find any single absolute principle that will cover all cases, but rather to make some broad general observations that shall embrace all the diverse circumstances and at the same time express each with greatest definiteness. The field for investigation must be clearly presented and have its data determinable with certainty and completeness, and such can be found in the flora of the northern U. S., eastward from the Rockies. This has been more thoroughly studied than any other so large section of American flora, and is familiar to a large proportion of students.

[1] Condensed for THE AMERICAN NATURALIST from a more extended thesis on the subject.

[2] University of Chicago.

Taking this, then, as the field, here is the problem presenting itself:—From March to November each month brings a new prospect in field and forest, an edition of flower-life distinctively its own; and each edition seems thoroughly to harmonize with its own peculiar season. Each offers characteristic features, and every careful observer can feel in this succession of differing forms a harmony into which any decided change would break discordantly. To bring this more forcibly to the mind, conceive for a moment the existing series somewhat transposed: imagine the prairies brilliant with Solidago and dotted with the purple Aster in early May; Trillium adorning the woodlands in September; the vivid Lilium superbum and the flaming Asclepias tuberosa in the April meadows; Hepatica and Sanguinaria in mid-July; and Epigæa in late autumn. Entirely aside from the element of novelty, such a picture would be bewilderingly inharmonious, and its features out of tune with their position by virtue simply of their character,—in this there would be an appreciable and evident lack of fitness. To say that the fall flowers are not the spring flowers, or those of summer are neither, merely because they have chosen at random this season or that is neither science nor common sense. The truth is forced upon us that the various groups of flowering plants are not scattered indiscriminately from one end of the seasons to the other, but are regulated by definite systematic principles; and that just as relations can be traced between physical geography and geographical distribution, or between plant-history and geological periods, so is there a connection between the relations of season to season and the relations of their respective floras.

In this inquiry we see constantly the impossibility of drawing sharp lines of demarkation between successive groups of conditions; and, as in classification systems, so in serially arranging successive floras, it is impossible to follow a linear order. Also, exceptional instances are many, and hence, to reach conclusions that are broadly true, *predominant* types must be considered, though the unusual cases may be in themselves manifestly significant. Only a broad sweep of data can bring out a general connection between the multiplicity of considerations. To this end it will be reasonable to consider the groups of flowering plants in the most strictly natural order of their evolutionary relationships, from the lowest up. That this evolutionary system is largely based on floral structure is suggestively apropos of our theme, but how far the intimacy of the connection may extend the further development of the discussion will reveal.

Passing to the outline of recorded observation we may discuss each condition of the problem as it arises. The three seasons considered have these limits:—spring; late March, April, May: summer; June, July, August: autumn; September and October. *All* statements *refer only* to the area about covered by Gray's Revised Manual: the U. S. north of Tennessee and eastward from west Kansas.

Of the two series of flowering plants, the Gymnospermæ and Angiospermæ modern botany concedes that the former, from their near approach to the higher Pteridopyta, represent the lower character of development, though the highly specialized Coniferæ may rise to a position nearly *parallel* to the highest Angiospermæ. The Coniferæ comprise all our indigenous Gymnospermæ;—and all flower in the spring from late March to earliest May, none in summer or autumn.

In the Angiospermæ, the Monocotyledons and Dicotyledons are two nearly parallel classes, the Monocotyls, though not transitional, representing, as a class, a lower character of development than the Dicotyls. Compare first the two classes in a general manner: The indigenous Dicotyls number much over twice the indigenous Monocotyls, and of the latter over half are in the great orders Cyperaceæ and Graminaceæ. And these orders demand special attention, for they together represent one of the most remarkable instances of high specialization in the whole census of plant-life. Apropos of this let us call to mind for further use the five characters of organic development which certain carefully systematic evolutiontsts!! have recognized:—*typical* forms, which present all the main characters of their group with fullest intensity; *generalized-normal* which have the normal characters somewhat poorly developed and defined; *specialized-normal,* which retain the normal structure but with evident one-sided development of it; *generalized-aberrant*, which depart from the normal but drift toward several or many outside relationships; and *specialized-aberrant*, which go off on a distinct individual line of their own. The Cyperaeæ and Graminaceæ are *specialized-aberrant* Monocotyls; and as they depart from the rest of the Monocotyls in structure, so, in the main, does their blooming season stand apart. Though extending from May, it culminates, particularly with the Graminaceæ, in the late summer and early fall, and stretches on into October. With reference to all other Monocotyls, note that by far the majority,—typical, normal, and *generalized-aberrant*,—confine their blooming season to spring, or early summer, or mid-summer, though fewer in the last. But in late summer and autumn occur only a few isolated cases. Indeed, even in the Glumaceæ excepted in the last statements, the great predominant genus of Cyperaceæ, the genus Carex, including much over half the order, belongs strictly to May. On the other hand, the Dicotyls, the higher Angiospermæ, are spread straight through the seasons, from March to November, represented by forms of all characters,—typical, normal, and aberrant. Thus, excluding Graminaceæ and several genera of Cyperaceæ, the Dicotyls may be said to constitute almost the entire flora of late summer and of autumn.

The Spadicifloræ and Liliifloræ form two fairly distinct subclasses of Monocotyls, closely parallel and somewhat interrelated. Though a debatable question, the imperfect and reduced flowers so general in the Spadicifloræ rather justify the conclusion that these are of the lower order of development. Moreover, throughout this subclass diclinism predominates, while the Liliifloræ are generally both hermaphrodite and complete and with well-developed perianth.

Normal and typical Spadicifloræ are the Araceæ. All these flower in May or June, except Symplocarpus. That its odorous scapes push out of the swamp mud in April is presumably a provision to insure cross-fertilization of the inconspicuous, though strong-scented, spadices before they are hidden by the subsequent growth of the huge rank foliage. Later, through the summer, flower the Typhaceæ, which, as *generalized-aberrant* Spadicifloræ, represent a rather more advanced degree of specialization than most Araceæ. Also in mid-summer come the remarkable little Lemnaceæ, usually considered a highly *specialized-aberrant* offshoot from Araceæ, though the connection is doubtful.

Among Liliifloræ the three apocarpal orders, Alismaceæ, Juncaginaceæ, and Naiadaceæ, form a remarkably aberrant group, of few species, but wide-spread, particularly Sagittaria and Alisma. All come in late summer, and some among the exceptional non-glumaceous Monocotyls of autumn. Potamogeton, in Naiadaceæ, numbers a good many species, and comes late; but note that the genus is one of the most peculiarly specialized.

All the Spadicifloræ and Apocarpal Liliifloræ are scarce a tenth of the remaining Monocotyls, the Syncarpal Liliifloræ. This division naturally subdivides into the Hypogynæ and Epigynæ, somewhat parallel and closely inter-related. In the light of our present knowledge of the morphology of the hypogynous and epigynous flower there can be no doubt that the Epigynæ here represent the higher order of development, although many Hypogynæ may rise to a more than equivalent degree of specialization,—precisely as the genus Felis is considered to represent a lower order of development but a higher degree of specialization than the anthropoid apes.

In the non-glumaceous Hypogynæ most prominent is the order Liliaceæ, in which are, pre-eminently, typical and normal forms. Among the normal, particularly the more generalized, the first bloom in late April,—notably, for instance, Erythronium, about the earliest of Monocotyls. Scarcely later come Trillium, Uvularia, Smilacina, Polygonatum, Maianthemum, and others. Other genera extend through May and early June, and a few, finally, belong to mid-summer. Certain of these last, as Allium and Smilax, are, though normal, markedly more specialized than the principal spring-flowering genera. But the mid-summer genus Lilium claims peculiar prominence as an ideally "*typical*" genus in all the term implies. *Lilium philadelphicum, L. catesbæi, L. canadense,* and *L. superbum* stand together in the July meadows as the type of their order and of the Hypogynæ. Their high order of development and their blooming season has a significant bearing on our problem. The aquatic Pontederiaceæ and the ephemeral Commelinaceæ, both few in species, and the odd genera Aletris and Xyris, are of mid-summer. With Smilax comes the nearly-related Dioscorea. Markedly conspicuous mid-summer Hypogynæ, rather intermediate between Liliaceæ and Cyperaceæ, are the widespread and aberrant, glumaceous types, Juncaceæ. But even these are less highly specialized than the two great orders Cyperaceæ and Graminaceæ, comprising over half of all our Monocotyls. The Graminaceæ are unquestionably the more highly specialized, and as distinctly *aberrant,* among Liliifloræ, as are the Lilia *typical.* Their period of greatest predominance extends from mid-July well into October. In Cyperaceæ it is curious that over half the order, the great genus Carex, attains full perfection in May; while the *type*-genus Cyperus belongs to August and September, most other genera to mid-summer, and a few to June. But mark especially: all the summer and fall Cyperaceæ, save a very few, are hermaphrodite, while Carex is entirely unisexual. The significance of this will come up later.

The review of Monocotyls closes with the Epigynous Liliifloræ, a small group compared with the Hypogynæ, but peculiarly interesting. Of the *generalized-normal* order Amaryllidaceæ we have only one wide-spread species, the little Hypoxis, of early summer. Iris comes in the spring and Sisyrinchium a little later, both rather specialized genera. Finally, the crowning glory of its class is the highly specialized order Orchidaceæ. Late in May come the earliest forms,—Orchis, Arethusa, and Corallorhiza. In early June:—Pogonia, Liparis, Calopogon, Listera, several green Habenarias, and the splendid genus Cypripedium. The succession of species in this genus is instructive:—Earliest, in late May, comes the little white *C. candidum;* a little later the low stemless type with its large complicated flower, *C. acaule;* still later the small-flowered but tall-growing *C. parviflorum;* later yet, the large cousin of the last, *C. pubescens;* and latest, late in June, most robust, vigorous, and conspicuous, the splendid *C. spectabile.* In late June and through July come other Pogonias and Corallorhizas; Microstylis, Goodyera, and one or two Spiranthes, and all the most beautiful Habenarias. Last, in September and October, singularly isolated from nearly all their kinsman, are several of the little Spiranthes,—why they come thus is a baffling question. Retrospectively we remark that of non-glumaceous Liliifloræ the two predominant orders are Liliaceæ and Orchidaceæ; that the first are largely normal and generalized, the second aberrant and specialized; and that the first predominate in the spring, the second in summer.

In the Dicotyls two quite distinct subclasses may be recognized: the one, the Diclinæ, is a very natural group, small but of great importance, embracing the closely related orders of trees and shrubs, Platanaceæ, Juglandaceæ, Cupuliferæ, and Salicaceæ; the other, vastly the larger, exhibits a broad, rather indefinite range of characters, and may be termed, in contra-distinction, the "Hermaphroditæ," because hermaphroditism, though by no means universal, predominates in it. The Diclinæ obviously approach the Coniferæ, among Gymnospermæ, in wood-structure and manner of growth, and in amentaceous diclinous inflorescence. Whence there is just reason to consider them, though wonderfully specialized, of a lower character of development than the Hermaphroditæ. Unisexual flowers, or the analogues of unisexual flowers, are the rule in Gymnospermæ and the higher Pteridophyta, and hence it reasonably follows that diclinous Angiospermæ are lower than hermaphrodite; and, further, diclinism in all Angiospermæ is either a perpetuation of the ancestral type or a reversion to it. In Diclinæ and in the Spadicifloral Monocotyls it is probably a perpetuation; in Carex, many Graminaceæ, and elsewhere among Angiospermæ, more likely reversion, retrogressive evolution. Note here the peculiar fact that in spring, from early March to June, blossom these diclinous groups:—all Coniferæ, the Araceæ, the great genus Carex, the Diclinæ, the Lauraceæ, several diclinous Ranunculaceæ, Urticaceæ, and many others; while in summer and fall come only:—a few Alismaceæ and Typhaceæ, many Graminaceæ, the Euphorbiaceæ, some Urticaceæ, and a few other isolated cases, but altogether a comparatively small number,—especially so because the Graminaceæ mentioned rarely have spikes entirely of unisexual flowers and hence do not strictly fit the case. The diclinism occurring in many Compositæ is not referred to, because it is not analogous to diclinism in other plants, and the Compositæ are relegated to a category of their own by their highly specialized inflorescence;—their diclinous "capitum" is functionally equivalent to a single perfect flower in other Angiosperms. The blossoming of so many trees, especially the Diclinæ, in earliest spring, before leaf-budding, must evidently have at least partial connection with anemophilous cross-fertilization.

The Hermaphroditæ (this term only signifying a *predominant* character) parts naturally into the Choripetalæ and Sympetalæ, nearly parallel and somewhat inter-related. The first includes the Incompletæ (so-called Apetalæ), which cannot be naturally made a separate division. It is conceded now that the Sympetalæ are higher than the Choripetalæ, though the divisions are not successive, save in that the first probably rose from some aberrant form of the second. There are three clear sub-divisions of the Choripetalæ, partly serial and partly parallel,—Hypogynæ (including so-called Disciflorae), Perigynæ, and Epigynæ. The Epigynæ are past question the highest, and the Perigynæ rather intermediate.

Earliest of the Hypogynæ are the Ranunculaceæ, peculiarly normal and typical and distinctively spring-flowering, extending from mid-April to early June. Hepatica, Anemonella, Caltha, Ranunculus, Aquilegia,—all synonymous with spring. Note that the more specialized forms, such as Aquilegia, Delphinium, Aconitum, etc., are the later, and some Clematis belongs to summer. With this early order come also our Magnoliaceæ and Berberidaceæ; late in May the Dicentra and Corydalis; through May and June the particularly natural and normal order Cruciferæ, more specialized, however, than Ranunculaceæ. In April comes that wonderfully symmetrical and typical form of the Papaveraceæ, the Sanguinaria. Remarkably aberrant in habit, but rather generalized in floral structure is the Sarracenia. It blossoms in latest May and early June. Among the earliest blossoms is the so abundant little normal type, Claytonia. Viola is a large, distinctive, and cosmopolitan genus, rather specialized-normal in character. Oddly enough it has species in bloom from April to October, some blossoming both spring and fall, besides producing cleistogamous flowers all summer. Yet even in so constantly present blossoms we easily recognize a period during which they reach by far their greatest abundance and perfection, viz.: May and June. Two unique orders belong to summer, Cistaceæ and Hypericaceæ, the second the later and remarkable particularly for its polyadelphous stamens. The incomplete flowered Urticaceæ belong mainly to summer, all save the group of spring-flowering shrubs and trees, Morus, Celtis, Planera, and Ulmus. All these are diclinous or polygamous, and Ulmus seems to possibly and probably connect its order with the Diclinæ,—like these it flowers in March and early April. Turning back to the near relatives of the Ranunculaceæ we find in mid-summer the aquatic genera Cabomba, Brasenia, Nymphæa, Nuphar, and Nelumbo, all *specialized-normal*, practicularly Nelumbo, the latest to flower. The so-called Discifloral Hypogynæ rank somewhat above such typical forms as the Ranunculaceæ and Cruciferæ, and among them stand several important summer orders:—Caryophyllaceæ; Malvaceæ; the strange Euphorbiaceæ of July, August, and September; and the Geraniaceæ, of which the aberrant Impatiens is latest. Anacardiaceæ belong to June. But the two tree-families, Tiliaceæ and Sapindaceæ come in spring and early June.

In the Perigynæ the preëminently normal and typical order is Rosaceæ, standing here as the Ranunculaceæ among Hypogynæ. Somewhat later than the latter order in starting the Rosaceæ reach perfection in late May and through June. At much the same time, but scattered along later into the summer, comes the less normal order Saxifragaceæ, of which the aberrant genus Parnassia, an odd little type, holds an isolated place in the late autumn flora. The distinctive order Leguminosæ, by far the most numerous of our Choripetalæ, flourishes throughout the summer and well into autumn. The aberrant Drosera is summer-flowering. Rhamnaceæ, and, particularly, the diclinous Lauraceæ, and the Hamamelidaceæ, belong to spring,—though Hamamelis, oddly enough, blooms in October.

As the typical Hypogynæ are characteristic of spring, so the several more important orders of Epigynæ belong peculiarly to summer and early fall:—the great order Onagraceæ, and the Lythraceæ; in late summer the strangely organized Passiflora; in hottest July our Cactaceæ, pushed up from the south-west; and in fullest sovereignty in July and August, though stretching from May to October, the widespread Umbelliferæ; the peculiar tropical Cucurbitaceæ from July to October; the more generalized Araliaceæ mainly in spring; and the shrubs and trees of the Cornaceæ also early. The anomalous Asarum and Aristolochia are scattered from May to July.

The Sympetalæ part naturally into the Hypogynæ, isocarpal and anisocarpal; and the Epigynæ. In Hypogynæ typical Isocarpæ, the more generalized group, are Ericaceæ, coming from earliest spring late into May and early June, and, at the same time, the Diapensiaceæ and Primulaceæ, the last rather later. Pyroleæ, in which there is a reversion to charipetalism, extend into July. Polemoniaceæ, somewhat transitional to the Anisocarpæ, bloom through May, June and July. In Anisocarpæ note:—the tree-order Oleaceæ, early flowering; the parasitic Orobanchaceæ, scattered from April to October; Catalpa and Bignonia in spring, and the brilliant *Tecoma radicans* in July; the Borraginaceæ, few in spring, reach perfection in summer; Convolvulaceæ and the unique Solanaceæ, from mid-summer into autumn; the aquatic Utriculariaceæ, entirely in summer; the great specialized orders Scrophulariaceæ and Labiatæ, throughout the seasons but in greatest predominance from mid-summer late into autumn; also then the Verbenaceæ. Apocynaceæ and the highly *specialized-aberrant* Asclepiadaceæ come in mid-summer. Characteristic of autumn are the Gentianaceæ, whose relation to the two last named orders gives them a high rank. A few species occur much earlier than the typical genus Gentiana.

Turn to the Epigynæ:—Caprifoliaceæ and Rubiaceæ, though scattered, predominate in summer; Campanulaceæ, particularly in late summer and in autumn,—the finest type *C. americana*, coming in September. Late in summer and in September, the Lobeliaceæ are in fullest perfection,—the splendid *Lobelia cardinalis* and *L. syphilitica* being late. And lastly, we meet the vast order Compositæ, undoubtedly nearly the highest of flowering plants. So numerous a group would naturally spread throughout the seasons, but mark:—it comes in all its glory late in August and straightway through the autumn, when we have, among many, those gorgeous genera, Solidago and Aster. Here the fact confronts us, that in the autumn the higher Sympetalæ hold sweeping predominance over the higher Choripetalæ.

Few data of any consequence have been omitted from this review, and the evolutionary system followed has been defined step by step because upon it the fabric of the argument mainly depends. The deductions are these:—*From early spring to late autumn there is a progression in the general character of the flower-groups, from the lower to the higher,—successive groups succeeding each other in time, parallel groups coming synchronously.* And the later in order may be *types* of a higher character of development, *or* they may be *specializations* of a group whose *normal* forms belonged to an earlier season. In their blooming season, *the more perfect succeed the more simple; the aberrant, the normal; the specialized, the generalized.* But with the general observation arise certain modifying conditions. The blooming period may sometimes vary from the general rule to better bring the flowers among the most favorable conditions for cross-fertilization,—in the case of anemophilous pollination before referred to; or, even more obviously, in the case of entomophilous pollination, though here it is often doubtful whether the flower adapts itself to the insect's season or vice versa. Again, plants that are frontiersmen from the characteristic vegetation of a hotter clime may be expected in the hottest of the seasons,—e. g.: the Cactaceæ. There is an evident limitation of the flowering of our trees and shrubs to spring and earliest summer. This may largely be due to the excess of vital energy held stored up in woody trunks and branches,—and in Coniferæ in the evergreen foliage,—ready to burst forth with the first coming of warmth. Diclinism is most frequent in the spring months,—where this occurs in the lower groups of plants the case is covered by the general principle; but when diclinism obtains in highly specialized forms, as a result of retrogressive evolution, the problem becomes difficult,—the interesting question suggests itself: Does reversion in structure here revert the flowering period to an earlier season? As a case in point, recall the genus Carex. Again, there is a determining function in the character of the flower's habitat:—The spring flowers seek largely the protection of the woodlands; marsh-plants reach perfection mainly in latest spring and through the summer, though some, like Caltha, are early; the aquatics of ponds and river glory in the summer sun; and the flowers of meadow and prairie and thicket-margin luxuriate from mid-summer to the end of autumn. This last recalls the recent observations of Conway McMillan on "tension-line flora," and we note with interest that the highly organized tension-line flora gives us our later blossoms to a large extent. Further, every practical botanist knows that the herbaceous flora of summer, as a whole, shows a great advance in *vegetative* luxuriance over the corresponding flora of spring. But it does not follow that that of fall in turn advances, for vegetative luxuriance means primarily—heat. Yet the truth remains that this is not the fundamental criterion of plant aristocracy,—in the giant calamite of geologic ages flowed humbler blood than flows to-day in the dandelion of our backyard grass-plots. So each new factor that arises, far from weakening, but adds significance to the fundamental principle.

Here the question rises: Why should there be a correspondence between the course of the flower seasons and the system of floral evolution? Solve this, and the "philosophy of flower seasons" is an open riddle. But for the present it is only possible to indicate the direction in which the answer probably lies: The most simple and generalized forms, coming first in the course of floral evolution, have had the longest time in which to adapt themselves to existent climatic conditions;

and, reciprocally, climatic conditions have become more and more favorable to the rapid development of the said forms. So a floral type that ages ago would have reached its perfection only after a long continuance of favoring season, now may burst into the fulness of its maturity with the first warmth of spring. But as change succeeded change in the course of time, a maximum point would be reached, from which the conditions would become less and less favorable to the rapid development of types surviving from an earlier age. Then these would dwindle from the earth,—replaced, driven out, by those that had come into existence in a later age. Thus, in the ages to come, the early flowers of to-day will disappear; to be replaced by what are now our later flowers; whose place, in turn, will be filled by forms that are yet to be. All this is but a bare suggestion, yet in it may be, perchance, the spark of truth that will guide further observation to a more definite decision.

This very relation between flowers and seasons that the evolutionary floral system brings to light, may, in turn, modify somewhat that system, and so eradicate many seeming anomalies. And thus the added law may be better established by the perfecting of the fundamental one,—and vice versa. This consideration cannot be ignored.

In the light of all these facts and their regulating principles we can feel with fullest power that harmony of relations in the flora of each succeeding month,—a harmony to which even the casual observer cannot be insensible. The quarter of our country we have scanned is a wide sweep—coast-plain, hill-regions, mountains, and prairie; and if it offers so significant suggestions we can justly say, inductively, that there must be much here that is of far wider application. At least, there is full cause to believe that more extended research in this little-tested field of flower philosophy will be well repaid; and it may, further, open up an analogous field, yet unthought-of, in the realms of lower, flowerless, plant-life. The story told, we realize that its plot is simply another instance of the expression of universal law in that which rather seems a law unto itself.

THE MORPHOLOGY OF ROOT TUBERCLES OF LEGUMINOSÆ.

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The object of this research was to give a more detailed account of the anatomical structure of root tubercles, thus adding perhaps somewhat toward clearing up some of the difficulties in the comparatively little known field of teratology. It is true much labor has been expended in the endeavor to get a correct understanding of "symbiosis" and the relation of *Rhizobia* to certain plants. The life history and morphology of the root bacteria have received most of the attention while the tubercles themselves have been almost entirely forgotten. Frank, who has done much in this line of research offers but little concerning tubercle morphology. Nearly all of his attention is directed toward the "*Bakteroiden.*" The same is true of Beyerinck, Brunchorst, Waronin and the others. Some of the pupils of Frank have also made noteworthy researches concerning Rhizobia. Recently Frank and Moeller[2] have engaged in a controversy with regard to the "*Dimorphismus der Wurzelknöllchen der Erbse.*" Frank has also described the lenticular structure of root tubercles. Beyond this, little of importance seems to have been done with root tubercle morphology.

In my own researches, mature tubercles were taken from various *Leguminosæ* toward the close of the vegetative period, since at that time tissues have acquired their most marked morphological characteristics. The earlier stages of development were studied at various periods of the season. The final summing up was not completed until late in the year. (Dec., 1892.)

The tubercles are in themselves abnormal growths produced by the local irritation of certain organisms, the Rhizobia; and

[1] The investigations described in this paper were carried on in the laboratories of botany, of the University of Minnesota.

[2] Berichte der deutsch. bot. Ges., Hefte 3 und 5, 1892.

etiologically resemble those growths produced by certain animals as for example the *Heterodora* or *Anguillula* cysts found on some roots. Morphologically, however, they are clearly distinct.

In some cases these tubercles make their appearance shortly after germination. In others not until plants have reached the flowering stage or even later. In some cases they do not appear at all, that depending upon the nature of soil in which the plants grow as explained by Frank[3] and others. The macroscopic appearances of some tubercles have been more or less perfectly described in a previous article.[4] The form is quite constant in a given species of plant. In *Phaseolus vulgaris* and *Amphicarpaea comosa*, for instance, they are spherical. In *Melilotus alba, Pisum sativum, Trifolium pratense* and *Trifolium repens* they are oblong, narrow at point of attachment, often slightly forked, cordate or pear shaped. Usually they occur singly, less often, as for example in *Melilotus alba* they grow into large grape-like bunches. Like root branches they usually develop acropetally though there are numerous exceptions. They are most common on roots near the surface of the soil; sometimes they are found at a considerable depth. They are never found in close proximity to growing root tips. They occur either on the main root or its branches.

Tubercles seem always to develop exogenously. The direct causes of their development are the Rhizobia, of which there are at least several species.[5] Predisposing causes are, nature of soil and condition of atmosphere as to temperature and moisture, etc. The various kinds of Rhizobia appear to be more or less abundant in all normal soil. Whenever a given species finds a suitable lodging place on the root-surface it multiplies and by some means gains access to one or more of the surface cells and infection is completed. Just how infection takes place is not definitely known. It is thought that the Rhizobia have the power to dissolve the cell membrane of the host; just how is not stated. Frank, Moeller[6] and others maintain

[3] Pilz symbiosa der Leguminosen, 1890.

[4] Bulletin Torrey Bot. Club, July, 1892.

[5] Bulletin Torrey Bot. Club, July, 1892.

[6] Ber. der deutsch. bot. Ges., Heft 5, 1892.

that infection takes place by means of the "*Infektionsfäden.*" This seems improbable since the "*Infektionsfäden*" are not always present. I could find no trace of them in *Phaseolus vulgaris.* They are sometimes present in *Trifolium pratense.* I have been unable to find them in *Robinia pseudacacia,* although Moeller states that they are present. In all those cases in which I found them I could detect no connection between them and the Rhizobia. They are sometimes found in tissues outside of the tubercle having no apparent connection with it. In chemical behavior and microscopical appearance the "*Infektionsfäden*" differ considerably from the Rhizobia. The "*Infektionsfäden*" consist of a more highly refractive albuminoid substance and stain less readily than the Rhizobia. I have often found them in old tubercles of *Trifolium pratense* in which the Rhizobia and cell protoplasm had been almost wholly removed showing that they have a greater vitality than either the plant cell or the Rhizobia. Heretofore no one has been able to detect a membrane on the "*Infektionsfäden.*" Recently Moeller[7] has announced the discovery of a cellulose membrane surrounding the "Bacteria zoogleæ"—"*Infektionsfäden.*" This membrane, he asserts, is secreted by the cell protoplasm as a protection against the intruding bacteria (Rhizobia). In the same article Moeller notes that the bacteria (Rhizobia) have the power to dissolve cellulose. These statements are certainly a little difficult to understand. It would seem improbable that the bacteria (Rhizobia) should at one and the same time dissolve cellulose and also have a coating of it deposited on them as a protection against their intrusion. It is known that eggs of parasites, larvæ in the resting stage, calcium oxalate crystals, etc., when found in plant tissues have had secreted around them a coating of cellulose. In such cases, however, the foreign substance does not at the same time have the power of dissolving cellulose.

Without going into further discussion, it is known that the Rhizobia gain access to the interior of the surface root-cells where they multiply rapidly. By their irritating presence, increased protoplasmic action takes place. Not only do the

[7] Ber. der deutsch. bot. Ges., Heft 5, 1892.

PLATE XVII.

Root Tubercles of Leguminosæ.

infected cells grow and multiply much more rapidly but the adjoining cells likewise take on increased activity. On microscopic examination there will be noted a slight protuberance, swelling outward but still covered by the root epidermal layer. This incipient tumor consists of two kinds of meristematic tissue, the centrally located portion of infected cells and the adjoining outer portion of noninfected cells. This meristem tissue is engaged in active cell division. The original infected cells divide and produce auto-infected daughter cells. Outwardly a corky tissue is developed from a distinct phellogen layer, usually one or two cells in thickness. These phellogen cells divide tangentially and often contain starch and calcium oxalate crystals. I have found a cork layer on all tubercles examined thus far. Centrally cell division goes on less rapidly until the pericambium of the root is reached which is also involved in the change. A vascular bundle starts from the root-vascular system and extends peripherally toward the infected area until quite near it where it divides into from four to seven branches which continue centrifugally (in reference to root) through the outer part of the tubercle meristen to near its apex. These vascular bundles consists of conducting vessels, like those of the root, surrounded by bast cells: the whole is encircled by a sheath of cells whose outer walls are considerably thickened.

In spherical tubercles the cambium is of equal thickness in all parts. In elongated and irregular forms the meristematic tissue is more abundant in the extended points, that is, there may be one or more apical areas in the same tubercle. The cambium cells are of the ordinary small, angular, closely united, rather thin walled variety. The cells may divide in any plane. The cork layer usually consists of thin walled rectangular cells, often with intercellular air passages. In *Phaseolus vulgaris* the cork cells are considerably rounded, in Robinia they are rather irregular. The entire cork layer is continuous with the unchanged endodermal layer of the root. The entire tubercle is covered over by an epidermal layer of cells contiguous with that of the root. No root-hairs are present. Early in the development of the tubercle the root-hairs become dwarfed and soon disappear. The plant can no longer use them as organs of absorption on account of the impervious layer of cork. The tubercle receives its nourishment by means of the vascular bundle system and the parenchymatous conducting tissue of the root which is continuous with that of the tubercle. The outline of the infected area is wavy, there being a depression before each vascular bundle as seen in a cross section. Single, or groups of noninfected cells are generally distributed through the infected area. In the centre may be found a noninfected area of considerable size, as in *Robinia pseudacacia.* The infected cells resemble those of the noninfected cambium in that they are angular and closely united, there being no intercellular spaces. They differ in that they are much larger and in that they have undergone peculiar protoplasmic and nuclear changes. The cells are entirely filled with Rhizobia and protoplasm. The Rhizobia feed upon the cell protoplasm and in turn appropriate for the use of the plant the free nitrogen of the air. In the case of *Rhizobium mutabile* the abundant food supply causes it to become much enlarged and to assume various forms during the season, hence the name. No other species seem to undergo such extensive changes. As to the position the Rhizobia take in the cell, I have noticed some peculiarities. In colonies of *Rhizobium mutabile* in *Melilotus alba* the long axes are all directed toward the nucleus. *Trifolium* which contains the same species of Rhizobium does not show the same arrangement. Here they are placed in all concievable positions. Why they should take this position in *Melilotus alba* I am unable to state. In *Phaseolus vulgaris* and *Pisum sativum* they are often collected into Zoogloeae as is clearly shown in thin sections.

In *Amphicarpaea comosa* and *Phaseolus vulgaris* I have always found well developed lenticels on the tubercles. They are developed from a clearly marked lenticular phellogen, showing tangential cell division. The phellogen of the lenticels as well as that of the cork layer is developed from a large celled parenchymatous tissue lying above the cambium layer. The lenticular phellogen is not depressed into the underlying tissue, as is usually the case, but somewhat elevated above it. The lenticels consist of the usual loosely connected, rounded cork cells and are always located above the vascular bundles. They no doubt serve as a means for the interchanging of gases between the exterior and interior by way of the vascular bundles. Frank maintains that the cork layer as well as the infected area have intercellular air spaces for the interchange of gases. As already mentioned the infected area consists of closely united firm walled cells, such as are usually found in meristematic tissues. Furthermore the infected area is entirely cut off from the cork layer by means of the cambium which certainly has no intercellular passages. Hence it would be rather difficult to see what function intercellular spaces would play in the infected area. Tubercles possessing lenticels no doubt give off considerable gas. I have noticed that the tubercles of a growing bean plant when placed in water would have a glistening appearance due to a thin layer of air or some gas separating them from the water. After a time very minute gas bubbles would form on the surface of the tubercle. As to the source and nature of this gas I am unable to give any satisfactory explanation. It is very likely dependent upon the largely increased metabolic processes going on in the tubercle, Frank has made some experiments on the subject without however, coming to any definite conclusions.

Starch is usually present to some extent in tubercles, especially in those infected by *Rhizobium mutabile.* There is some in tubercles of *Amphicarpaea comosa,* little or none in tubercles of *Phaseolus vulgaris* and *Robinia pseudacacia.* The starch is always found in the noninfected meristem tissue especially the cork phellogen and next to the infected area. This is simply *stored starch* like that found in other parts of the root.

Frank maintains that there are two varieties of Rhizobia always to be found in two different kinds of tubercles of *Pisum sativum.* One variety is said to have the power of producing within itself highly refractive amyloid bodies closely related to amylo-dextrin found in some of the Florideae. Moeller agrees with Frank in regard to the presence in some Rhizobia of the highly refractive bodies but maintains that they consist of some fatty derivative, as cholesterin. Both agree that these bodies are readily stained with iodine solution, but while Frank notes a reddish brown stain Moeller affirms the color to be dark brown. I have noted similar highly refractive bodies in *Rhizobium mutabile* of *Melilotus alba, Trifolium pratense, Trifolium repens,* and *Lathyrus odoratus* but not in *Phaseolus vulgaris,* or *Pisum sativum.* These two last named plants are infected by *Rhizobium Frankii* var. *major* and *minor* respectively. So far I have only found these bodies in *Rhizobium mutabile.* These bodies are, as before stated, highly refractive; generally rounded, and may be located in the centre or toward the periphery of the usually more or less modified *Rhizobium.* I have been unable to stain them with tincture of iodine. Fuschin stains them with difficulty. The various aniline dyes have practically no effect upon them. As to their chemical nature I am not prepared to express a definite opinion. I am of the opinion that they are not starch. I am more inclined to Moeller's view that they are due to a fatty degeneration of protoplasm in improperly nourished Rhizobia. This would especially be expected in mature degenerating tubercles, which are the only ones that contain the Rhizobia with refractive bodies. Fatty degeneration is quite common in animal protoplasm. It sometimes happens that a starch granule is deposited inside of the partially or wholly empty case of a Rhizobium. This however is purely accidental and does not occur often. Of course such Rhizobia will contain highly refractive bodies that stain readily with iodine.

The greatest changes take place in the infected area of the tubercle. Here everything points to increased protoplasmic activity. The cells grow and multiply rapidly, they are entirely filled with a mixture of Rhizobia and protoplasm and in some cases the "*Infektionsfäden.*" The nuclei are abnormally large, the nucleoli become more distinct. All the different cell elements stain much more heavily than those of the normal cell. In *Phaseolus vulgaris* the nuclei becomes very much modified, they increase in size, the nuclear wall thickens, sooner or later the weaker spots of the wall give way and allow the nucleoplasm to protrude giving the whole an amoeba like appearance. Finally the nuclear wall ruptures on one side and allows the nucleoplasm to escape and mix more or less with the cell protoplasm (cytoplasm). The nucleoli retain their normal size and form; some of them retain a position next to the nuclear wall, others escape into the "mycoplasm" of Frank. I have not noticed such extensive nuclear changes in any tubercles except those of *Phaseolus vulgaris.*

The question as to what becomes of the contents of the infected cells might be briefly considered. Formerly I expressed it as an opinion that the plant at the close of the vegetative period and also at other suitable times absorbed the protoplasmic contents of the Rhizobia. I do not now think that that is the rule if it occurs at all. I believe that normally the tubercles are destroyed by the ordinary process of decay and the Rhizobia thus liberated. I have found the usual number of tubercles on *Trifolium pratense* and *Melilotus alba* as late as December 10th when I was compelled to chop them out of the frozen ground. The tubercles were filled with *Rhizobium mutabile,* apparently in normal condition. I have found well filled tubercles on dead, matured plants of *Phaseolus vulgaris.* The Rhizobia were apparently in a resting stage, waiting to be liberated. It is true in some cases the tubercles were emptied during or before the close of the vegetative period. Even in such cases I do not believe that the contents were taken up by the host but rather that the tubercles died and decayed because it did not receive enough nourishment from the plant and soil.

The question as to what position the tubercles hold, morphologically considered, is of some interest. The absence of a root-cap, of root-hairs and the fact that it develops exogenously would show that it does not resemble a root-branch. In position it shows neither positive nor negative geotropism though it occurs most frequently on roots near the surface. That may be, as Frank maintains, because the tubercles require a coating of air to keep them from direct contact with moisture. But since the tubercle is nourished by the plant and the coating of air escapes from the tubercle itself it is difficult to see why they should not develop in deep soil as well. It may be that there is a tendency toward negative geotropism. I have never been able to find tubercles on any other part of the plant than the root or its branches. Frank has found Rhizobia in stem, leaves and even the embryo. I have searched for them repeatedly in tissues outside of the root but have not found any. Tubercles resemble growing tissues in the abundance of Albuminoid compounds. Calcium oxalate crystals are common in the noninfected cambium especially the cork phellogan. Some of the crystals have a coating of cellulose secreted around them by the cell protoplasm. Any abnormal growth resembles histologically the tissue upon which it develops; hence one would expect the tubercles to resemble anatomically the roots upon which they grow. Yet it seems that the tubercles have more anatomical characters belonging to a stem than to a root, as already indicated.

Resume.

1. Root tubercles develop exogenously.
2. Tubercles grow from a meristematic area surrounding the infected region and separating it from the external cork layer.
3. Cork as well as lenticles develop from a well marked phellogen.
4. Tubercles have a well developed vascular system differing from that of the root.
5. *Phaseolus vulgaris* and *Amphicarpaea comosa* have tubercles with well developed lenticels, differing somewhat from those on the stem.
6. There is more or less starch in tubercles produced by *Rhizobium mutabile.*
7. Sometimes *Rhizobium mutabile* contains highly refractive bodies whose nature is not definitely known.
8. Anatomically a tubercle resembles a stem more closely than a root.
9. Generally tubercles are not found empty at the close of vegetative period.
10. Probably the plant does not reabsorb the protoplasmic contents of the Rhizobia at any time.
11. Nuclei in tubercles of *Phaseolus vulgaris* undergo great changes.

EXPLANATION OF PLATES.

A. Longitudinal section of a mature tubercle of *Melilotus alba.*

- a. Cork layer.
- b. Phellogen.
- c. Vascular bundle in longitudinal section.
- d. Infected area showing the Rhizobia radiating from the nucleus as a centre.
- e. Vascular bundle, cross section.
- f. Apex of cambium layer.
- h. Starch layer next to infected area.
- i. *Rhizobium mutabile* of *Melilotus alba* as seen in the early part of November.
- j. Calcium oxalate crystals.
- k. Parenchymatous tissue continuous with that of the root.
- r. Noninfected cells in the infected area bearing starch.

B. Cross section of a tubercle of *Phaseolus vulgaris.*

- a. Cork layer consisting of rounded cells.
- b. Phellogen.
- c. Lenticels.
- d. Infected area, Rhizobia are arranged in zoogloeae.
- e. Vascular bundles, all in cross section.
- g. Calcium oxalate crystals.
- i. *Rhizobium frankii* var. *majus* from bean tubercle.
- j. Normal nucleoli. 1. Nuclear wall. 3. Nucleoli. 4. Nucleoplasm.
- k. Much modified nuclei form infected area. 1. Nuclear membrane. 2. Processes of the nucleoplasm. 3. Nucleoli. 4. Nucleoplasm.

C. Details.

1. Small portion of tubercle of *Trifolium pratense* invaded by the "Infektions fäden" (*Schinzia leguminosorum*). a. Hyphæ of the fungus. b. Enlargements next to cell wall. c. " Haustoria."

2. Diagrammatic longitudinal section of *Robinia pseudacacia.* a. Cork layer. The cells are more irregular than those of the root. c. Vascular system. d. Infected area. e. noninfected areas.

3. Same as 1, but without the " Infektions fäden " and showing the cell entirely filled with the much modified *Rhizobium mutabile.* Nuclei are much enlarged and nucleoli show distinctly.

4. b. Much modified *Rhizobia mutabilia* with highly refractive bodies c. a. Starch granule which is capped by the empty case of a Rhizobium, b. á. A starch granule just forming inside of a partially empty Rhizobium case. a. Some free starch granules.

5. Cross section of a vascular bundle. a. Sheath. b. Phloem. c. Vessels.

ON THE STRUCTURE OF THE CARAPACE IN THE DEVONIAN CRUSTACEAN RHINOCARIS; AND THE RELATION OF THE GENUS TO MESOTHYRA AND THE PHYLLOCARIDA.

BY JOHN M. CLARKE.

In the original account of the peculiar fossil *Rhinocaris*,[1] the carapace was described, from the best evidence then obtainable, as univalvular, with a rostrum projecting conspicuously and consolidated with the valve. The type of structure appeared to be a remarkable departure from that exemplified in the prevailing phyllocarid crustacea of the Devonian (*Echinocaris, Elymocaris, Tropidocaris*), and seemed to evince in the very structure mentioned, strong affinities with the Decapods.

The diagnosis of the genus was virtually based upon a single specimen in which the carapace had been laterally compressed in such a manner as to demonstrate the non-existence of a median suture or hinge, and to conceal any evidence of other longitudinal sutures; and in which, also, the rostrum was laterally flattened and apparently continuous with the carapace.

For several years I have been carefully searching for additional information concerning this peculiar crustacean. A considerable number of specimens from the shales of the Hamilton group of Ontario County, New York, have come into my hands, but the test of the animal is so very tenuous that it seems well nigh impossible to secure examples which have not been subjected to some distortion, and that is usually the greatest at structural points of critical importance. Several excellent specimens, however, have been obtained, some of them kindly furnished by Mr. F. B. Loomis, of Spencerport, N. Y.

The carapace of *Rhinocaris columbina* Clarke, (the typical

[1] Palæontology of New York, vol. vii, pp. lviii, 195, pl. xxxi, figs. 16–21, 1888.

species) consists of four distinct and separate parts; two broad lateral plates or valves, a narrow median or axial plate, and an anterior median plate or rostrum.

The valves have an elongate, somewhat semi-oval marginal outline, narrower posteriorly than anteriorly, with a truncate or concave posterior extremity. They come into contact at only a single point, and that is in the axial line at about one-fourth of the median length from the anterior margin. At this point a projecting angle is formed on each by the attenuation and termination of the rostrum and median plate, and the projecting points appear to come into simple apposition, though it is possible that they slightly overlap; there is, however, no satisfactory evidence of the clasping of the valves at this point, such as that occurring in the great species *Mesothyra Oceani*.[2]

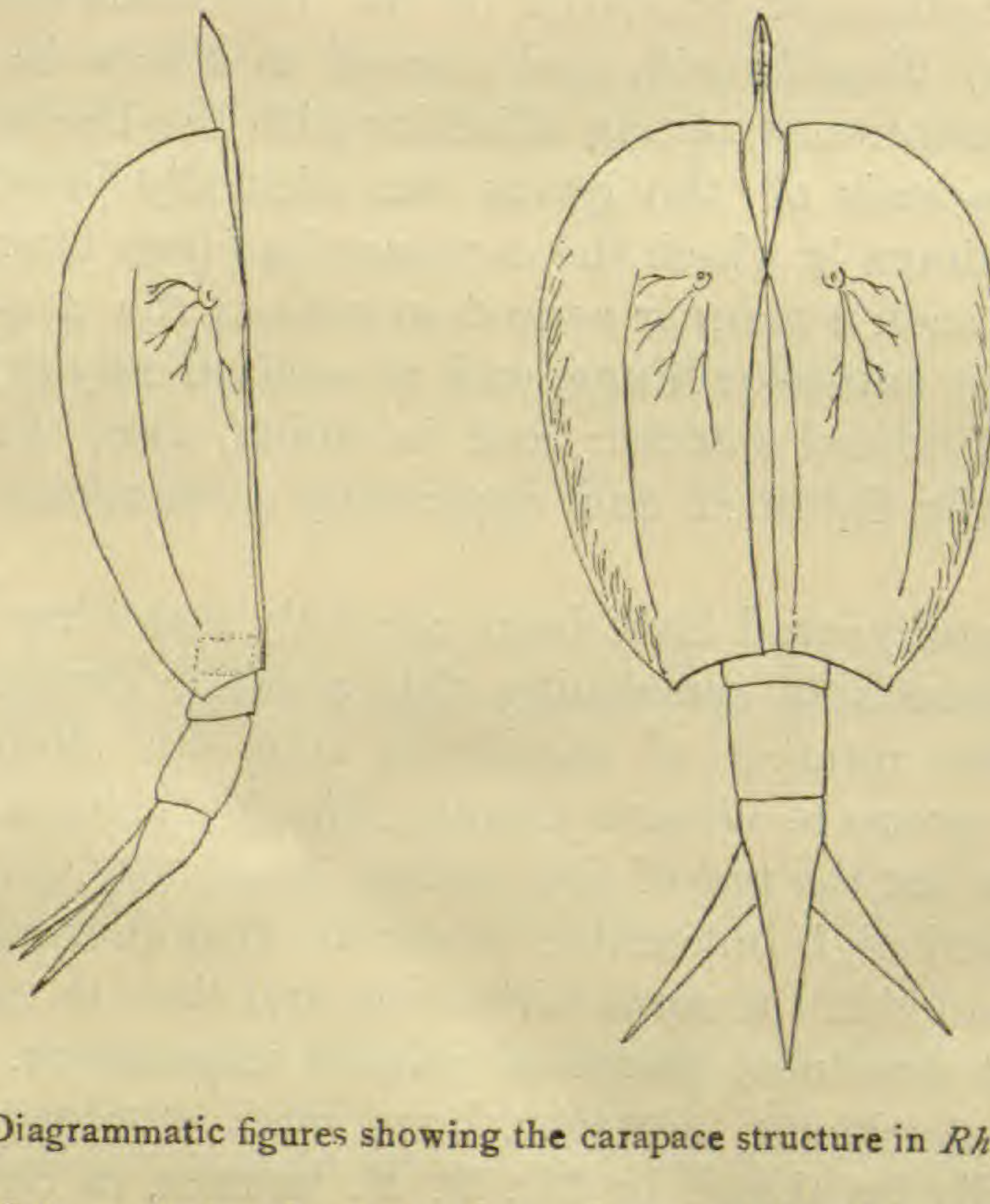

FIG. 1. Diagrammatic figures showing the carapace structure in *Rhinocaris*.

Opposite this point of contact and considerably within the median line of each valve, is a visual node having the form

[2] *Op. cit.* pl. xxxii, fig. 6; pl. xxxiii, figs. 4, 5.

of a low pustule with a single central depression or pit. From the base of this node radiates a series of linear, sparsely branching sinuses which extend laterally and posteriorly toward the marginal regions, the longest traversing nearly one-third the length of the valves. There is a very faint ridge or carina which lies just outside the middle of each valve and extends subparallel to the outer margin, for nearly the length of the valve, though reaching neither its anterior nor posterior margin.

In addition to these characters, the valves, over the marginal regions, bear the fine anastomosing elevated lines which characterize all the phyllocarid crustacea.

The rostrum is an elongate plate having, when flattened horizontally, somewhat the form of a willow leaf. Its broader end is inserted into the anterior gap between the valves and its posterior extremity is acute. As the plate begins to project beyond the anterior edge of the valves of the carapace, it narrows, its lateral expansions become deflected, the median portion tapering rapidly and becoming slightly incurved toward the tip.

The plane of the anterior half of the plate stands at nearly right angles to that of the posterior half, as shown in the accompanying figures. That this organ is in symphysis with

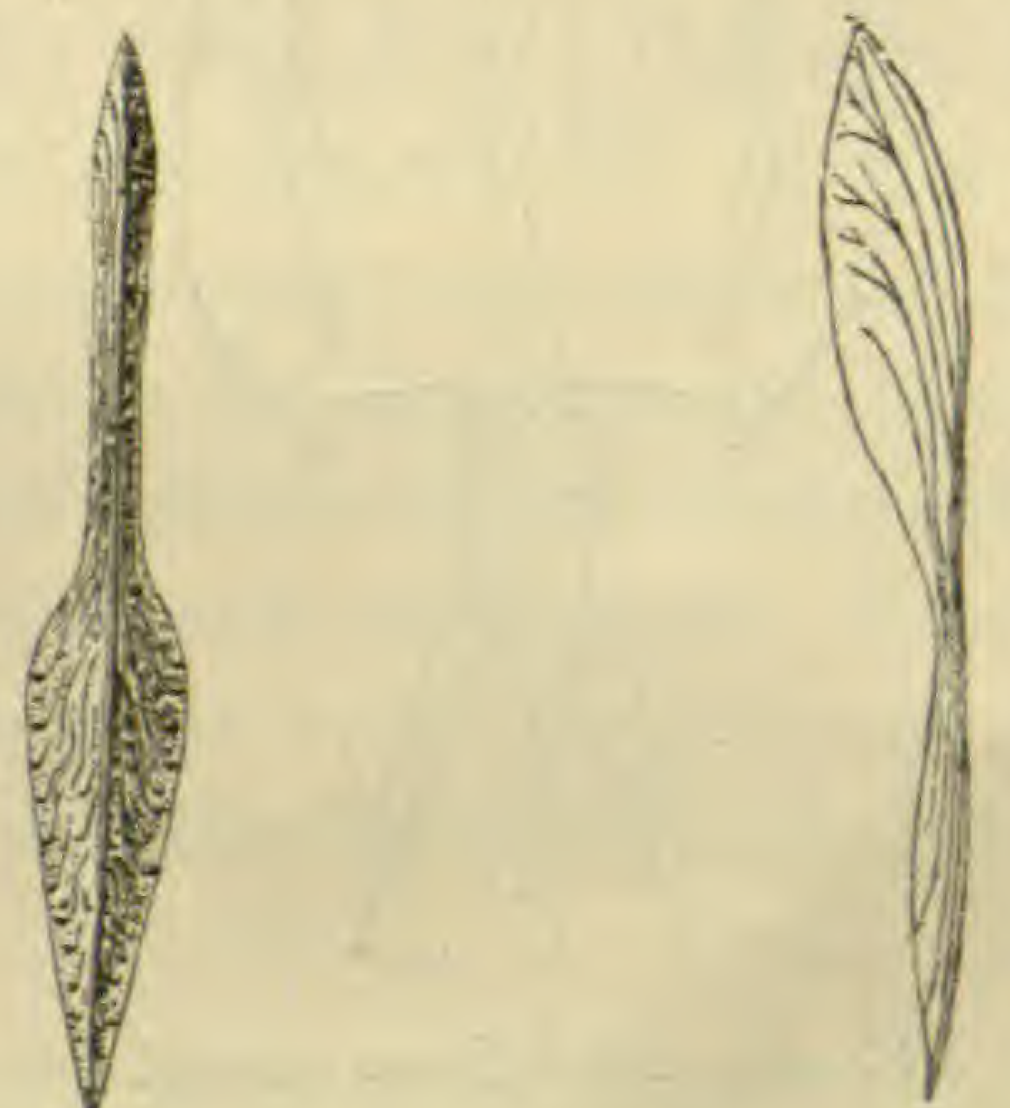

FIG. 2. Dorsal view and outline profile of the rostrum of *Rhinocaris columbina.*

the valves is evident from the fact that it is rarely found in its normal position. The surface is peculiarly ornamented by a series of elevated lines forming a sort of midrib; over the lateral posterior expansions the lines become much finer, diverge radially from the center after the manner of leaf veins, anastomosing to some degree, frequently terminating in oblique punctæ, and in parts where the lines disappear the punctæ remain.

The median plate. This is a very narrow body, its width exceeding at no point the greatest diameter of the rostrum. It begins at the union of the valves, in an acute angle, but its lateral margins soon become subparallel or convex outwardly. In relative proportions its length is about eight times its width.

Along the median axis it bears an elevated ridge-like line, from which there is a gentle slope on each side, and it was essentially from this evidence of continuity of the test on the axial line and from the concealment of the sutures between this plate and the valves, that the carapace was originally described as univalvular. The fine incised lines of the surface diverge anteriorly from this ridge.

In discussing, in Volume VII of the Paleontology of New York,[3] the structure of the great carapaces from the lower

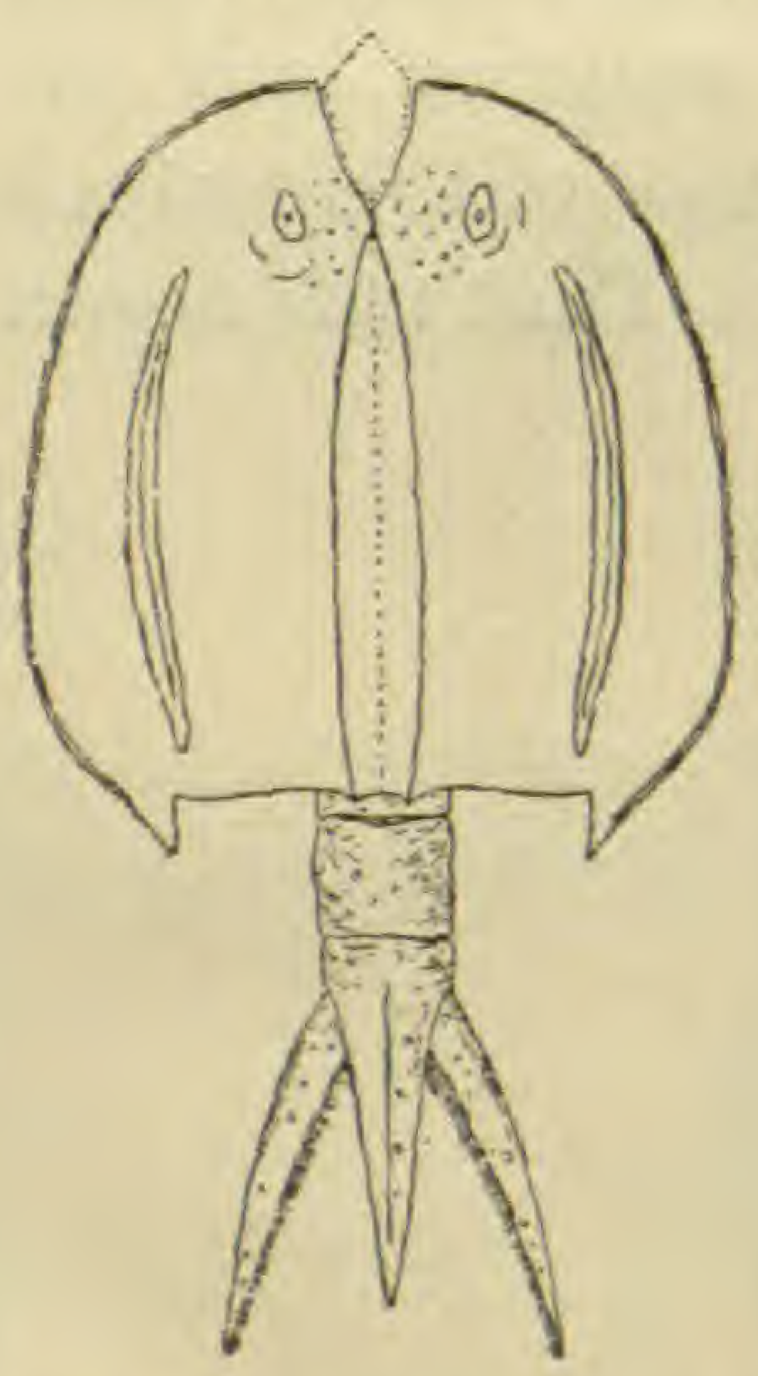

FIG. 3. *Mesothyra oceani.*

Chemung beds at Ithaca, N. Y., which had theretofore been known as *Dithyrocaris neptuni*, it was shown that these carapaces (now termed *Mesothyra oceani*) must have had a composition similar to that we now find to have actually existed in

[3] *Op. cit.* p. 184, pl. xxxi, figs. 8–10.

Rhinocaris. This presumptive structure was exhibited in a diagrammatic figure upon Plate xxxii, of which a reduced copy is here given. Though neither the rostrum nor the median plate in *Mesothyra* has yet been seen, all doubt of their existence is removed, and it affords a personal gratification to find this reconstruction of *Mesothyra* so fully substantiated by our present knowledge of the carapace in *Rhinocaris.*

FIG. 4. The median plate of *Rhinocaris columbina.*

The structure of the visual organ affords a further correspondence in the two genera, and one of some morphological significance.

In regard to the number of abdominal segments, present evidence indicates a difference in the two, *Rhinocaris columbina* having at least three, and *Mesothyra* having shown but two.

In the genus *Tropidocaris* Beecher, it has been shown that the type species, *T. bicarinata,* possesses a rostrum,[4] and its anterior extension is not unlike that of *Rhinocaris,* but there is now no satisfactory evidence of a free median plate in any of these species. Unfortunately the accessible specimens of the species are not very satisfactorily preserved, and the originals described by Mr. Beecher in Report PP of the Second Geological Survey of Pennsylvania, are understood to be beyond the reach of further investigation for the present. In plaster casts of the originals, the median suture on the hinge appears to be invariably in the longitudinal axis of the test. The original specimens of *Rhinocaris scaphoptera* and *Tropidocaris hamiltoniæ,* which were collected by me in the Hamilton shales of Ontario County, N. Y., both show some evidence of a quite narrow median plate, and the former possesses a stout rostrum,[4] while in the *Mesothyra* (*Dithyrocaris ?*) *veneris,* from the Marcellus shales, both median plate and rostrum are distinctly seen.[5]

It may be questioned if the multicarinate carapaces composing the genus *Tropidocaris* should be placed in close asso-

[4] *Op. cit.* pl. xxxi, fig. 22, 23.

[5] *Op. cit.* pl. xxxiii, fig. 3.

ciation with the unicarinate carapaces such as are possessed by *Rhinocaris columbina*, *R. scaphoptera*, *Mesothyra oceani*, *M.* (*Dithyrocaris?*) *veneris*, *Tropidocaris hamiltoniæ*, etc. All the latter appear to have possessed the carapace structure of *Rhinocaris columbina*, and if they are to be considered as representing different modifications of this type, sufficient to entitle them to distinct generic appellations, the following division of them may be preferable to that now standing: under *Rhinocaris; R. columbina*, *Mesothyra veneris;* under *Mesothyra; M. oceani*, *Tropidocaris hamiltoniæ*, *Rhinocaris scaphoptera.*

In regard to the unicarinate genus *Argas*, or *Dithyrocaris*, it may be stated that as described and illustrated by European writers, it has not been shown to exist in the paleozoic faunas of North America. When the structure of the carapace in the type species shall become more precisely known, we shall have a better basis for the comparison of these fossils with those under consideration, but at present we are not justified in assuming that they possessed the same structure as the unicarinate Rhinocarids.

Leaving these points of systematics, we find in *Rhinocaris* and its allies a remarkable carapace structure, an explanation of which it is difficult to find among fossil or recent crustaceans. We may conceive the double suture to have been a temporary modification of the Ceratiocarid type, induced by a necessity for movement of the lateral parts of the carapace after anchylosis has become established along the original median hinge. The evidence favors the belief that the valves were capable of motion along the double hinge, and nearly every specimen demonstrates the fact that the parts were separable along these lines after but slight maceration of the tissues.

No satisfactory elucidation of the origin and morphological significance of this structure appears from a study of the embryological phases of *Nebalia* as given by Metschnikoff, Claus and Packard, nor in the development of the Decapods as shown by Sars, S. I. Smith, Brooks, Bumpus and others. It is, nevertheless, in the development history of *Nebalia* and the

Decapods that the key to the taxonomic value of these features must be sought.

The existence of such a structure among the fossils usually classed as Phyllocarida, suggests a question as to the latitude of this ordinal term, proposed by Packard in 1879, for the living *Nebalia* and its fossil allies. The hinging, or median division by suture, of the carapace in many of these creatures, has been regarded here as among the Phyllopods, as of minor importance by most authors who have agreed to associate with *Nebalia* such fossil forms as *Ceratiocaris*, *Echinocaris*, etc. Claus used the term *Leptostraca* (also founded upon the structure of *Nebalia*) with a somewhat more restricted meaning. In a recent work on the *Ceratiocaridæ* of Great Britain, the authors, Professor T. Rupert Jones and Dr. Henry Woodward, have divided the Phyllocarida into two groups (1) those with univalved, and (2) those with bivalved carapaces. The greater number of the genera included in the first of these divisions are imperfectly known and quite obscure in their structural relations. Such are *Discinocaris*, *Spathiocaris*, *Aptychopsis*, *Ellipsocaris*, *Dipterocaris*, etc., etc. As the living *Nebalia* is univalved and without hinge, it is in this division that one would expect to find the closest approach to its structure, and it is, in fact, the case that none of the so-called Phyllocarida approaches *Nebalia* so closely in the structure of the test as the early paleozoic (Cambrian) genus *Hymenocaris*. In both, the telson is represented by a modification of three pairs of caudal spines or setæ, and both have about the same degree of abdominal segmentation, though *Nebalia* possess a rostrum, while *Hymenocaris*, as far as we now know, is devoid of one.

FIG. 5. *Hymenocaris vermicauda.*

FIG. 6. The flattened carapace of *Nebalia bipes*. (After Packard.)

Another very early univalved species, not unlike *Nebalia*, but wonderfully similar to the living Phyllopod *Apus*, is the *Protocaris marshii* Walcott, from the Olenellus-zone of the Cambrian. The figures here introduced, taken from the works of Walcott and Packard, will serve to show this similarity. The

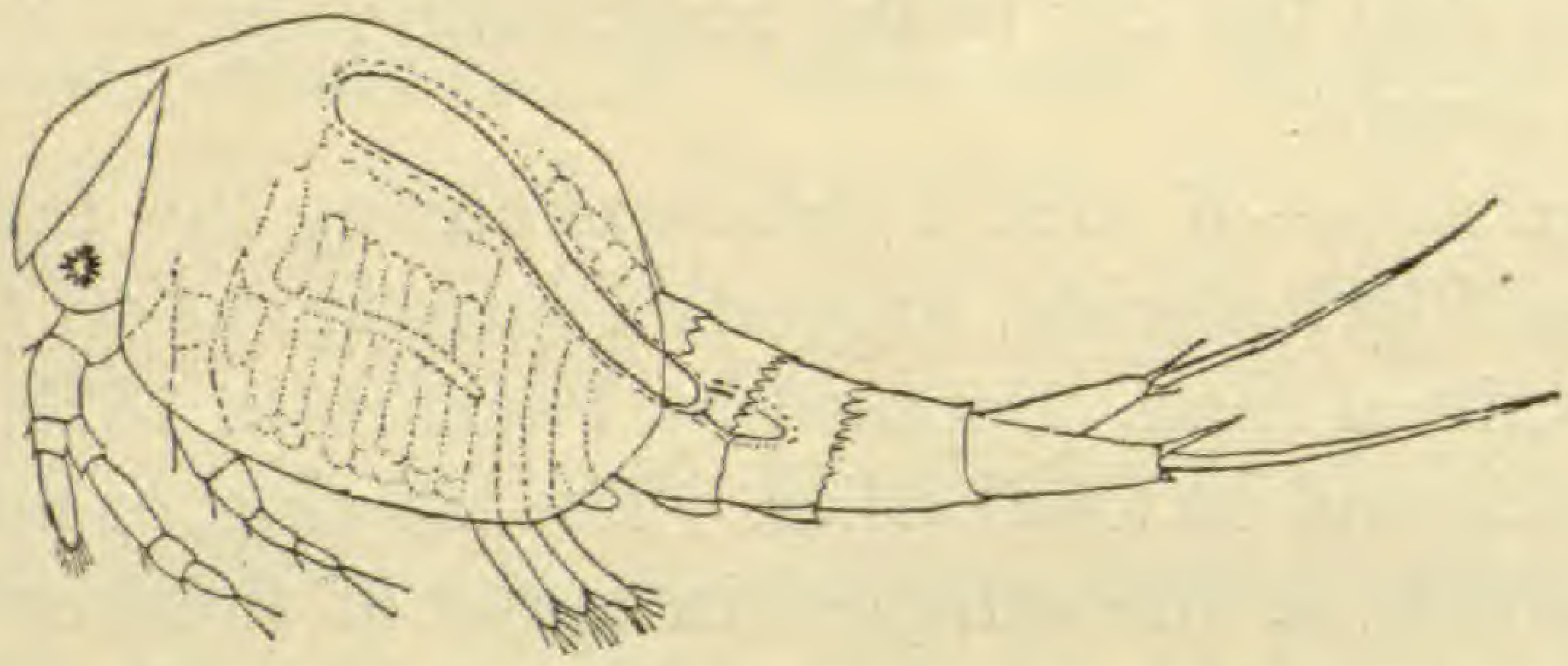

FIG. 7. Young of *Nebalia geoffroyi*. (After Metschnikoff.)

single example of *Protocaris* known, has probably been subjected to some horizontal distortion in the shale, giving the carapace a disproportionate size with reference to *Apus*, possibly also serving to obliterate any external evidence of ocular nodes which may have existed, but the remarkable closeness in the form of the abdominal segments, the degree of segmentation and the single strong pair of caudal processes, renders it highly probable that in *Protocaris*, we have to do with an apudiform phyllopod rather than with a nebalioid phyllocarid.

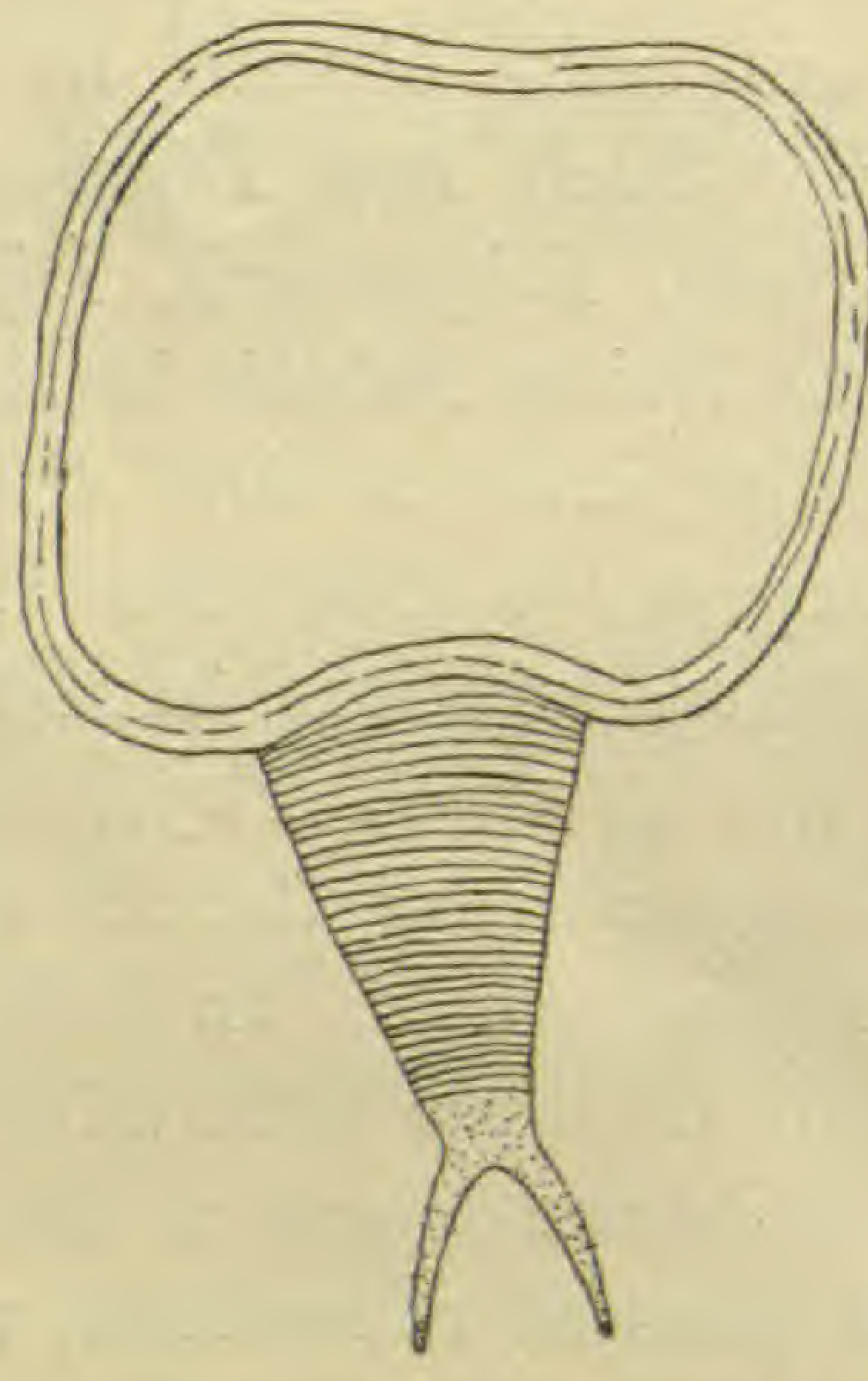

FIG. 8. *Protocaris marshii*. (After Walcott.)

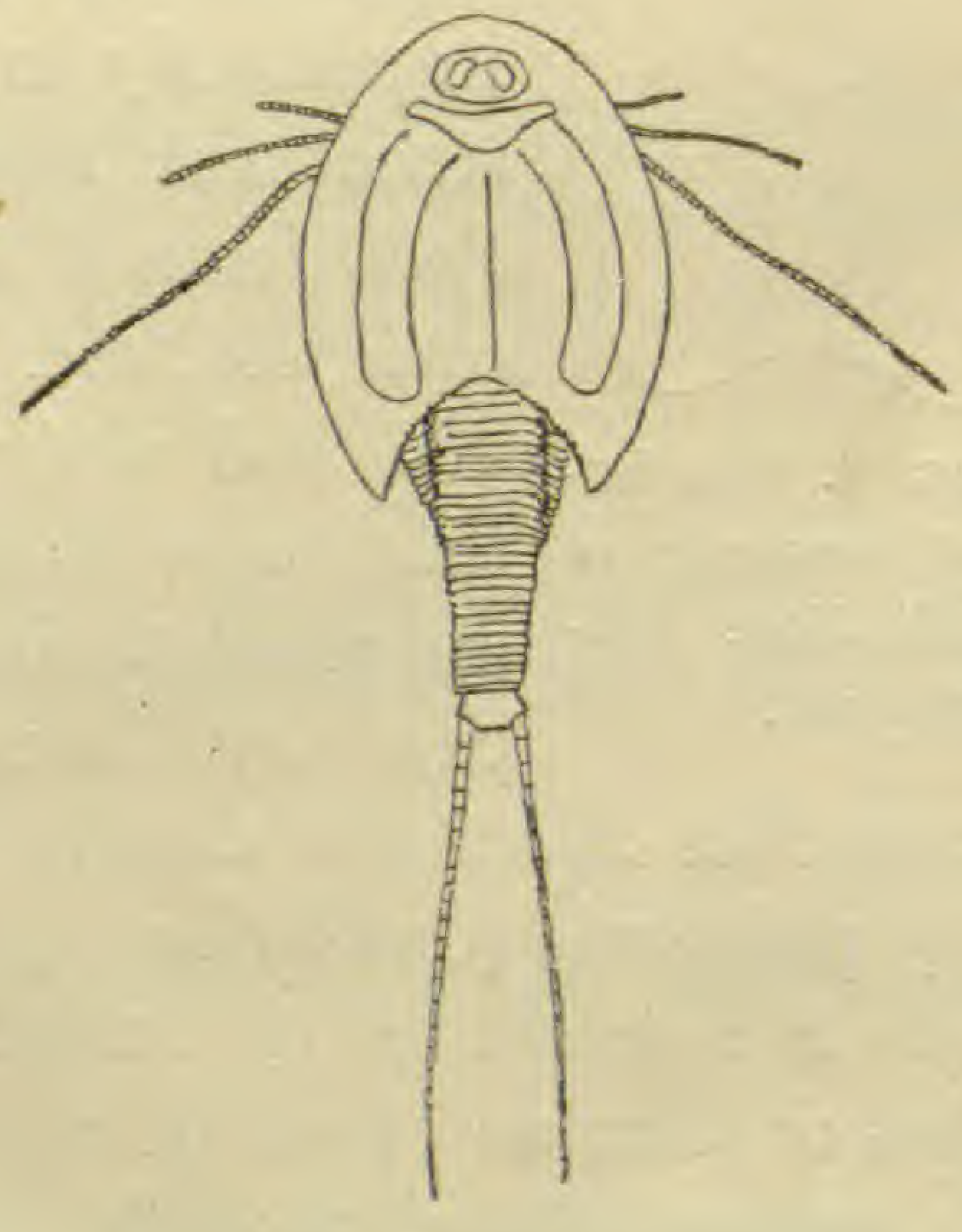

FIG. 9. *Apus æqualis*. (After Packard.)

Among the bivalved genera, not including *Estheria* and *Leaia* which Messrs. Jones and Woodward have placed with the Phyllocarids, there is throughout a general resemblance to

Nebalia except in this division of the carapace; a rostrum was present in most, though in some, as *Echinocaris,* a large amount of material has as yet failed to establish its existence. *Nebalia* possesses stalked compound eyes, which make no node or other configuration upon the exterior of the carapace. In *Echinocaris,* one of the numerous nodes in the cephalic region is undoubtedly ocular, and sometimes shows a slight depression at its summit; the other nodes are probably of muscular origin.

In *Ceratiocaris* there is no external evidence of eyes, while *Emmelezoe, Tropidocaris* and *Elymocaris* all possess nodes which may be definitely referred to the ocular organ.

Figures of *Emmelezoe* given by Jones and Woodward indicate that its structure is similiar to that of *Rhinocaris,* and it is evident that differences of structure in this respect between all of these genera and *Mesothyra* as represented in the accompanying figures, is simply one of degree. It is, therefore, a pertinent query whether such a fixed external ocular body as this, with a single central depression, is in any way indicative of stalked compound eye. We are strongly of the opinion that it is not, but, rather, indicates that these ancient representatives of nebaliad structures were sessile eyed.

Among the crustaceans we have been considering there appear to be at least four types of test-structure which are well distinguished.

1. That of *Apus* (*Protocaris;* a synthetic type, not necessarily a Phyllopod because *Apus* is one.
2. That of *Nebalia,* in a restricted sense (*Hymenocaris*).
3. That of *Ceratiocaris* (*Echinocaris, Elymocaris,* etc.).
4. That of *Rhinocaris* (*Mesothyra, Dithyrocaris? ?*).

It was proposed, when *Rhinocaris* was believed to represent a univalved, rostrate carapace, to distinguish it not only as a genus, but as a separate family, *Rhinocaridæ,* from other Phyllocarids; and it was at the same time proposed to place *Mesothyra,* with a supposed structure which we have now shown to exist in *Rhinocaris,* in a distinct family, the *Pinnicaridæ.* It is now evident that the two fossils are very closely related and it will not do to separate them by more than a generic difference; we may therefore retain the family term *Rhinocaridæ* and discard the other.

GENERAL PHYSIOLOGY AND ITS RELATION TO MORPHOLOGY.[1]

BY C. O. WHITMAN.

It is only as a zoologist that I venture to discuss this subject; and only in this capacity that I undertake to defend the proposition, that *general zoological physiology* is the promising field in which morphology and physiology may work most profitably together.

Morphology and physiology are two quite distinct sides of biology, each with definite and constant peculiarities of method and aim; but these two sides are only the statical and the dynamical aspect of one and the same thing; one presents the *feature*, the other the *expression*. It is only as a matter of convenience that these two aspects are dealt with separately; they are complemental, and have their full meaning only when united. The same function may appear in different forms, but a knowledge of the forms is nevertheless indispensable to an understanding of the function, and, conversely, the function must be known before we can arrive at a complete interpretation of the form. The best interests of biology demand that morphology and physiology should be kept in working contact. That is the lesson of the hour, which thoughtful investigators on both sides are coming more and more to realize. The separation of these two great branches of biology has been carried to an extreme that impedes the progress of both—an extreme that is unnatural and that has resulted from keeping physiology too exclusively in the service of medicine.

Physiology has come to mean, in practice at least, little more than the science which treats of the functions of fully developed organs. That this is an important side of physiology goes without saying, but there is another side no less important, which has been hitherto left almost wholly to mor-

[1]From the Fifth Annual Report on the Marine Biological Laboratory of Wood's Holl, 1892.

phologists. That we have to deal with functions of organisms as well as with functions of organs, is a truth that could not escape the student of Darwin's or Wallace's works. Still we have just begun to heed the fact that the broader physiology of the future must include the biological economy of organisms as well as the functional economy of organs. I repeat *the biological economy of organisms* must become an integral part of physiology, not only in theory, but in practice as well.

The activities and inter-relations of *organisms* bear the same relation to their morphology, as do the functions and correlations of *organs* to their anatomy. The former activities differ from the latter only in degree, just as an organism differs from an organ only as a composite differs from a simple. As the morphology of organisms includes organology, so the physiology of organisms embraces the functions of organs. As the one covers all organic forms from the most minute and simple up to the most highly differentiated and complex, so the other covers all vital phenomena, whether manifested in the smallest particle of living protoplasm, in a cell, a special tissue, an organ, an organism, a species, or any group of organisms. Form and function are always the two aspects, inseparably linked together throughout the entire organic world.

The work of the physiologist runs perfectly parallel with that of the morphologist, and wherever the one divides there the other divides, and for precisely similar reasons. We have the morphology of adult individuals, likewise the physiology; we have the morphology of the developing individual (ontogeny), likewise embryological physiology ("physiontogeny"); then we have the morphology of the species (phylogeny), and along side the physiology, or the phylogeny of functions ("physiophyly," Haeckel).

Metaphysiosis[2] is as old and as universal as metamorphosis, and to attempt to explain functions as we find them to-day without considering their historical development, is in many cases at least, as idle as trying to account for the specified forms

[2]This word suggests itself so readily, that it will hardly be recognized as novel; it is at least self-defining.

of existing organisms without the aid of their genealogy. Monumental failures of this kind might be cited on both sides; but it may be said that morphologists have almost universally abandoned this standpoint, while physiologists have quite generally adhered to it. It is the one-sided anthropocentric development of physiology that has retarded its progress, and that still waits to be corrected. Presumptuous as such statements may appear, coming from a morphologist, they are nevertheless true and must be declared so long as the malady of one of the twin branches of biology remains as the affliction of the other. So long as such fundamental functions of organisms as heredity, variation, adaptation, are neglected by physiologists, so long will physiology have to bear the reproach of having some of its more inviting fields pre-occupied and developed by morphologists.

What processes of life are more universal or more fundamental than those exhibited in and about the dividing nucleus? What function of living protoplasm has more to tell us about how the organism comes into existence and how the foundation is laid for the development of all the higher functions, than that of cleavage? What phenomenon of life stands more in need of a physiological explanation than that of sex differentiation? What question has a more direct practical bearing on the education and development of the human race than that of the transmission of acquired characters? What functions of more transcendent interest than those of the various sense organs? Where could a more beautiful example of the evolution of function be found than is furnished in our special senses? How intensely interesting the subject of the derivation of such functions! Will the physiologist, or his protègè the psychologist, give a share of attention to these important matters, or must the morphologist not only find the problem but work it out whenever it falls within the range of evolution? That would mean working under all the disadvantages attending the separation of two co-ordinate branches which are complemental one to the other. Morphology would lose its natural helpmate, and physiology would forsake its best guide. Morphology analyses the organic machine and thus lays the foundation for understanding its physiological use; physiology puts the suggestions of morphology to the test of experiment, and elucidates the dynamical side of the machine. What the machine consists of and what it can do, go together to make up a full concept of its structure and its functions. But the concurrence of the two sciences does not stop here. Morphology raises the question, how came the organic mechanism into existence? Has it had a history, reaching its present state of perfection through a long series of gradations, the first term of which was a relatively simple stage? The embryological history is traced out and the paleontological records are searched until the evidence from both sources establishes the fact, that the organ or organism under study is but the summation of modifications and elaborations of a relatively simple primordial. This point settled, physiology is called upon to complete the story. Have the functions remained the same throughout the series, or have they undergone a series of modifications, differentiations, and improvements more or less parallel with the morphological series? To answer this question, physiology has to appeal to the same sources of evidence as does morphology, namely, paleontology and embryology.

The paleontolgical series of forms cannot of course be experimented with; but form and function are so correlated that the latter may often be inferred from the former, and *vice versa.* The embryological series, often including free larval stages, furnishes one of the grandest fields for experimental study. Here the physiologist has an opportunity not only to study by experiment but also by direct observation and inference, and thus to join hands with the morphologist both in methods and results.

We are compelled to recognize different *orders* of individualities,—as the cell, the tissue, the organ, the organism, the corm—and of course every order must have its physiology as well as its morphology. Morphology and physiology are co-extensive, each claiming the whole organic world—as it was, as it is, and as it becomes. So long as we contradistinguish form and function, we must abide by the logic of definition. We cannot reduce the circumference of the animate world, however many radii and concentric circles we draw around our specialties. We may limit the province but not the realm. If we limit our study to man, we do not annihilate his relations to the rest of the animate world. Human physiology and human morphology represent only the latest terms of series stretching back to remote initial terms. The complexities of structure and function of the later terms we can never hope to understand until, through the study of a sufficient number of mean terms, we are able to determine the initial ones.

Three general series, each more or less incomplete, are accessible to study: (1) The systematic series, consisting of adult organisms, (2) the paleontological series, and (3) the developmental series. Morphology approaches these series by *comparative* study, and seeks to make each contribute as complete a story as possible. The same sources and the same method are open to physiology. The importance of the comparative method in physiology and the intimate co-relationship of physiology with morphology are well exemplified in a charming little treatise by Metschnikoff on "*La Pathologie Comparée de l'Inflammation*"—a work that must be reckoned as one of the fairest gems that adorn the annals of the Pasteur Institute. This monumental work shows how medicine itself must take its lessons from *comparative biology*, and approach its work from the standpoint of evolution.

The history of morphology and physiology is one continuous illustration of their inter-dependence. When the famous Harvey was asked what led him to think of the circulation of the blood he at once referred the original suggestion to one of the morphological features of the vascular apparatus—the valves and their arrangement. The hint furnished by structure was then followed up and tested by experiment, and the result was a discovery that brought the position of valves, pulsation of the heart, effects of ligatures, and other facts into rational relation to one another.

The history of theories of generation furnishes a capital example of how physiological speculation has been guided, checked, and corrected by morphological discovery. The old doctrine of preformation, or pre-existence of organisms in the germ, and the notion of the inclusion of one germ preformation within another, was certainly strongly suggested by the unfolding of plant buds and by the metamorphoses of insects; but as soon as it became possible to examine more minutely the phases of development, it was found that the fine-spun theories of Bonnet and Haller were refuted by morphological facts, and the doctrine of epigenesis, defended by Aristotle and Harvey, was led to triumph through the observations of Caspar Friedrich Wolff.

Our special senses have afforded one of the most fertile fields for speculative physiology. It is needless to dwell on antiquated hypotheses of " vital spirits " residing in the nerves, of a subtle nervous humor, or " imponderable fluid " drawn from the blood and secreted by medullary matter (Cuvier). The history of the hypotheses of life, sensation and volition are largely, as Whewell has well remarked, " the story of the *failures* of physiological speculation. " It is to the cultivation of the morphological sciences that physiology owes in a very large measure, its deliverance from the temptation to stray into the region of metaphysics.

As morphology furnishes the ground structure on which physiology operates, it naturally takes the place of pioneer and guide; but if permitted to wander too far in advance, it soon finds itself entangled with physiological problems with which it is not prepared to cope, and its efforts to release itself often end in sterile speculation. The workers on both sides should therefore advance abreast, in hand to hand contact. It is only in such reciprocally helpful relations that specialists can attain the highest possible individual development, and it is only when morphological and physiological experience and knowledge combine, that biology can accomplish such brilliant feats as that of Cuvier in reconstructing an extinct organism from its fragmentary remains.

The association of morphological and physiological research enlarges the field of vision on both sides, reduces the chances of useless labor, corrects false notions, stimulates inquiry, converts half views into whole views, and withal secures mutual respect.

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RECENT LITERATURE.

Conquest of the Vegetable World.[1]—This volume forms one or the series *Etudes d'Histoire Générale.* The author, M. Louis Bourdeau, treats the subject under twelve different heads, classifying plants according to the use made of them by man. The introduction gives a general theory of the increase of plants, both naturally and by cultivation. Following this are successive chapters on plants used directly as food and those from which food is manufactured in the form of liquors, oils and sugars; the fodder plants and those from which extracts are made, to be used medicinally, or as perfumery; plants useful for the arts and industries, and those which subserve merely ornamental purposes. The work concludes with a chapter on the creation and preservation of artificial varieties of some types of plants.

Report of the Minnesota Geological and Natural History Survey for the Year 1891.[2]—This quarto publication of 344 pages comprises reports on the crystalline rocks and the oxide of manganese, by Mr. N. H. Wilson; the Mesabi iron range, by H. V. Winchell; a record of field observations in four granite areas, with a catalogue of rock specimens, by Mr. U. S. Grant; a sketch of the costal topography of the north side of Lake Superior, with special reference to the abandoned strands of Lake Warren, by Mr. A. C. Lawson; a composite paper on the Diatomaceae of Minnesota Inter-glacial peat; and the usual lists of additions to the Museum and library.

The iron-ore interests have developed so rapidly that the Survey has found it incumbent to pay close attention to the geographic distribution of the rocks carrying this ore, and to the questions relating to their geology. Hence the more important papers in this report are the ones bearing upon those subjects.

The Vertebrate Paleontology of the Llano Estacado.[3]—This report embraces the determination of the species, from the most available parts of the skeleton, of the vertebrata found by the party

[1] Conquête du Monde Vegetal. Par Louis Bourdeau, Paris, 1893. M. Felix Alcan, Editeur.

[2] The Geological and Natural History Survey of Minnesota. The Twentieth Annual Report, for the year 1891, Minneapolis, 1893.

[3] A Preliminary Report, by E. D. Cope. From the fourth Annual Report of the Geological Survey of Texas (1892); published July 1st, 1893.

of the Geological Survey of Texas of 1892, which explored the eastern border of the Staked Plain from the Texas Pacific R. R. on the south to the Denver and Fort Worth road on the north. The party was under the direction of Mr. Wm. F. Cummins, who was accompanied by Professor Cope. They examined exposures of the beds of the Trias, and of Cenozoic beds of the terranes Loup Fork, Blanco and Equus, together with a bed between the Loup Fork and Blanco. The number of species obtained from each of these horizons is as follows: Trias, 7; Loup Fork, 17; Blanco, 16; Equus, 10; bed between Loup Fork and Blanco, 8; total, 58. Of these, eleven were not regarded as determinable. Of the forty-seven species determined, the following were first discovered by the explorations of the geological survey; Trias, 4; Loup Fork, 3; intercalated bed, 3; Blanco, 14; Equus, 5: total, 29. Among the results we find the following. The establishment of a peculiar species of *Episcoposaurus* from the Trias. The discovery of a Tetrabelodon, not previously known to be of Loup Fork age, allied to the *T. serridens.* The determination of the range of variation of the dentition of the *Protohippus placidus*, and the determination of the temporary dentition of Protohippus and Hippotherium. The more important results obtained from the bed intercalated above the Loup Fork is the finding of a new species of Protohippus, Hippidium, and Equus, each; the last named allied to the *E. minutus*; the discovery of new genera of Mustelidae and Hyaenidae from the Blanco bed; the rehabilitation of the *Tetrabelodon shepardii* Leidy hitherto known from a single molar tooth; the species being found to resemble in some respects the genus Dinotherium. Also the determination of three other mastodons from the Blanco bed, and of a large new species of camel of the genus Pliauchenia; the discovery of a true horse (*Equus minutus* Cope) not larger than a sheep. The Equus bed yielded a huge Mylodon, represented by fragments only, four species of horses, and three of camels of the genus Holomeniscus, two of the last named being new to science.

Twenty-three plates illustrate the report, which add much to its value, although little can be said in favor of their artistic merits, as they are printed on ordinary paper.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Recent Volcanic Eruptions in California.—In a paper published in *The Independent*, Professor G. Frederick Wright makes the following remarks concerning recent volcanic eruptions in California:

"The absence in America of volcanic phenomena east of the Rocky Mountains is amply compensated for by their abundance west of them. Probably the largest lava fields in the world are situated in Idaho, Washington, Oregon, California and Nevada. In age these belong to the latest of the geological periods, being for the most part tertiary. For many reasons there is much interest in determining how near down to the present time these volcanic eruptions have continued.

"The traveler over the lava beds of the Pacific slope cannot fail to be impressed by the fresh appearance of the basalt which covers so large a part of the surface. Considerable areas can readily be found whose surface looks as fresh as that of the slag from the furnace of yesterday. Many reports have been set in circulation by travelers that some of the volcanic cones have been witnessed by them in active eruption. Thus the members of Astor's party who, in 1811, crossed the Teton Mountains just south of the Yellowstone Park, averred that they saw peaks to the north of them sending forth volcanic smoke and vapor. As they were men of large experience, some men of science have been inclined to give credence to their opinion, and are confirmed in this view by the fresh appearance of some of the craters in the vicinity of Mount Jefferson, on the shores of Henry's Lake; while the activity of the geysers in the Yellowstone Park is perhaps indicative of the continued activity of volcanic forces throughout that general region.

"But there are so many phenomena that may be mistaken for volcanic smoke and vapor when seen from a distance that it is safer not to credit such general statements. Clouds and drifting snow might easily deceive a distant observer. It is probably thus that the reports originated concerning the volcanic activity of Mount Hood during the middle of this century. Mount Hood is indeed a volcanic crater; but so far from being active it is now filled with snow. Mount Rainier, or Tacoma, presents, however, the double phenomena of blowing hot and cold at the same time. The upper 5,000 feet of its surface is almost a continuous sheet of ice, but through a small orifice in a portion of the crater which crowns the summit, volcanic steam continues to find vent, and furnishes heat for the unlucky explorer who is compelled to spend a night at that lofty elevation.

"The most definite account of what may be called an historically recent volcanic eruption of any considerable extent in the region referred to at the outset has just been published in a Bulletin of the United States Geological Survey, by Mr. J. S. Diller. The area described is in northern California, in the vicinity of Lassen Peak, about one hundred miles southeast of Mount Shasta. Lassen Peak is itself a vast volcanic cone, and the center of numerous others smaller in size and later in origin, but all of recent geological age. The Cinder Cone, which was the special subject of Mr. Diller's researches, is ten miles northeast of Lassen Peak, in the vicinity of Snag Lake. The general elevation is here a little over 6,000 feet above the sea, and his cone rises 640 feet above the lowest point of its base, having a diameter of 2,000 feet at the bottom, and 750 feet at the top, and is composed of cinders which readily yield and slide down under one's weight as he walks over them.

"This Cinder Cone belongs to the earliest part of the eruption, and, in Mr. Diller's opinion, cannot be much more than two hundred years old. At the same time with the explosive eruption that produced the Cinder Cone, an immense amount of volcanic sand was ejected and scattered about the base for a distance of eight miles in every direction. Near the base this is between six and seven feet in depth, and thins out gradually toward the margin. Some time subsequent to this explosive outburst there took place a quiet flow of basalt, which poured from the southeast side of the cone, and spread itself over the sand, covering an area about three miles long by a little over a mile in width. The edge of this flow everywhere presents a precipitous front about one hundred feet in height, and Snag Lake is formed by the dam which this basalt stream has extended across the valley into which it flowed.

"The data for determining the age of this eruption seem to be as conclusive as could be desired. Dead pine trees, with their roots in the original soil, can still be seen projecting above the volcanic sand of the first eruption, and in some instances they have been partially overwhelmed by the later eruption of basalt, and their decaying tops project from under it. But the living trees all grow upon the surface of volcanic sand, and near the base of the cone their roots are not long enough to reach the original soil. The age of the oldest of the trees found living does not exceed two hundred years, and that, doubtless, as Mr. Diller supposes, very closely marks the date of the earlier eruption. Ordinarily, also, pine trees, overwhelmed as this original forest was, would not survive more than thirty years. In the conditions of this dry climate two hundred years is a long time for them to remain exposed to the air without complete decay.

"The demonstration of so much volcanic activity at so recent a date in California renders it altogether likely that other eruptions will occur in that region in process of time, and that others have occurred at no great distance in the past. Previous to the eruption of the year 79, there was no historic record that Vesuvius had been an active volcano, and at a later period—between the fourteenth and seventeenth centuries—more than three hundred years elapsed without any serious eruption. It will be a matter of surprise if the volcanic forces west of the Rocky Mountains do not yet assert themselves with greater or less vigor. These investigations of Mr. Diller, therefore, show the possibility of bringing down to a reasonably modern period the date of the remains of man which have been found under the lava in various places on the Pacific Coast.

"Even Table Mountain in California might seem to yield a modern chronology in view of one fact brought out by Mr. Diller. It has been supposed that all of the erosion of the deeper valleys about Table Mountain has been subsequent to the time when this lava stream filled up the old channel of the Stanislaus River. In the light of Mr. Diller's observations, however, it would seem possible to suppose that the Table Mountain lava flow did not always follow the lowest channels open to it, but that it may have built up for itself obstructions in front of which it might turn aside to occupy abandoned channels of the old river at a higher level. This, at any rate, was a theory which suggested itself to me a year ago, as I examined the country about ten miles above Sonora, where the Table Mountain stream of lava crosses to the left side of the present Stanislaus. That the theory suggested to my mind in reference to the Table Mountain flow might have been a fact would seem no more strange than the actual course of some of the streams of lava which Mr. Diller has traced from the Cinder Cone so carefully studied by him. He says: 'At first the main stream flowed to the southeast, but gradually turned around to the left, until its direction was slightly west of north, where, though having flowed a total distance of three miles, the cessation of its flow was not more than a mile and a half from the vent. This course was not determined by the original configuration of the land, but by the obstructions to the later streams furnished by the cooling of earlier streams.'

"In view of present activity in the discussions of the antiquity of man, I can but regard this publication of Mr. Diller as of the very highest importance as calculated to allay the fears of a certain portion of the Christian public, and to check the hasty inferences that some are likely to draw from the recent facts which have been so freely published concerning the relation of man to the lava beds of the Pacific Coast. The time has not yet come to give the full chronological significance to those facts."

Continental Problems.—The annual address of Mr. G. K. Gilbert, President of the Geological Society of America, consisted of a statement of six unsolved continental problems, with a discussion of each question in turn. (1) "How are Continents supported?" introduced the doctrine of Rigidity versus Isostasy, with the weight of evidence in favor of the latter doctrine. (2) "Does heat or composition determine the difference in density of the material of the earth's crust?" was discussed in connection with (3) "What caused the Continental Plateau?" in which the author spoke at length of the only hypothesis yet advanced, that of Mr. Dana, which deserves to be more fully compared with the body of modern data. (4) "Why do Continental Areas rise and fall?" is a problem for which no solution has been suggested. (5) "Are Continents Permanent?" may probably be answered in the affirmative, but the fact is not yet fully established. (6) "Do Continents Grow?" is still open to discussion, although the doctrine has been generally accepted. In the author's opinion, the greater part of the data from which continental growth has been inferred may be fictitious and misleading. (Bull. Geol. Soc. Am., Vol. IV, 1893.)

Mineral Resources of the United States for 1891.[1]—This volume is the eighth of a series begun in 1882. It deals with the mineral progress of the year 1891, and contains a complete statement of the mineral products of that year. The opening chapter is a summary of the quantity and value of the metallic and non-metallic products for 1891, and also contains tabular statements of the outputs from 1880 to 1891. Under the head of Iron Ores, a résumé of the progress in the manufacture of iron and steel in the United States for the past twenty years is given.

The names of the contributors of the various sections appear in connection with the subjects treated.

[1] Mineral Resources of the United States for the Calendar Year 1891. David S. Day, Chief of Division of Mining Statistics and Technology. Washington, 1893.

Note on an Upper Devonian Fish from Canada.—A collection of fishes made by Mr. Jex at Campbelltown and Scaumenac Bay, Canada, has been recently examined by Dr. R. H. Traquair. Among them is a fine series of *Phaneropleuron curtum* Whiteaves, which shows clearly that the short break in the dorsal fin, which Whiteaves figured, but thought might be an accidental or abnormal character, is a natural division, and that the dorsal fin is in two distinct portions. Dr. Traquair feels justified in erecting the Whiteaves species into a new genus characterized by its double dorsal fin, and proposes for it the name *Scaumenacia curta*. (Geol. Mag., June, 1893.)

The Diatomaceæ of the Triassic (?) sandstone of New Jersey.—When I first settled in Newark, New Jersey, twenty years ago, I went about looking at the red sandstone for Diatomaceæ in it; but did not find them. I found pieces of trunks of wood. I found carbonate, silicate and sulphide of copper and carbonate of lime and mica, and worm burrows and ripple marks but nothing else. No minute fossils like Diatomaceæ. I looked at the sandstone every now and then, reasoning that it was a fresh water sediment, most likely laid down in very shallow water, and must contain the remains of Diatomaceæ, if they existed then. I examined the sandstone at Glen Ridge, about two miles from the station at Bloomfield on the Montclair and Bloomfield branch railroad where the Glen Ridge quarry and mining company have a quarry and are mining for copper. I examined the white sandstone at Forest Hill on the Greenwood Lake railroad and the old Schuyler copper mines at Belleville. I visited the red sandstone in the cutting where the Greenwood Lake railroad came through at Arlington just above Newark on the Passaic river. The cut is deep and it shows the sandstone dipping to the northwest and also a fissure which parted the rock in a nearly north and south direction or parallel to their strike. It is about five feet wide and shows rounded pieces of trap. This strongly indicates that the trap is not far below and that heat partially metamorphosed the rocks. This is one of the few fissures in the Triassic. The shale shows worm burrows and ripple marks. This would seem to point to a later instrusion than the Triassic of the trap. I examined the shale with acids for Diatomaceæ but without success. At last in June of this year, 1893, I found a spot immediately on the Passaic river just south of the city of Passaic where L. H. Arden has a brick yard in operation. I found he mined the clay from which the brick was made close by, and I visited the clay pit and saw the clay in finely stratified layers about as thin as paper and extending to about twelve feet upward from the rain water which had accumulated here, on the day I saw it. The clay was red or brown and rather poor and the layers looking like a heap of reddish paper with darker papers introduced every now and then. On the top of this was about two feet of red glacial gravel in the form of till and between the gravel and the clay was a pocket of yellow clay which evidently belonged to the glacial deposit which I have examined all over northern New Jersey and which forms the so-called Lacustrine, Sedimentary or Sub Peat deposits of Diatomaceæ which occur from Nova Scotia to Pennsylvania on the Atlantic coast of the United States. This stratified clay is Triassic and I examined it with considerable interest for it was formed in shallow fresh water, and contained Diatomaceæ, scarce it is true, but the first Diatomacæ geologically speaking that have been found anywhere on the globe if we except the Diatomaceæ of the Carboniferous Coal found by Count Castracane some years ago. But the coal in which he discovered Diatomaceæ is doubtfully carboniferous. Perhaps it may be Tertiary. The Diatomaceæ I found in the Triassic clay were *Gomphonema acuminatum* and *Brebissonia lanceolata* along with straight sponge spicules. The clay was Triassic beyond a doubt for it was under the glacial clay and glacial till. What it rested upon is doubtful, Triassic sandstone most likely, for Triassic sandstone covers this part of New Jersey and no other rock is seen. It is important to note the finding of Triassic Diatomaceæ at this time and perhaps they will be seen in quantity further on. The color of the Triassic sandstone due to red iron oxide is remarkable and deserves investigation. The same color is present in the Catskill sandstone and at first they could be classed as one, but of course the fossils are different, and are very scarce in the Triassic, and rather plenty in the Catskill. It can hardly come from the magnetite on the border of the sandstone, as I. C. Russell suggests, for that, although present in New Jersey, is not always present and cannot be the cause of the red color of the Catskill sandstone. Perhaps it is present as an iron silicate, for it is more difficult to dissolve by boiling in acids than simple iron oxide.

ARTHUR M. EDWARDS, M. D.

Do Glaciers Excavate ?—The recent critical examination of Alpine and other mountain valleys by Professor T. G. Bonney, confirms the conclusion he reached in 1874, that these valleys appear to be much older than the ice age, and to have been but little modified during the period or maximum extension of the glaciers. Mr. Bonney asserts that the erosive power of glaciers is small—quite unequal to the work which has been ascribed to it. In this connection the author considers the difficulties presented by certain Alpine lakes in attributing them to the erosive action of glaciers. The position of such lakes as Constance, Geneva, Como, etc., and the subaqueous contours of Como and Geneva militate against the glacial erosion theory. The hypothesis offered by Mr. Bonney as an explanation of these lake basins is that originally they were eroded by ordinary agencies, and that their beds have been subsequently affected by differential movements. He instances as an example bearing out his theory the Great Lakes of North America whose origin has been so ably demonstrated by Dr. J. W. Spencer. (Geog. Journ., June, 1893.)

Plistocene Deposits of Russia.—Mr. S. Nikitin has given a brief account of the Quaternary deposits of Russia in a pamphlet of thirty-four large octavo pages. It is, however, merely a summary of a more detailed report which he is soon to publish. The paper closes with the following statement of the principal theses:

1. "The sub-division of the stone age into paleolithic and neolithic epochs should be preserved for European Russia, because it here coincides with the geological divisions into Pleistocene and modern, which are, in their turn, based upon paleontological data.

2. "The study of the glacial deposits of Finland and of the western region furnishes no proof of the existence of two distinct glacial epochs and an inter-glacial epoch. All the facts can be explained by the phenomena of the oscillation of the glacier at the time of its gradual, but irregular, retreat.

3. "If, however, one accepts the Swedish and Prussian theory of the sub-division of the glacial period into two epochs and an interglacial epoch, the second glaciation cannot have extended beyond the western region, in a certain part (comparatively restricted) of the Baltic region of Finland and of the government of Olonetz.

4. "The other portion of Russia subjected to glaciation, has only one morainic stage, corresponding to the deposits of the first glacial epoch of the Swedes.

5. "At the epoch of the more extended glaciation, the major part of Russia presented the aspect of a desert of ice, similar to that of Greenland, carrying no moraine upon its surface, and presenting no elevation free from ice, where forest vegetation could be preserved.

6. "The time corresponding to the interglacial epoch and the second glaciation of the Swedes, was probably, for the greater part of Russia, the epoch of the formation of the ancient lake deposits, the loess, and

the upper terraces of the rivers, which constitute the principal repository for the bones of the mammoth and other extinct mammals, which abounded here while Scandinavia and Finland were still covered by the glacier.

7. "In accordance with the composition and genesis of her Quaternary deposits, European Russia may be divided into a series of typical regions which are very characteristic, although resting upon differences which are scarcely recognizable, but which illustrate none the less the life of the immense Russian plain during the Quaternary period, and the formation of her superficial deposits.

8. "In the second portion of the glacial epoch, or of the pleistocene, the mammoth and other large mammals inhabited southern and eastern Russia in great numbers. As the glacier retreated, these animals advanced toward the north and northwest; toward the close of the pleistocene they reached Finland for a short time, and then disappeared entirely throughout the whole extent of European Russia, but probably later in the northeastern part and in Siberia.

9. "Man lived contemporaneously with the mammoth during the second part of the glacial epoch along the limits of glaciation, possessing an industry well-advanced, making use of fire among other things, but producing implements solely of naked flint. As the glacier retired, man advanced toward the north and northwest; he arrived in Finland and the Baltic region after the close of glaciation and after the disappearance of the mammoth; but man himself possessed already the more advanced culture of the neolithic age, and besides implements of trimmed flint, he knew how to make implements in polished stone, pottery, etc.

10. "European Russia shows no traces of man in the first part of the Pleistocene, or of any more ancient man." (Am. Journ. Sci., June, 1893.)

BOTANY.

Check-List of New North American Plants.—The botanical publications of the Department of Agriculture at Washington are becoming year by year of more scientific value, and at the same time more useful. Botanists have come to look upon the "Contributions from the U. S. National Herbarium" as real contributions which they are glad to receive, and in which they may feel a just pride. The last number (No. 7) consists of a "Systematic and Alphabetic Index to New Species of North American Phanerogams and Pteridophytes, published in 1892," prepared by Miss Josephine A. Clark. Appearing the middle of July, it is refreshingly recent, and makes us hope that under the energetic management of Chief Coville this will be the rule with publications from his division.

The list is much like the one published last year (Sept. 20, 1892), and as then described, it is based upon the card index of new species and new combinations, made primarily for the use of the Botanical Division. Its usefulness there, suggested to Dr. Vasey its publication for the benefit of botanists throughout the country.

A marked improvement which we notice with great pleasure is the uniform decapitalization of all specific names, and the omission of the comma before the name of the author. We trust that this will hereafter be the rule in the National Herbarium.

Charles E. Bessey.

Shall we Decapitalize Specific Names ?—By the time that this is in print, the Botanical Club of the A. A. A. S. will have discussed and perhaps decided this question; but we wish here to record before this anticipated action, our conviction that it is but a question of time when decapitalization will be the rule. It is to be hoped that the Club will decide in favor of it now, but if it does not, it will but defer the matter a few years. The revulsion against the over-capitalization of DeCandolle, Gray and Watson may not now be strong enough to demand absolute decapitalization ; it may be satisfied with retaining the capital initial for genitives of personal names, and possibly for old substantives. This would be a great improvement, inasmuch as it would require the decapitalization of nearly one-half of the names now capitalized in the new edition of Gray's Manual.

Of course, every one knows that grammatically the argument is a pretty strong one in favor of a partial capitalization, but something may be said on the other side, even on this ground. Primarily the specific name is a limiting or qualifying term, that is, it has an adjectival function, and as such it is properly written with the small initial letter. There should be no question as to such cases as *virginiana, coroliniana, pennsylvanica,* etc. Linne himself wrote them with the small initial letter, as also Willdenow and Sprengel. Why then should there be any hesitancy in writing *oakesiana, purshiana, kalmianum,* etc.? Even in Gray's Manual we have *sambucifolia, alnifolia, hyssopifolius, nepetæfolia,* and, most astonishing of all, *fossombronioides.* Why the Italian Fossombroni should be decapitalized here, it will puzzle any advocate of capitalization to explain.

Nothing is gained by capitalizing, and it requires some extra effort to remember whether to use the capital or not, while by decapitalizing we gain much in appearance of the printed page, and save appreciably in time and the effort to remember a complicated rule.

CHARLES E. BESSEY.

The Use of Personal Names in Designating Species.[1]— The first sentence of the thirty-second article of the Paris Code is as follows: "The specific name ought, in general, to indicate something of the appearance, the characters, the origin, the history or the properties of the species." The twenty-seventh section of the rules of nomenclature adopted in 1877 by the zoologists of the American Association for the Advancement of Science (with the advice of Dr. Gray, and other botanists) is almost identical with the foregoing: "The specific name should, in general, indicate some feature of the appearance, characters, origin, history or properties of the species." The purpose of the rule cited is, without question, to favor the adoption of names which have some real significance, and when we look over the work of the great masters in descriptive botany we see how fully they followed its spirit. In the first and third editions of Linne's "Species Plantarum" nearly all the specific names are in some degree, descriptive. One finds names as follows (pp. 118–119) *suecica, canadensis, tomentosa, trifoliata, viscosa, alternifolia, perennis, uniflora, biflora, umbellata, corym bosa, latifolia,* etc. If we compare Linne's practice with that of recent descriptive botanists we find a great change in the frequency with which personal names are used. In the first two hundred pages of Vol. I, of the first edition of the "Species Plantarum," including about

[1] Read before the Botanical Club of the A. A. A. S., August 21, 1893.

one thousand species, there are not to exceed seven such names, viz: *michelianus, lœflingiana, halleri, matthioli, Gmeleni, monelli,* and *Osbeckii,* (notice in passing, the capitalization, which is still maintained in the third edition). Here we have less than one per cent of names derived from personal names, which is in striking contrast with what we find in recent lists.

In the list of New Species of North American Phanerogams and Pteridophytes, published in 1891, issued by the U. S. National Herbarium, *twenty-three per cent* of the specific names are derived from personal names. In the similar list for 1892 we find a little more than 18 per cent. of such names. Taking the two years together, the personal names are exactly twenty-one per cent. of the whole. Has not this thrusting forward of personal names gone entirely too far? It certainly violates every principle of good taste. Botanists may soon be properly charged by other scientific men with showing an over-eagerness to gain the petty notoriety which attaches to having one's name borne by some plant. There should be a speedy reform in this practice.

It is a proper thing to construct a euphonious name from the name of an eminent botanist, and apply it to a new genus. There is some dignity in such a procedure; but there is a great deal of difference between the dedication of a genus to a great man, and the other practice of assigning new species to every collector,—*because the collectors like it!*

CHARLES E. BESSEY.

Botany at the Madison Meetings.—The most notable gathering of American botanists in recent times took place in August of the present year in connection with the forty-second meeting of the American Association for the Advancement of Science, and the several affiliated societies. Especial efforts had been made to secure a large attendance, which was successful beyond the most sanguine expectations. But few of the more active of our botanists were absent, and these were unavoidably detained.

This being the first year of the existence of a separate section (G) of botany, all members of the Association watched the experiment with much interest. But when the permanent secretary announced in the closing general session that the new section had received *one-fifth* of all the papers presented to the Association, all doubts as to the ability of the botanists to maintain a separate section disappeared.

The session opened on Thursday, August 17, with the address of the Vice-President on "Evolution and Classification," the burden of which was that in the present classification, of the higher plants especially, the facts of evolution are practically ignored.

On Friday papers as follows were read:

G. F. ATKINSON, Photography as a means for recording the macroscopic characters of micro-organisms in artificial cultures. The author detailed his method of securing good photographs by means of oblique light in connection with a black card interposed between the object and the source of light.

G. F. ATKINSON, Symbiosis in the roots of Ophioglosseæ. A fungus appears to be present in the cortical tissues of the roots of all the species examined.

B. T. GALLOWAY, Observations on a rust affecting the leaves of the Jersey or Scrub Pine. This was a discussion of the structure of the normal and diseased leaves, and an account of the mode of infection by the parasite, *Coleosporium pini.*

W. J. BEAL, Prophylla of Gramineæ. Illustrated by drawings and sketches.

CHARLES R. BARNES, On the food of green plants. This was one of the most carefully written papers presented during the meetings. The author proposed a sharper separation of the operations concerned in the nutrition of plants, as follows: (1) *Photosyntax,* for the fixation of carbon by chlororphyll; (2) *Digestion* and (3) *Assimilation.* The publication of this paper will be looked for with interest.

J. CHRISTIAN BAY, A new infection needle for the study of lower plants. Illustrated by sketches and examples.

G. F. ATKINSON, Comparative study of the structure and function of the sporangia of ferns in the dispersion of spores. Illustrated by a number of large drawings.

BYRON D. HALSTED, The Solandi printing applied to botanical work. By the use of sensitive photographer's paper the author is able to obtain fine negatives directly from leaves, and from these he prints very useful photographs. Many specimens of this process were shown.

N. L. BRITTON, Present aspects of the nomenclature question. Analyzing the subject as it presents itself to-day. There are (1) the pre-Linnæans, who would go back in nomenclature to authors earlier than Linné; (2) those who would begin with the Systema Naturæ of Linné, 1735; (3) those who would begin with Linné's Genera Plantarum, 1737; and (4) those who with most botanists would begin with Linné's Species Plantarum, 1753. To these may be added (5) a few who would select a date still more recent.

T. A. WILLIAMS, Lichens of the Black Hills. Eighty-three species and varieties are known, many of which are northern and western.

J. CHRISTIAN BAY, The bibliography of American botanical literature. The author made a plea for the beginning of such work.

DOUGLAS H. CAMPBELL, Notes on the development of *Marattia douglasii.* Describing the prothallia, and suggesting a relationship with certain Hepaticæ.

On Monday papers were read as follows:

THEOBALD SMITH, Further observations on the fermentation-tube, with special reference to anærobiosis, reduction, and gas production. Illustrated by the apparatus used by the author.

JOHN G. JACK, The fructification of *Juniperus.* The author finds that the fruits of *J. virginiana* ripen the first season, while in *J. sabina* var. *procumbens* it requires two seasons, and in *J. communis,* three seasons.

S. G. WRIGHT, The minute structure and development of the motile organ in the leaf of the Red-bud. This was an anatomical and physiological paper.

ERWIN F. SMITH, Two new and distinctive diseases of Cucurbits. Describing an *Alternaria* on melons, and another on cucumbers and cantaloupes due to bacteria.

CONWAY MCMILLAN, Preliminary statement concerning botanical laboratories and instruction in American universities and colleges. This paper was considered so important that the Association requested the Commissioner of Education at Washington to print it as one of the educational bulletins. Incidentally, it appears that many colleges are still giving *as college work,* short spring term courses in Gray's "Lessons!!"

The reading of this paper resulted in the appointment of a committee consisting of Drs. Coulter, Campbell and Britton, to inquire into the teaching of botany in the secondary schools of the United States.

BYRON D. HALSTED, The shrinkage of leaves in drying. By means of photographs by the "Solandi" process, it was shown that the shrinkage is often considerable.

M. B. THOMAS, The roots of orchids.

L. H. PAMMEL, Preliminary notes on some chromogenic bacteria of the Ames flora.

B. T. GALLOWAY, Results of some recent work on rust of wheat.

J. H. PILLSBURY, On the quantitive analysis of the colors of flowers and foliage.

For want of time the four last named were read by title.

On Tuesday the following papers were read.

S. M. Tracy, Distribution of the Gramineæ in the United States. Illustrated by many maps.

N. L. Britton, A consideration of species based upon the theory of evolution. An attempt to formulate our present ideas of species.

Elizabeth G. Britton, A revision of the genus *Physcomitrium*. Showing that while we supposed that we had half a dozen species, it appears that we have nearly or quite double that number.

W. T. Swingle, On *Cephaluros mycoidea* and *Phyllosiphon* sp., two parasitic algæ new to North America. These curious plants, the first of which lives upon Magnolia leaves and the latter upon the leaves of *Arisœma*, appear to be truly parasitic.

Frederick V. Coville, An analysis of the conditions affecting the distribution of plants. These were given as temperature, light, food, water and mechanique.

J. C. Arthur, Deviation in development due to the use of unripe seeds. As this paper will be published in full in the Naturalist, no summary will now be attempted.

W. T. Swingle, The principal diseases of citrous fruits now being studied at Eustis, Fla. Illustrated by specimens of fresh material.

P. H. Rolfs, A sclerotium disease of plants. Giving details of the structure.

Elizabeth G. Britton, *Ulota americana* Mitten and *Orthotrichum americanum* Beauv. The author discussed fully the question of their identity, which appears to be established.

The following were read by title for want of time:

L. H. Pammel, Notes on *Rœstelia pyrata*, Crossing of Cucurbits and A case of poisoning by the wild parsnip, *Cicuta maculata*, (three papers).

The Botanical Club held sessions on Friday, Monday and Tuesday. It received the report of the committee appointed last year to prepare a check list of North American phanerogams, and after much dicussion, provision was made for printing it. In this connection, Rule III of the "Rochester Code," was modified so as to allow the use of a specific name identical with the generic. The rule now reads as follows:

"In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained."

Another important action of the club was that relating to the proposed American botanical society. A committee of ten was elected and empowered to increase its number to twenty-five, to organize such a society. The following is the committee: J. C. Arthur, G. F.

Atkinson, C. R. Barnes, C. E. Bessey, L. H. Bailey, N. L. Britton, Mrs. E. G. Britton, J. M. Coulter, F. V. Coville, D. H. Campbell, D. C. Eaton, W. G. Farlow, E. L. Greene, B. D. Halsted, Arthur Hollick, C. MacMillan, B. L. Robinson, F. L. Scribner, C. L. Sargent, J. D. Smith, Wm. Trelease, R. Thaxter, L. M. Underwood, L. F. Ward, W. P. Wilson.

Papers were read in the club, many of them of much importance.

On Saturday the Club accompanied the Association to the Dells of the Wisconsin River, and spent a day in collecting and in the enjoyment of the beautiful scenery, with much of social pleasure.

An American botanical society is now assured. The committee to effect an organization met promptly and made preliminary arrangements for a meeting next year in connection with the Association. A sub-committee consisting of Messrs Trelease, Coulter, Bailey, MacMillan and Sargent, was appointed to attend to the details of permanent organization.

The Botanical Congress which had been called by the committee appointed for the purpose, convened at 10 o'clock, A. M., August 23, with 37 members. Since, for various reasons, but few foreign botanists were able to attend, the name adopted was the "Madison Botanical Congress." Dr. E. L- Greene of California was elected President and Henri de Vilmorin of France, and L. M. Underwood of Indiana, Vice-Presidents. J. C. Arthur of Indiana, B. L. Robinson of Massachusetts, and F. V. Coville of the District of Columbia, Secretaries. C. R. Barnes of Wisconsin was elected Treasurer.

Committee reports were received, as follows:

On the Nomenclature of Plant Diseases. After discussion this was referred to an enlarged committee, of which Dr. B. D. Halsted of New Jersey is chairman, with instructions to report in 1894 to Section G of the American Association for the Advancement of Science.

On the terminology of Vegetable Physiology; suggesting greater precision in the use of terms. This was likewise referred to a committee, with Dr. J. C. Arthur of Indiana as chairman, to report to Section G in 1894.

On the terminology of Anatomy and Morphology. After discussion a committee of five, with Dr. D. H. Campbell of California as chairman, was appointed to report in 1894 to Section G.

On the Nomenclature of Horticultural forms; recommending for the present the use of Nicholson's "Dictionary of Gardening," supplemented by the "Index Kewensis," for scientific names. This report was adopted.

On the Bibliography of North American Botany; urging the necessity of the early inauguration of bibliographic work, and suggesting rules for uniform methods of citation. The congress voted affirmatively upon the first proposition, and then referred it to a committee with Dr. C. R. Barnes of Wisconsin as chairman. The rules as to methods of citation were agreed to, and will be printed in the proceedings of the congress.

On the terminology of Geographical Botany. After short discussion this was referred to a committee with F. V. Coville of the District of Columbia as chairman.

Appropriate resolutions were presented and adopted regarding the death of Alphonse de Candolle, and George Vasey.

Resolutions were adopted respecting the condition of the United States National Herbarium, at present deposited in a building in Washington which from its construction and use is liable to destruction by fire, and the United States Congress was memorialized to make early provision for a fire-proof building for the preservation of this scientific treasure. The Secretary of Agriculture was respectfully requested to urge prompt action in this matter.

The thanks of the Congress were extended to Dr. Otto Kuntze for valuable printed papers presented by him for the use of the members.

On Wednesnay afternoon open invitation of the local committee of arrangements the members of the Congress took part in a botanical excursion to Lake Wingra, and after adjournment (Thursday, 5 P. M.), all enjoyed a two hours' moonlight ride upon Lake Mendota.

There is no space in this account for a full notice of the botanical papers read in the Society for the Promotion of Agricultural Science. The Secretary, Dr. Frear, communicates the following titles:

W. J. Beal. Methods of killing Couch- or Quack-Grass.

W. J. Beal. Some Grass Mixtures for lawns.

W. R. Lazenby. Sub-irrigation for Green-house and Garden.

C. E. Bessey. The Weeds of Nebraska.

B. D. Halsted. Potatoes by the direct method.

G. F. Atkinson. A new fungus disease of the Apple.

B. T. Galloway. The Macrosporium disease of potatoes.

J. C. Arthur. A new factor in improving farm crops.

These will be published in the proceedings of the Society.

The attendance of working botanists was unusually large at all the meetings in Madison. Many men whose faces are rarely seen were present, some for the first time in their lives. A few of the active botanists of the country who have usually taken part in such meetngs were missed, while on the other hand, the older members were made aware of the fact that there is a rapidly growing group of younger men who are pushing their way to the front by their good work.—Charles E. Bessey.

ZOOLOGY.

Classification of the Actiniæ.—In his account[1] of the Actiniæ of the "Albatross" collections of 1887–88, Professor J. P. McMurrich gives first a historical résumé of the growth of our knowledge of the Actinians and then presents his own ideas of the limits and arrangement of the families, followed by a description of the forms collected by the "Albatross." In the historical part we notice that the separation of the Bryozoa (better Polyzoa) from the Cœlenterates is credited to Milne Edwards. We had always understood that the discovery was made by J. Vaughan Thompson in 1830.

Changing the typographical arrangement Professor McMurrich gives the following classification of the Hexactinians.

A. Tentacles arranged in cycles — ACTINIÆ.
- *a.* Column simple
  - 1. Tentacles cylindrical, smooth.
    - * Sphincter absent or weak, entodermal.
      - † Mesenteries not numerous. — Halcampidæ.
      - † † Mesenteries numerous. — Antheidæ.
    - * * Sphincter entodermal, tentacles deciduous. — Boloceridæ.
    - * * * Sphincter mesoglœal.
      - † No acontia. — Paractidæ.
      - † † Acontia. — Sagartidæ.
    - * * * * Sphincter entodermal, circumscribed.
      - † Acrorhagi wart-like. — Bunodidæ.
      - † † Acrorhagi foliate. — Phyllactidæ.
  - 2. Tentacles warty or branched.
    - * Tentacles simple. — Heteractidæ.
    - * * Tentacles compound. — Thalassianthidæ.
  - 3. Tentacles reduced to stomidia. — { Polyopidæ. Sicyonidæ.
- *b.* Column provided in its upper part with branched or globular processes. — Dendromelidæ.
- *c.* Free swimming forms. — Minyidæ.

B. Tentacles arranged radially — STICHODACLYHINÆ.
- *a.* Tentacles all of one form.
  - 1. Tentacles few, capitate — Corallimorphidæ.
  - 2. Tentacles numerous, cylindrical. — Discosomidæ.

[1] Proc. Nat. Mus., XV., p. 119, 1893.

3. Tentacles nodulated. Aurelianidæ.

b. Tentacles of two forms.

1. Marginal tentacles cylindrical; disc tentacles wart-like, branched or foliate. Rhododactidæ.
2. Marginal tentacles pinnate; disc tentacles wart-like. Phymanthidæ.

c. Tentacles of various forms, not cylindrical. Cryptopdendridæ.

It is a pity that the Government cannot provide good illustrations for papers like this, but like all the publications of the Fish Commission it has put up with unsatisfactory photo-cuts.

Maioid Crabs in the National Museum.—Miss Mary J. Rathbun continues[2] her studies of the Maioid Crabs by an account of the species of the family Maiidæ in the National Museum. She enumerates 39 species as occurring in the collection and gives a list of desiderata which includes 100 species. The new forms described are *Chionœcetes tannerii, Cœlocerus grandis, Lepteces* (n. g.) *ornatus and Hyastenus caribbœus.* The paper concludes with an extract from the as yet unpublished MSS. of the late Dr. Stimpson, a part of his final report upon the Crustacea of the Ringold and Rodgers Expedition to the North Pacific. The value of this last would have been increased by including references to the preliminary report on the same expedition published in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1857.

A New Lancelet.[3]—Dr. E. A. Andrews regard the small lancelet which was found by the Johns Hopkins Marine Station in the Bahamas as the type of a distinct genus of Acraniata to which he has given the name *Asymmetron lucayanum.* The chief anatomical peculiarities of the form are found in the asymmetrical character of the reproductive organs, which occur on the right side of the body alone, in the absence of fin-rays from the ventral fin and in the presence of a long caudal process extending posterior to the last myotome. Dr. Andrews has also collected the literature of the various species of Amphioxus from which we learn that the following species have been described from the world.

Branchiostoma lanceolatum: Scandinavia, England, Mediterranean, Chesapeake Bay? Fiji Island?

B. caribœum: Mouth of La Plata, Brazil, St. Thomas, Jamaica,

[2] Proc. Nat. Mus., XVI, p. 63, 1893.

[3] Studies from Biol. Laby., Johns Hopkins, V, 1893.

Tampa Bay, Gulf of Mexico, Beufort, N. C.

B. cultellum: Australia.

B. bassanum: Australia.

B. belcheri: Australia.

B. elongatum: Peru.

B. californiense: California.

Asymmetron lucayanum: Bahamas.

Besides these, specimens have been reported from Japan, Ceylon, and the Bermudas. It is possible that the *B. cultellum* of the above list may prove to be a species of Asymmetron. Peters genus Epigonichthys is apparently regarded as synonymous with Branchiostoma.

Descriptions of Four New Rodents from California.—During the past year I have received among other mammals a considerable series of Californian rodents of the genera Sitomys, Reithrodontomys and Onychomys. In the identification of these it was found necessary to determine, if possible, the status of certain Californian forms described by Professor Baird in 1857, more especially of his *Hesperomys eremicus, H. boylii, H. gambelii* and *H. austerus.* The results of this study were necessarily incomplete, and, though far from satisfactory, some points of importance seemed sufficiently proven to warrant publication, and a paper was in preparation and nearly ready for the printer when Dr. J. A. Allen's Article on a collection of mammals from the San Pedro Martir region of Lower California came out in the Bulletin of the American Museum of Natural History.

This covered so exactly much of the same ground gone over by my own investigations in so much more exhaustive a manner and with such similar results, the original scope of this paper has been materially changed.

Among the series lately received by me from collectors in southern California there are four forms apparently undescribed. In determining the status of these I am greatly indebted to Dr. J. A. Allen for the loan of specimens from the New York Museum of Natural History, and for the critical examination of some of my own, forming the basis of this paper.

For the loan of the type specimen of *Onychomys torridus* and a large series of rodents from southern California, thanks are due to Mr. F. W. True of the National Museum, and Mr. Gerrit S. Miller, Jr., of Peterboro, New York.

1. *Sitomys major* Sp. nov. (Type No. 1202, ♂; Col. of S. N. Rhoads, Squirrel Inn, San Bernardino Co., July 1, 1893; col. by R. B. Herron).

Description.—Size large, somewhat less than largest *S. californicus.* Tail about length of head and body, stout, and scantily covered with coarse hairs; terminal pencil inappreciable. Hind feet smaller than in *californicus.* Ears large, more rounded and thinly-haired than in *californicus.* Color pale, grayish buff on upper parts, becoming brownish on rump and lacking any darker dorsal stripe. Sides, from eyes to root of tail, more buffy than upper parts, but no definite lateral stripe. Lower parts uniform grayish white, lacking buffy or plumbeous tints on throat and ventral region always present in *californicus.* A narrow, black, ring encircles each eye.

Measurements.[1]—Total length, 193.5; tail, 98.5; hind foot, 22.5. Skull—total length, 28.5; basilar length, 20.5; zygomatic breadth, 13.8; length of nasals, 10.5; interorbital constriction, 4.3.

Another specimen, a female, taken at the same date and place, has lost half the tail during life. In no other respect does she differ from the type, the length of the head and body and of the feet being the same in both.

In size, form, dentition and relative measurements the skull of *major* differs inappreciably from its near ally, *californicus.* The resemblance of *major* to Baird's description of "*Hesperomys boylii*" and its apparent affinities with *californicus* inclined me to the belief that it was his "Long-tailed Mouse," and that it should be classed a sub-species of *californicus* as *S. californicus boylii.* Dr. Allen, who has examined the type of *boylii,* and to whom I submitted the two specimens of *major* for an opinion on this question, thinks their identity very doubtful, though admitting their apparent resemblance in size and coloration; neither does he consider the relationship of *major* to *californicus* at all close. Independently of this verdict I should have hesitated to give *major* full specific rank.

I am informed that Dr. Merriam has secured a series of *Sitomys* from the type locality of *boylii* in Eldorado Co., which will enable him shortly to re-describe that species and settle a much involved question in the synonomy of this very puzzling genus.

2. *Sitomys herronii*[2] Sp. nov. (Type No. 815, ♀, Col. of S. N. Rhoads, San Bernardino Valley, Cal., March 3, 1893, col. by R. B. Herron.)

Description.—Body short and stout; ears large, very thinly and minutely haired. Tail very long and slender (one-third longer than head

[1] All measurements given in this paper are in millimeters, and were made by collector before skinning.

[2] For Mr. R. B. Herron, whose abilities as an expert and painstaking field-collector more than deserves public recognition.

and body), clothed with minute, whitish hairs, slightly darker along ridge, the annuli not concealed thereby. There is no dark ring around eyes. Upper parts uniformly buffy gray, lacking any tendency to a darker median area, the lower sides and cheeks becoming purer ochraceous buff, the root of the tail being encircled by same color. The face is grayer than rest of upper parts. Pelage very soft, long and full. Feet white, small and slender, upper half of thighs and fore-legs, buff. Lower parts soiled gray washed with buff, whitest on chin, darkest on breast and belly.

Measurements.—Total length, 200 ; tail, 115 ; hind foot, 21. Skull —total length, 24.5 ; basilar length, 18.5; zygomatic breadth, 12.3 ; length of nasals, 9.2 ; interorbital construction, 3.5

This species is represented by four specimens, all taken in March, April, and June, on the ranch of the gentleman whose name they bear.

They belong to the long-and-naked-tailed, large-eared group of *Sitomys* typified by *eremicus.* In colors and general proportions the nearest ally of *herronii* is probably the *S. rowleyi*[3] of Dr. Allen, from Utah. It differs therefrom according to Dr. Allen, "in slenderer feet, buffy white instead of pure white underparts, rather grayer head and naked, instead of hairy, tail." *Herronii* also differs markedly from *rowleyi* in its skull measurements when compared with those given for the latter species by Dr. Allen. The length of nasals, given as "5.5" for *rowleyi,* is probably a typographical error. I have seen no skull of *Sitomys* in which the nasals measure less than seven millimeters, and, to judge by its other dimensions, *rowleyi* must be a large species. In its average characters *herronii* comes most closely to *Sitomys eremicus* and its sub-species *fraterculus*,[4] from both of which it may readily be distinguished by its buffy tints and larger size. Cranially, it has a broader and flatter rostrum, less recurved upper incisors and relatively much longer and wider incisive foramina than *eremicus.* There is no decided variation in size and color among the *herronii* series in my possession, the type being a fair average of the lot.

3. *Onychomys ramona*[5] Sp. nov. (Type No. 823, ♀, Col. S. N. Rhoads, San Bernardino Valley, Cal., April 11, 1893, col. by R. B. Herron).

Description.—Size somewhat larger than *O. torridus,* with larger ears. Colors similar to *O. longicauda,* but with an appreciable dorsal stripe and shorter, stout tail. Skull averaging larger or as large as *O.*

[3] Bull. Am. Mus. Nat. Hist., V, 76.

[4] Mr. Miller, who describes *fraterculus* as a full species, now considers it a "dark coast form of *eremicus.*"

[5] For "Ramona," "H. H." Jackson's heroine of the San Bernardino Valley.

torridus and of the same proportions, but with a relatively longer mandible and higher coronoid process.

Measurements.—Total length, 147; tail, 48; hind foot, 18; ear, from crown, 12.

I have examined the type of *torridus*, with which *ramona* shows closer affinities than with any other member of the genus. Making allowance for the facts the type was "skinned out of alcohol," and the skull is missing, it is easy to see that *torridus* is externally a very different looking mouse from *ramona*, being lighter and more unicolor above and lacking the bright vinaceous wash on the sides.

Adopting the cranial and superficial characters given for *torridus* by Dr. Merriam in North American Fauna, No. 2, the two are best distinguished as follows:

Onychomys torridus.	*Onychomys ramona.*
1. Above, uniform dull, tawny cinnamon.	1. Above, grayish vinaceous buff.
2. No darker dorsal stripe.	2. Darker grayish dorsally.
3. No black ring around eye.	3. Narrow, black ring round eye.
4. Tail with dark dorsal stripe reaching three-fourths its length.	4. Tail with dark dorsal stripe, seven-eighths to nine-tenths its length.
5. Average measurements:—length, 135; tail, 45; hind-foot, 20; ear, from crown, 10.	5. Average measurements (five adults): — length, 139; tail, 48; hind-foot, 19; ear, from crown, 13.

CRANIAL MEASUREMENTS.

	torridus	*ramona*
Basilar length (of Hensel)	18.5	19.
Greatest zygomatic breadth	12.5	12.6
" parietal "	11.4	11.5
Interorbital constriction	4.2	5.
Length of nasals	9.6	10.
Foramen-magnum to incisive foramina	12.5	13.4
Alveolar length of upper molar series	3.5	3.8
Length of mandible	13.2	15.
Height of coronoid process from angle	5.8	6.8

Up to the present time no Onychomys has been recorded from California that I am aware of. Dr. Merriam informs me a large series was taken there by the Death Valley Expedition, but owing to the delay in the publication of the second part of the report on the expedition this material was, of course, unavailable in the present connection.

The American Museum of Natural History has no specimens of Onychomys from California. Two winter specimens from Dulzura, San Diego Co., Cal., were loaned by Mr. Miller. They are unaccompanied by other data, or measurements, or skulls, and so were not included in the above diagnosis. They differ from the type of *ramona* in apparently smaller size and darker dorsal shade, in which respects they more closely resemble two October specimens of *ramona*. It may be remarked that this peculiar dorsal shading is also characteristic of the majority of Dulzura *Sitomys* and *Reithrodontomys* I have examined, as compared with the same species from San Bernardino Valley, but it is not sufficient to warrant special recognition in any case.

One half-grown and one young—adult specimen of *ramona* entirely lack the characteristic colors of upper parts in fully adult specimens, being of a uniform pale steel-gray above. The same striking difference, due to age, is very noticeable in a series of *Sitomys* and *Perognathus* taken in the same region.

4. *Reithrodontomys pallidus* Sp. nov. (Type No. $\frac{3289}{2568}$, ♀, Col. Amer. Mus. Nat. History, Santa Ysabel, Cal., March, 12, 1890, col. by F. Stephens).

Description.—Smaller and lighter colored than *R. longicaudus*. Colors of upper parts tawny or buffy gray, much lighter than that of *Mus musculus*. Median dorsal area darker than sides and face, the latter being washed with ochraceous, that color becoming purer on cheeks and lateral lines of belly. Belly white, with light plumbeous cast from exposed bases of hairs. Small ventral spot and space between fore-legs, tinged with buff. Chin and throat white. Tail of same relative length as *longicaudus*, but much more finely haired and annulated, and more slender and distinctly bicolor as in corresponding parts of body. Ears relatively larger than in *longicaudus*, lighter colored and with a fulvous spot at their anterior bases. Feet pure white.

Measurements.—Total length, 137 ; tail, 73 ; hind foot, 16. Skull—total length, 19.2 ; basilar length, 14.6 ; zygomatic breadth, 10.2 ; length of nasals, 7.1 ; interorbital constriction, 3.

Only one specimen of this mouse was secured at San Bernardino. Mr. Herron reports them very rare while *longicauda* seems to be abundant near its type locality about San Francisco.

Two specimens, kindly sent me by Dr. Allen, from Santa Ysabel, are evidently the same species. They are more fully adult than the San Bernardino specimen, and, like other San Diego County skins, are blacker above. Their external and cranial characters confirm their identity with mine as contrasted with *longicaudus.* Owing to the more typical character of Dr. Allen's specimens, I have chosen one of them for the type in preference to my own. Duplicates of *pallidus* from the San Bernardino Valley southward, will most probably confirm its good specific characters. Its alliance to *megalotis* is certainly more remote than with *longicaudus.* Its possible identity with *montanus* is very doubtful on geographical grounds alone, the latter being probably, as Dr. Allen indicates, an eastern Rocky Mountain form of *humilis.* Dr. Allen's *aztecus* from New Mexico differs from it in larger size, relatively much shorter tail, less buffy color, and in cranial proportions.

In external measurements *pallidus* is much shorter and smaller-bodied than *longicaudus* and has smaller feet. In skull measurements it shows the same diminution in length with greater relative zygomatic breadth and a blunter, less attenuated rostrum. The relative length of mandible to height of coronoid process above angle in *pallidus* is in the same direction. The coronoid process in *pallidus* is sharply hooked, in *longicaudus* it is bluntly recurved.

These features are shown in the following table :

BODY MEASUREMENTS.

	longicaudus (4 adults)	*pallidus* (3 adults)
Total length	153.	138.
Length of tail vertebræ	80.	75.
" " hind foot	18.	16.
" " ear, from crown (from skin)	10.5	11.
SKULL MEASUREMENTS.		
Basilar length (of Hensel)	15.6	14.6
Greatest zygomatic breadth	9.8	10.2
Interorbital constriction	3.	3.
Length of nasals	7.8	7.1
Total length of skull	20.5	19.2
Length of mandible	12.	11.
Height of coronoid process from angle	5.1	5.

—SAMUEL N. RHOADS.

Zoological News. Reptilia.—Dr. Stejneger describes[4] as new *Xantusia henshawi* from San Diego Co., California. It may be distinguished from the other members of the genus by the possession of two interfrontonasals; one row of superciliaries; frontoparietals in contact; an interoccipital, and a vertical pupil.

Birds.—Robert Ridgway describes[5] *Odontophorus consobrinus* from Southern Mexico. It is much like *O. guttatus*, but is often darker and lacks any buff or tawny color in the crest.

Mammals.—J. A. Allen enumerates[6] fourteen species of Thomomys including four (*Th. monticolus, aureus, fossor,* and *toltecus* which are new.)

[4] Proc. Nat. Mus., XVI, p. 467, 1893.

[5] Proc. Nat. Mus., XVI, p. 469, 1893.

[6] Bull. Am. Mus. Nat. His., V, p. 47, 1893.

ARCHEOLOGY AND ETHNOLOGY.[1]

Ninth International Congress of Americanists.—Huelva, Spain, Oct. 7–11, 1892.—The Congress was held in the Cloisters of the Convent of La Rabida at Palos. These had been restored in the style as when Columbus resided there during the preparation for his first voyage to America.

It was opened by an address of Senor Canovas del Castillo, the Premier of Spain. He sketched the history of America, showing the Monks of Rabida and the inhabitants of Palos were strong supporters of Columbus in the organization of his expedition.

The Bishop of Badajos made a speech referring to the fraternity existing between Spain and America. This was enthusiastically responded to by Senor Palma of Peru.

A grand ball was given at night to the members of the Congress by the Municipality of Huelva.

In the evening the U. S. Warship Bennington arrived at the Port of Huelva, having in tow the two Spanish Caravels Nina and Pinta. which had been built at Barcelona under the supervision of Lieut, Wm. McC. Little, acting for Mr. Wm. S. Curtis, Chief of the Bureau of American Republics, and intended to traverse the Ocean and Great Lakes and be exhibited at Chicago in 1893.

At the session of the 8th, the representative of British Guiana asked of the Spanish Government permission to search the archives of Seville for ancient documents concerning the Discovery of America. Senor Canovas del Castillo responded heartily in the affirmative.

M. Lucien Adam of France and Senor Fabic of Spain, the President of the Congress, spoke as to the best methods of Studying the American question.

Dr. Benk, a delegate from Austria, proposed the publication of a general map of America; indeed his proposition was but a part of the general one for a map of the entire world. Dr. Benk explained his proposition, which was that this map should be upon the universal scale of 1 to 1 million, or about 16 statute miles to the inch. This would require he said, about 936 sheets, of which the land might be shown on 769 sheets. Each sheet of the map up to 60° North Latitude would embrace 5° in each direction. The more northern sheets would

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

embrace 10° of Longitude. It was proposed to give great attention to the physical and political characteristics and that the sea should be represented as well as the land. The rivers were to be in blue and the hills in brown. Contours to be drawn at elevations of 100, 300, 500 and 1200, and the areas enclosed therein to be tinted. The Meredian of Greenwich to be accepted for the entire map. All places in countries using the Latin alphabet to be preserved as officially spelled. Other alphabets and unwritten languages to be spelled phonetically or according to some system yet to be agreed upon. Professor Benk estimated the cost of an edition of a thousand copies which show only the land surface to be in round numbers, 1 million of dollars, and the 769 sheets, if sold at ½ dollar per sheet would produce less than 400,000 dollars, leaving the sum of 600,000 to be divided among the respective countries. The consensus of opinion was that this would be great desideratum; whether it could be accomplished or not, was in greater doubt. But Dr. Benk argued that it would be a long stride toward successful accomplishment if an international agreement could be made, by which a uniform scale could be adopted for the making of such a map. This international agreement, he says, could be agitated only before such Congresses, allowing the delegates upon their return to their respective countries to agitate the subject, and prepare either the Government or public opinion for a successful result.

There was further discussion and other papers read, some of which had no very close relations to America and very small right to appear before the Congress of Americanists.

The rest of the day was taken up by the banquet and preparation for the fetes.

The King and Queen Regent arrived on the 10th, and during that and next day the city of Huelva and the town of Palos and the Convent of La Rabida were given over to the fetes.

At the Paris Congress, objection was made to going to Huelva by Dr. Brinton, and the outcome verified the wisdom of the objection. It was a magnificent Naval Review—40 warships of various Nations—display of bunting—firing of guns—shouting, cheering, banqueting, and fetes in grand style; but as a scientific or historic Congress, it made but slight progress.

The Queen gave a reception at the Hotel Colon at which about 1,000 guests attended. The Column erected at La Rabida by the Government, at an expense of about 450,000 pesatas (francs) in commemoration of Columbus was inaugurated. These were attended by everybody. The locality was, of course, in gala dress. Guns, flags, music, with the bright dresses of the women and clergy, the gay uniforms of the Civil, Military and Naval Authorities and Officers, with the decorations of the pavilion and throne-room in crimson velvet and magnificent tapestries, of which the Spanish government possesses so many specimens, conspired to make a brilliant and imposing scene.

The Secretary, Senor Juan Zaragossa, was most effective in sécuring subscribers to the Congress of whom he had over 2,000, though only about 200 were in attendance, and but few of these were constant at the meetings or gave attention to its business. As a fete, it was a grand success; as a congress, its benefits were few.

The Exposicion Historico-Americano.—Madrid, Spain, 1892. —The Exposition was held in a permanent building, one which was new—just completed, and is intended as the home of the National Library, the Archeological Museum, and the Galleries of Sculpture and Modern Painting. It occupies the entire square between the Paseo de Recoletos and the Calle de Serrano for two opposite sides, and upon the other, the Calles Villa Neuva and Jorge Juan. The cornerstone of this building was laid in 1866, under the reign of Isabella II, and the building was intended for the Department of the Interior. Work progressed upon it until the foundations were laid and brought to the level of the ground, when the Revolution by which Queen Isabella was dethroned, brought it to a standstill. It thus remained until 1884, when the project was again brought forward and the celebrated architect, Antonio Ruiz del Salces, presented new plans for the building as a Library and Museum.

On the 19th of January, 1887, the contract for the completion of the building was entered into with Don Juan Cruneda at the price of 10,000,000 pesatas. (A pesata is the Spanish unit coin and equal to a franc French or 20 cents American money.) Two architects were chosen, the one to represent the government, the other to represent the contractor, and they were made, jointly, superintendents of the building. Under their joint direction, the contractor performed his work. The sequel proves the wisdom of this arrangement, for the building is erected in a satisfactory manner and apparently without dispute or disagreement. It is the custom among the English and American visitors in Spain to point, with a certain degree of reproach, to the Spanish character as carrying its love of ease and good nature to such an extent as to sap their energy; and to call them in derision, the "Mañana people," because it is said they propose never to do to-day what they can put off till to-morrow. But the erection of this palace, running over a period of time since

1866, costing two million dollars, has been completed so that the contractor was able to deliver it over, a finished building, and move out of it with all his forces within less than two months from the date originally fixed by the contract. The building is in the form of a rectangle. On the longest sides, that is facing east and west (the Paseo de Recoletos and the Calle de Serrano), the building is 446 feet long. On the other sides it is 410 feet long. The principal façade and entrance is on the Paseo de Recoletos, the secondary one on the Calle de Serrano. The building is three stories—a basement and a first and second story. The basement is built of granite, the first and second stories of marble and brick. The projections in the centre and at the corners are made to break the sameness of the long stretch of smooth wall—these projections are of Spanish marble, not clear white, but grey, streaked with yellow, and slightly ornamented with engaged columns or buttresses. The style of the building is of Greek architecture, though of no definite or particular style. The windows are square without caps or other ornamentation and without stile or mullion. They are about 25 feet high and 7 feet wide, and are filled with clear plate glass allowing the utmost amount of light to pass through. The cornice is of the Greek style; the moulding is quite heavy, though in good proportion, and projects above the flat roof which it hides entirely. The building covers a superfice of 16,850 meters. There is slight decoration upon the outside of the building except at the two entrances mentioned. Owing to the lay of the land, the entrance to the principal story is much higher on the Paseo de Recoletos than upon the Calle de Serrano. This fact has been used to advantage in making the former the principal entrance with higher and broader steps, more doors and entrances, greater amount of ornament and decoration, and altogether more imposing in appearance. The approach is by three flights of steps extending the whole width of the façade, with a broad terrace between each one which is utilized by placing pedestals and statuary opposite the pillars or columns between the doors of entrance. Some of these statues are seated and some are standing. Those seated are San Isadore and Alfonso the Wise; those standing are Luis Vives, Lopez de Vega, Nobrija and Cervantes. In various places on the façades and vestibules, are placed medallions representing many of the great men of Spain. On the façade of the Calle de Serrano, the pedestal upon each side of the entering stairway is occupied by immense griffins 20 feet long and 10 feet high, with human heads and breasts, and lion and eagle claws. Outside of these on the pedestals against engaged columns, are respectively the statues of Berreguette and Velasquez. The palace is a magnificent building, plain, simple, in good style and good taste, solid, impressive, not over-decorated, and excellently arranged for its purpose. There are at present, housed and under its roof, three Expositions, one in each story, distinct from each other, and organized by different authorities. That in the basement is entirely Spanish, belongs to the War and Navy Department, and consists of objects furnished by these two departments. On the first or principal story, is the International Exposition Historico-Americano, in which all objects are supposed to have relations to America and belonging to a period prior to 1700. Senor Navarro-Reverter is Delegate-General. The second story contains the Exposition Historico-European. Its objects relate entirely to Europe, but principally to Spain, and have a greater or less antiquity. Padre Fita is Delegate-General. He is a Jesuit Father, a very learned man, an ardent and wise Archeologist, and of unblemished character. His good qualities were such as that when his appeal was made to the church authorities throughout Spain for the loan of their treasures, assuring them of their safety and return, he received such offers of valuable objects as to enable him to fill his entire space with the richest and most interesting.

Let us enter this building. The basement is 20 feet to the ceiling and it has 22 rooms. The first story is 27 feet to the ceiling and has 46 rooms. The second story is 30 feet to the ceiling and has 49 rooms. The principal display rooms or halls form the outside of the rectangle. On the side toward the Calle de Serrano, these halls are 45 feet wide. On the other sides of the rectangle they are but 35 feet wide. The centre of the rectangle is devoted principally to the Library. The Reading Room is in the center, is a most excellent arrangement, and is magnificently decorated. The Standards and Coats of Arms of Spain, of all the Provinces and the principal Cities are here displayed by frescoes upon the walls. Medallions of great scientists, historians, literati, form a part of the decoration. It is 95 feet square, without obstruction to the roof, from which it is lighted by sky-light. The books are to be arranged in stacks running out from this central room like the spokes of a wheel. As we enter the building from the Calle de Serrano, to visit the Exposition Americano in the principal story, a turn to the left takes us into the section occupied by the United States, 6 rooms in all. We can pass from one hall to the other half round the rectangle, and out upon the opposite side, or continue clear around to the place of entrance. The halls containing the displays of the various countries follow in this order:—Nicaragua, Guatemala and Dominican

Republic, Equador, Uruguay, Peru, Argentine Republic, the Museums of Madrid, Costa Rica, Denmark, and the Antilles, which takes us to the opposite entrance, crossing which, we begin again—Portugal, Spain, Germany, Sweden and Norway, U. S. of Colombia, Mexico—the latter occupying the same relative position upon the opposite side of the entrance from Calle de Serrano as does the United States, and occupies about the same space. The Archeological Museum of Madrid occupies interior rooms. The arrangements for light in all these rooms is admirable. There are many windows, they are on both sides of the halls, the inner ones opening upon the interior courts. These courts are without galleries or ceilings, are open to the sky and covered with glass at the same height as the roof, thus affording nearly the same opportunity for light as is given from the outside.

The total number of objects comprising the display of the United States, was as follows:—

Department of Prehistoric Anthropology	5,000
Department of Ethnology	2,200
Philadelphia Exhibit, and Coins, Medals and Money from Bureau of Engraving and Printing, Mint, and U. S. National Museum	4,000
Hemenway Expedition	3,500
Iconographia Columbina	310
	15,310

Not Catalogued—estimated—

Books	1,000	
Photographs	1,500	
Lithographs	500	
Wing Frames	600	
Maps, Pictures	300	
Agricultural Department	100	
Indian Schools	300	
Animals	50	4,350
Total objects,		19,660

Considered as 20,000 objects.

(*To be continued.*)

SCIENTIFIC NEWS.

Contrary to the experience of most summer laboratories this season, the Marine Biological Laboratory at Woods Holl is filled to overflowing. Over 100 students are in attendance, this number being the greatest in the history of the institution. Those in charge report a very gratifying improvement in the ability of those attending.

Dr. H. Kelly Corning, formerly at Prag, is now to be addressed at the Anatomischer Anstalt in Basel.

Friedrich Ziegler, Freiburg i. B., has just published a new catalogue of his wax models illustrating embryological subjects. These models are real works of art, and are most valuable aids in instruction. More or less complete exhibits of them may be seen in Harvard, Johns Hopkins, Bryn Mawr, Michigan University, Chicago University, Clarke University, Cornell, Wisconsin University, Oberlin, Wellesley, Minnesota University, Boston Society of Natural History, Columbia College, Rochester University, University of Illinois, and Northwestern University. The whole collection, as far as ready for the market, includes 279 models, which are furnished for $602.84.

Dr. H. B. Ward, formerly instructor in Zoology in Michigan University, has been appointed Associate Professor of Zoology in the University of Nebraska. After Sept. 15, his address is Lincoln, Nebr. With his appointment Professor E. A. Barbour is relieved of the instruction in Zoology, and will have only that in Geology.

Dr. Zander has been appointed extraordinary professor of Anatomy in the University of Königsberg.

Mr. Edward J. Bles, formerly Fellow at Owens College, Manchester, is now Director of the Biological Station, at Plymouth, England.

Dr. Hermann von Ihering is now the Director of the Zoological Division of the Museum at Sao Paulo, Brazil.

Dr. Adelbert Seitz has been appointed Director of the Zoological Garden at Frankfurt a. M.

Henry Viallanes, Director of the Zoological Station at Arcachon, France, died the last of May, 1893, aged 36 years. He was one of the most promising of the younger French zoologists, and had made the structure of the Arthropod nervous system a subject peculiarly his own.

J. F. M. Bigot, possibly the best known student of the Diptera, died in Paris, April 14, 1893, in his 75th year.

The death of Professor Carl Semper, on May 29, was not unexpected. For some time he had been suffering in health, and lately had done no teaching in the University of Würzburg. He is best known for his prolonged researches in the Philippine Islands, the scientific results of which have formed a splendid monument to his name. He visited the United States in 1876, and gave a course of lectures before the Lowell Institute in Boston, which later were issued in that most suggestive volume, "Animal Life as Effected by External Conditions."

Dr. Eugen Korschelt, formerly of Berlin, has been appointed Professor of Zoology in the University of Marburg.

The attempt to reduce the rate of postage upon natural history specimens sent through the mails of the postal union has failed. Such specimens can only be sent at regular letter rates (5 cents for each half ounce) except to Canada and Mexico, where the rate for such specimens is a cent an ounce. Dried animals, including insects, are excluded entirely from the mails.

Mr. James Wood-Mason died at sea on the voyage from Calcutta to London, May 6, 1893. He was born in Gloucestershire in 1846; was later connected with the Indian Museum, and at the time of his death was Professor of Comparative Anatomy in the Medical College of Bengal. He was best known for his work upon the Morphology of Arthropods, his systematic work on the Crustacea of India and his explorations of the deep waters of the Gulf of Bengal with the dredge.

The Chicago Exposition is furnishing the best opportunity for studying the external characteristics of human races that has ever been presented to Americans. There are colonies of Dahomeyans, Samoans, Egyptians, Javanese, Japanese, Esquimaux, North American Indians, Hindoos, Turks, etc. Every person interested in Ethnology should visit the Exposition.

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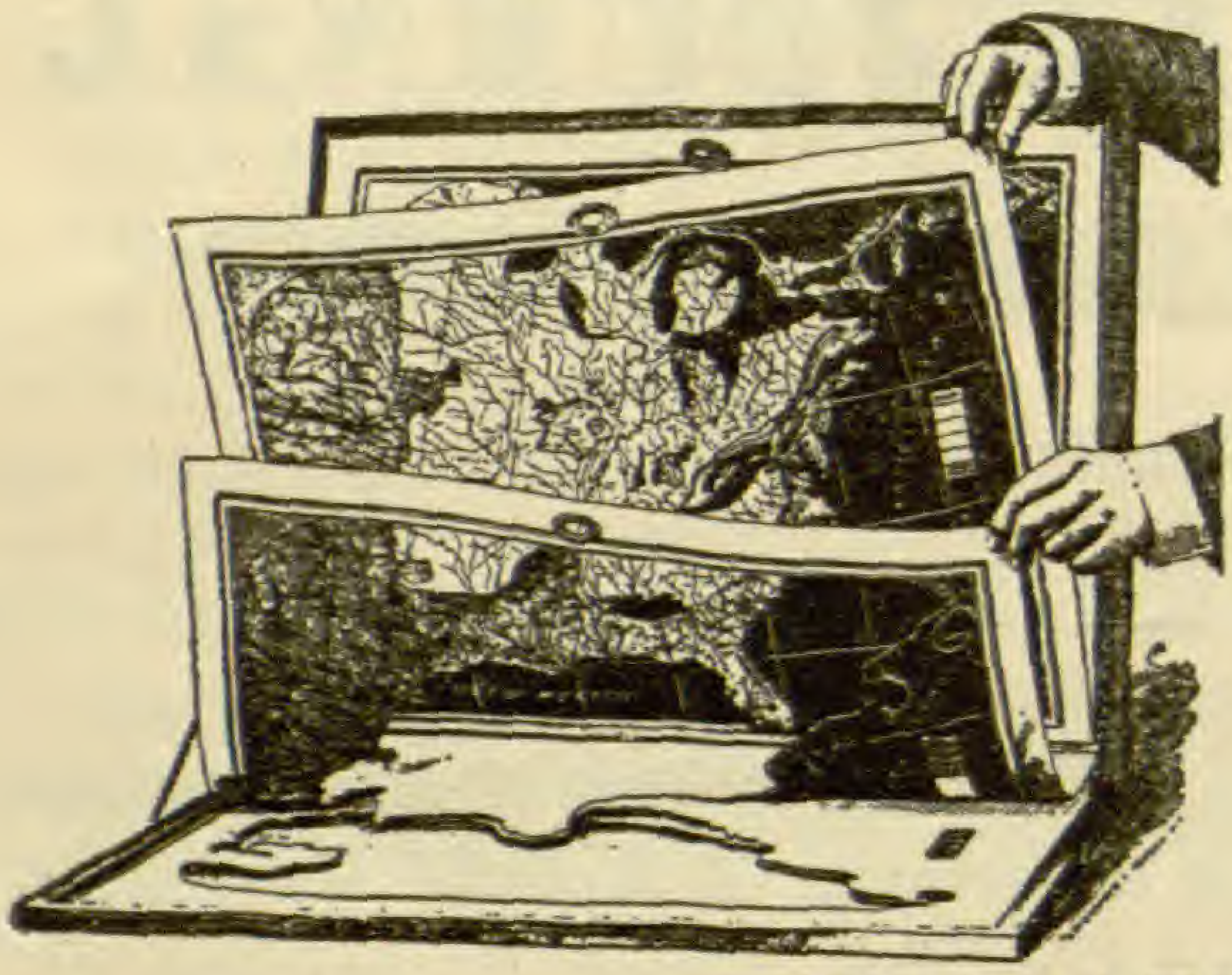

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BACTERIOLOGY IN ITS GENERAL RELATIONS.[1]

By H. L. RUSSELL.

Bacteriology, although the youngest member of the biological sisterhood, has developed so rapidly within the past two decades, that to-day it may fairly claim for itself an independent basis. Independent, however, not in sense of isolation from other branches of scientific thought, but as occupying a field that is more or less distinct in itself. The scope of this subject has already widened to such an extent, and the literature grown to be so voluminous, that it is fairly entitled to be ranked as a separate branch of biology. This necessity is also emphasized by the difference in technique, that separates it more or less distinctly from other departments of research.

It was not until the middle of the present century that the affinities of the bacteria were even approximately determined. Zoologists first claimed this class of organisms as belonging to the animal kingdom, but gradually, as bacterial forms became better known, and more fully studied, their plant-like similarities were detemined. Botanists, for many years contributed but little toward a more perfect knowledge of this class, and it is the science of medicine that bacteriology must ever regard as its foster parent. The establishment of the causal relation between these minute forms of organic life and disease, at once invested them with increased importance and made them sub-

[1]Delivered before the Biological Club of the University of Chicago, Feb'y, 1893.

jects of paramount interest to the student of medicine. Although the main interest that bacteriology calls forth is still in its relation to medicine, broadly considered, it has proved itself so valuable an adjunct in widely different fields, that as a science, it can no longer be subordinated to any particular subject. To-day, it may fairly be said to exert a powerful influence on a number of widely separated departments of a scientific as well as of applied nature and investigations from a bacteriological standpoint have thrown much light upon many obscure problems in these different branches.

The purpose of this paper is to indicate in a general way the extent of the influence that this science is exerting on other lines of work as measured by some of the results that have been recently obtained. This can be done only in barest outline, if we would compass the entire range of its activities within the limits of a single paper. A rapid review, will however, give us a fuller comprehension of the relation that the subject as a whole bears to other departments of thought. The influence of scientific study is of a reciprocal nature, and the impetus that one branch receives from the discovery of a general principle, manifests itself to a greater or lesser degree in all related lines of study. The relation which exists between this subject in general, and medicine and hygiene must always be most intimate, for it is along these lines that the greatest advance in bacteriology has been made. It is therefore meet that in the consideration of this subject, we should first emphasize the effect that it has produced in the field of medicine, but as this is the phase that is usually presented, allusion to it here will be made only in very general terms.

Perhaps it is not too much to say, that no theory in pathology has been more fruitful of practical results than the germ theory of disease. Not only has it established the etiology of contagious maladies upon a rational and scientific basis, but it has formulated well defined principles of treatment that are now successfully employed, particularly in the departments of surgery and hygiene. What was once blindly accepted as a "visitation of Providence," from which there was no escape, is now known to be due to the action of these minute forms of organic life. To-day we consider them in the light of science rather than the gloom of superstition, and the terror of devastating pestilence is largely diminished when its cause is unmasked.

Perhaps on the whole the greatest benefit that bacteriology has conferred upon the "healing art" lies in the fulfilment of the old adage "that an ounce of prevention is worth a pound of cure." It has shown its value mainly in *preventing* rather than in *curing* disease, so that prophylaxis has gained far more than therapeutics. A more intimate knowledge of the conditions aiding or retarding the development of bacteria has resulted in improved methods of sanitation, by which the physician is able to circumscribe and control an outbreak of contagious disease.

Our knowledge of all the conditions of bacterial development is as yet comparatively limited, but the application of the principles that have already been established, has aided materially in checking the progress of these types of disease. Among these, the cholera epidemic of last year is a notable example. Starting from its native home on the Ganges, where it is endemic, it travelled step by step, following the lines of commerce. Entering Europe by way of Russia, where amid its squalid and famished millions, existed the most favorable conditions for its propagation, it was further spread by exiled Jews, who carried the contagion to many of the commercial marts of western Europe. The history of past epidemics demonstrates that its march westward has been almost always unobstructed, and had we been living in the light of two decades ago, it would probably have ravaged the denser portions of the west, as it has done in the past, and as it does in the east to-day. We may not be able to stamp out the scourge at once, but it cannot be denied that the restrictive methods of the German Government last season, checked the spread of the epidemic in that country, and our efficient quarantine regulations prevented its gaining a foothold in our metropolis. We may not know all there is to be known concerning the character of the contagion, but what we have already learned, points to a more successful method of action in repressing it than any we have heretofore possessed.

Prophylaxis, or preventive treatment, may be carried on in two ways. We may prevent disease, either by destroying the cause of the infection, or by rendering our bodies refractory to the attack of the disease germ. The first is accomplished by disinfection, the latter by preventive inoculation. What Jenner did with small-pox is an entirely empirical manner, modern bacteriology has effected in the light of established principle. The brilliant researches of Pasteur and his pupils along these lines, not only in the case of human infection as in hydrophobia, the mortality of which at the Pasteur Institute at Paris has now fallen to less than one-half of one per cent., but also certain animal diseases like splenic fever in sheep and cattle, erysipelas in swine and cholera in fowls, are practical testimonials of the advance that modern bacteriology has to offer in the direction of prophylactic treatment. The Berlin school, while it has not as yet succeeded in applying its methods in so widespread and practical a way, has placed the question of acquired immunity upon a firmer scientific basis. The discoveries of Fränkel, Brieger, Kitasato, Behring, and Ehrlich are all of supreme importance from an experimental standpoint. These observers have been able to immunize various animals by artificial means against such diseases as tetanus, diphtheria, pneumonia and erysipelas of swine. Not only have they endowed the animal body with such properties that it can successfully antagonize either the germ or its toxic product, but in some cases, have actually restored the animal to its normal healthy condition after the disease had been established.

How far these results can be utilized in combating disease in the human system is not yet definitely known. In the consideration of the probable value of these results to therapeutics, we need to be conservative in our conclusions, for the conditions are widely different between an experimental disease in animals and its natural course in man. From the present outlook, it seems that any permanent advance along this line will be based upon successful efforts in securing artificial immunity. The conditions must first be worked out experimentally upon the lower animals, and it will require patient and extended research before they can be applied to human ills. The most pronounced results so far in this connection, are accomplished by the *blood serum therapeutic methods,* as demonstrated by Behring and Emmerich. This theory rests upon the conception that in an animal artificially immuned, a certain change has taken place in the blood serum by which it has become endowed with antibacterial, as well as with antitoxic properties; also that the serum of an animal thus protected possesses in itself a positive therapeutic value. Kitasato, two years ago, succeeded in rendering mice so refractory toward the poison of the tetanus bacillus, that they were able to withstand an injection of three hundred times the ordinary fatal dose. The serum of these immuned animals when injected into susceptible controls, that had been infected with virulent tetanus cultures was able to arrest the progress of the disease even after the characteristic symptoms of tetanus had been manifested throughout the body. Not only has this course been applied to experimental tetanus in mice, but rabbits, dogs, horses and sheep, all of which are susceptible to the disease, have been rendered refractory by these artifical methods.

This plan of treatment has recently been used in tetanus in man. The curative substance was secured from the serum of artificially immuned rabbits and dogs, and there are already on record over a dozen cases of human tetanus that have been successfully treated by this method of inoculation. Some of the cases were so far advanced that paralysis had already set in, yet the injected material was able to neutralize the toxicity of the poison, and inhibit its further production. The application of this method to other diseases analogous in character promises favorable results, and the problem to-day in this connection, lies not so much in further proof of the theory, as it does in the ability to artificially immunize animals of adequate size to procure the serum in sufficient quantities to be utilized in actual practice. Behring has succeeded with diphtheria in conferring immunity upon rabbits and guinea pigs and has found that their serum is likewise able to check the experimental disease in infected controls. Subsequently he accomplished the same result in animals of the size of sheep, rendering them resistent to the infection, so that the serum in adequate quantities can be secured for use in the treatment of the human disease.

Medical science awaits with intense interest the next step, and it is possible that in the near future "the red demon of the nursery" will be brought under control.

Turning from the beneficent results which have been secured to medicine, to other lines of activity, the results of bacteriological research are equally efficient. Chief among these are some results obtained in reference to agriculture. In its relation to medicine, bacteriology deals mainly with those forms that have adapted themselves to a wholly, or semi-parasitic mode of existence. These however represent but a minor fraction of the whole number of species that have been isolated. In agriculture, saprophytic, as well as parasitic species enter into consideration, and here parasitism is not confined to the animal body as a host, but is to be observed in plant tissue as well. To the agriculturist then, bacteria come in a dual guise. They are both a friend and a foe. Some species are to him a direct benefactor, some render him aid in a more indirect manner, while others are a positive detriment to the success of his calling. How to increase the activity of the friendly forms, and diminish the ravages of the noxious ones, is the constant study of the agricultural bacteriologist.

The field, which for convenience we here classify as agricultural bacteriology, is made up of so many widely separated subjects, that the detailed methods in one class, cannot be successfully utilized in the examination of another. For example, the attempt to isolate the organism of nitrification which baffled investigators for so long a time, was fruitless mainly because they relied almost entirely upon the gelatine method of Koch. Each special subject must be studied by itself and the technique developed for the method of work in establishing the etiology of a bacterial plant, disease differs widely from that which must be used in studying the processes of nitrification or the fixation of the free nitrogen of the atmosphere. In reviewing the progress of agricultural bacteriology, we can only allude to the lines of work which have been opened up in this fertile field of research. It may be confidently asserted that as yet, we stand on the threshold of discovery in this department, and the work can scarcely be said to be more than inaugurated. What the possibilities of the future are, no man can safely predict.

Study in veterinary pathology has gone hand in hand with that of human disease, and the etiology of numerous contagious diseases in domestic animals have been thoroughly investigated. Actinomycosis in cattle, glanders in horses, and splenic fever in sheep besides numerous other septicemic diseases, like hog-cholera, swine plague, chicken cholera, *rouget* or swine erysipelas are classic examples in our textbooks. A fuller knowledge of the history and etiology of this class of diseases, has not only better enabled the farmer to check their spread, both by remedial and prophylactic treatment, but it has awakened an economic interest that is steadily progressing along practical lines.

Besides these parasites, confined to animal organisms, the husbandman has to contend with a series of forms, which only find their normal hosts in vegetable tissue. The farmer and horticulturist need to be always on the alert to protect their harvests from the ravages of these enemies. Insects and fungi are an ever present menace to success, but not a small number of plant maladies are to be traced directly to a bacterial source. Such destructive diseases as the apple and pear blight, the tuberculosis of the olive, the "yellows" of the hyacinth, as well the blight of oats, sorghum, Indian corn, and other cereals are often due to an invasion of germs of a bacterial nature. The conditions by which these diseases are propagated and spread are such, that some of them can be eradicated, now that we know how the infection is transmitted. To illustrate, the pear or fire blight, which has been observed in this country for a hundred years, and which in some sections has become so destructive as to practically ruin the industry, can now be managed with comparative ease. Through the researches of Waite, it has been ascertained that the infection is transmitted by insects in their visits to the flower for nectar. The germs thus carried from an infected to a healthy tree are deposited on the nectary as the insect garners the honeyed store. A lodgment effected, the germ finds a rich nutrient medium and it multiplies profusely, penetrating finally the exposed cells of the nectary, which are destitute of a cuticle. With an entrance once established, the contagion spreads from blossom to twig, from twig to branch, until at last the whole tree structure becomes involved, and falls a prey to the disease. Since we have learned that the blackened leaves and branches contain the virus, it becomes only a matter of watchfulness and care on the part of the husbandman to check and ultimately stamp out the malady by the excision and burning of the diseased tissue.

Another problem of vast importance not only to agriculturists, but to sanitarians, is the subject of nitrification, or the conversion of nitrogen bearing substances into nitrates and nitrites. It has been an established fact, known for years, that under certain conditions, there was an increase in the nitrous and nitric salts in the soil, but just how this was brought about, was for a long time an unsolved problem. Chemists had explained the phenomenon on a purely chemical basis, and it was believed that the nitrogen of the air was oxidized, either by the action of ozone or oxygen. Pasteur as a result of his studies on fermentation was the first to suggest that the production of nitric acid in the soil might be due to organized ferments. This idea was taken up by Schloesing and Müntz fifteen years ago, and the working out of the present accepted biological theory of nitrification is largely due to the untiring labors of these eminent French investigators, as they laid the basis for the more brilliant and successful results of Winogradsky and Warington.

Interesting as is the story, time will not permit entering upon the detailed steps by which the germ theory was finally proven. For a number of years after it had been shown that organized ferments played the chief rôle, no advance was made in the isolation of the organism as the different investigators failed to produce any nitrification with the germs they had separated from the soil. Warington states, that over a hundred different species of bacteria had each been carefully tested as to their ability to nitrify ammoniacal solutions and that with every one a negative result was reached. It is less than three years ago that the efforts of bacteriologists to obtain the specific cause of the process were crowned with success. Frankland isolated the germ by dilution, and at the same time Winogradsky succeeded in separating it by another process. The unique feature of this germ was that they could not make it grow upon gelatine. This peculiar individuality explained the failure of previous investigators who had confined their methods to gelatine media. Experiments demonstrated that this germ was only able to oxidize ammonia into *nitrous* acid. Important as was this discovery, it was only one step in the process. The conversion of nitrous acid and its salts into the more stable nitrates, eluded their best efforts.

Winogradsky at last succeeded in isolating the organism from mixed cultures by the use of gelatinous silica mixed with inorganic salts.

In this way the various steps of the process were clearly demonstrated and the biological theory of nitrification was established upon a firm and scientific basis. This theory claims that the nitrification of ammonia in the soil takes place in two successive stages, the change in each case being produced by distinct and separate organisms. In the first stage ammonia is oxidized into nitrous acid and then this is acted upon by another (a second) organism and is converted into a nitrate. Ordinarily, as observed in nature, the two processes occur simultaneously so that the ammonia passes in continuous combination from its simpler form into its ultimate stage as nitric acid, or some of its salts. The economic value of this discovery cannot be estimated. It is not only a complete and satisfactory scientific solution of a complex process, but is of invaluable aid to the agriculturist in demonstrating to him the source of the most essential element in soil restoration and in teaching him how he can best conserve and utilize this expensive product.

It has also an important bearing upon certain phases of hygiene for the success of the intermittent filtration of water through the soil seems to be based upon the nitrifying action which takes place within the filter. Filtration has been in use a long time as a means of water purification and the theory that bases its efficiency in the mechanical or chemical separation from its impurities has long been the accepted one.

Many of the observed facts did not seem however to accord with this explanation, and when it was found that certain protoplasmic poisons like chloroform injuriously affected the efficiency of filters, the relation between it and living organisms was suspected. This led to a careful study of the question from a bacteriological standpoint, and the discovery was soon made that there was a direct relation between the process of nitrification as it went on in the filter and its effectual operation.

The solution of another interesting subject, that of the fixation of the free nitrogen of the air by certain plants, also bids fair to be solved by bacteriological methods. Agriculturists long ago recognized the fact that certain species of plants belonging to Leguminosæ, such as clover, alfalfa, etc., possessed special properties in enriching the soil; that not only could these crops dispense with the application of fertilizers, but that they possessed the elements by which impoverished soils might be restored to their original fertility quicker and cheaper than by any other method. This knowledge, the fruitage of observation and experience awakened an interest in the causal relations between the one and the other, productive of many interesting and ingenious hypotheses. Liebig concluded that as clover could be grown upon the same ground for years without the addition of fertilizers, that it must absorb nitrogen direct from the air through its aerial organs, and then transfer this store to the roots, and so enrich the soil. Carefully conducted experiments have failed however to reveal any direct absorption by the leaves and stems of plants. This peculiar property, limited so far as we at present know, to the Leguminosæ was finally correlated with the presence of small excrescences or tuberculous swellings on the roots of these plants. These are found in great profusion on the young rootlets of this class of plants, and seem to be universally absent in all other genera.[2]

For a long time they were regarded as pathological structures, and it was only when it was found that legumes grown in *sterilized soil* were poorly nourished and entirely devoid of tubercles, that the causal relation of these structures with the peculiar property of the plant was recognized. These observations were followed by more systematic experiments by Hellriegel and Wilfarth, who discovered that the production of the tubercle depended upon the germ contents of the soil. Beyerinck, Prasmowski and others succeeded in isolating the germ which possessed the ability to penetrate the young root hairs and the cortical parenchyma of succulent roots. These bacteria set up an irritation in the plant tissue that causes the formation of a meristem, and thus the tubercles are produced as lateral outgrowths from the root.

The tubercle is filled with peculiar shaped bacteria, which possess the ability in some way not yet perfectly understood, of fixing the nitrogen of the air in such a condition that it can be utilized by the plant. Our knowledge concerning the details of the process is far from complete, but this rational explanation of the phenomena has opened the way for further research. The problem that at present awaits solution is to find whether there is any difference between the organisms infecting one variety and those that are symbiotic in another.

The artificial selection and cultivation of these forms that have the greatest ability as " nitrogen collectors " is a question of prime importance. Like that of nitrification it involves great economic interests, inasmuch as it is the key to the solution of the important question of the restoration of impoverished soils.

It would be treating our subject in a very imperfect manner were we to close our résumé of the influence that bacteriology

[2] Recent experiments (Landw. Vers. Stat. XLI, 138) seem to indicate that the tubercles on the roots of *Elæagnus angustifolia*, a member of the Elæagnaceæ, a close relative to the Leguminosæ are developed by bacteria. Infection by means of soil washings of sterilized soil planted with these seedlings gave more luxuriant growth than controls in sterilized soil. The organism has been isolated in pure culture and is found to differ from *Bacillus radicicola*, the form so common in the legumes.

has exerted upon argricultural pursuits without stating the position of it with reference to dairying.

Milk, like every other organic substance, is subject to certain changes, and these conditions are now known to be directly traceable to the influence of micro-organisms. These so-called "diseases" of milk are mainly fermentative in their character and modern bacteriology has shown the dairyman that they can be entirely prevented if he handles his product in a rational way. Milk, as it comes from the cow, is entirely devoid of germ life, but its high degree of temperature when freshly drawn and the exceedingly nutritious food medium that is offered, afford the optimum of conditions for the development of any bacteria that find their way into the fluid. The ubiquity of distribution of fermentative organisms render it impossible to entirely avoid their action, but the losses of the milk-dealer can be greatly diminished if cleanliness is scrupulously observed.

While the milkman wishes to avoid bacteria as far as possible, the buttermaker should welcome them as his friend. Many forms are, of course, undesirable, but from the recent investigations in this field there is no question but that the bacterial content of butter largely influences its keeping qualities as well as the peculiar flavor for which such fancy prices are paid. The process of "ripening" or "souring" cream that is practiced by every butter maker is a natural bacterial fermentation. Better and more butter is obtained from ripened than from "sweet" cream. If this is so, the question naturally arises, Why can we not isolate the forms that are capable of prorucing these changes and add them directly to the cream rather than to trust to their spontaneous development? The researches of Hansen in the realm of pure yeast ferments have revolutionized the brewing industry within the last five years, and the introduction of pure cultures of yeast for fermentative purposes has made a better, and what is still more important, a more uniform product. Now the same field seems to be opening in the process of butter-making. Danish and German creameries are now being supplied with pure bacterial cultures that are early added to the cream in order to produce as a result of the fermentative changes the desired flavor.

In this way uniformity of product is assured, and as many undesirable forms are choked out by the introduction and control of pure cultures, the keeping qualities of the butter are much improved.

The utility of bacteria in connection with milk and its products may still be further extended, for the necessity of their presence in cheese making is even more imperative than in butter making. Here they are an indispensable requisite to the production of a palatable product. New cheese is flat and insipid, and it requires a certain period of time in which it undergoes a change that is called the ripening or maturing stage before it is fit for use. Duclaux and others have shown that the production of the delicate flavors are due to the transformation of the casein into soluble albuminoids by means of the ferments that are produced as a result of bacterial growth. This ripening process is then due to the action of specific germs. The various kinds of cheeses that possess such a variety of flavors are, no doubt, due to the action of different forms of bacteria, but the threshold of this work is scarcely more than crossed, and, as one of the leading experts in this country has said, further advance in perfecting the processes of cheese manufacture is impossible, unless they include the aid of bacteriology.

(*To be continued.*)

A CASE OF LATEROVERSION OF THE OPHIDIAN HEART.

By Pierre A. Fish.

The specimen had already been partially dissected by one of the laboratory students in the Anatomical Department (Cornell) before attention was called to the peculiar cardiac arrangement.

The body had been divested of its skin until within six centimeters of the vent and seven centimeters of the tip of the mandible; the cranium had been removed, leaving the mandible still attached to the body; the heart had been exposed and the ventral portion of the pericardial sac, if any had existed, was gone. A normal specimen was put into the hands of the student for further dissection and the anomalous one has awaited careful examination since 1891.

Enough characters remained to enable one to identify it with a reasonable amount of certainty as *Ophibolus doliatus* var. *triangulus* or as commonly known, the spotted adder or milk snake.

Its total length was 85 centimeters (2 feet 10 inches); from the tip of the mandible to the apex of the heart the distance was 11 centimeters, the heart itself from the apex of the ventricle to the base of the right auricle being 1·8 centimeters.

The interior of the pericardium (already exposed) presented a somewhat cone-shaped cavity through the length of which, and a little to the right of the mid-line, the pulmonary and post caval veins passed. These did not lie freely in the sac but were held in place by a narrow, but distinct fold projecting from the dorsal wall of the pericardium.

A considerable depression for the reception of the ventricle was formed just cephalad of the auricles by a sinistral deflection of the trachea and œsophagus; the trachea also showed signs of compression on the side adjacent to the heart. No trace of a true pericardium was apparent here, but there seemed to be a somewhat excessive development of connective tissue.

Aside from the very peculiar position of the ventricle, one of the most striking features was the unusual engorgement of the vessels of the left side with blood, in the immediate proximity of the heart. The left auricle also presented this feature while the right was comparatively empty.

A superficial examination of the conditions seemed to show that there had been a complete ante-version of the whole heart, the ventral surface becoming dorsal and the dorsal ventral. On carefully removing the dense connective tissue covering the surface of the ventricle, this conclusion was shown to be erroneous from the fact that the aortic arches were found to arise from this apparent, and at the same time real ventral aspect. This as well as some theoretical reasons would demonstrate quite effectively that true ante-version could not have occurred.

What appears to be the most logical inference, and dissection seems to confirm it, is that rotation must have taken place, the fixed point being at about the place of divergence of the two aortic arches; and since the apex of the ventricle points in a diametrically opposite direction to that found in the normal condition, it must therefore have passed from right to left and through an arc of 180°—provided the heart was ever normal. The apparent left side of the ventricle would then be the true morphological right side and *vice versa.*

The auricles would naturally tend to follow the ventricle in this rotation, but there is no very marked displacement of their relations to each other. This does not hold true with regard to the ventricle in its new location, for the apparent right, but really the morphologically left side is in a line with the right auricle and the morphological right side is in a line with the left auricle.

An effectual restraint would be offered against this migratory tendency of the auricles, in the case of the right auricle by the pulmonary vein which would prevent its passing the mid-line. And similarly for the left auricle by the left aortic arch, which would prevent any movement of the auricle in a cephalic direction. The usual disproportion of size between the two auricles is not evident, though this may be accounted for by the collapsed condition of the right as compared with the left side. The ventricle if it has rotated must have passed along the ventral aspect of the left auricle.

After a careful and completer dissection of the heart and the vessels adjacent to it so that the parts could be more easily manipulated, it was found that the ventricle could be returned to an approximately normal position which assisted quite materially in elucidating the relationship of the vessels to the heart and to each other.

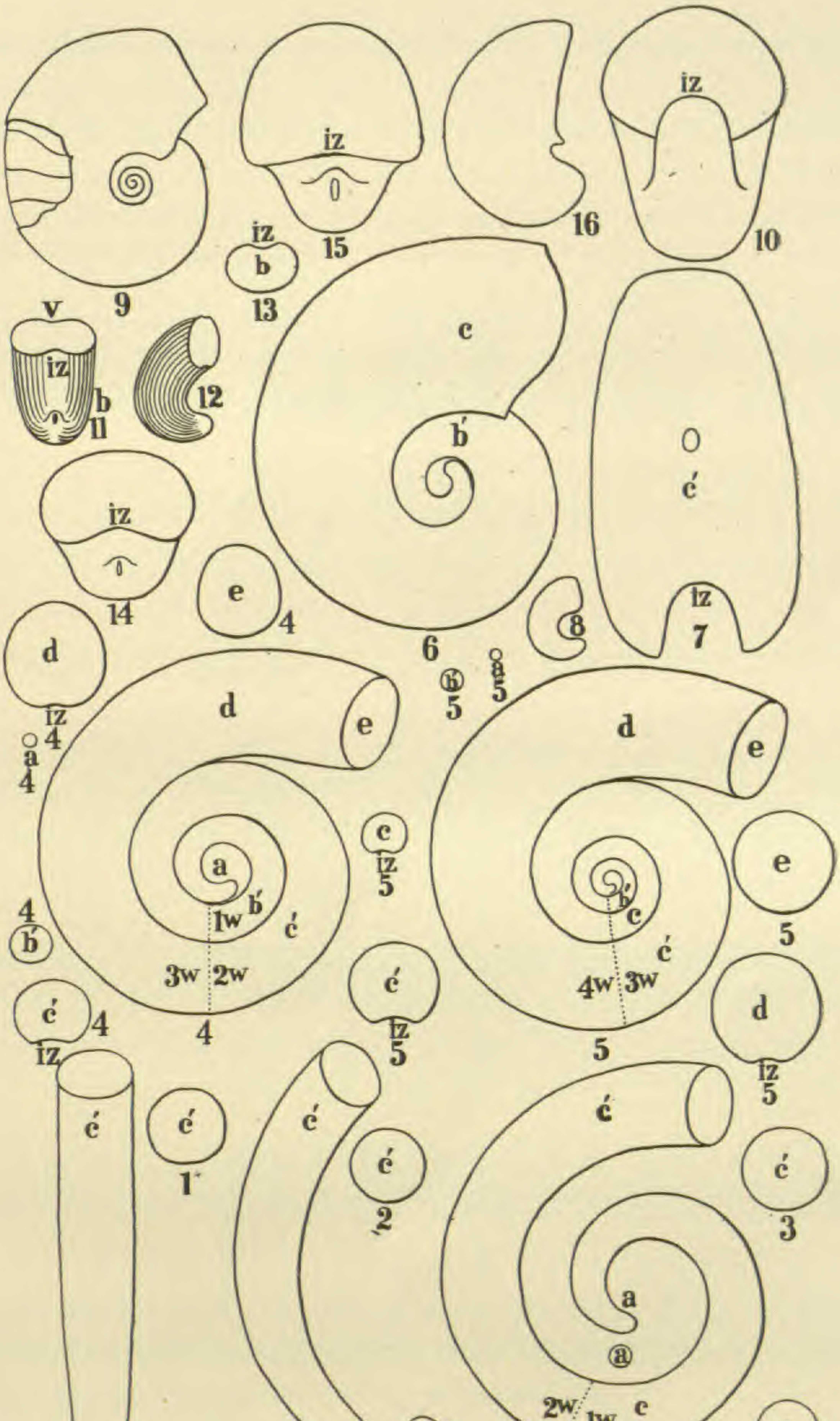
The two aortas at their diverging point are twisted half around each other, the right in this case being smaller than the left and sending off only one branch—the cervical artery; the right aorta then passes dorsad of the trachea and œsophagus in an oblique caudal direction until it meets the left to form the common aorta.

The left aorta presents a peculiar enlargement shortly after emerging from its " twist, " due perhaps to over-distention with coagulated blood, and at the point of the greatest convexity of its curve it sends off the carotid artery and gradually diminishes in calibre until it meets its fellow. It would appear from this that the left aorta, instead of being a mere connecting branch as is usually the case, has assumed the chief function of the right, supplying the head with blood through the carotid. The two aortas retain their crossed origins at the ventricle as in normal specimens. It is not improbable that the right aorta suffers more by the twisting than does the left, causing a greater retardation of the flow of blood and thus offering a possible explanation for its diminished size and partial loss of function.

The right jugular vein was somewhat enlarged near the heart but empty and was partially compressed by the ventricle. At about the level of the auriculo-ventricular furrow it receives the (pre?) azygous vein and the common venous trunk, which is of smaller calibre than the jugular, then follows the dorsal contour of the right auricle, arching over to enter the sinus venosus at about the point of entrance of the postcava.

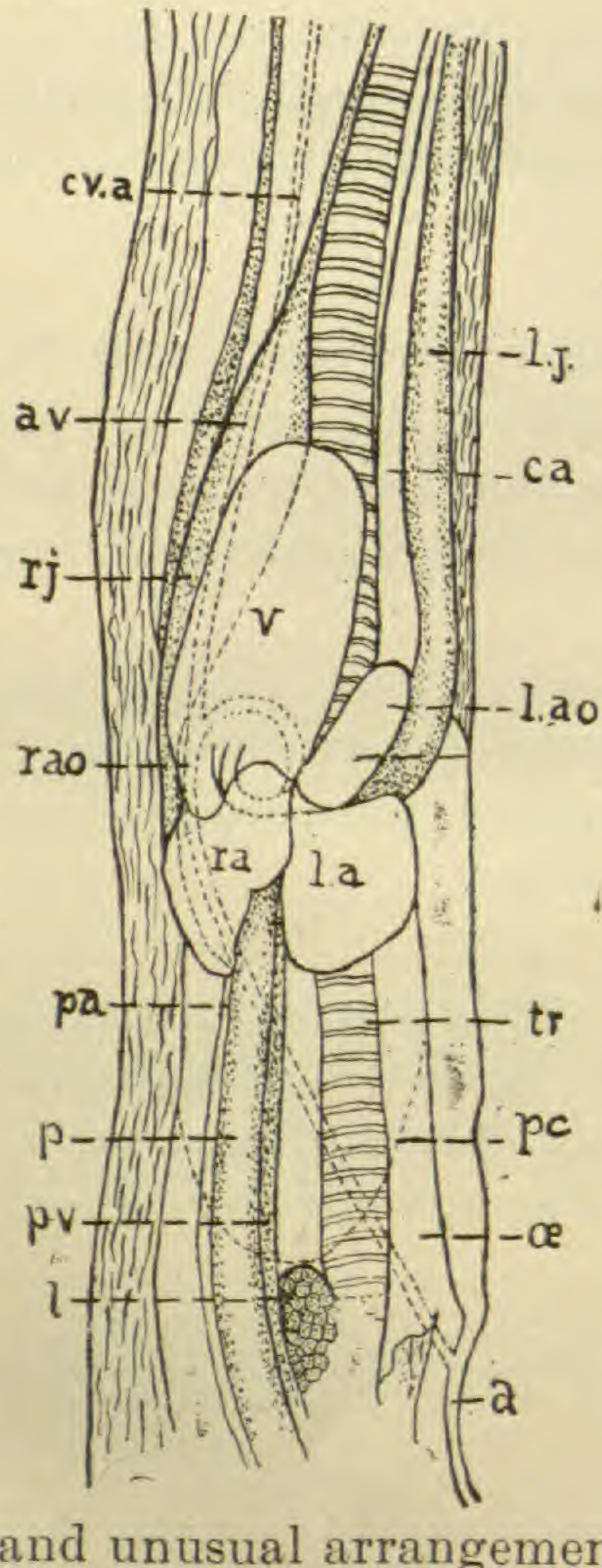
The position of the sinus which normally is perhaps more

PLATE XVIII.



Hyatt on Cephalopoda.

dorsal than lateral has, on account of the rotation, assumed a more nearly mesial and ventral location, thus bringing the postcava in line with the pulmonary vein to which it seemed to be quite closely adherent. The left jugular vein likewise presents a central enlargement and forms a sling-like support for the arch of the left aorta.



In the intricate and unusual arrangement of the parts here, the vein was inadvertently cut so that its course to the right auricle could not be satisfactorily determined.

The pulmonary vein passes from the lung through the pericardial cavity accompanied by the post-cava and passes between the two auricles more ventral than dorsal and enters the left auricle.

The significance of the central enlargements of the left aorta and the carotid artery and of the left and right jugular veins is not apparent, unless they may in some way be correlated with the anomalous position of the cardiac parts. These vessels nearer the heart are of smaller calibre, and on account of their twisted condition must retard the flow of blood considerably, the enlargements, then, may function as reservoirs for a reserve blood supply.

Such factors as gravity, pressure, mode and direction of progression would militate against the view of a post-natal development of this anomaly and would render more plausible the idea that it was due to some congenital or fortuitous embryonic condition.

The accompanying figure was traced from a photograph enlarged three diameters, the veins are shaded; the dotted lines indicate vessels that were too deep or insufficiently dissected to show at the time of photographing, and have been filled in freehand.

Specimens of *Eutænia sirtalis*, *Tropidonotus sipedon*, *Crotalus horridus*, and *Python molurus* were used for controls. Among them some interesting facts were observed which may serve as a basis for a future paper.

Reference letters. *a*, common aorta; *av*, azygus vein; *ca*, carotid artery; *cva*, cervical artery; *l*, lung; *la*, left auricle; *lao*, left aorta; *lj*, left jugular; *œ*, œsophagus; *p*, postcava; *pa*, pulmonary artery; *pc*, pericardium; *ra*, right auricle; *rao*, right aorta; *tr*, trachea; *v*, ventricle. Magnified 2 diameters.

PHYLOGENY OF AN ACQUIRED CHARACTERISTIC.

BY ALPHEUS HYATT.

An acquired character is a modification which makes its appearance in the adult or later stages of development and is obviously dependent for its origin upon other than hereditary causes. I have elsewhere defined that branch of science which deals with such problems as Ctetology and such characters as ctetic or acquired. The characteristic dealt with in the paper of which this is an abstract, is of essential importance among Nautiloids and Ammonoids or all of the Cephalopoda having chambered shells and living within their shells. It consists mainly of an impression made on the inner side or dorsum of each outer whorl during the coiling up, as the whorl grows and is moulded over the venter or outer side of the next inner whorl.

This matter will be better understood, if a short description is given of the following figures. Figs. 1–2 show an almost

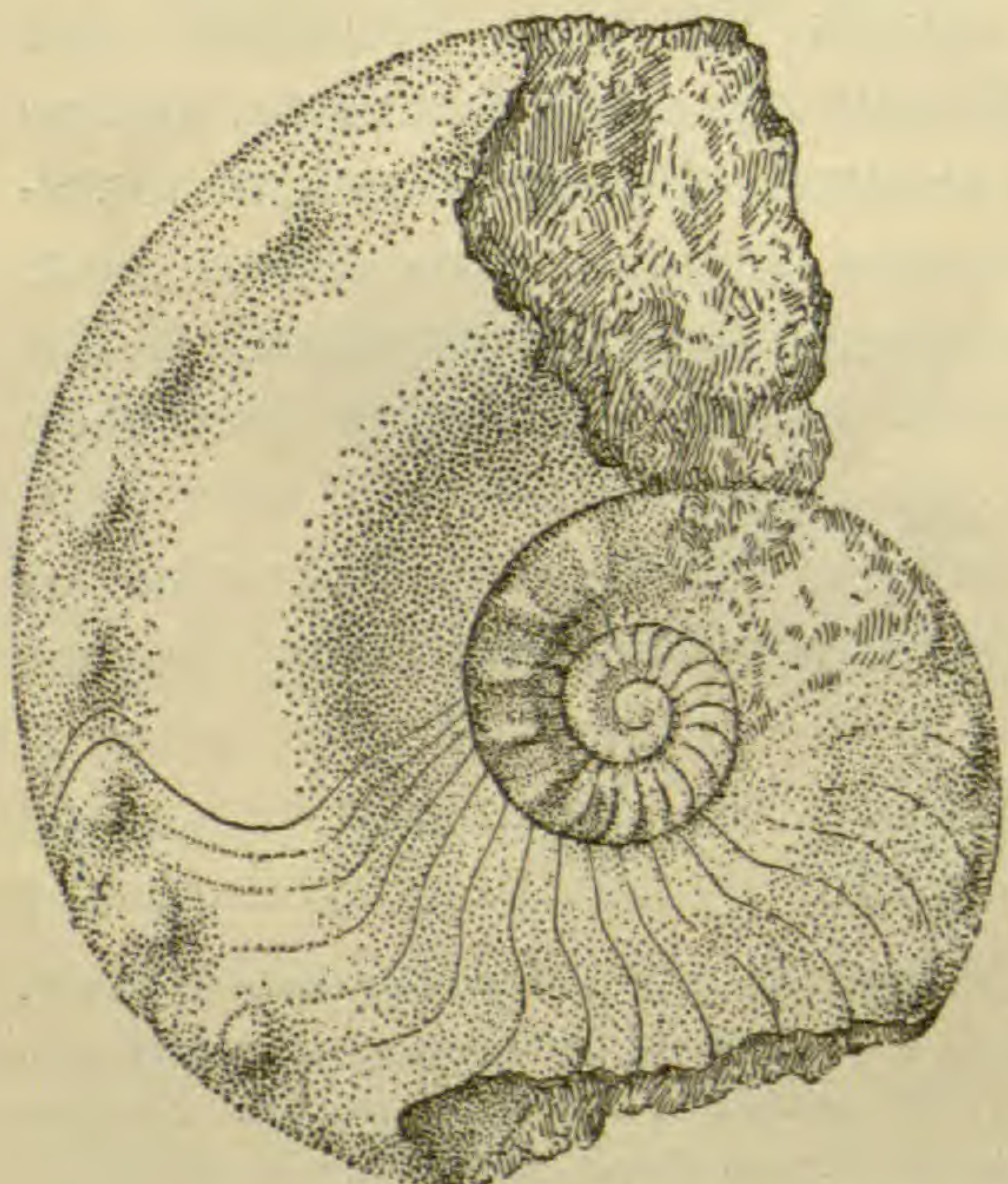


FIG. 1.

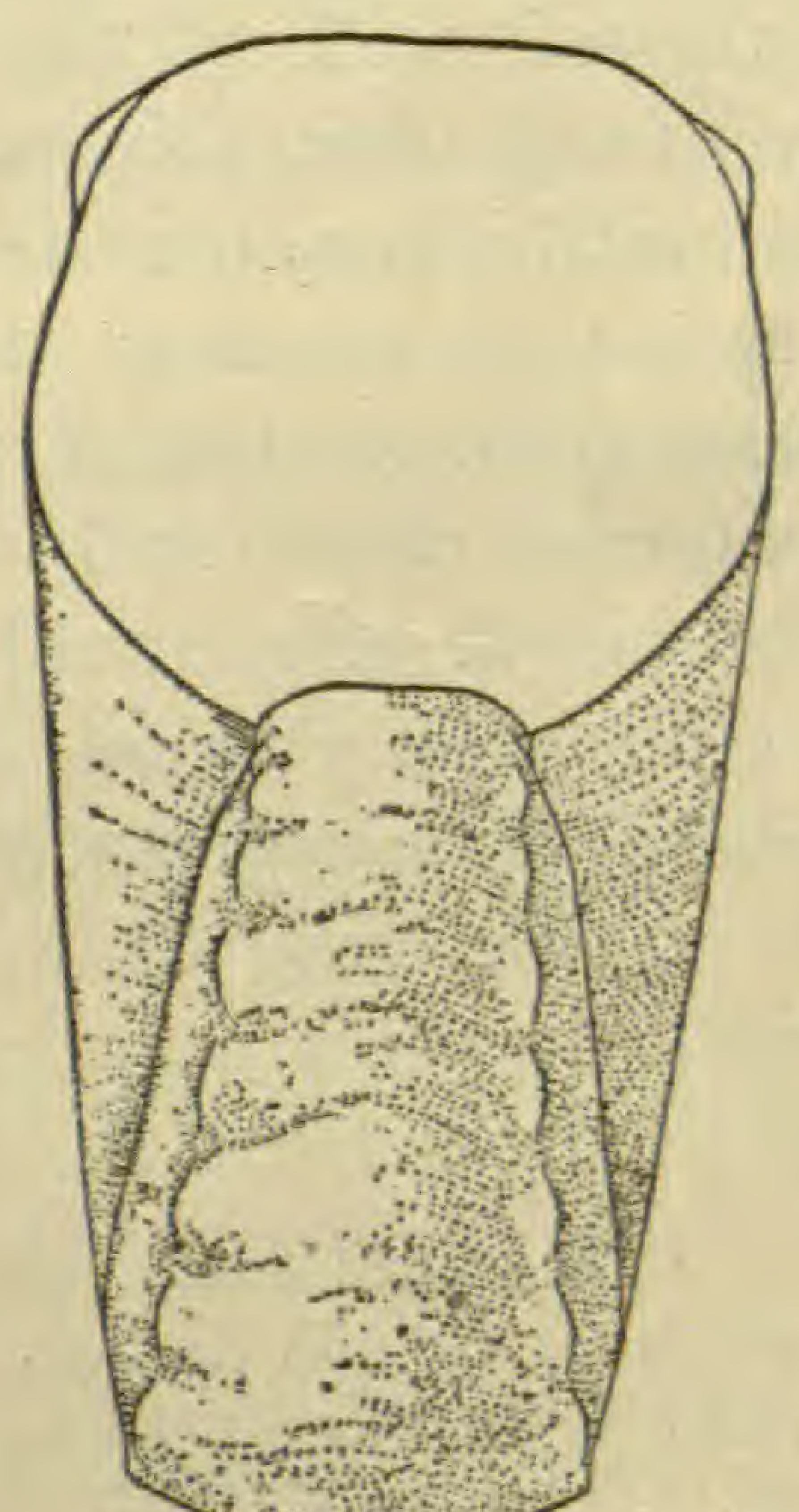


FIG. 2.

complete fossil cast of a full grown *Metatoceras cavatiformis* Hyatt, and some of the lines or sutures made in the external surface of the cast by the intersections of the partitions or septa that cut up the coiled tube of the living shell into air chambers. Figs. 3–4 show a broken specimen of the same

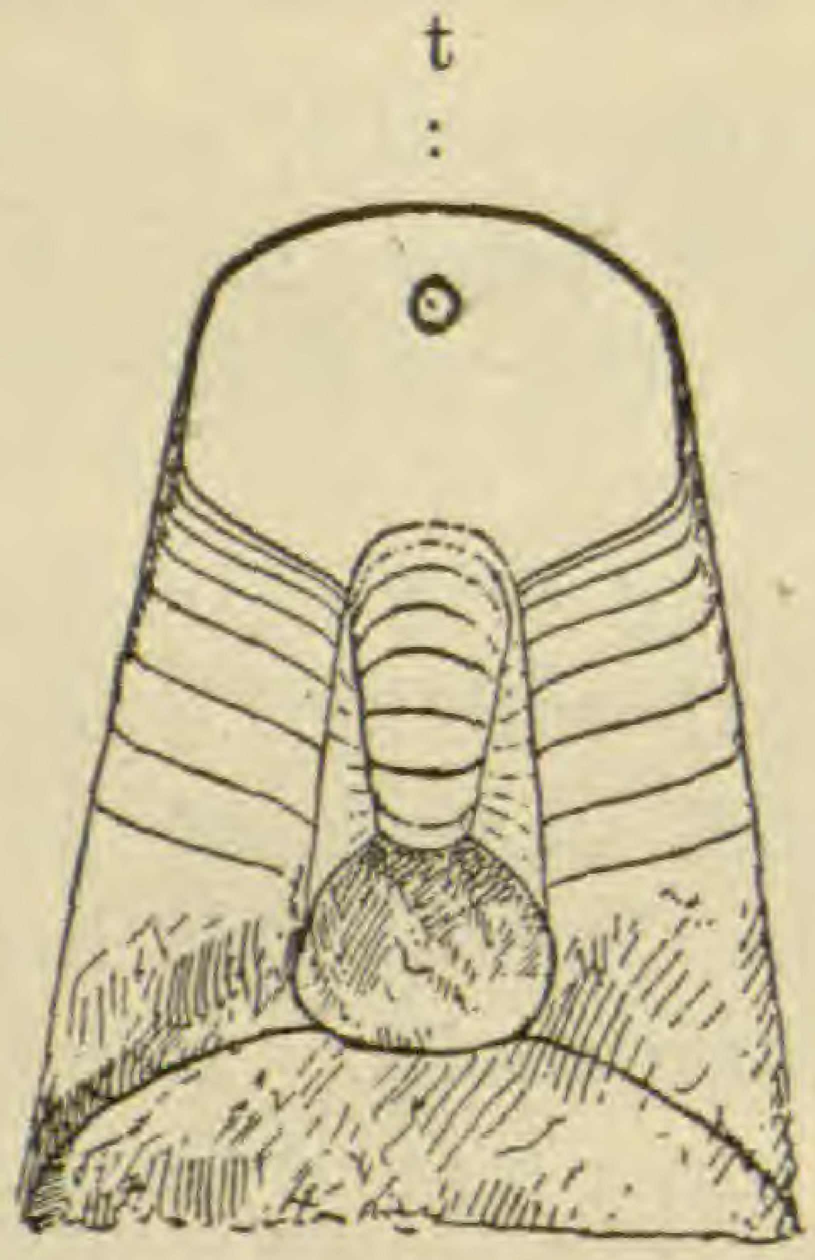


FIG. 3.

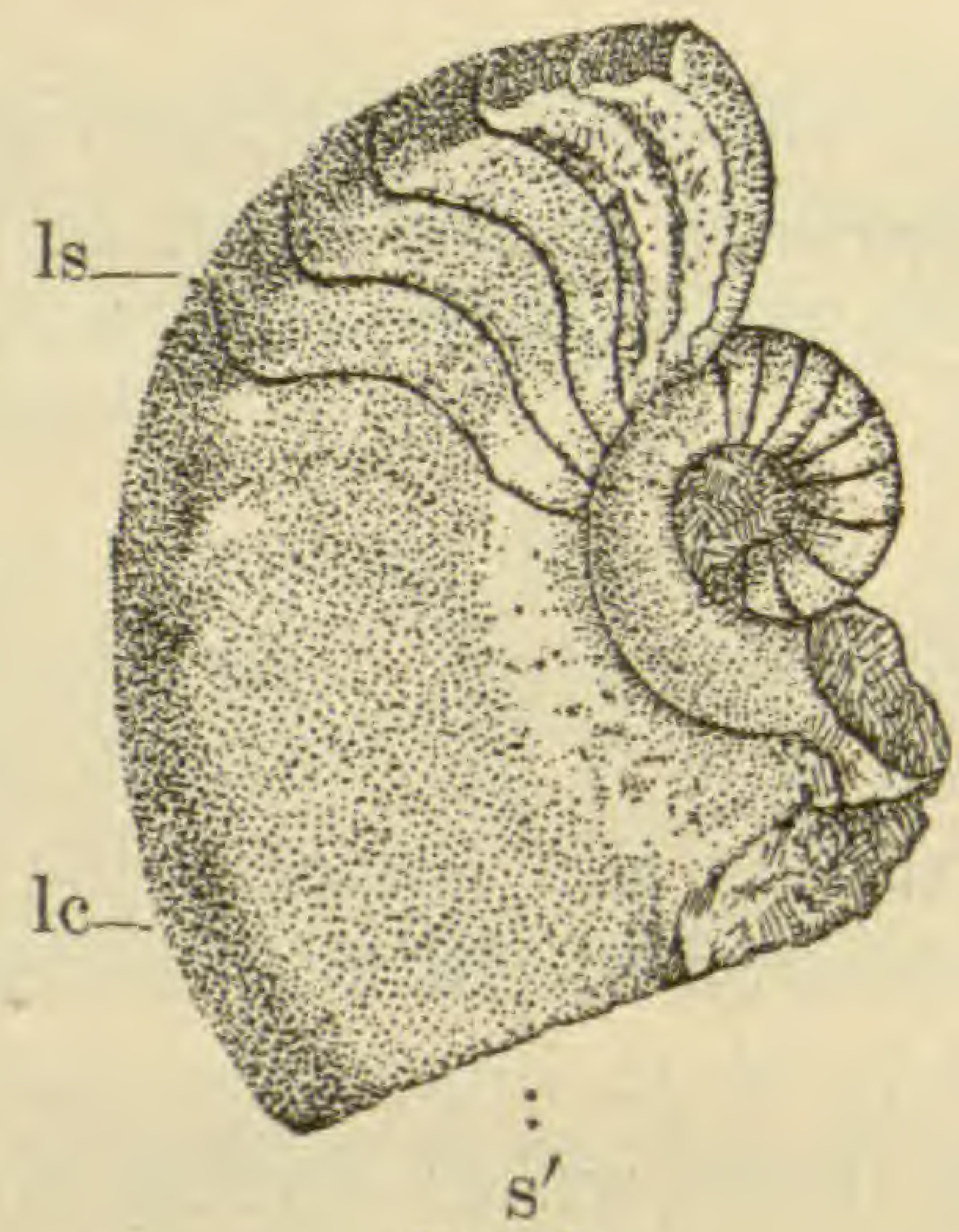


FIG. 4.

species, but with the outer and older whorls in large part removed. The innermost septum near the center of the coil was built across the interior after the animal had constructed the hollow apex or point. It then moved along adding to the external wall of the tube, which has been destroyed and removed from this cast, and built the second septum, and so on until it reached the tenth septum. By some freak of fossilization a number of the septa beyond this have been destroyed, so that if we were to remove the fragment of the external whorl and take out the center which has just been described, this would have the exact aspect of a cast of a young shell with ten air chambers.[1] The eleventh air space or chamber being open and without divisions would then appear to be the living chamber which the animal occupied when it built the tenth septum. Normally the shell really continued to progress from the tenth septum by additions to the outer

[1] The shaded area in the center, shaped like a large inverted comma, was an open space in the living shell. This is almost invariably filled by the rocky matrix in which the shells occur and is often, as in this specimen, allowed to remain. See also figs. 4, 5, 6, on Pl. XVIII, which show the comma shaped umbilical perforations or openings left at the center through the crytoceran form of the young.

wall and put in new septa behind it, together with the connecting tube until it reached s′, and finally the last septum, l. s. This one, l. s., was really the last one built and it formed the floor of a true living chamber, l. c., formerly occupied by the animal at the time of its death and burial in the sediment of the Carboniferous period. Figs 1–2 show a similar fossil but with a longer, although still incomplete living chamber. If the external wall of shell had been preserved none of these structures could be seen. Figs. 5–7 show a fossil *Temnochilus crassus*, a shell of the same family with this external wall pre-

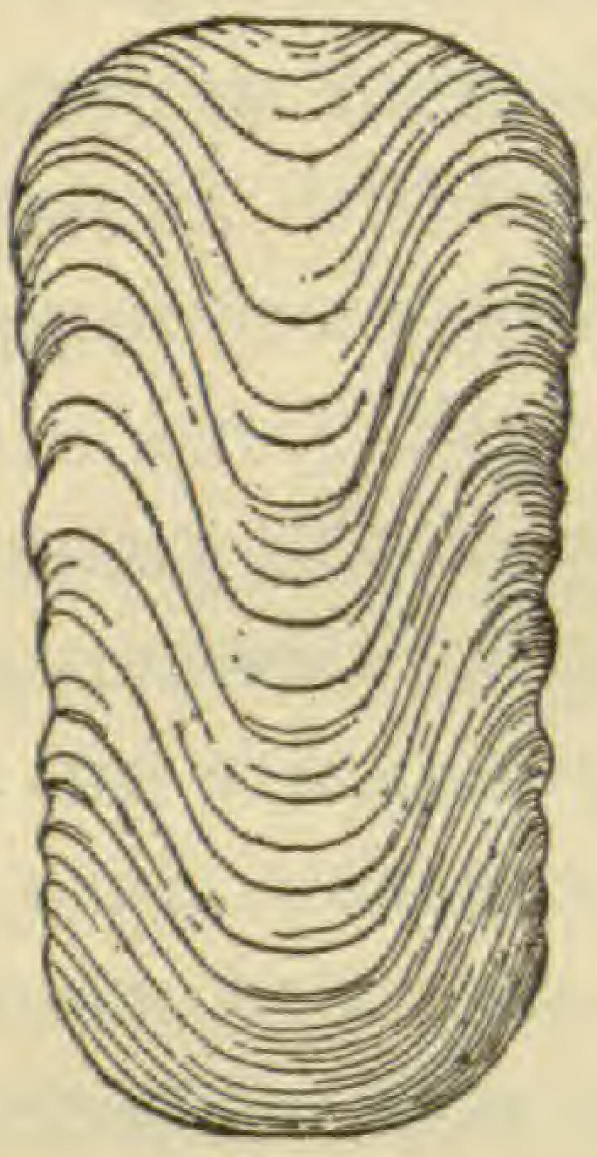


FIG. 5.


FIG. 6.

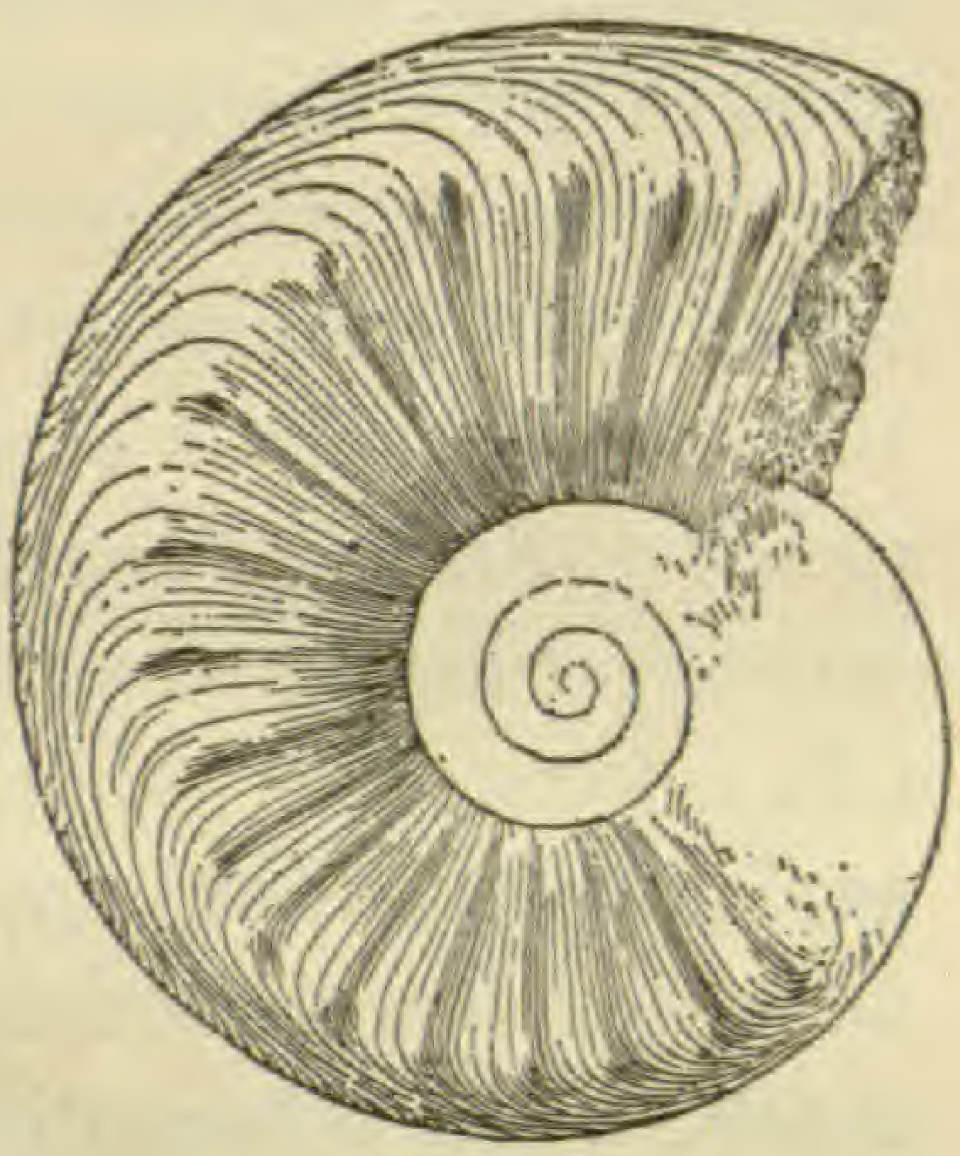


FIG. 7.

served and all these internal structures covered up. The impressed zone is the re-entrant curve shown in all these figures and especially marked in the lower outline of an outer whorl of another Carboniferous species, *Metacoceras dubium* Hyatt, fig. 8, im. z.

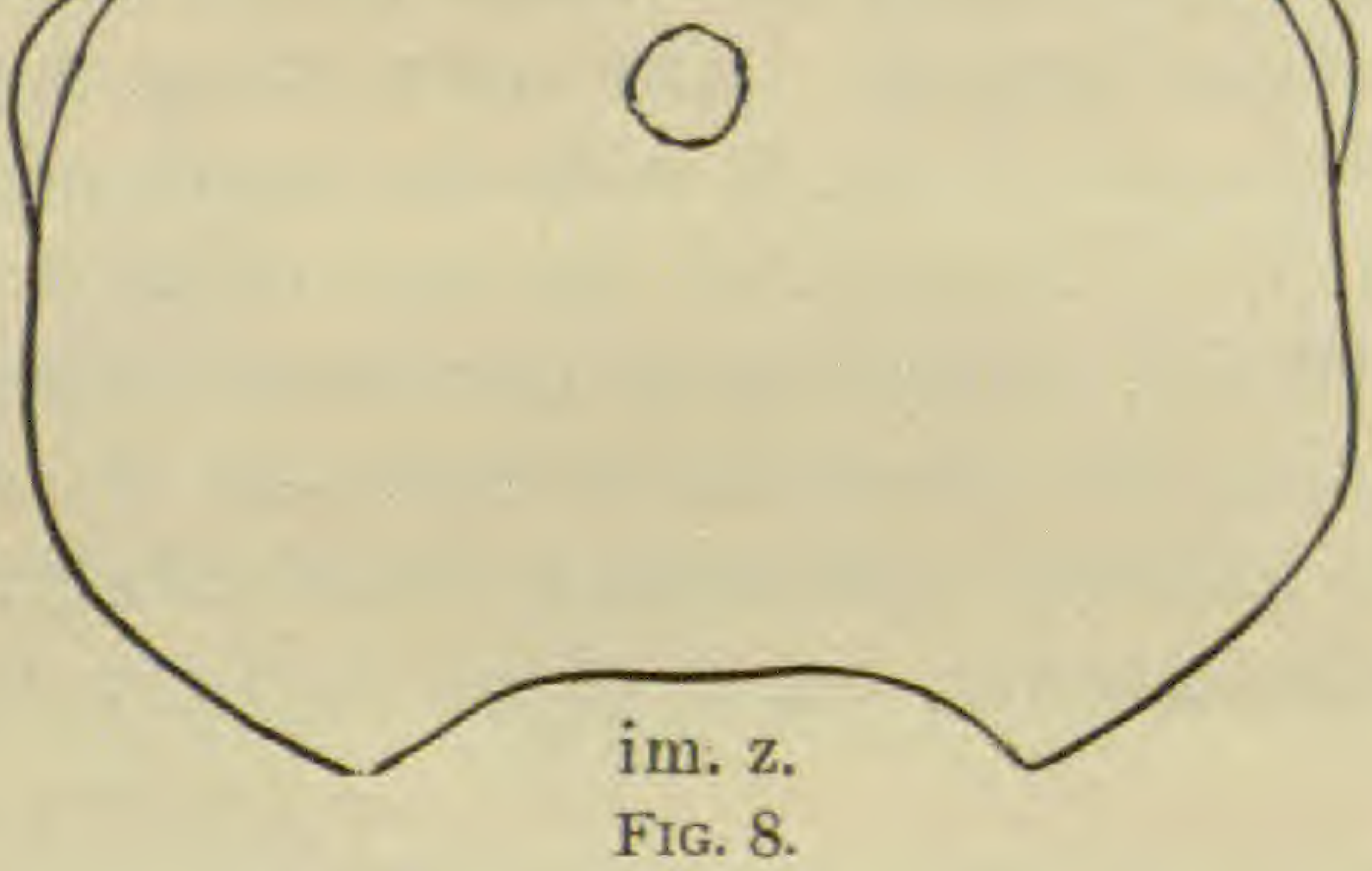


FIG. 8.

It is not necessary to go into a discussion of the details of internal structures and their relations to the impressed zone in this abstract, but it is essential to give a general description of the morphogeny of the order of Nautiloids.

This group of chambered cephalopods contains the following classes of forms: first, straight, conical shells, type Orthoceras, pl. XVIII, fig. 1; second, curved cones, Cyrtoceras, pl. XVIII, fig. 2; third, loosely coiled, open whorled cones, Do., fig. 3; fourth, coiled cones with the whorls more or less enveloping, Do., fig. 5. The fourth and fifth forms are usually included in the old genus, Nautilus. Practically, it is better to designate the first class as orthoceran, the second as cyrtoceran, the third as gyroceran, and the fourth and fifth as nautilian. In tracing genetic series through time they are found to diverge in their evolution, starting with the orthoceran and passing through parallel lines of forms, many of the genetic series having in succession cyrtoceran, gyroceran and even nautilian forms of the fourth and fifth classes. Others are not so perfectly parallel, stopping short with the cyrtoceran class of forms or the gyroceran. Many also begin with cyrtoceran shells, while others diverge from the gyroceran, and still other series have only nautilian shells of different grades of close coiling and involution.

The application of the law of repetition in heredity to the chambered shell-covered Cephalopods, shows that the straight orthoceran shells, pl. XVIII, fig. 1, were repeated in the young of the curved cyrtoceran forms, pl. XVIII, fig. 2, and these forms in their turn in the young of the gyroceran forms, pl. Do., fig. 3; and this may be seen by comparing the young or apical part of each shell represented in outline with the full grown shells of the preceding figures. The apex of fig. 2, with the whole of fig. 1; the apex of fig. 3, with the whole of fig. 2. It will be understood, of course, that the figures in outline represent full grown shells, except when otherwise explained and that they were built like the shells of figs. 1–2, by an animal living in their interiors and adding band after band of shelly matter to the exterior, but in these outlines the shell is supposed to be perfect and the internal structures concealed.[2] The young of pl. XVIII, fig. 4, which represents the fourth class of forms repeats the cyrtoceran form, then curves more closely and just before it comes in contact there is a short time when it overlaps the apex without touching it. At this time it is plainly gyroceran like the whole of fig. 3. After it touches the first whorl just beyond the apex it remains in contact and the inner side or dorsum of the second or overlapping whorl begins to show a flattening as a result of this collision of the whorls. The sections of the orthoceran, cyrtoceran and gyroceran whorls show no such flattening in any of the specimens examined, although hundreds of different kinds have been studied. The sections are designated on the plate by the same letters as the supposed lines of the sections made through the tube, and although diagrammatic figures, they give a sufficiently clear general explanation of the facts observed. More specific figures could have been given in abundance and will be given in the paper now in course of preparation.

Pl. XVIII, fig. 5, shows the same phenomena as figure 4. The young is at first cyrtoceran like the adult whorl of figure 2, and open, then becomes gyroceran in curvature and finally overlaps the apex when it has arrived at the end of the first volution, but does not at first touch it. Then coming into contact it acquires a flattened area or faint impressed zone on the dorsum or inner side of the second volution as is shown in the section fig. 5c. This is similar to the section of figure 4 shown in fig. 4c′, which represents a cut through an adult whorl of the fourth class of forms. It differs only in being smaller on account of the younger stage of growth at which it occurs.

The entire series of forms from orthoceran to nautilian is more or less represented, even in the earliest period at which the Nautiloids appear, namely, in the rocks of the Quebec Group. There is, however, this qualification: the fifth class of forms, or the involute nautilian, are comparatively rare and become more abundant in successive periods. The young

[2] Except in fig. 9 in which a portion of the shell is broken away showing the cast of the interior and the sutures.

of Nautilian shells of the earlier periods are also not so closely coiled, or, in other words, remain open and similar to cyrtoceras for a longer time during their growth. This is shown by the large size of the central hole, or umbilical perforation, left in the center of full grown shells. This perforation is much larger, as a rule, in Paleozoic than in the Mesozoic forms.

In each period the genetic series or groups of nautilian forms have peculiarities of structure in the sutures, ornaments apertures, etc., by which they can be separated from each other and these peculiarities are the same as those possessed by gyroceran, cyrtoceran and often orthoceran shells which occurred often earlier in time so that one can trace each group of nautilian shells back to its ancestors through the parallel stages of evolution above described. The groups, in other words, are parallel in their morphogenesis, like two individuals of the same parents in their development from youth to old age.

In all of these cases the impressed zone originates as described above after the whorls come in contact, never before this time in the growth of any individuals. Barrandioceras is one of the most involute shells known in the Silurian, and pl. XVIII, fig. 6, gives a true sketch of this species; fig. 7, shows a section of a full grown shell with a decided impressed zone; and fig. 8, is the young. This last is a purely cyrtoceran form with a compressed elliptical section like that of fig. 7, but no impressed zone, the inner side being rounded like the diagram of Cyrtoceras, fig. 2. The impressed zone is not present in the young of Ophidioceras, the closest coiled of all these forms, nor in the young of any species of the Silurian before the whorls touch, so far as known, and all of the species likely to present this peculiarity have been investigated.

The impressed zone is also invariably lost in the oldest stage of the whorl of every individual when the whorls cease to continue to grow in contact. This condition is represented in the last part of the outermost whorl of figs. 4 and 5 in sections, figs. 4e, 5e, and in the outlines of their apertures which are elliptical. The sections represent cuts through the whorls when, as is the case in extreme age, these cease to increase in size. As soon as this senile contraction begins to occur the sides shrink, becoming narrower, the amount of involution becomes less, and the impressed zone, shrinks in breadth as shown in the sections. When the whorl finally parts company in consequence of continued contraction the already shrunken impressed zone, figs. 4d, 5d, rapidly disappears and the apertures of such shells are frequently as round and free from indentations on the inner as on the outer side, as is shown at the free end of the figures 4 and 5.

In normally uncoiled forms, usually named Lituites, when the adult or young is coiled, and the succeeding stages, whether representing adults or old shells, are uncoiled, the phenomena are similar. The impressed zone is lost after the growth ceases to bring the whorls of the shell into contact.

The young and the adults of many of these forms have now been observed in the earliest periods and it is, therefore, obvious that during these early times the impressed zone must have been a modification of the whorl which took place in consequence of the mechanical effects produced by close coiling. This characteristic is slight when the coiling is slight and is developed in precise proportion to the increase of coiling or involution of the whorls and, on the other hand, when through degeneration due to age, or to other causes, the whorls cease growing in contact, the impressed zone gradually disappears.

Thus it always appears preceded and accompanied by an observable tendency in the mode of growth toward closer coiling and that this tendency is quite capable of producing the impressed zone can hardly be denied with any show of reason, since the charateristic disappears in proportion as the pressure is relieved through the degeneration of the powers of growth force to continue the normal rate of progressive increase of bulk in old or young or prematurely degenerate shells and in uncoiled whorls of all kinds and all ages.

The shells of Devonian series of Nautiloids have also been extensively examined, especially in the more involute nautilian forms of the genus Nephriticeras, and so far not one has been found with the slightest indication of the presence of an impressed zone in the cyrtoceran or gyroceran stages of development. In several examples also, the disappearance of this characteristic has been observed in the last stages of old whorls. There is, therefore, every reason for regarding the impressed zone as a ctetic characteristic acquired in the later stages of growth and not hereditary so far as is known in any shells of the earlier paleozoic periods.

The same statement may also be made with regard to the majority of Carboniferous shells. There is, however, a notable exception in *Coloceras globatum* (sp. De Kon.) Hyatt, and very likely some other species of closely coiled nautilian shells. In *C. globatum* of Visé, Belgium, I found in seven specimens that the impressed zone appeared while the whorl was still in the cyrtoceran stage. Pl. XVIII, figs. 9–10, give outlines of the adult of this species, and figs. 11–12, of the young and the zone, showing that the impression appeared long before the whorls touched each other and began to assume nautilian characters. Section, fig. 13b, shows the impressed zone occurring in the cyrtoceran stage while the venter or outer side of the whorl was rounded. Such facts admit of but one explanation, namely, that in this species the impressed zone had become hereditary and was in consequence repeated at an early age, previous to the occurrence of close coiling which produced it in the ancestral forms of the same group.

There are certain correlative characters which lead me to think that this is only a partial statement and perhaps a more complete and better one would be as follows: that the impressed zone, together with a peculiar broadening out of the dorsum and helmet-shaped section of the whorl, and perhaps also certain forms of sutures occurred in the early stages of some Carboniferous species before the nautilian stage, and consequently they must have been introduced by heredity into the development of this species before the tendency to close coiling had completed the first whorl. Thus these characters, although purely ctetic in origin, were repeated before the usual conditions recurred in the ontogeny of this species which had obviously and repeatedly produced them in the nautilian forms of the earlier paleozoic and the more generalized genetic series of the Carboniferous. That this species, *Col. globatum*, is a highly specialized species is shown by other characteristics, especially the early inheritance of a furrowed abdomen, shown at v in Pl. XVIII, fig. 11, and a peculiar aperture.

The Triassic period is unimportant in this connection since it has but few nautilian species that are deeply involute and also sufficiently well known to throw any light upon this problem. All of the true orthoceran, cyrtoceran and gyroceran forms diminish in the Carboniferous and disappear with the Trias.

The Jura contains a considerable number of nautilian shells of different genera of which the cyrtoceran stages are sufficiently well known. *Cenoceros aratum*, of which several specimens have been studied, shows the impressed zone and correlative characters in this stage; *C. lineatum* is the same; *C. clausum*, same; *C. intermedium*, same. Pl. XVIII, fig. 14, shows the cyrtoceran stage in a shell of *C.* , with a well developed impressed zone, i. z. Endolobus is a characteristic paleozoic type and there is a single survivor of this series in the Jura, *End.* (*Naut.*) *excavatum* sp. D'Orb. It is, therefore, very interesting and instructive to note that this species has the impressed zone, according to D'Orbigny's figure, during the cyrtoceran stage. This species has a large umbilical perforation and is slower in coiling up than other Jurassic species. The evidence that the impressed zone and its correlative characteristics are inherited in most species of the Jura before the habit of close coiling could have acted upon the whorls so as to produce this modification is, therefore very general and convincing.

The leading characteristic of parallelism in all genetic series of Nautiloids is, as may be inferred from the facts cited. a tendency toward closer coiling and greater involution in the more specialized forms of each separate series and a correlative increase in the profundity of the impressed zone. When the impressed zone becomes inheritable in some closely coiled and involute specialized shells of the Carboniferous and in similar shells in about all of the genetic series of the Jura this result is also directly connected with the observed fact of the quicker development of the coiling up tendency in the young of these Jurassic shells. This is shown by the small diameter of the umbilical perforation in the centers of the shells of the Carboniferous. It is also connected with the fact that the primitive uncoiled forms, orthoceran, cyrtoceran and gyroceran shells begin to die out in the Carboniferous and cease with the Trias as mentioned above.

This demonstration of the characters that accompany progress in close coiling, enables me to fill a gap which occurs in the evidence during the Cretaceous. In this period the existence of the impressed zone during the cyrtoceran stage of individuals has not been clearly established by observation except in two species, a form allied to *Cymatoceras pseudoelegans* D'Orbigny, from Faxoe, and *Cymatoceras elegans* from Rouen. In other shells, although a considerable number have been broken down, the state of preservation has been invariably imperfect. The coiling, however, in the young of all the shells examined is notably more accelerated than in the similar shells of the Jura, and the whorls broader and having more specialized characteristics correlative with closer coiling and the early existence of an impressed zone. It is, therefore, fair to infer that the evidence when accessible will confirm the facts observed in previous periods.

The same arguments apply also to the Cenozoics, except that in this period there is as yet no evidence of the early inheritance of the impressed zone. I have not yet succeeded with the Aturia, which is the only genus represented by favorably preserved specimens within my reach, in exposing the apex of the whorl. The shells of this period, so far as I know them, are, however, excessively involute and have exceedingly small umbilical perforations with very deep impressed zones after the whorls touch. The umbilical perforation in Aturia is in fact smaller than in any nautiloid known to me.

The imperfect evidence so far gathered in the Cretaceous, and the absence of positive evidence in the Cenozoics, does not, therefore, seriously affect conclusions reached in this paper, since these are merely gaps in the history of the evolution or phylogeny of the impressed zone; and all the correlative characteristics which accompany the inheritance of the impressed zone in the cyrtoceran stages of species which have this peculiarity have been observed to be present.

The terminal members of the Nautiloids are, of course, the existing species. *Nautilus pompilius* has been examined in a considerable number of specimens and in all of these the impressed zone and correlative helmet-shaped whorl and broad flattened dorsal side appears during the cyrtoceran stage. Pl. XVIII, figs. 15–16 are outlines of the shell of this species during the cyrtoceran stage exhibiting the helmet shaped whorl, broad dorsum, or inner side, and its impressed zone, iz. Thus, when the whorls touch, as in all the nautilian shells of the Carboniferous, Jura and Cretaceous in which the same acceleration of development also occurs, the whorl is already prepared to become involute and to mould itself more readily and rapidly over the surfaces of the apex and the side of the succeeding whorls. In other words, heredity has begun the work before the whorls touch, and before the deepening and enlargment of the impressed zone through the pressure of close coiling is begun. There are quite a number of characteristics in the species of existing Nautili which lead to the inference that they are survivors of Jurassic and generalized Cretaceous and Cenozoic forms; the size of the umbilical perforations, the smoothness of the shells, the simplicity of the sutures, and so on. These facts are of importance only in so far as they show that the existing Nautilus does not represent the acme of progress of its order but is a descendant of shells with less complicated structures than many of the genera of the Carboniferous, Jura, and Cretaceous.

EXPLANATION OF PLATE XVIII.

LETTERING.

a. Apex of shell. This usually bears a scar on the point, as shown in figs. 14 and 15, but this has no bearing on the question discussed, and has not been described. This also represents the youngest or cyrtoceran stage in the growth of the shell, fig. 8 being a young shell with complete living chamber. This letter also indicates the location of the sections correspondingly lettered in the figures.

b is used to indicate the section of the cyrtoceran stage in figs. 11–13.

b′ is used to indicate the place of the sections, figs. 4–5b′, upon the whorls of figs. 4–5. They were taken through the whorl in the gyroceran stage.

c is used for the adolescent stage of growth in the whorl and the corresponding sections.

c′ is used for the full grown stage in the growth of the whorl and the corresponding sections:

d for the first part of the senile stage:

e for the final and most degenerative part of the senile stage:

i. z. for the impressed zone.

v venter or outer side of the shell, the dorsum being the inner side of the whorl.

w for the whorls, thus 1 w in figs. 3 and 4 means the end of the first whorl, 2 w the beginning of the second whorl, 3 w that of the third whorl. These letters serve to show the progressive increase in numbers of the whorls in the different classes of forms.

FIGURES.

Fig. 1. Outline of an orthoceran shell.

Fig. 2. Outline of cyrtoceran shell.

Fig. 3. Outline of gyroceran shell.

Fig. 3. Outline of nautilian shell, having a larger umbilical perforation at (a) and fewer whorls at the same age, than in fig. 5, in other words it is less tightly and completely coiled up than the class of shells represented by that figure.

Fig. 5. A nautilian shell with tighter coils than in fig. 4 and the whorls coming in contact and the impressed zone begining at an earlier stage.

Fig. 6. Barrandioceras——(sp. Barrande) Hyatt, showing the most involute of the Silurian shells so far as known; fig. 6 is reduced in size but the section fig. 7 is natural size.

Fig. 8. A young shell of the same, natural size, with complete living chamber.

Fig. 9–10. Coloceras globatum (sp. De Koninck) Hyatt, adult. Fig. 9 has a part of the outer shell broken off showing the edges of the septal partitions (sutures) as lines on the strong cast of the interior.

Figs. 11–13. Same to show the cyrtoceran stage and section, with its impressed zone.

Fig. 14.

Figs. 15–16. Nautilus pompilius to show the cyrtoceran stage with its impressed zone.

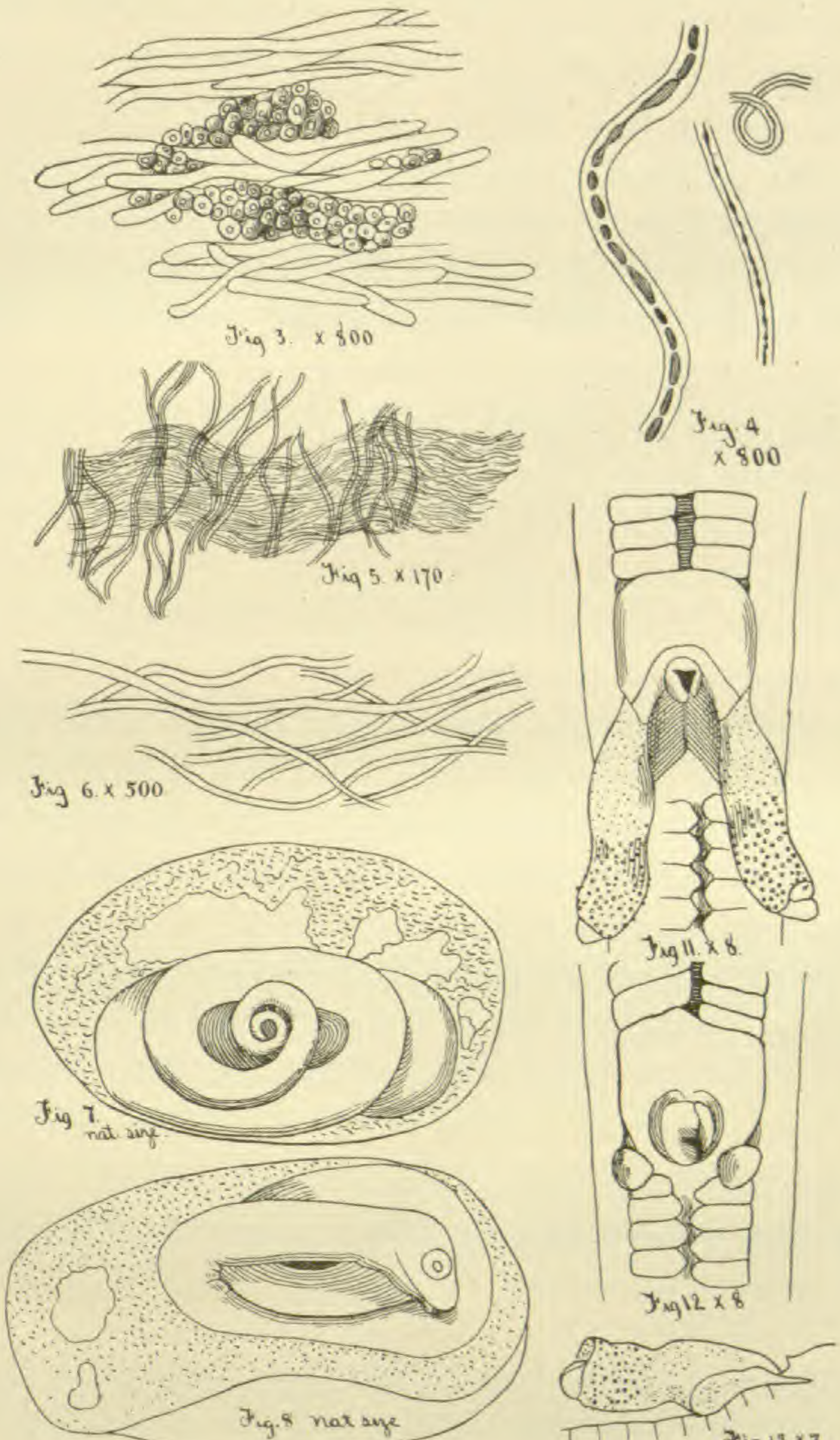
THE EGGS OF PITYOPHIS MELANOLEUCUS.

BY J. PERCY MOORE.

In the absence of any complete published account of the breeding habits of the pine snake, the following notes may interest some of the readers of the NATURALIST. The material which furnished the data for this account was collected on Aug. 3, 1892, at Formosa Bog, Cape May Co., N. J., by a party of students from the Sea Isle City Marine Laboratory, who, under the guidance of Dr. J. M. Macfarlane, were engaged in botanical investigation of the region. The nest was brought to their attention through the courtesy of Mr. Peter Hoff, one of those rare genuises of the woods whom it is the pleasure and profit of the naturalist to meet with now and then in his wanderings, and to whom our exploring parties were indebted for many kindnesses.

The snake which mothered the brood was a fine specimen of its kind, nearly six feet in length, and one of Mr. Hoff's most valued companions, for it was well-known to him as a regular habitué of his fields and barrens. At the time of oviposition, which occurred in the middle of May, Mr. Hoff saw the snake traverse the entire length (about 100 yards) of a field planted with squash and cucumber vines, pausing frequently to test the quality of the soil, which was of a loose sandy nature, with its snout. A spot was finally selected by the side of a row of plants, where the more tenacious character of the soil favored the construction of a nest. Excavation was begun by loosening the soil with the head, which was worked under the surface; and the loose earth thrown out. By alternately breaking the ground with the head, and brushing away the loosened soil with the tail, as Mr. Hoff stated, a tunnel was finally constructed of sufficient length to entirely conceal the snake. Within this tunnel it remained entirely hidden from view until oviposition was accomplished, when the entrance was closed and the locality deserted.

PLATE XIX.



Pityophis melanoleucus.

Mr. Philip P. Calvert, who was present at the excavation of the eggs, furnished me with facts relating to their position and surroundings. They occupied an enlargement of the tunnel 6–8 inches below the surface, where they were massed together in a single coherent cluster—the shells being very firmly cemented together wherever they came in contact. Ten eggs in all were found, three of which were detached from the mass in removal; the remaining seven are shown in Fig. 1 (from a sketch by Mr. v. Iterson, the laboratory artist), which I am able to reproduce here through the kindness of Dr. Ryder.

The eggs are of irregular ellipsoidal shapes, varying much in size and proportions, and exhibiting, as a result of the various pressures to which they have been subjected, irregular depressions and protuberances. In size they range from 50x37 mm. to 64x 45 mm., a long narrow egg measuring 61x35 mm., and a short broad one 60x44 mm. The average measurement of the seven is 59x41 mm., exhibiting a mean variation in length of 4 mm., and in breadth of 3 mm. The variation in size is due chiefly, if not solely, to the variable amount of yolk present.

In the hope of raising some of the young, several of the eggs were placed in a box of dampened sand and stood in a sunny spot: but on being opened after three weeks the embryos were dead, and development interrupted at the point that had been reached on Aug. 4, when I received the eggs.

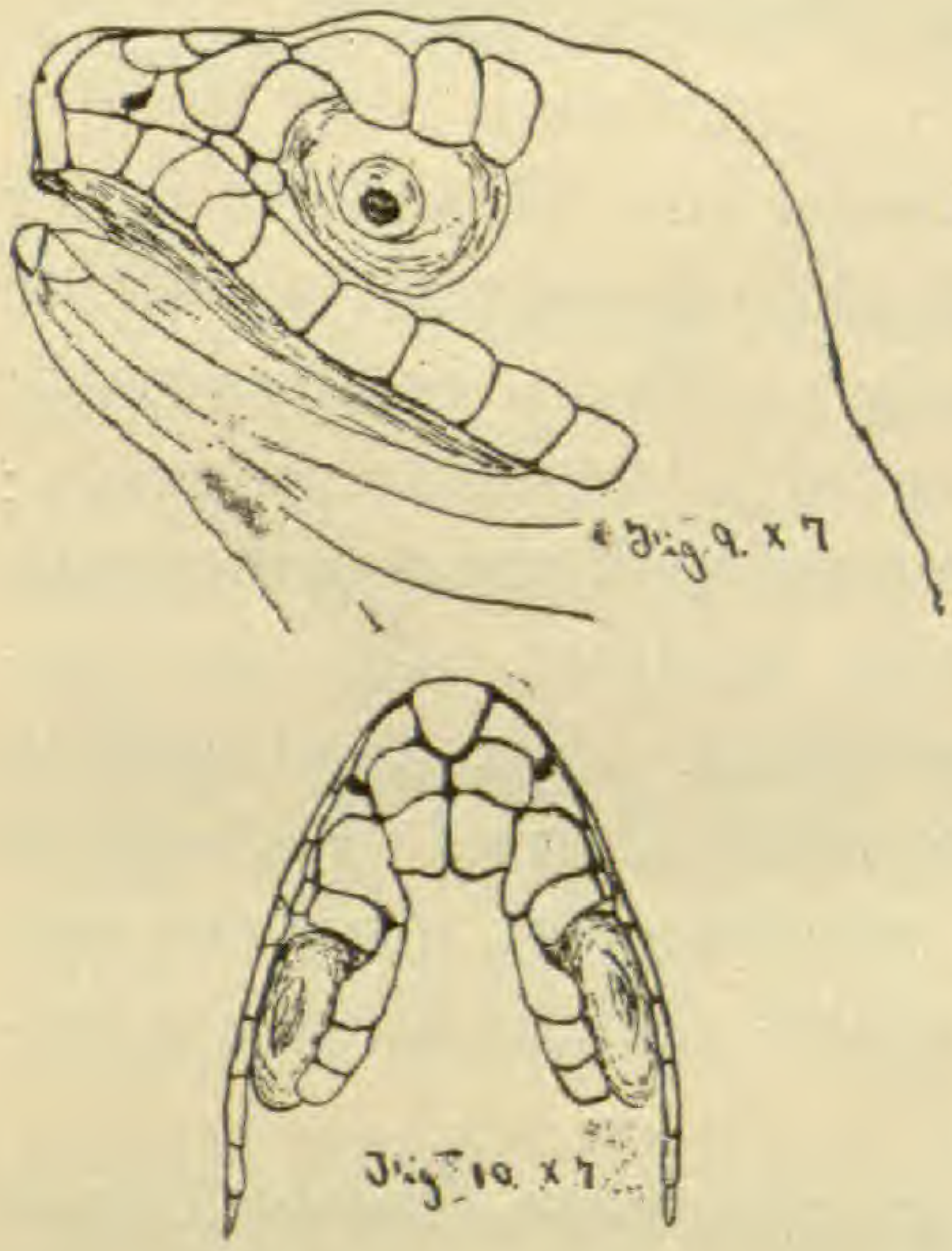
When fresh, the egg-shell was flexible and elastic, and of a very tough parchment-like character; and was very tensely and firmly stretched over its contents; but after a few days' exposure to evaporation, it became somewhat loose and wrinkled.

Its structure is interesting. Externally there is a thin incrustation of calcareous matter, which impregnates only the outer layers of the matted fibres of which the shell is mainly composed, and which appears to be present chiefly in the form of minute crystals and hexagonal plates. Over the greater part of the surface the calcareous crust is minutely cracked into elongated polygonal and irregularly lozenge-shaped areas, resembling the modern "crackle-ware" or the surface of old porcelain (Fig. 2). This appearance is particularly noticeable about the equator of the egg, where the long diameters of the areas are parallel to the long diameter of the egg, an arrangement due in part to a conformation of the areas to the curvatures of the surface, and in part to the structure of the fibrous shell. Calcareous deposit is most abundant at the poles of the eggs, and wherever two shells come in contact, they are firmly cemented together by the same material, all of which usually adheres as an elliptical area to one of the shells, when two thus joined are forcibly pulled apart (Fig. 1, a).

The shell is wonderfully tough for its thickness, which is only from $\frac{1}{5}$ – $\frac{1}{6}$ mm., made up, except for the superficial deposit of mineral matter, entirely of highly elastic fibres resembling in their disposition to curl when broken, and their neutral reaction to acetic acid, the yellow elastic connective tissue fibers. These vary somewhat in thickness, the largest having a diameter of $\frac{1}{200}$ mm., the smallest of $\frac{1}{400}$ mm., and the bulk of $\frac{1}{350}$ mm. They are extremely long, and I rarely found an end not artificially made. Naturally, they seem frequently to terminate in ovoidal or cylindrical swellings which are often sharply twisted, bent or folded. Unlike those which form the shell of bird's eggs, these fibres branched but very rarely, although short filamentous processes were not infrequently seen attached along their sides. Several fibres were traced under the microscope for an inch of their lengths without a single branching being detected. Two or more fibres frequently run side by side for long distances, and separating, give rise to a deceptive appearance of branching.

The most interesting fact to be noted with regard to the structure of the fibres is that they are tubular. Most, if not all of them, possess a distinct and continuous lumen, having a diameter of from $\frac{1}{3}$ to $\frac{1}{2}$ that of the entire fibre. This structure is well-shown in cross section (Fig. 3), and perhaps even more strikingly in specimens which, after having been allowed to dry, are mounted in glycerine, when the lumen becomes very conspicuous from the chain of minute air-bubbles which fill it and mark its course as a dark beaded line (Fig. 4).

The manner in which the egg-shell is built up out of these fibres is strikingly different from what obtains in the membrana putaminis of a bird's egg. Here the shell is built up of a number of distinct laminæ, in each of which the great bulk of the fibres have a generally straight and parallel direction obliquely around the egg, though their course is a regularly wavy one. They do not intricately cross and recross in every direction as in the chick's egg, but the fibres are generally disposed at angles of about 45° to the principal axis of the egg, the direction of the obliquity alternating in successive layers from one side to the other of this axis, so that fibres of successive laminæ are disposed at right angles to one another; those of alternate layers are parallel. The number of laminæ appears to be a matter of some constancy. Specimens from various parts of shells of three eggs were regularly separable into 9 or 10 distinct laminæ, which could be stripped off from the entire extent of pieces an inch square without exhibiting any signs of thinning out. I regard them, therefore, as being continuous over the entire shell. These layers are separable from one another with great ease, but it is noticeable in stripping them apart that a few fibres from one layer are always adherent to the adjacent layers, although there appears to be no extensive invasion of one layer by the fibres of another, except among the external ones. In any one lamina the sinuous course of the fibres causes a firm felting and interlocking among them (Figs. 5 and 6). The alternation of the direction of the fibres is shown in vertical section, but not very clearly, owing to the wavy courses which they take (Fig. 3).



FIGS. 9–10.
Head of Foetal Pityophis.

The optical effects resulting from this structure are striking and peculiar when the entire series of separated layers are placed side by side in corresponding positions on a moistened slide. Those pieces in which the fibres are disposed at right angles to the rays of light coming in from a window appear, to an eye placed at the proper angle to catch the reflected light, of a beautiful, glistening, satiny white; while those the fibres of which lie parallel to the same rays, and present no reflecting surfaces, appear dull and lustreless. These appearances can be instantly changed from one set to another on revolving the slide over an angular distance of 90.°

A place of natural division, where separation is more readily effected than elsewhere occurs between the 3d and 4th inner layers. The three innermost ones then appear to constitute together the membrana putaminis. There is apparently no disposition toward the formation of a lenticular air-space; this being prevented by the high elasticity of the membranous shell, which causes it to continually contract over the contents as they shrink through evaporation. This contractility appears, however, to be limited, as noted above. Perhaps it is an adaptation to the varying conditions of moisture and drought to which these eggs, and others of their kind, are subjected.

The external six or seven layers are more closely bound together, and constitute the shell proper. The depressions in the surface of one layer resulting from the wavy course of the fibres, accommodate elevations on the surface of adjacent ones, thus greatly increasing the strength of the shell and making possible that partial invasion of one layer by the fibres of adjacent ones which is mentioned above, and which becomes more marked externally. These binding fibres may be seen to stretch and break as two layers are torn asunder.

The wavy structure also produces on the surface beneath the calcareous crust, and especially where two shells have been united, a peculiar pebbled appearance, like the pebbled binding of books. The outer layers in which the calcareous matter is deposited, have a less regular structure—the fibres being more irregularly interwoven; but when the mineral matter is removed with acid, the fibres readily disentangle and separate, being bound by no other cementing substance. Cement substance appears to be absent also from the other layers; which may be easily teased up, when the fibres float off freely in the mounting medium.

A rough analysis of the shell gives the following results.

Water	29·5 per cent.
Soluble mineral matter (almost entirely calcium carbonate)	16·6 per cent.
Organic matter	53·7 per cent.
	99·8

Well advanced embryos were found within the eggs. These must have been at least 10 or 11 weeks old. Those examined numbered equally males and females. They have an average length of 6¾ inches, the tail being 1$\frac{1}{16}$ inches in a male and slightly less in a female specimen.

The embryos lie deeply embedded on one side of the abundant yolk, which envelops, and almost completely surrounds them, being packed thoroughly in among the folds; and in alcoholic specimens, requiring to be largely cut away to expose the full length of the embryo. The young snakes are arranged in somewhat irregular spiral coils, the larger folds of which are directed in the long diameter of the egg. There is no regularity in the arrangement of the folds; the spiral being sometimes wound in a left-handed, sometimes in a right-handed direction, figs. 7 and 8. Large clear albuminous masses are frequently embedded in the yolk.

The umbilical cord is short, measuring about ⅝ inch in length and $\frac{3}{32}$ inch in diameter. It leaves the body anywhere between ½ and 1 inch in front of the vent, between which points the somatic folds are entirely free from one another, while for a distance of an inch to an inch and one-half anterior to the umbilical cord they are only very feebly united. Beyond this point the gastrosteges are complete. These number in all 216 in one ♀ specimen examined—a number slightly less than the adult possesses. The anal plate is single, and the number of scales in a vertical row normal.

On the head the absence of certain plates present in the adult is noticeable. The scutes have not yet developed over the roof of the prominent brain case, nor in the post-ocular region. The frontal and parietal plates are not indicated at all, and the developed plates show some curious differences from the adult condition. The supraocular is clearly divided by two transverse grooves into three scutes, of which the anterior is largest. I suspect that the others may be really post-oculars which are here displaced by the prominent eyes. A small scute which may unite with the loreal underlies the preocular. Four postfrontals are present, the external pair being much the larger; but the single pair of prefrontals shows no indication of a division. The superior labials number 9, one more than in a specimen of the adult which I have compared. The inferior labials, except the first, are not developed, but the mental is well marked. The description of the head scutes is made from a single specimen, the only one which was well enough preserved to show them satisfactorily; figs. 9 and 10.

The egg tooth is indicated by a narrow fold which arises just below the ventral margin of the rostral scute. Rows of small papillæ on the jaws and palate represent the developing teeth. Their number and position are as in the adult.

In all male examples the paired penes were fully extruded immediately behind the anal plate; rudimentary penes were present in the females as a pair of low conical elevations in corresponding positions, fig. 12. In well preserved specimens each hemipenis is a somewhat compressed organ attached by a narrowed base. A constriction about the middle separates a basal from a somewhat more swollen terminal portion, which ends in a pair of rounded lobes, of which the dorsal is the larger and arises from a thickened rim which is seen to become continuous below with the more ventral lobe. On the external side of each hemipenis is a rather prominent lateral lobe.

Proximad to the median constriction the surface is dotted with numerous fine pointed projections, while the distal portion is covered by larger smoothly rounded papillæ. No papillæ whatever are present on the dorsal terminal lobe, which is quite smooth. Figs. 11–13.

Explanation of Plates XIX, XX.

Pityophis melanoleucus.

Fig. 1—Cluster of seven eggs represented as they naturally cohere. a—point at which an eighth egg was attached. Natural size.

Fig. 2—Surface cracking of the calcareous crust—from an equatorial region. x 10.

Fig. 3—Vertical section of a small portion of the egg shell showing a small part of five laminæ. x 800.

Fig. 4—Several fibres of different sizes after being dried and mounted in glycerin. The lumens are filled with air. x 800.

Fig. 5—Surface view of a small portion of a lamina x 170.

Fig. 6—A few isolated fibres x 500.

Fig. 7–8—Two views of embryos in their natural positions on the yolk. Natural size.

Fig. 9—Left side of head of an embryo showing the scutes. x 7 ; p. 881.

Fig. 10—Dorsal view of the same x 7; p. 881.

Fig. 11—Anal plate and penes of a male x 8.

Fig. 12—Same region of a female. a—rudimentary penes. x 8.

Fig. 13—Lateral (external) view of a hemipenis x 7.

EDITORIALS.

—PUBLIC spirited citizens of Chicago have formed a corporation for the purpose of creating and sustaining a museum, which shall furnish to the public of the city an educational exhibition. It is an opportune time for such a project, as there is much in the Columbian Exhibition that can be obtained, which would serve as a nucleus round which a great museum may be collected. It is proposed that the museum shall be located near to Jackson Park and the University, and for the present the California building, one of the largest of this class in the park, is to be utilized for this purpose. The corporators have made an excellent beginning in appointing Prof. F. W. Putnam the managing director. Thus a scientific stamp is given to the enterprise at the outset, and its future value as an educational medium is secured. It is expected that Professor Putnam will organize the museum into departments, and will place over each a competent head, who will make the institution a medium of original research as well as of exhibition, as is the case with all the great museums of the world. It will thus become useful, not only to the general public, but to the University and to the Academy of Sciences. The corps of scientific experts connected with the museum and the University, would revive the Academy of Sciences, which has been dormant of latter times. This would give it a position in the country second to none west of the Allegheny Mountains, instead of being, as in late years, less productive than the societies of Cincinnati and St. Louis. If Chicago is the city she claims to be, she will do this, and more. She will have an Academy of Sciences which consists exclusively of scientific men. Only such a membership can give an Academy its proper position in the world, and prevent the organization from being a travesty of what it ought to be and might be.

—THE Postmaster General of the last administration, Mr. Wanamaker, proposed, it is said, to change the names of the post-offices throughout the country which are duplicates of those previously given to older offices. Perhaps Mr. Wanamaker found the task too onerous; at all events it has never been accomplished. It is hardly likely the present administration will undertake it, as it would savor too much of "paternalism" for democrats to tolerate, but as duplicate names have become an annoying evil, a future administration may make the needed reform. Nearly all the names of towns with which we are familiar in American geography have now been duplicated, generally several times. New cases appear in the papers continually. We recently noticed a half dozen or more stations on a branch of the Santa Fe R, R. system, whose names have been taken in toto from the time-table of the Pennsylvania R. R., west of Philadelphia. Many or all of these places are or will be post-offices. As the Santa Fe system is controlled in Boston we wonder at this piece of plagiarism (!), for Boston has never been noted for lack of originality. If this is possible from Boston, the stupidity of the rest of the country in the matter of names is easily understood! Nevertheless, Philadelphians (ignoring Kensington and Southwark), may protest in the names of Passyunk, Manayunk and Moyamensing, against such incapacity. There can be only one Chicago, one New York, one Philadelphia, etc., and those communities that duplicate these names simply efface themselves, as the French say. There is nothing easier than to find or invent new names, hence it is incomprehensible why American people should wish to call their homes Paris, Mexico or Berlin. In any case, if geography is to be taught in our public schools, or letters reach their destination, this maze of confusion must be corrected.

—THE scheme of Mr. J. C. Bay to publish a yearly bibliography of American botany deserves every encouragement. He proposes an absolutely complete list of all papers upon American botany, accompanied by short abstracts of each, the whole to be published six months after the close of the year. We understand that a publisher has been found who is willing to undertake the publication, but the prompt issue of the volumes will doubtless prove a matter of some difficulty. Thus, of Just's Botanical "Jahresbericht," the volume for 1890 is completed in 1893, the same is true for the Zoological summary of the "Archiv. für Naturgesechihte," while the delay in the appearance of the English "Zoological Record" and the Naples Jahresbericht, though not quite so bad, is very aggravating to those who desire to keep fully abreast with the times.

—THE question is often asked, Why do the American zoologists so universally neglect the American Association for the Advancement of Science? For many years scarcely an American publishing zoologist has been present at the meeting while the few papers on zoological subjects are in striking contrast to the interest shown in the sister science of botany. The reasons for this state of affairs are not readily stated.

Possibly most potent of all is the feeling that the association is far from being a representive of American science, and that it has degenerated into an annual junketing party. It is certain that the interests of science have been often sacrificed to excursions which interrupt the sessions, and which should be postponed to their close. Then, too, criticisms are often heard that it is run as a close corporation, that nominating boards are packed in order that certain persons may be put in office and that the expenses of the Association are far greater than they should be for the results achieved. There is, too, an inside history which can not be detailed which would explain a large portion of the indifference displayed. Before the Association can regain its influence it must undergo a complete transformation in its management and methods of administration. It must also present features which will attract the better workers of the country.

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RECENT LITERATURE.

Wiedersheim's Comparative Anatomy.[1]—Professor Robert Wiedersheim has given us two distinct manuals of Comparative Anatomy. One of these, the "Lehrbuch," although it has passed through three German editions, has not appeared in English, while the the other, the "Grundriss" was translated several years ago. This latter, the "Little Wiedersheim," has now appeared in a third edition, and all its claims to being the "little" work have disappeared. It is, in every respect, a new edition, as there is scarcely a page upon which new additions have not been made, while whole sections have been entirely rewritten. It now forms a mine of facts which no morphologist can ignore. Everywhere it seems up to date, the results of investigators in all parts of the world being incorporated into its pages. A work like this cannot be summarized in a few lines, and all we can do is to express our generally high appreciation of the work and to notice a few novelties introduced into the new edition. First of these is an explanation of the names of animals mentioned in the text with a reference to their place in the system, a feature of great value to the beginner. Thus we find "*Cephalaspidae*, armored ganoid from the Devonian and Upper Silurian formations (belongs with the oldest fishes)." Another innovation in this edition is the collection of the literature (as in the "Lehrbuch") in an appendix. In this latter part we could wish that the "running head" of the pages were sub-divided, so as to indicate at a glance the subject below; and, while making criticisms, we would say that were the reference letters in the legends of the cuts arranged in alphabetical order, it would be a great convenience. We learn, incidentally, that a new edition of the "Lehrbuch" is not soon to appear, but the "grundriss" work will be the vade mecum of all students of vertebrate morphology.

Mill's Diatomaceæ.[2]—The scope of this work is best shown by a statement of what it contains. The first chapter treats of what diatoms are and where they occur; the second of their structure; the third of their movements; the fourth of their classification; the fifth of reproduction; the sixth and seventh of collecting and mounting; the eighth of

[1] R. Wiedersheim. Grundriss der vergleichenden Anatomie der Wirbelthiere. III Aufl. Jena, 1893, pp. xxx, 695.

[2] An introduction to the study of the Diatomaceæ, by Frederick Wm. Mills, with a bibliography by Julien Deby. 8 vo. pp. xix, 243, London, Iliffe & Son, Washington, The Microscopical Co., 1893.

the study with the microscope; the ninth of microphotography, and the tenth consists of a large bibliography of diatom literature. Of the general treatment of the subject there is much to be desired. The chapter on microphotography is clear, and will doubtless prove of value to students, but the rest of the work is rather antiquated. Thus, the chapter on the movement of diatoms is based upon an article dated 1866, and is without a single reference to the later literature, the observations of Pfitzer, Schilberszky, etc., being ignored. The bibliography appears to be fairly complete, but the proof-reading of this portion is very bad. The typographical appearance of the book is good, but the publishers have committed the not unusual fault of putting it upon much too heavy paper.

Kennel's Zoology.[3]—In the past three or four years we have noticed not a few German text-books covering a greater or smaller portion of the field of zoology. This is the latest to appear on our table. In most respects it pleases us, in others it does not. Its author is at once too radical and too conservative. Thus he has completely done away with the old group of worms; he denies the validity of the group of Arthropods, and has assigned Amphioxus to the group of Tunicates, the latter group, in his linear arrangement, being sandwiched between the Brachiopods and Molluscs. To descend to details: The work is divided into two parts—general and special zoology. In the first we have, at the beginning, a discourse on what is a species followed by a brief account of evolution, and this in turn by the usual definitions of organic and inorganic, animals and plants, individuals, etc. Then follows the cell, protozoa, tissues and organs. In the special part we find the systematic zoology of the Metazoa with novelties enough. As already hinted, the old group of worms is dismembered, and the Arthropods are given short shrift with a few words like the following: "The Tracheata, which have previously been regarded as a sub-group of the class of Arthropoda, equivalent to the Crustacea, have, as it appears, aside from a series of external resemblances of form and extremities, no nearer relationships to the crabs." The failure to recognize the Chordates as a valid division seems also a questionable procedure. The 310 figures which illustrate the work have been mostly drawn by the author, either from nature or with the use of pre-existing figures, and are largely reproduced by some of the mechanical processes. Many of the diagrams are very instructive. Press-work and paper are good, as we always find them in German text-books.

[3] Lehrbuch der Zoologie von Dr. Julius Kennel. Stuttgart, Ferdinand Enke, 1893, 8vo, pp. xvi x 678.

General Notes.

GEOGRAPHY AND TRAVELS.

The State University of Iowa Biological Expedition to the West Indies and Florida Keys.—A somewhat novel departure along educational lines was successfully carried out during the past spring and summer under the auspices of the State University of Iowa. A party consisting of three instructors and eighteen students chartered a 116-ton schooner and spent the months of May, June and July in biological work in the vicinity of the Bahamas, Cuba and the Florida Keys. The university furnished a very satisfactory equipment for a biological laboratory which was fitted up on board, a good working library of marine zoology, and also an equipment for dredging down to 250 fathoms, and a collecting outfit for marine work. All other expenses were met by the members of the party, the entire cost, including transportation from Iowa City to Baltimore and return, and board for the entire time, being only $200 for each person.

The first dredging was done on the Great Bahama Banks, where many interesting things were found. Next the party proceeded to the famous "Pentacrinus grounds" off Havana, where they succeeded in securing a quantity of the much-prized Crinoids at depths varying from 150 to 250 fathoms.

When it is remembered that this was done with a *sailing* vessel and *without steam* for hoisting, the members of the party will be pardoned for feeling somewhat elated over their success.

This was the first occasion on which iron rope has been used for dredging at such a depth with a sailing vessel. Many persons considered it impracticable, but Professor Alexander Agassiz thought it could be done. We found that the rope worked admirably and not a single fathom was lost during the three months of the cruise. Of course, no little credit is due the students, who worked manfully at the cranks of the hoisting machine day after day in the tropical heat.

The expedition was accorded many favors by the Cuban Government, and enjoyed the time spent at Havana and Bahia Honda, a port some forty miles to the westward. The local authorities at this latter place, however, seemed to regard the party as a filibustering expedition, in spite of the ladies on board. The shoal water collecting was

PLATE XX.

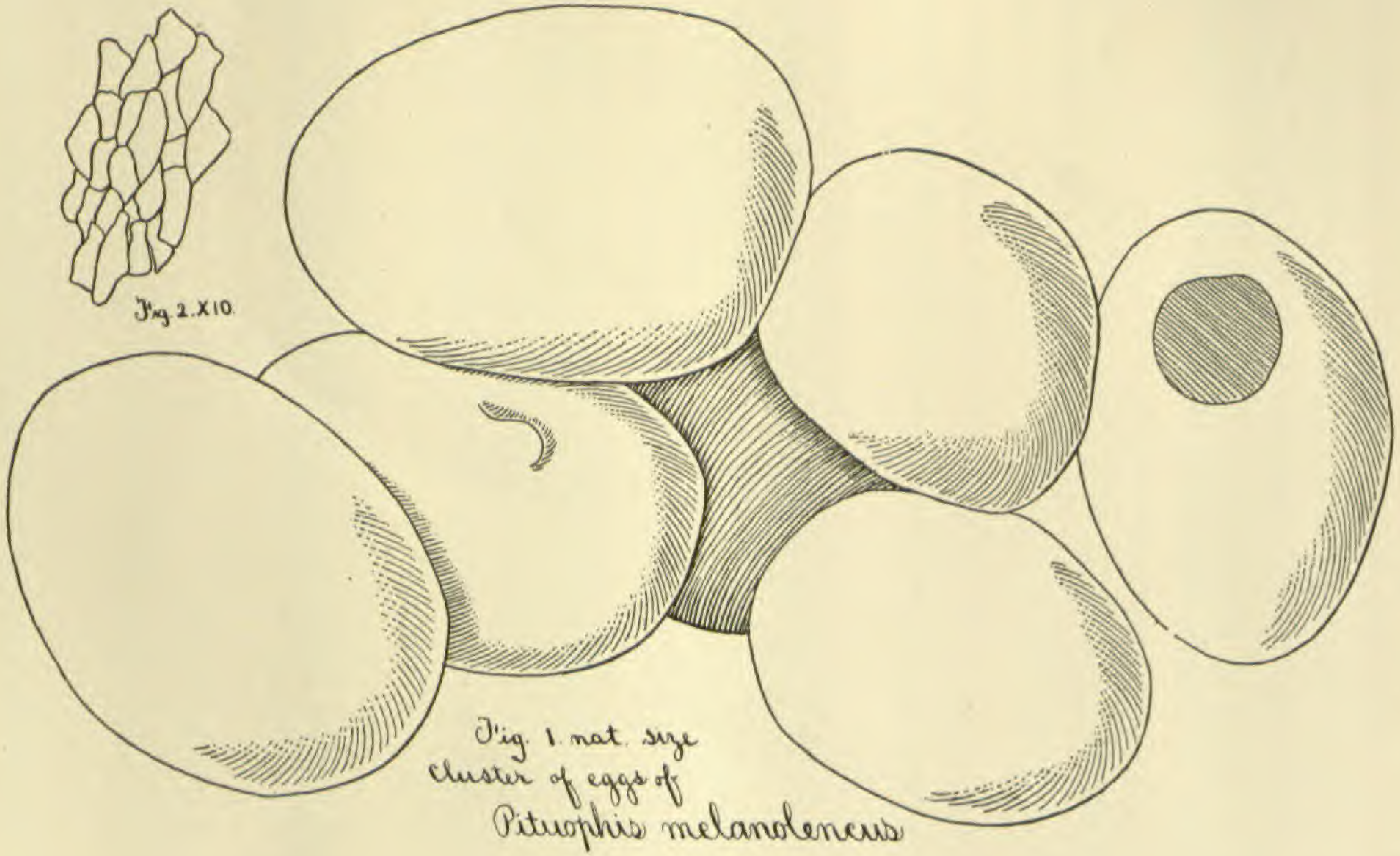
Fig. 2. X10.
Fig. 1. nat. size
cluster of eggs of
Pituophis melanoleucus

excellent in this region, and a quantity of material was secured, although no one was allowed to go more than thirty yards inland from the water's edge.

From Bahia Honda the Iowans went to Key West, where they were not allowed to land on account of a yellow fever scare, but were ordered to quarantine at the Dry Tortugas, which was anything but a hardship, for a better ground for marine biological work would be hard to find. The quarantine officer, Dr. Robert Murry, was untiring in his courtesies, letting the members of the expedition have the full run of old Fort Jefferson, and, better yet, of the moat around it, which is, in effect, a grand aquarium such as delights the zoological heart.

On two occasions the whole party had the rare privilege of studying fully expanded Millipores, while living corals of many species were always at hand.

Two weeks were spent in dredging on the famous "Pourtales Plateau," between Sand and Sombrero Keys, at depths varying from seventy-five to two hundred and fifty fathoms. A great quantity of material was thus secured, including some characteristic deep-sea forms, such as Asthenosoma, calcareous sponges and old-fashioned corals.

Returning again to the Bahamas, the littoral and terrestrial faunas near Spanish Wells, Eleuthera, were very carefully explored, and a rich harvest secured. The shoal connecting Eleuthera with Little San Salvador was dredged, the most notable results being some particularly beautiful hydroids.

Thence a homeward passage of eight days concluded a cruise which will be remembered with delight by every member of the party, and which was as remarkable for the absence of any mishaps as for the educational and scientific results which will certainly accrue.

In addition to the specimens secured and notes taken by the party, a splendid series of photographs, taken principally by Instructor G. L. Howser, constitute the best of records of the cruise.

—C. C. Nutting.

GEOLOGY AND PALEONTOLOGY.

A New Plistocene Sabre-Tooth.—During the past summer I obtained for the museum of the Academy of Natural Sciences of Philadelphia, some fossil remains of vertebrata from the western part of Oklahoma. These consist chiefly of parts of a single skeleton with teeth of *Elephas primigenius columbii.* Mixed with these were found the bones of a sabre-tooth cat. A few of these only, together with some teeth, were saved. These include parts of three metacarpals, three phalanges of probably a single digit, and the head of the femur. The teeth include five incisors, two superior canines, and two molars, one of them the superior sectorial in perfect preservation. The animal had attained full size, but the epiphysis of the head of the femur is not coossified. The dimensions are equal to those of a lion, (*Uncia leo*), of the same age; and those of the superior sectorial are similar to those of the *Smilodon fatalis* Leidy, and a little smaller than those of the *S. neogœus* Lund, of South America.

Generic character. So far as preserved, the parts agree with those of the genus *Smilodon*, with one exception. This is that the superior sectorial tooth possesses no internal root, not even a rudiment. The protocone is wanting in Smilodon, but its corresponding root is present, but in this form the root also has disappeared, so that it may be regarded as presenting the last stage of specialization in the cats, a circumstance which is appropriate to its late appearance in time. I therefore suppose the species to represent a genus, to which I give the name of Dinobastis.

Specific characters. The canine teeth are large, with elongate compressed crowns, a little more convex on the external than the internal face. The cutting edges are finely serrate. The anterior edge differs from that of the *Smilodon neogœus* in that it turns inward toward the base of the crown, presenting inward. In the *S. neogœus* this edge is not incurved. The superior sectorial has a large anterior basal lobe and a rudiment of a second at its anterior base. It does not attain the importance of a lobe, as it does in the *S. fatalis.* The part of the crown anterior to the paracone forms about one-fourth of the longitudinal extent of the crown; in the *S. fatalis,* is forms about one-third. The paracone is prominent, and is strongly convex on the external face. The metacone has a nearly straight edge, and its external face displays a shallow vertical groove near the middle. The long diameter of its base is 1·5 as great as that of the paracone. The crowns of the external incisors are oblique, and slightly incurved; they have robust cutting edges, which are finely serrate, and no basal lobes. The incisors 1 and 2 have small conic lobes at the base of the crown, which are well separated from each other at their bases. Those of I. 1 are subequal, while the external of I. 2 is smaller than the internal, and nearer the base of the crown. The crowns proper of 1 and 2 are acutely conic with semicircular section, the posterior face being flat. The edges of I. 2 are feebly crenate; those of I. 1 are smooth.

The metacarpals represented are II, IV and V; of these No. IV is best preserved. It differs from that of the lion in the smaller transverse diameter of the head, and in the fact that the superior face of the diaclast[1] is nearly continuous with the proximal or unciform surface. The shaft is quite as robust as that of the lion. The shaft of the fifth metacarpal is on the contrary more slender. Its section is a triangle with convex limbs, and the obtuse apex external. The phalanges have forms and proportions similar to those of the fifth digit of the lion. The second phalange is a little shorter, and the margins display but small traces of the bases of the sheath, which has been broken off. Otherwise the ungual phalange resembles that of the lion.

Measurements.

				mm.
Diameters crown I. 3	longitudinal,			22
	transverse,			13
Diameters crown superior canine	longitudinal,			80
	anteroposterior,			28
	transverse at base,			12
Diameters superior carnassial	anteroposterior,			35
	vertical	paracone,		18
		metacone,		13
Transverse diameter of head of femur,				40
Diameters head MC. IV,	anteroposterior, (restored),			22
	transverse,			15
Transverse diameter shaft MC. IV at middle,				16
Anteroposterior diameter shaft MC. IV at middle,				11
Length of phalange ? V 1,				38
" " " ? V 2,				24
" " " ? V 3,				22

This species, which I propose to call *Dinobastis serus*, increases the number of our Plistocene Felidæ to four. The three other species are *Smilodon fatalis* Leidy, *S. gracilis* Cope, and *Felis atrox* Leidy.

[1] For the explanation of this term see the Annual Report of the Geological Survey of Texas, 1892, Report on Vertebrate Paleontology of the Llano Estacado, p. 55.

MINERALOGY AND PETROGRAPHY.[1]

Anorthosites and Diabases from the Minnesota Shore of Lake Superior.—Along them iddle stretch of the Minnesota shore of Lake Superior occur several exposures of a light-colored, coarse rock, consisting essentially of a basic plagioclase feldspar which, according to Lawson,[2] is sometimes bytownite; but more frequently anorthite or labradorite. This plagioclase is usually fresh and quite vitreous in appearance. It contains, as inclusions, small bleb-like masses of augite, plates and rods of the same mineral arranged parallel to the clinopinacoid, liquid enclosures, dust particles and small grains of hematite. In addition to the plagioclase there is also often present in the rock a small number of triangular augite plates between the feldspars. This rock which the author calls an "anorthosite," is found in knobs and bosses, and as boulders in the overlying Keweenawan eruptives. The rock is evidently an eruptive which is much older than the volcanic flows constituting a large proportion of the Keweenawan beds.

A second article by the same author[3] treats of the coarse diabase in "gabbro" sheets interpolated between the sedimentary beds of the Animikie. These are thought by the writer to be laccolitic in origin, i. e., to have been intruded between the sedimentaries after these had been solidified, and some of them even later than the time of deposition of the younger Keweenawan series. This conclusion is reached after a careful study of the contacts between the eruptives and the sedimentaries, which has brought to view the existence of contact phenomena at both the upper and lower surfaces of the diabase. The sheets of eruptives have been named the "Logan sills" in honor of Sir Wm. Logan, who was one of the pioneer geologists in the Lake Superior region.

The Volcanic Rocks of the Andes.—In a review of Küch's volcanic rocks of the Andes, Iddings[5] asserts that the chemical relations of the rocks studied indicate clearly that they all belong to the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Geol. and Nat. Hist. Survey of Minn. Bull. No. 8.
[3] Ib. p. 24.
[4] Reiss and Stubel: Reisen in Sud-Amerika. Geologische Studien in der Republik Colombia, I. Petrographie, 1. Die Vulkanischen Gesteine bearbeitet von Richard Kuch. Berlin, 1892.
[5] Jour. of Geology. Vol. 1, p. 164.

same consanguinous group as do the Cordilleran rocks of Mexico and the United States, and their nature indicates that the magma producing the Andes types has not yet become as highly differentiated as that which yielded the corresponding volcanics in North America.

Basalts and Trachytes from Gough's Island.—Pirsson[6] has examined some pebbles gathered from the beach of Gough's Island in the South Atlantic. He finds two of them consisting of basalt, and the others of trachyte glass and tuff. The glass is a pitchy-black mass, filled with small pores and marked here and there by a phenocryst of plagioclase. In thin sections it appears as a brown unaltered isotropic substance containing magnetite, apatite, olivine and saidine phenocysts and microlites of the last-named mineral. An analysis of the rock gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	Mgo	CaO	Na_2O	K_2O	H_2O	Total
61.22	.42	18.01	1.32	4.51	tr.	.44	1.88	6.49	5.93	.46	=100.68

Density = 2.210. The rock is thus shown to be unquestionably a trachyte in spite of the fact that it contains occasional olivines. The mineral evidently crystallized in an early stage of the rock's history, as all its grains have been subjected to magmatic resorption.

The Origin of the Gneisses of Heidelberg.—In gneisses occurring in the region northwest of Heidelberg, Osann[7] finds lenticular masses of graphitic and apatite schists, and therefore concludes that the gneisses are of sedimentary origin. The rocks do not possess the true gneissic foliation, since their feldspar, quartz, etc., do not show a sequence in origin, nor do their micas exhibit the pressure phenomena usually observed in the micas of other gneisses. Their structure is described as the "hornfels structure" which is characteristic of contact products. The graphitic schists consist principally of quartz, muscovite, graphite and flecks like the "Knoten" of contact rocks, which are formed by the aggregation of plates of a green micaceous substance. The apatite schist is composed of 55% apatite, 43% quartz, and 2% of graphite, tourmaline and rutile. An analysis gave: CaO = 30.22; P_2O_5 = 22.86; F = 2.16; Insol. = 43.52.

Petrographical News.—Retgers[8] communicates in a few brief notes the results of his examination of rocks collected in southern

[6] Amer. Jour. Sci., XLV, 1893, p. 380.
[7] Mitth. gross. Bad. geol. Landesanst. Bd II, p. 372.
[8] Neues Jahrb. f. Min., etc., 1893, I, p. 39.

Borneo. Actinolite, smaragdite, and glaucophane schists are the most interesting foliated rocks studied. They contain, in addition to their characteristic components: epidote, garnet and orthoclase, most of which show the effects of torsion and pressure. A quartzite is remarkable in that it contains andalusite, sillimanite, rutile, zircon and tourmaline. The eruptives mentioned by the author as existing in this portion of the island are porphyrites, diorite, gabbro, peridotite, serpentine and a pyroxenite (augite-fels).

Analysis of cretaceous lithographic limestones from various localities in America and Germany give such discordant results that Volney[9] thinks it impossible to judge from analyses alone as to the commercial and technical value of such rocks. The organic matter in the stones contains nitrogen and traces of iodine. It is believed to be the residue of cretaceous fossils, and to be the cause of the peculiarly fine precipitation of the calcareous substance of good stones.

The term "poikilite" has already been referred to in this note as descriptive of a rock-structure produced by the inclusion of many differently orientated particles of some mineral irregularly distributed within large plates of another mineral. This structure has been described by so many petrographers as occurring in so many different rocks that Williams[10] suggests its general use and proposes "micropoicelitic" as the term descriptive of the structure when observed microscopically.

Some excellent examples of cone-in-cone structure in a concretion from the coal measures of Wolverhampton, England, are noted by Cole[11] as exhibiting clearly the crystalline structure of these bodies and their identity in mode of origin with spherulitic growths.

The rocks occurring at Cingolina in the Euganean Hills, described by Tchichatcheff[12] a few years ago, have been reinvestigated by Graeff and Brauns,[13] who find augite-syenite and olivine-diabase cut by dykes of hornblende and augite andesites. The plagioclase of the latter rock includes a large mass of the rock's groundmass which has crystallized largely as plagioclase with the same orientation as a thin zone of the same substance surrounding the corroded host.

New Minerals—*Sundtite.*—In some specimens of a silver ore from a mine at Oururo in Bolivia, Brögger[14] finds masses and crystals

[9] Journ. Amer. Chem. Soc., XIV, No. 10.
[10] Jour. of Geol., Vol. 1, p. 176.
[11] Miner. Magazine, X, p. 136.
[12] Neues Jahrb f. Min., etc., 1884, II, p. 140.
[13] Ib., 1893, I, p 123.
[14] Zeits. F. Kryst, XXI, p. 193.

of a dark tetrahedrite-like mineral associated with stibnite and pyrite. The dark mineral is steel-gray, with a black streak. Its hardness is 3–4 and density 5.5. Measurements of the crystals, some of which are 1 cm. long, indicated an orthorhombic symmetry. Twenty-one forms were observed, and from these the axial ratio $a : b : c = .6771 : 1 : .4458$ was determined. An analysis gave :

Cu	Ag	Fe	Sb	S		Total
1.49	11.81	6.58	45.03	35.89	=	100.80

which corresponds to the formula $(Ag_2.\ Cu_2.\ Fe)\ (SbS_3)_2$, or a salt of normal sulph-antimonic acid. Sundtite presents no analogies, either in composition or in its crystallographic characteristics, with other sulph-antimonates. Its nearest crystallographic relative is deschynite (RNb_2O_6). The new mineral is a commercially valuable ore of silver.

Melanostibian is another new mineral obtained by Igelström[15] from the celebrated manganese mine, Sjögrufvan, Grythyttan, Orebro, Sweden. It occurs as narrow veins in the dolomite, which is the bearer of all the ores of the mine. The mineral is in raven black, metallic-looking masses and tiny crystals, that are either tetragonal or orthorhombic. The streak of the mineral is cherry red, and its hardness 4. It is insoluble in dilute hydrochloric acid, but slowly dissolves in boiling acid. Its composition, corresponding to 6(Mn Fe)O Sb_2O_3, was deduced from the following figures:

Sb_2O_3	FeO	MnO	CaO	MgO	H_2O	Total
37.50	27.30	29.62	1.97	1.03	1.06 =	98.48

Graphitite.—Upon treatment with nitric acid under certain conditions, the graphite from Ceylon, Norway and Canada yields an oxidation product that is different from the corresponding product obtained from the graphite of Fichtelgebirge, Siberia and Greenland. The materials of the two groups are therefore regarded by Luzi[16] as different, and as worthy of distinctive names. The mineral from the last-named localities is called graphitite.

American Minerals.—The *cookeite* of Paris and Hebron, Me., has been known for some time as a micaceous mineral closely related to the chlorites. In habit its plates are hexagonal, and are nearly always arranged in radial groups. These plates, according to Pen-

[15] Ib. p. 246.
[16] Ber. d. deutsch. chem. Ges., XXVI, p. 890.

field,[17] consist of an inner uniaxial hexagon surrounded by six segments extinguishing parallel to their edges and showing a biaxial interference figure. The mineral is monoclinic and is twinned like the clinochlor[18] from Texas, Pa. It is associated with quartz, lepidolite and tourmaline, and has probably been derived from the latter by alteration. An analysis of carefully selected material gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	Li_2O	H_2O	F	Total	O = F	
34.00	45.06	.45	.04	.14	.19	4.02	14.96	.46	=99.32	—.19	=99.13

This corresponds to the formula Li $[Al(OH)_2]_3$ $(SiO_3)_2$. The density of cookeite is 2.675.

The results of an examination of *zunyite* from the Charter Oak mine, at Red Mountain, Orange Co., Colo., and of *xenotime* from Cheyenne Mountain, El Paso Co., in the same State, have recently been communicated by Penfield.[19] The zunyite occurrence is five miles north of the original occurrence of the mineral first described by Hillebrand. The mineral is in little tetrahedrons scattered through an altered porphyrite. An analysis of these gave:

SiO_2	Al_2O_3	Fe_2O_3	Cl	F	H_2O	P_2O_5	CaO	Na_2O	Total	O=Cl&F	
24.11	57.20	.61	2.62	5.81	11.12	.64	.11	.48	=102.70	—3.03	=99.67

corresponding to $[Al(Cl.F.OH)_2]_6$ Al_2 $(SiO_4)_3$. Zunyite is found also in the mine as a white pulverulent mass resembling kaolin, but which consists of tiny octahedral crystals. The xenotime was from the tysonite locality described by Hidden[20] in 1885. It was a single fresh crystal of a brown color, implanted on a gangue of quartz and feldspar. Its density was found to be 5.106, and its composition: $P_2O_5 = 32.11$; Yt. Er = 67.78; Ign. = .18.

In the crystalline dolomite of Canaan, Ct., Hobbs[21] has discovered a rose-colored *talc*, that is noticeable for its large percentage of calcium and aluminium. Its analysis yielded:

SiO_2	Al_2O_3	MgO	CaO	FeO	MnO	H_2O	Total
61.48	3.04	22.54	4.19	.77	tr.	5.54	= 100.56

The density of the mineral is 2.86. It is optically negative, and its axial angle 2 E is 15° 30′.

In a recent Bulletin of the United States Geological Survey, Mel-

[17] Amer. Jour. Sci., XLV, 1893, p. 393.
[18] Ib. XLIV, p. 201.
[19] Ib. XLV, 1893, p. 396.
[20] Ib. XXIX, p. 249.

ville[22] has given the results of analysis of several American minerals as follows: *Natrolite* (I) from Magnet Cave, Ark.; a light-colored *tourmaline* (II) from Nevada Co., Cal.; *spessartite* (III) from Llano Co., Texas, and *bismuthinite* from Sinola, Mexico. Figures follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	F	B_2O_3
I	47.56	26.82		.20		.13	.09		15.40	9.63		
II	36.40	33.64	3.13			1.51	10.01	.12	2.49	3.53	.74	8.74
III	35.93	18.08		4.60	31.77	8.48	.69	.17		.36		

The spessartite contains also traces of TiO_2 and BaO.

Mineralogical News.—W. Ramsay[23] has discovered zonal growths of *epidote* substance in crystals of this mineral from the Sulzbachthal in Salzburg, Zöptan in Moravia, Arendal in Norway, Haddam, Conn., and from Traversella, Brosso and Ala in Piedmont. The different zones possess not only different colors, but they have also different extinction planes and diffent refractive indices, as do also different portions of the same zones.

Fragments and small crystals of carbon with all the physical properties of *carbonado* have been prepared by Moisson[24] upon dissolving carbon in iron and cooling the mass slowly under pressure.

Miscellaneous.—McMahon[25] has elaborated a systematic course in micro-chemical analysis based on the production of the sulphates and double sulphates of the elements. These salts are described as they appear on the object glass under the microscope, their habits are depicted and their constant peculiarities, if they possess any, are portrayed with some minuteness. The methods of analysis developed by the author will prove of great convenience to petrographers if they are found as practicable as they are declared to be.

The eighth volume of the mineral resources of the United States, edited by Dr. D. T. Day,[26] contains statistical data for the calendar year 1891. The total value of metallic products mined during this period amounts to over $181,000,000, and that of the non-metallic products over $241,000,000. The most notable article in the volume is an historical description of the past "twenty years of progress in the manufacture of iron and steel in the United States."

[21] Ib. XLV, 1893. p. 404.
[22] Bull. No. 90. U. S. Geol. Survey, p. 38.
[23] Neues. Jahrb. f. Min., etc., 1893, I, p. 111.
[24] Comptes Rendus, Feb. 6. Ref. in Nature, Feb. 16, 1893, p. 370.
[25] Miner. Magazine, X, p. 79.
[26] Mineral Resources of the U. S. Calendar year, 1891. Washington. Govt. Printing Office, 1893.

ENTOMOLOGY.[1]

Two Twig Galls on Populus Fremontei.—On the 25th of April, 1892, two galls were found on growing twigs of *Populus fremontei* in Las Cruces, New Mexico, and the following are descriptions of them.

Warted Gall.—Length and breadth, 22 mm., thickness 13 mm. Formed on side of twig, round, roughly and irregularly circular in outline, rather flattened, excrescentic or finely warted on the whole upper surface and edges or sides, involving about one-half of the body of the twig, the under surface next the twig covered by the thin spread bark expanded from the involved surface of the twig. Excrescentic portion of gall overlapping the smoother inferior portion on edges, brownish gray in color, the lower surface covered by the spread bark being pale greenish gray like the bark of the twig. Gall woody interiorly, the excrescentic portion filled with small cavities. On twig 5 to 6 mm. in diameter, but spread to 7 mm. at center of gall.

One specimen. Occupants unknown.

Tumor-like Gall.—Length, 12 mm.; width, about 5½ mm.; height (from twig), about 4 mm. Elongate, in shape something like a miniature mud-wasp cell, growing lengthwise on twig like an elongate tumor, one side broadly amalgamated with body of twig. Externally rather smooth, being wholly covered by the distended bark of the twig. Pale greenish gray in color, like the adjoining bark. Gall maker emerges by a circular exit hole 1 mm. in diameter, situated at the tip end of the gall, which is the more pointed end without reference to its being distal or proximal on the twig.

Three galls approximated on same twig, two being grown into each other side by side. A gall fly had escaped from each gall at some time previous to April 3, 1893. Two of the galls showed the exit hole conspicuous and open, but the third appeared to be still tenanted. On examination, however, it was found that the fly had escaped from this one also, but the circular flap of bark, which either the larva cuts on all sides but one before assuming the pupa state or else the adult cuts before it can emerge from the pupal cell, leaving a hinge-like portion intact, had sprung back in place perfectly closing and concealing the place of exit. From the cast pupal skins which remained in the cells, the occupant is apparently hymenopterous.

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

The larval gallery in one gall was 5 mm. long, by 1 mm. wide. In the other two galls there was nothing but the short terminal cell in which the pupa had lodged until it transformed, being just large enough for its accommodation, the larval gallery having evidently been lost and absorbed during the growth of the twig. In fact, the pressure of the growth was so great that the impression of the pupa was left in the walls of the cell.

—C. H. TYLER TOWNSEND.

A Woolly Leaf-gall on Oak near Grand Canon.—On the approach to the Grand Cañon, by the wagon road to Hance's, July 7, 1892, numerous specimens of a woolly or fuzzy-looking leaf gall were found on a low growth of a *Quercus* much resembling *alba*, at a point several miles from the rim of the cañon. This oak has been identified by Mr. F. V. Coville as *Q. gambelii.*

Gall.—Length, 5 to 9 mm.; greatest width, 3 to 5 mm.; height, 2 to 3 mm. Formed on upper side of leaf, but also showing below, irregularly oblong in outline, nearly always narrower at one end, always on one side of the midrib, extending usually from midrib to margin. Consisting simply of a portion of the leaf puckered up or elevated above the surrounding portion, both surfaces (upper and under) being equally and thickly clothed with very fine woolly but nearly straight hairs, standing straight out from the surface from which they sprung. Pubescence whitish with a greenish, or with a slightly yellowish tinge at least in dried specimens; apparently but an increased abnormal development or hypertrophy and multiplication of the naturally very short pubescence of the oak leaf, very thick and of equal length on upper and lower sides. The pubescence is $\frac{3}{5}$ to $\frac{4}{5}$ mm. long. The puckered portion of the leaf which is elevated and bears this pubescence is not thickened, but of same thickness as rest of the leaf, thus making the thickness of a vertical section of the gall about $1\frac{3}{5}$ mm.

Described from 9 or 10 galls. There is no sign of the gall-maker, and it is hard to see what the larvæ of the latter would feed on unless they are microscopic. It seems certain, however, that this is a gall formed by some insect.

—C. H. TYLER TOWNSEND.

A Hymenopterous Gall on the Creosote Bush.—A peculiar spherical twig gall, much resembling in its formation the fruit of the buttonwood or plane-tree, has been frequently found on the creosote bushes (*Larrea mexicana*), on the mesa to the east of Las Cruces, New Mexico. All the galls of this species that have been found, however, have invariably been dried and dead ones. No green ones have been met with. The following description is drawn from old galls.

Gall.—Diameter, 18 to 27 mm. Rounded, more or less spherical in general shape, always formed around the twig which usually represents the axis of the gall; consisting of a rather hard central portion formed of resinous closely packed layers of very narrow leaflets radiating in all directions from the central point outward. The larvæ of the gall-maker live and transform in rather closely approximated cells on all sides, in this portion, with their ends all pointed to the center. Outside of this cell-containing portion, the very narrow leaflets, which nearer the center are closely packed into a resinous and nearly solid mass, are prolonged each one separately but more or less disposed in whorls, thickly covering the whole outer surface of the gall. These give the gall a coarsely fibrous appearance, as if it consisted of a knotted bunch of coarse fibers with the ends all sticking outward on the surface. The color of the dried galls is brown, varying from light to dark; that of the growing gall is doubtless green. The cells above mentioned, in which the gall occupants live, are rather elongate, pointed at the inner end, slightly flattened, about $1\frac{4}{5}$ mm. in greatest width one way by $1\frac{1}{5}$ mm. the other, and about 4 mm. long.

Described from three galls collected May 15, 1891. They are with hardly any doubt hymenopterous. Galls contain no remains of occupants. In plan of structure this gall greatly resembles that formed by a species of *Andricus* on leaves of scrub oak in the Organ Mountains. (See Can. Ent., 1892, p. 200).

—C. H. Tyler Townsend.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Exposicion Historico Americano, Madrid, Spain, 1892. (*Continued from p.* 843).—I may be excused if I should give, in a most general manner, some intimation of the displays made by other countries of which we have no catalogue and no report. I should premise this by saying that this Exposition was the finest Pre-Historic or Proto-Historic or Archæologic display of American objects probably ever united under one roof. While we might be able to find more extensive displays from the United States than were here shown, and they might find in Mexico more extensive displays of Mexican antiquities than were at Madrid, and so on with regard to every country of America; but in this Exposition all these good things were brought together, and one had the opportunity, by passing from one hall to another to see the representatives of the good things of all countries. This made it the best thing of its kind ever produced.

Nicaragua adjoins the United States of America. A large proportion of its antiquities came from the Islands of Zapatera and Solentiname, in Lake Nicaragua. A leading object was a sample idol of stone from Zappatera similar to those in my department from the same locality. There were many objects in gold, not the same as those from Chiriqui or Antioquia, but bearing resemblance thereto. There were arrow- and spear-points of obsidian, the polished stone hatchets and similar objects showing them to belong to the Age of Polished Stone. They had quite a number of mealing stones—metates—some with legs and animal feet and animal heads, and altogether curiously-worked objects of art. They had a mass of pre-historic pottery, the shoe-shaped urn, the yellow and red decorated pottery, tripod bowls or dishes. Mr. Myorga, the head of the Commission, classed these as Aztecs, or as having a relation to the Aztec civilization.

Guatemala had an extensive display of antiquities. Stone idols mealing stones—metates—decorated with the heads of animals, stone tables, pestles, hammers, cores, chips, flakes, and arrow-and spear-points of obsidian. They had a fine display of pottery of all kinds and sorts, plain and decorated, of various sizes, and making as complete a series as possible. Their Spanish antiquities, or those brought to them or left there by the Conquistadores, were of considerable number and of

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

great interest—swords, halberds, spikes, pieces of armor, clothing, etc., etc. They had not a few literary works of literary and historic value, ancient books in manuscript, olographs and autographs of their great men.

The History of the Province of San Vicente Ferrer, a work by the Friar Francisco Ximenez, which, at whatever time it was commenced, seems to have been finished before 1720; another, "Isagoge Apologetico, General de las Indias." Photographic reproductions of the original volume of the history, by Bernard Diaz.

The Dominican Republic.—This little country was represented in greater part by historic than by prehistoric objects. Its cargo was composed principally of those objects which related to the Spanish occupation. One of principal interest was the First Cross. It was made of wood, erected in the first church that was established in the western world. Some of the stones of that construction, the plate, and similar objects, had greater value to the eyes of the Dominicans than others of greater scientific value.

In the display of Peru, the Argentine Republic and Uraguay, they exhibited more of the Inca civilization than of the Aztecs. The display was not formidable in numbers, nor were the objects of great size, but there was enough to assign them to the same scale of civilization as that which belonged to the Age of Polished Stone. There were objects of copper and gold.

Ecuador had an abundant collection of pottery of different forms, as of vases, dishes, platters, cups, figures of animals, and human representation, etc., of the usual form—the antique stone-work of the same description, polished stone hatchets, stone mortars, mealing stones, pestles, and copper implements, etc.

One of the peculiar objects presented in the Exposition at Madrid (and there were only three of them in the entire Exposition) was a Mummified human Head, the bones having all been removed, and it being reduced in size to about that of one sixth, skin and features all retained in proper proportion, the hair long and black, with a half-dozen strands of cord drawn through the lips.

Costa Rica was represented by her Minister, Senor Peralta, by Mr. Alfaro, Director of the National Museum at San José, and by Mr. Ferraz. Costa Rica had two large rooms assigned to her, and though one of the smallest countries, she filled and adorned with beauty and taste, the large space assigned to her. She displayed a considerable number of large stone objects, exceeding, in this regard, almost any other of her sister countries—stone objects in human form, others in animal form and apparently of natural size. The display of pottery was large and that shown was of a superior order. This collection was very extensive, and included every kind, both in shape and size, of pottery which belonged to the country. But that which was particularly interesting about Costa Rica was her unusually large display of gold objects. The greater part of these had never been shown in any public exhibition; they had been, for the most part, excavated and exhumed by Mr. Alfarro himself, or through his immediate exertions. I had no opportunity to examine them save in a slight and cursory manner; it would seem to be established that they were made, in addition to other supposed methods, by melting and casting. I had the privilege of taking some of them apart myself and choosing those pieces which had the greatest appearance of solder. I found no trace thereof, but it appeared impossible to have been done otherwise than by casting. I would not be understood to intimate that all of them were made thus, nor that none were made by soldering.

Sweden and Norway.—These two countries which occupy so close a relationship politically, were very properly installed together. Baron Nordenskiold was the Chief Commissioner, with Professor Bovallius for his aid. The center of the hall was occupied by a large glass case, the dimensions of which were to be counted by yards. It contained a model of the ship Vega, in which the Chief Commissioner made his celebrated discoveries and voyages in 1878–80. Arranged in the same case and making part of the display, were the various implements, tools, weapons, arms, domestic utensils, ornaments, dress, etc., of the people visited during the voyage. Associated with them were the Kyaks of Alaska, all the dress of the fishermen and hunters while on the water, and their arms, instruments and weapons.

One of the most interesting displays of the entire Exhibition was the ancient maps, the nucleus of which was the private collection of Baron Nordenskiold, and which he had been forming during many years past—atlases, maps, charts, globes, etc., were here without number—some of them the rarest and most valuable to be found. One corner of the hall was devoted to the discoveries and investigations of Mr. Gustavus Nordenskiold, the son of the Baron, among the Pueblos and Cliff-dwellings of Arizona and the Cañons of the San Juan and its tributaries. The volume containing a description of his discoveries, with all the necessary illustrations, is now in course of publication in Sweden, to be made in English as well as Swedish, and intended to be a rich and valuable volume.

Collections of Archæologic specimens by Dr. Bovallius during his visit of exploration in Nicaragua, were here displayed, as well as the same in the Antilles by Dr. Hjalmarson. Norway presented but a small display, the principal and most attractive item of which was a model of the great Viking ship which had been excavated from the tumulus of Godhav'n, now on display in the Archæologic Museum at Christiania, a smaller model of which is in the National Museum.

Denmark had a modest display, considering her Archæologic riches, but she was bound by the condition governing this, that, though but a novel and interesting departure, her display was confined almost exclusively to the discoveries made by the Danes through Iceland upon the Atlantic Coast, and so here was to be found a good representation of Greenland and Eskimo life from that country. Accompanying this Greenland display, were maps, charts, publications of every sort relating to the early discovery of America by the Norsemen. The maps, real or imaginary, of Massachusetts Bay and the coast of New Jersey, with the supposed voyages of the discoverers of the X and XI Century, at least in completeness. Whatever of relics that could be gathered were here displayed, and, altogether, it was the most satisfactory argument in favor of the discovery of America anterior to Columbus that has ever been made.

Germany.—The German representative was Dr. Ed. Seler, and he presented, in the hall allotted to him, the riches of the German Museum as they have been gathered during the many enterprising voyages of scientific investigation which his country has started throughout the Western Continent. Dr. Seler's investigations and discoveries in Guatemala, Honduras and the Mosquito Coast were here exhibited the form of a plaster or pulp reproduction of a score or more great Aboriginal monuments of those countries, so strange and wonderful, so little known. The investigations of Reiss and Stübel in Peru and representatives of the great collection made by them—first, of painted and decorated pottery, and second, of the polochromatic textile fabrics, was much to be admired.

United States of Colombia.—This country had but a small display. It was visited by me two or three times, each time with increased interest. Although I saw other objects during my first visit, my attention was soon attracted to the display of gold objects which this country possesses from the interior Province of Antioquia.

The National Museum possesses 20 or 30 of these gold specimens of this country, and feels that it already possesses a sufficient number and must decline to increase that number by purchase. Imagine my surprise to see in the display of this little country, sloping shelves, three or four feet wide, covered with black velvet, running along an entire side of the room, however, within glass cases which were abundantly guarded, and dotted over this black velvet were gold objects to be counted by the hundred—how many there were, I do not know. There were parts of two collections, one of which cost in Colombia, $75,000, and the other, that of Don Restrepo, who was present representing his country at Madrid, which cost $30,000. I, as Curator of my Department, had selected my little display of gold ornaments and taken them to Madrid, intending them for exhibition, but when I saw this magnificent and glittering display of prehistoric gold ornaments from this little country, I decided I could never put mine on display, and, upon preparing for my return, carefully packed them up and brought them home with me, and they are now displayed in their usual place in my department of the Museum.

Mexico.—She is our neighbor at home and she was our neighbor at the Exposition. She occupied about the same number of rooms as we did. While she had more objects, they were smaller and did not take so much space. I give the nearest sketch of some of the objects presented by Mexico, principally from memory: Models and reproductions in plaster, paper or staff of several of the principal monuments of their country. All that we have in our Museum of the Abadiano and Lorillard Collections were thus represented, if I may except the Calendar Stone, which unfortunately met with an accident well provided against, but which wrought its destruction. The monument was natural size, the same as we have in our museum, and was made of paper pulp; to guarantee safe carriage it had been hermetically sealed and soldered in a case of sheet lead, and this, with the necessary protecting straw, etc., was, in its turn, placed in a wooden box. It was brought by ship and landed at Santander. The attempt to bring it down through Spain by car, proved it to be too large to pass through tunnels and similar narrow places, and it therefore had to be brought by wagon. At some part of the voyage it was necessary to move or change the object, and for that purpose wooden strips had been nailed along the sides of the case to be used as handles. When placed on the wagon for transportation, these strips were pulled off and the nails by which they had been fastened, pulled out, leaving nail-holes upward and exposed to the weather. It rained upon the load nearly every day of the transport across the mountains, and enough water trickled through these nail-holes to dampen, then wet, and finally destroy the paper pulp of which the model was made, and when it was opened in the palace, it had been resolved into its original pulpy condition. The Stone of Sacrifice, the God of Silence, Teoyoamiqui and all the rest came through in safety. The Mexican section displayed models in wood, of several of their antique monuments, and sometimes the country around them on a reduced scale. The Aztec town of Zempoala, the Pyramid of Papaulta, and the Ruins of Xochicalco, were fine models. They occupied places in the center of each room. There were the usual amount of antique armor, arms and instruments, stones, ornamental utensils, and worked bone. There were a hundred or more of the T-shaped copper implements, quantities of pottery, etc. There was a fine series of plaster reproductions of the ancient inhabitants, showing individuals of both sexes and all ages, and attempting to reproduce the races or tribes from the different provinces. This reconstruction extended to their clothing and equipments, their arms, offensive and defensive, tombs, utensils, household and ceremonial, and the original adornments of gold and other reproductions. There was a fine series of maps, charts, and the originals of two Codicxes with paintings and sketches.

This display was intended at the time of its preparation in Mexico to be transported to Chicago for the World's Columbian Exposition, but the postponement of closing time at Madrid, and the necessity for its shipment *via* Havana prevented. Could this display have reached Chicago, Mexico would have appeared to much better advantage in this department.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Proceedings of the Botanical Club, of the Forty-second Meeting of the A. A. A. S., Madison, Wisconsin, August 16–22, 1893.—(Condensed from the Secretary's notes.)—Friday, Aug. 18.—The president and secretary being absent, the club was called to order by the vice-president, Professor W. A. Kellerman, and on motion W. T. Swingle was elected Secretary.

The committee on Nomenclature, continued from the last meeting, made the following report:

"To the Botanical Club of the A. A. A. S.: Your committee appointed at the Rochester meeting to prepare a check list of the flowering and fern plants of northeastern North America on the rules of nomenclature adopted by the club at that meeting would respectfully report:

"That the task assigned the committee has been performed, and the manuscript of the list is herewith presented, nearly complete for printing.

"The committee presents the following recommendations:

"1. The amendment of section III of the Rochester code of nomenclature by striking out all after the word 'retained.'

"This recommendation is based on the mature judgment of the committee after watching for a year the progress of the demand for a rule which shall permit no exception whatever, and effect the closest approximation to the immutability of the specific name.

"2. The publication of the check list for the club by the committee and the continuance of the committee for that purpose.

"3. That the form and the time of publication be referred to the committee with power to act.

"4. That the general sequence of the natural orders as taken up in Engler and Prantl's "Natürlichen Pflanzenfamilien" be adopted.

"5. That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, priority of place shall decide.

"6. That in the elevation of a plant originally described as a variety to a species, or the reduction of a described species to a variety, the original name shall in all cases be retained."

On motion the recommendations were taken up in order for discussion and action. The first recommendation was adopted after some discussion. On motion the consideration of the second recommendation was postponed until after the others were disposed of.

On motion the third recommendation was also postponed.

On motion the fourth recommendation was adopted unanimously.

On motion the fifth recommendation was amended to read "That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, precedence shall decide. On motion it was adopted as amended.

The sixth recommendation was discussed some time but was not brought to a vote before the club adjourned until Monday.

Monday, Aug. 21.—On motion the chair was authorized to appoint a committee of two to nominate officers for the next meeting. Prof. A. S. Hitchcock and Dr. Erwin F. Smith were placed on this committee.

On motion the remaining portions of the report of the committee on nomenclature were referred back to the committee with instructions to report Tuesday morning.

The report of the treasurer was then read, showing a deficit of $6.16. This deficit was liquidated by voluntary contributions.

The following papers were read:

Mrs. E. G. Britton, "The genus Bruchia in North America, with description of one new species." Mrs. E. G. Britton, "The necessity of seeing types." Prof. A. S. Hitchcock, "*Ampelopsis quinquefolia* var. *vitacea* Knerr." Dr. J. C. Arthur, "Exhibition of a centrifugal machine." The instrument is a new one devised by the author, costing much less than those made in Germany. Mr. T. C. McDougal, "Intertwining of tendrils." Mrs. E. G. Britton, "Jaeger's Adumbratio, and herbarium of mosses." The whole moss herbarium of Jaeger on which the Adumbratio was founded has come into the possession of Columbia College. Dr. W. A. Kellerman, "Notes on the exploration of the flora of Ohio." Prof. A. S. Hitchcock, "Pollination of *Œnothera missuriensis* and *Pentstemon cobæa*."

Dr. D. H. Campbell, "Prothallial stage of Ophioglossaceæ." Records finding during the present year what are with little question the prothallia of *Botrychium*. Dr. Erwin F. Smith, "The increasing prevalence of a root disease of stone fruits." Dr. C. E. Bessey, "The use of personal names in designating species." Objects to the abuse of this practice by botanists.

Tuesday, Aug. 22.—The following were elected officers for the next meeting:

President, Dr. D. H. Campbell, Leland Stanford Jr. University, Palo Alto, California; vice-president, Professor D. C. Eaton, Yale College, New Haven, Conn.; secretary-treasurer, W. T. Swingle, U. S. Sub-tropical Laboratory, Eustis, Florida.

The committee on nomenclature then reported that they had recon. sidered all the remaining portions of the report which had been referred back to them, and were unable to bring in any other recommendations. On motion these remaining portions of the report were referred to the committe with power to act, and the committee was continued.

The committee appointed at the Rochester meeting to consider the feasibility of establishing an American Botanical Society presented a majority report adverse to forming such an organization at the present time and place. Prof. C. R. Barnes then presented a minority report favoring the project, and outlined a plan of organization, providing for a committee of twenty-five to constitute the charter members.

On motion the minority report was adopted by a vote of 21 to 10.

The committee of twenty-five is as follows: J. C. Arthur, Lafayette. Ind.; G. F. Atkinson, Ithaca, N. Y.; L. H. Bailey, Ithaca, N. Y.; C. R. Barnes, Madison, Wis.; C. E. Bessey, Lincoln, Nebr.; Mrs. E. C. Britton, New York, N. Y.; N. L. Britton, New York, N. Y.; D. H. Campbell, Palo Alto, Cal.; J. M. Coulter, Lake Forest, Ill.; F. V. Coville, Washington, D. C.; D. C. Eaton, New Haven, Conn.; W. G. Farlow, Cambridge, Mass.; E. L. Greene, Berkeley, Cal.; B. D. Halsted, New Brunswick, N. J.; Arthur Hollick, New York, N. Y.; Conway Macmillan, Minneapolis, Minn.; B. L. Robinson, Cambridge, Mass.; C. S. Sargent, Brookline, Mass.; F. L. Scribner, Knoxville, Tenn.; J. D. Smith, New York, N. Y.; Roland Thaxter, Cambridge, Mass.; Wm. Trelease, St. Louis, Mo.; L. M. Underwood, Greencastle, Ind.; L. F. Ward, Washington, D. C.; W. P. Wilson, Philadelphia, Pa. The reading of papers was then resumed as follows:

Dr. J. C. Arthur, "A self-registering auxanometer." A relatively inexpensive instrument devised by the author. Dr. B. D. Halsted, "A new Exobasidium on Andromeda." Dr. B. D. Halsted, "Phyllosticta following insect work." Dr. B. D. Halsted, "A white-smut new to America." Dr. B. D. Halsted, "A water-loving Ascomycete." Mr. W. T. Swingle, "A new palm from Florida." Mr. W. T. Swingle, "The southernmost botanical laboratory in the United States." Giving a short account of the Sub-tropical Laboratory of the Division of Vegetable Pathology, lately established at Eustis, Florida, by the U. S. Department of Agriculture. A. B. Seymour, "Synonymy of *Valsa* *stellulata* and its allies." A. B. Seymour, "A key to species of Cladonia." Mr. Seymour exhibited this key, the work of F. L. Sargent. S. A. Beach, "Some observations on black-knot."

For want of time the following papers were read by title: L. H. Bailey, "Sand-Dune weeds." W. W. Rowlee, "The propagation of *Ranunculus delphinifolius* by runners." E. J. Durand, "Some notes on the germination of the spores of *Enteridium rozeanum*." C. V. Riley, "Herbarium entomology." C. V. Riley, "Yucca pollination." B. T. Galloway, "Notes on 'hexenbesen' of Rubus." B. T. Galloway, "Some methods employed in the investigation of parasitic fungi and other organisms."

Upon motion two members were added to the committee on nomenclature. Dr. Wm. Trelease, and Dr. E. L. Greene were named.

The club then adjourned until the next meeting of the A. A. A. S. —Charles E. Bessey.

SCIENTIFIC NEWS.

Among the recent deaths we notice those of Leonard Blomefield, the veteran naturalist of Bath, England; George William Shrubsole of Chester, England, aged 66; Miss Anne Pratt, the author of "Flowering Plants and Ferns of Great Britain," aged 87; the geologists, D. Homfray and George Robert Vine; and Franz Kiaer, the bryologist of Christiania, Norway.

Many Americans will learn with regret of the recent death of Mr. George Brook. He was born at Huddersfield, England, in 1857, was trained in business in his father's cotton mills, but soon turned to science. His early work was done in an admirably equipped private laboratory at home where he maintained marine aquaria and studied the embryology of the Teleosts. In 1884 he became connected with the Scotch fishing board and in 1885 was appointed lecturer on embryology to the University of Edinburgh. Among his more important papers may be mentioned his "Challenger" memoir on the Antipatharia and his catalogue of the Madreporarian corals of the British Museum, one volume of which was issued just before his death, which occurred August 12, as the result of sunstroke.

Mr. James William Davis of Halifax, England, died July 21, 1893, at the age of 47. He is best known for his monographs on the fossil fishes, the results of studies carried on in moments snatched from the large business enterprises carried on by himself and his brother.

D. T. Macdougal, formerly assistant in the biological laboratories at Purdue University at Lafayette, Indiana, has been appointed instructor in plant physiology in the University of Minnesota.

Dartmouth College is to be congratulated in its call of Dr. William Patton to the newly established Chair of Biology.

Professor Dr. J. Sollas has been appointed petrologist to the geological survey of Ireland.

Dr. A. Dendy, well known for his researches on sponges, has been appointed Professor of Biology in Canterbury College, Christchurch, N. Z., and will enter upon his duties there, February 1, 1894.

Mr. E. Uline has been appointed Curator of the Herbarium in Lake Forest College, Lake Forest, Ill.

Maximilian von Hantken, the Hungarian geologist died last June. He was professor of Palæontology in the University of Buda Pesth and councilor of the Hungarian Ministry.

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ON THE GENERA OF THE DIPNOI DIPNEUMONES.

BY HOWARD AYERS.[1]

The Dipnoi are a group of piscine vertebrates, unusually interesting, alike to the morphologist, the paleontologist and the physiologist. Hitherto these animals have proved, in many respects, unsatisfactory objects of study, since the existing forms have been accessible to but few workers, and then only as more or less poorly-preserved alcoholic specimens. Only within the last few years has this condition of things changed so that quite recently our knowledge of this group has been enriched by many interesting and important additions to the morphology, physiology and the general biology of two of the members of the group representing the two commonly accepted genera.

The papers containing the results of the researches upon the living specimens of *Lepidosiren annectens* we owe to Professor J. Waldschmidt, who has worked out the Dipnoan brain from the comparative standpoint, and in histological detail, and to Professor W. N. Parker, who has studied in more or less detail almost all of the organs of the body except the skeletal and nervous systems. His study was directed to the solution of the numerous points left unsettled by previous workers who were less favored in the quality of their material, and not to a fundamental research into the nature and relationships of any

[1] Director of the Lake Laboratory, Milwaukee, Wis.

of the organs of the body. Professor Parker has gone over the ground covered by my paper on the anatomy and physiology of the Dipnoi,[2] and has cleared up some of the things which I was unable to carefully study, owing to the fact that the only material accessible at that time consisted of store-bought alcoholic specimens, intended, without doubt, for museum collections. Hence, it not unfrequently happened that questions depending upon histological detail could not be satisfactorily or finally solved. On the other hand, Parker has arrived at some conclusions which I think are hardly justified in the present state of our knowledge, and it is to these matters that we will now confine our attention. In my Freiburg paper I suggested that it was hardly permissible to maintain two distinct genera of the Dipneumones, and I based my suggestion upon the lack of adequate structural differences between the forms commonly held to be generically distinct. I proposed on that account to use the name *Lepidosiren* instead of the name *Protopterus* for the African species, and I called attention to the great scarcity of the individuals of *Lepidosiren paradoxa* in museum collections.

My remarks, and more especially the adoption of the name *Lepidosiren* as the sole genus of the *Dipneumones* had the effect of calling out a reply from the late Professor Anton Schneider, of Breslau,[3] and also an article by Dr. George Baur,[4] of Chicago University.

Quite recently, Parker publishes his agreement with the conclusions of Schneider and Baur as far as the generic distinctness of the African form is concerned. It may be of interest to the uninitiated to know that none of the recent writers have ever seen a fragment of a *Lepidosiren paradoxa* from South America, and we all alike depend upon the published accounts of this creature's anatomy by Bischoff, Hyrtl, Klein, and a few others, all of whose investigations were made on two or, at the most, three animals, and some of the workers had at their disposal for study only the material which had already been dissected by their predecessors, e. g., Hyrtl. Their papers were published some years ago (in the 40s or 50s), and leave much to be desired when examined for the solution of the problems of to-day.

Schneider's paper was based upon original investigation of a considerable number of African mud-fish from several widely-separated localities, and his conclusions are that *Protopterus* is not only generically distinct from *Lepidosiren*, but that there are also two well-defined species of the African form, to be separated on account of the number of ribs, the presence or absence of the cartilaginous fin-rays and some other characters of no importance here. Baur's paper is an historical resumé of the main facts about *Lepidosiren paradoxa*. In general, however, the reasons which have been given for keeping *Protopterus* distinct from *Lepidosiren* may be concisely stated as follows:

1. The presence of 4 gill-holes in *Lepidosiren* and 5 in *Protopterus*.

2. The presence of a larger number of ribs in *Lepidosiren*.

3. The absence of fin-rays in *Lepidosiren* and their presence in *Protopterus*.

4. The absence of external gills in *Lepidosiren* and their presence in *Protopterus*.

I shall now endeavor to show that the critics of my suggestion of the generic identity of these two forms have failed to bring any proof that it is not entirely reasonable and highly probable, and by their own investigation have weakened their case by discovering facts which go to prove the close relationship of these animals.

THE GILLS.

All the writers on this subject have failed to see the important agreement between the gill structures of *Lepidosiren* and *Protopterus*, and have been led off to base important conclusions on a relatively unimportant point in their anatomy. The statement which Schneider and Baur base so much upon, viz.: that *Protopterus* has 5 gill-slits, while *Lepidosiren* has only 4, certainly looks important enough to give the advocates of a genus apiece for these creatures ample warrant for their conclusions; but when we examine the actual significance of this difference in the number of holes in the side of the neck, most if not all the value of this character is destroyed, for the number of functional gills is the same in both animals.[5] The facts are that both animals have 5 gill-bars, but only $2\frac{1}{2}$ gills; that the first and second gill-clefts are in both forms devoid of a respiratory membrane or structures, although their secondary blood supply through the bronchial artery still persists. These two pair of gills are completely atrophied in both creatures physiologically since they no longer serve in respiration, and the denuded slits are subject to that variation which is the fate of all rudimentary organs. The first slit suffers most and is greatly reduced. In the two (or three?) specimens of *Lepidosiren* which have, up to date, been dissected, the edges of the slit seem to have grown together, while in *Protopterus*, though the slit is still open, it is very much reduced, being smaller than any of the other gill slits. I venture to say that no very large number of individuals of *Protopterus* have been examined with special reference to this point. However that may be, the coalescence of the walls of a degraded gill-slit is not a character of sufficient morphological importance to found a genus upon, except, perhaps, in the eyes of a confirmed genus builder.

In both forms neither the first nor second gill-bars bear any gill membranes, but both possess an hyoidean demibranch (opercular gill rudiment). This gill is composed of a single row of gill leaflets as in *Ceratodus*. The third and fourth gill bars are provided with a double row of gill leaflets, while on the fifth arch is found only a single row of leaflets, a condition not obtaining in any other *Dipnoan* or *Ganoid*.

When these animals were named, they were little known to science. If they had to be named as new discoveries to-day, and could both be studied together in so doing, most zoologists would include both animals in one genus, even if they did not group them as varieties of one species.

I wish to call the attention of those anatomists who would insist upon keeping *Lepidosiren* and *Protopterus* distinct upon the basis of the number of gill clefts left open irrespective of the fact that the number of functional gills is the same, to the fact that there are other fish with a variable number of gills which are considered by as good authority as Johannes Müller, to the extent of his knowledge of the case, to be *mere varieties* of *one species.* Müller found among the *Bdellostomæ* from the Cape of Good Hope, individuals with 6 pairs of gills, others with an extra gill added to one side of the body, and still others with 7 full pairs of gills.

I have ascertained that, taking all the *Bdellostomids* together, they form a series in which the gill variation runs between the minimum of 6 pairs and the maximum of 14 pairs, or a DIFFERENCE BETWEEN THE EXTREMES OF 8 PAIRS OF GILLS, AND YET ALL THESE INDIVIDUALS NOT ONLY BELONG TO THE SAME GENUS—THEY BELONG TO THE SAME SPECIES !

THE RIBS.

The number of ribs has been selected by Schneider as a character of *generic* as well as specific value. The possession of 56 ribs is held to be characteristic of *Lepidosiren parodoxa.* Considering the small number of individuals examined, this cannot justly be said to be a settled fact. Schneider's diagnosis of 30 ribs for *Protopterus amphibius*, and of 35 ribs for *P. annectens* as a safe specific character, is, to say the least, ill-chosen, for the reasons that the number of ribs varies in specimens from the same locality, which have no other distinguishing characters save another variable, viz.: the presence or absence of external gills, and for the further reason that some authors (Owen, loc. cit. p. 47) have counted at least 37 ribs in *P. annectens.* Schneider failed to define what structures he would have counted as ribs; but I assume he would admit all rib-like processes attached to the bare notochord between the pectoral and pelvic girdles as entitled to be named ribs irrespective of questions of homology. THE NUMBER OF SUCH PROCESSES IS INCONSTANT IN *Protopterus*, but the extremes of variation have not been definitely made out. The number probably varies with age, but this is not certain.

Parker[6] has shown that Schneider's second species of *Protopterus, P. amphibius* is a mistake. Schneider gives the Gambia as the habitat of this species. The distinctive characters separating this species from *annectens* are the presence of lateral cartilaginous rays in the fin membranes and only 30 ribs.

Schneider describes the fins of the *Protopterus* material which Peters brought from Quellimane as long and pointed, but flattened appendages. This was found to be true of the pectoral fin, the pelvic fin being thickened at its base. The cartilaginous axis of each fin bears on one side several cartilaginous rays which support the membranous border of the fin. This border is, in turn, stiffened by numerous horny filaments (horn-rays). This membrane is found on the ventral edge of the pectoral fin. Schneider found cartilaginous rays in *P. amphibius* only.

Parker states that his animals were from the Gambia, and that the specimens which he "examined for the purpose possess in the middle part of the fin, numerous cartilaginous parameres on each segment in both fins," which, according to Schneider, is one sure sign of *P. amphibius*, but Parker's animals also had 35 ribs, which is one of Schneider's marks of *P. annectens*. Parker concludes that there is possibly considerable variation in both these structures within the species, and this agrees with what Wiedersheim has previously found with respect to the FIN MEMBRANES, irrespective of their supporting structures.

EXTERNAL GILLS.

Owen,[7] McDonnell,[9] Schneider,[3] Wiedersheim,[14] Peters and Parker[6] describe or mention the existence of external gills in specimens of *Protopterus* from the different localities of Africa. Owen's observation has already been referred to. McDonnel simply states that he found three processes, rudimentary external gills the longest of which measurd 4‴.

Boas makes the following statements concerning the external gills of the African mud fish.

" Uber die sogenannten äusseren Kiemen von *Protopterus* müssen wir ein Wort sprechen. Die betreffenden Gebilde waren bei den zwei von mir untersuchten *Protopteri* sehr klein, offenbar ohne jegliche Funktion. NACH PETERS SIND SIE DAGEGEN BEI JUNGEN EXEMPLAREN STÄRKER ENTWICKELT. Ich glaube dass man diese organe . . . . am richtigsten, oder wahrscheinlichsten, in die Reihe der vielfachen accessorischen Athmungsorgane, die wir bei Fischen finden, stellt. Ich finde es ferner sehr zweifelhaft, ob sie etwas mit den äuseren kiemen von *Polypterus* gemein haben die anderen Ursprungs, anderen Baues ist und von anderun Blutgefässen versorgt wird."

The branchial blood-vessels, as described by Peters and Owen (for *Protopterus*), are very different structures.

Parker found external gills in all of the specimens examined by him, but his largest were still comparatively small animals. He quotes Peters as finding them on fish 2–3 feet long, and that in young specimens they are thinner, while in old specimens they are broader. Parker asserts that my statement that these gills are only present in young animals is certainly incorrect. Boas quotes Peters as above, which is not in harmony with Parker's use of Peters' words. The majority of writers on this point agree that they belong to small or young animals, as is the case with the gills of *Polypterus*, and Parker's material was not sufficient to add anything to the settlement of this question.

With reference to the food habits of *Lepidosiren annectens*, there is no longer any doubt as to its omnivorous tastes.

Professor Parker has shown that it may, at times, be cannibalistic, but he errs in supposing that I maintained that it had entirely changed its food habits. Starting from supposed carnivorous ancestors, I claimed that *Ceratodus* had become essentially herbivorous in its habits, while *Lepidosiren* had only partly modified its habits in this respect. On page 510 of my Freiburg paper, Professor Parker might have read: "Der Darm ist bei Ceratodus stärker verändert, als bei *Lepidosiren*, und diese Verschiedenheit correspondirt mit der Grösse der veränderung, die Function erfahren hat," and further, that "Das Futter des Ceratodus besteht gegenwärtig aus verschiedenen, kleinen Mollusken (reichliche Schale von Gasteropoden und Lamellibranchiaten fanden sich im Darme), Gras, Riethgras und Zahlreichen anderen Pflanzen stücken." And I further ascertained that while the plant remains were not masticated, the shells had all been crushed to fragments. Now, if *Ceratodus* eats animal food, and has been modified more than *Lepidosiren* in the direction of herbivorous diet, it follows that *Lepidosiren* is also partly carnivorous.

The quotation which Parker makes from my paper, referring to the breeding habits of the Dipnoi, applies to *Ceratodus* only, and not in any part to *Lepidosiren*, and the trouble arose in the transposition by the printer, of the reference number which occurs in my MS. after the word "Beobachtung," to the next line of the printed text. The transposition escaped correction in the proof. The authority for the statement is, to the best of my recollection, *The Zoologist*, 3d Ser. Vol. VII, 1884 (?).

After a study of the pectoral fins, to which Professor Parker devoted his special attention, he concluded that they do not serve the function of feelers. This conclusion is not well-grounded, for it rests upon the author's failure to find tactile SENSE ORGANS in the skin of the appendages. Our author remarks "that the nerve supply seems out of all proportion to the rudimentary muscles, and this fact renders the absence of sensory organs all the more surprising," and, on p. 124, "So far as I have been able to observe, *all* the sensory organs in connection with the epidermis have the form of the 'lateral-line organs' described above, and in this point therefore, as in many others, *Protopterus* resembles amphibians more than fishes," a conclusion which, will without doubt prove to be too lightly drawn, for from the knowledge which we possess of nerve endings in the skin of fishes, and the methods of demonstrating them, it should not be a very difficult matter to show that the large nerve supply is, in this instance, distributed to the epithelium of the pectoral appendages in its character of a sensory apparatus.

The nerve supply indicates that the brachial nerve must contain many sensory fibers. It is composed of the first three spinal nerves, the dorsal and ventral roots of the hypoglosal, and a branch of the vagus. There is every evidence that the appendage is a very sensitive tactile organ, and the nerve-end apparatus will be found by making a proper study of the skin.

Referring to the occurrence of taste-buds in the *Lepidosiren annectens*, Parker states that I have described somewhat similar organs on the palate of *Ceratodus*. As a matter of fact, the description I gave applied to both *Ceratodus* and *Protopterus*, though I figured the organs from *Ceratodus* alone. I am pleased to see that Parker is able to confirm my own observations in this respect.

Hyrtl states that the intestinal canal of *Lepidosiren paradoxa* is slightly S-haped in the horizontal plane.

In *Ceratodus forsterii* and *Lepidosiren annectens* I found there was no indication of curvatures in the horizontal plane; but Parker states that he finds the gut in *L. annectens* slightly curved (S-shaped) in the VERTICAL plane, and hence that my statement that the alimentary tract in the Dipnoi is strictly parallel with the notochord is incorrect.

Even Parker's observations show the correctness of my statement, while he says, on page 215, "The alimentary canal extends almost in a straight line from the mouth to the vent," making no mention of curves.

The sensory papilla which I found projecting as a finger-shaped process part way across the anterior narial opening in *L. annectens*, Parker was unable to detect. No histological examination was made of this papilla, but I judged it to be tactile in function and from its location to serve as a guard to the entrance of the nasal chamber.

Our author does not produce any evidence for the support of his change in the name of the URINARY BLADDER to that of the CLOACAL CÆCUM, and he adds nothing to our knowledge of either its structures or its functions, so that any comparison of this organ with the rectal gland of Elasmobranchs is entirely against the known morphological relations of the two organs. The rectal gland of Elasmobranchs is a diverticulum of the gut in close relation with the end of the spiral valve, while the urinary bladder of the Dipnoi is a pocket of the cloaca entirely foreign to the gut, since it lies outside of the rectal sphincter and in close relation with the openings of the kidney ducts.

With regard to the LYMPHOID ORGAN of the mid-gut, which was fully described in my paper, Parker thinks he has positive evidence that it is a spleen, and hence uses this designation throughout. The name was first applied to this structure by Klein. The term spleen in anatomy is used to designate a definite body of lymphoid tissue which is usually more or less closely connected with some part of the mid-gut, though it may lie in the mesentery far from the walls of the gut. The name is strictly morphological in its bearing, and does not carry with it the idea of specific and localized functions. So far as the mass forms a discrete body, the term spleen is appropriately applied to it, for it serves to definitely mark the mass, but when the mass is absent, or, in other words, when the tissue has other relations, e. g., as in the Dipnoi where it is inclosed WITHIN the wall of the gut, we not only do not gain in the accuracy of designation, but we detract from the definiteness of the name as applied to other forms.

In structure, these tissues are not to be distinguished from each other, and if the aggregation in the region of the mid-gut is to be called spleen, those in the hind-gut and fore-gut are likewise spleens. We avoid difficulties of nomenclature if we reserve the term spleen for a discrete mass of lymphoid tissue which lies in the mesentery outside of the walls of the mid-gut.

Professor Parker has done a great service in tracing out the extent of the pancreas which, in the Dipnoi, lies entirely within the walls of the gut between its two coats and which he has described in histological detail for the first time ; but the discovery of the pancreas and its ducts was made by McDonnell in 1858. This investigator made observations on living material which was afterward used for dissections, and he clearly states that the pancreatic ducts empty into the mid-gut in company with the bile ducts. Melville added a note to McDonnell's paper to the effect that both spleen and pancreas were present in the organ which the latter called pancreas.

No one has yet pointed out the very great significance which the condition of the pancreas in *Lepidosiren* has from a comparative anatomical standpoint. It is by far the most primitive condition of the organ known for the VERTEBRATA, since it remains entirely within the intestinal wall lying between the mucous membrane, of which it is an outgrowth, and the muscular coat of the gut and it thus represents a very early stage in the ontogency of the organ as it is developed in other animals.

Professor Parker states that the spiral valve in *Lepidosiren annectens* makes 6 or 7 turns. I found in all the specimens studied, and the point was specially examined, that the number was uniformly eight.

Our author attributes the statement to me that *Lepidosiren* lacks a distinct muscular coat to its stomach, and that in the intestine the musculature is only slightly developed.

On page 491 of my "Beiträge" I state: "Sowohl bei *Ceratodus* als bei *Lepidosiren* sind die Wände des Vorderdarmes auffallend dünn. Bei der maceration traten zwei deutliche Lagen von Muskelzellen hervor. Sie repräsentiren die Längs- und die Ring muskulater der höheren Wirbelthiere und sind sehr ähnlich der Muskelelementen der Cyclostomen, etc."

The passage which Parker alighted upon to misconstrue by taking it away from its context, reads as follows: "Bei *Ceratodus* ist das *Magenende* veshältnissmässig viel weiter als bei *Lepidosiren* (italics inserted here). Eine deutliche Muskulatur fehlt, doch sind zahlreiche spindelförmige Muskelzellen durch das ganze Bindegewebe der submucosa zerstreut."

Parker states that he failed to find the lobulation of the kidneys in *Protopterus* as described by me for the older individuals. My observations were made on a specimen 42 cm. long. The lobules were well-marked, but not so numerous or so sharply defined as in *Ceratodus*. He concurs in my statement that the so-called male organs of writers previous to 1884, were, in all probability, only immature female organs. Parker describes the presence of two vibratile filaments in the spermatozoan of *Protopterus* and considers this condition unique among vertebrates. I have observed the same structure in ripe spermatozoan of *Rhinoptera bonasus*. My observations were made on July 13, 1889, at the Marine Biological Laboratory, and it was found that the apparently single-headed, double-tailed spermatozoan resolved itself into a simple, straight filament, possessing a thickened body in the middle with a tapering filament given off from either end of it. The only difference between the two ends of the central body of the sperm-cell was the presence of the nucleus at one end from which the longer filament was given off. During life, both of these filaments are spirally but loosely coiled about one another, and during progressive motion this arrangement gives rise to the appearance of a vibratile membrane spirally placed on the tail. On adding Perenyi's fluid to the sperm, the cells, one and all, flew out straight and rigid, and the refractive body (nucleus ?) became very distinct in each. I have observed this structure in other fish spermatozoa, but never so distinctly marked as in the cow-nosed skate. It is possible that the double tail of *Protopterus* will be found to be constructed after this plan.

Owing to the very great scarcity of specimens of *Lepidosiren paradoxa*, it may be of interest to many to have a list of the known examples with their present resting places.

The following is a table of all the South American specimens of *Lepidosiren* yet taken and recorded :

Specimen	Discovered by	Locality.	Size.	Condition.	Museum.
No. 1	Natterer	Borba on the R. Madeira, 1836.	3 ft. 9 in.	Dissected	Vienna
No. 2	Na terer	Villa Nova on the R. Madeira, 1836.	1 ft. 10 in.	Dissected	Vienna
No. 3	Unknown	Unknown, 1840.			Paris
No. 4	Castelnau	Ucayali River, 1847.		Dissected	Paris
No. 5	Dr J. Barbosa Rodriguez	Igrapé de Aterro, (Manáos), 1886.	in cm. 85, female	Whole	Florence, Italy.
No. 6	Rodriguez	Autaz, Madeira River,'87	in cm. 40	Whole	Florence, Italy.

The fifth specimen was a female with well-developed eggs, which was caught in August, 1886. It was 85 cm. in length, and 28 cm. in girth at thep ectoral appendages. The body is distinctly cylindrical in shape, but somewhat flattened on the abdominal surface where the scales are bigger, thicker and lighter in color. The tail is short and much compressed, and is provided with an irregularly-rounded caudal fin, which is not continued cephalad as a true median fin, but only as a slight keel to the middle of the back. The fin rays of the caudal portion are cartilaginous. The pectorals and pelvic appendages lack a membranous edging. The pectorals are slender and compressed, while the pelvic appendages are stouter and conical in shape.

The scales are disposed in longitudinal rows, 10 in each, and are of a dark brownish purple color, with distinct blotches except on the belly. The lateral line is double. The eyes are small and lie beneath the skin. The branchial openings are very narrow, and are protected by thick fleshy flaps. External gills are absent, and the internal gills cannot be seen through the deep and narrow branchial slit. The mouth has fleshy lips. The gill-clefts are four in number, the fourth being much reduced. The three free branchial arches are fringed with conical papillae. The cloacal opening lies 10 mm. to the left of the median ventral line.

The sixth specimen comes from the same hands, and is in the Florence Natural History Museum.

It is much to be desired that these well-preserved specimens may become the means of clearing up many points in our account of the anatomy of the Dipneumonous Dipnoi.

[2] Jenaische Zeitschrift Bd. XI, 1885.

[3] Schneider, A., Uber die Flosen der Dipnoi und die Systematik von *Lepidosiren* und *Protopterus*, Zoologischer Anzeiger, No. 231, 1886.

[4] Baur, G., *Lepidosiren paradoxa*. Zoologischer Jahrbücher, II, 1887.

[5] The following notes on the statements given by different authors may be of interest in this connection:

Wiedersheim (Lehrbuch, p. 608) says *Protopterus* has 6 gill-bars and 5 gill-slits, with three and one-half gills.

Owen (Comp. Anat.. p. 468–481, '82, '85, '86) gives the same number of gill-bars, but says that there are 2 biserial, and 1 uniserial gill, besides which there is the opercular gill attached to the membrane supported by the hyoid. That "three seemingly analogous filaments (i. e., analogous to the embryonic external gills of Elasmobranchs) are retained on each side for a longer period in *Lepidosiren annectens*, but lose their vascular and respiratory character before they are absorbed."

Parker gives (Trans. Roy. Irish. Acad., V. 30, pt. 3, p. 161) 5 gill-bars and 4 gill-clefts, exclusive of the spiracle or hyobranchial.

There is a difference of one gill-bar between Parker and all other observers. There is a further discrepancy among observers as to the number of gills. In the case of *Lepidosiren paradoxa*, Bischoff and Hyrtl disagree as to the number of hemibranchs, the former describing the same arrangement of gills for *paradoxa* as exists in *annectens*, but Hyrtl, who worked over the same specimens, says that the gill-plates are absent on the first and last arches, only a trace of them being observable on the fifth. Since Hyrtl studied the material after Bischoff had dissected it, it seems probable that these gill filaments, being tender in nature, were broken away during the previous study, leaving only the " fadenförmigen Zotchen" found by Hyrtl.

[6] Parker, W. N., Anat., Physiol. of *Protopterus*, Trans. Irish Acad., 1892.

[7] Owen, R., Comp. Anat. Vertebrates and Description of *Lepidosiren annectens* Trans. Linn. Soc., XVII.

[8] Giglioli, *Lepidosiren paradoxa*, Nature, 1892.

[9] McDonnel, Anatomy and Physiology of *Lepidosiren annectens*, 1854.

[10] Bischoff, Th. L., *Lepidosiren paradoxa*, Leipzig, 1840.

[11] Hyrtl, J., *Lepidosiren paradoxa*, 1845.

[12] Klein, Beiträge zur Anatomie d. *Lepidosiren annectens*, Jahrb. d. ver. f. Naturk. in Würt., 1864, XX.

[13] Burckhardt, R., Das Nervensystem der Dipnoern (*Protopterus annectens*) 1892.

[14] Wiedersheim Grundriss der vergl. Anat. 2te ed. 1893.

ANIMAL INTELLIGENCE.

BY JAS. WEIR, JR., M. D.

"Intelligence is a conservative principle, and will always direct effort and use into lines which will be beneficial to its possessor."[1] This definition of intelligence is peculiarly applicable to the lower animals, inasmuch as it does not convey any idea of a purely intellectual operation of the mind. Every instance of ratiocination in the lower animals, has its origin in the fundamental principle of benefit to the animal evincing this faculty of reason. The words, reason and intelligence, are, in a measure, synonymous, for without intelligence, reason can not exist and *vice versa*—without reason there can be no intelligence. They are both psychic factors, dependent each upon the other. The lower animals do not evince a high degree of intelligence, yet high enough to lift the mental operation above the automatic and spontaneous action generally called —instinct. Instinct itself is, in a certain sense, a process of intelligence, though its immediate operations may not be due to reason. Instinct involves mental operations; if it did not it would simply be reflex action. It is heredity under a special name. The father transmits his mental peculiarities as well as his corporeal individualites to his son. The experiences of thousands of years leave their imprint on the succeeding generations until deductions and conclusions drawn from these experiences become in man, that psychic essence called mind. The lower animals pass through a like experience and arrive, each in his own sphere and degree, at a kindred mental destination.

Reflex action is simply muscular adaptation excited by appropriate stimulation without mental cognizance. Instinct has always a mental element; and the lowest animal that lives is no more governed by reflex action than is man himself. The action of a spider spinning her web, is just as vol-

[1]Cope: Origin of the Fittest, p. 40.

untary and is as much under mental direction and control, as the action of a carpenter building a house. That the very lowest forms of animal life give evidences of intelligence can no longer be denied. A very common rotifer whose body is cup-shaped and whose tail is armed with forceps, has been seen to seize a larger specimen with its forceps and thus attach itself to its cup. The larger rotifer immediately swung itself violently about until it met a piece of weed, this it seized with its forceps and began "the most extraordinary movements which were obviously directed toward ridding itself of its encumbrance." This it finally succeeded in doing, and the entire scene was so like intelligent action that the observer concludes "so that if we were to depend upon appearances alone, this one observation would be sufficient to induce me to attribute conscious determination to these microscopical organisms."[2] Conscious determination and ratiocination is found in animals as low down in the scale of animal life as the Rhizopoda. *Aethalia* will confine themselves to the water in a watch-glass in which they are placed, but when the glass is placed on sawdust, they will leave the water and go to the dust—their natural habitat.[3] These rhizopoda are content to remain in the water, as long as there is no sawdust in their vicinity, but as soon as they recognize the sawdust *through the glass*, they crawl over the rim of the latter to get into a more pleasing abode. This is a wonderful example of conscious determination to be found in an organism so low in the scale of life. Once, while examining some fungal cells, Carter saw a still more wonderful instance of intelligence in a rhizopod. He noticed that one of the spore cells had ruptured and that grains of starch were escaping from the crevice. Suddenly an *actinophrys* came into the field of vision and proceeding to the ruptured cell seized a grain of starch and then retired to some distance. Presently it returned to the same cell and extracted another grain through the crevice. "All this was repeated several times showing that the *actinophrys* knew that those were nutritious grains, that they were contained in this cell,

[2]Romanes: Animal Intelligence, p. 18.

[3]H. J. Carter: Annals of Natural History.

and that, although each time after incepting a grain it went away to some distance, it knew how to find its way back to the cell again which furnished this nutriment."[4] Oysters taken from a bank never uncovered by the sea, open their shells, lose the water within and soon die; but oysters kept in a reservoir and occasionally left uncovered, learn to keep their shells closed and live much longer when taken out of the water.[5] This is an act of intelligence due directly to experience without even the factor of heredity. It is an instance of almost immediate adaptation to surrounding circumstances One would not expect to find examples of animal intelligence in such a low order as the *Helicidæ*, yet several instances can be adduced where snails have not only shown ratiocination, but have also evinced love and affection.

A gentleman fixed a land-snail, with the mouth of the shell upward, in a chink of a rock. The animal protruded its foot to the utmost extent and, attaching it above, tried to pull the shell vertically in a straight line. Then it stretched its body to the right side, pulled, and failed to move the shell. It then stretched its foot to the left side, pulled with all its strength and released the shell. There were intervals of rest between these several attempts, during which, the snail remained quiescent.[6] Thus we see that it exerted force in three directions, never twice in the same direction, which fact proves conscious determination and no slight degree of intelligence. An observer, Mr. Lonsdale, placed two snails in a small and badly kept garden. One of them was weak and poorly nourished, the other strong and well. The strong one disappeared and was traced by its slimy track over a wall into a neighboring garden where there was plenty of food. Mr. Lonsdale thought that it had deserted its mate, but it subsequently appeared and conducted its comrade over the wall into the bountiful food supply of the neighboring garden. It seemed to coax and assist its feeble companion when it lingered on the way.[7] Here we see not only an example of memory and

[4]Ibid.

[5]Dicquemase: Journal de Physique, Vol. XXVIII, p. 244.

[6]White: A Londoner's walk to Edinburgh, p. 155.

[7]Darwin: Descent of Man, pp. 262–3.

discrimination, but also of affection and solicitude. After the snail had made its voyage of discovery, with rare unselfishness and true affection, it remembered its sick mate and returned for it.

Beneath the pavement in front of my door, a wasp (*Vespa nigra*) has her nest. The entrance to this nest is at the bottom of a *sulcus* formed by two parallel bricks. I rolled a piece of paper into a compact wad and placed it between the bricks and over the entrance during her absence. When she returned she seized the paper with her jaws and forelegs and endeavored to pull it away. This was prevented by the interposition of the brick on which she stood. She then went to the other side and tried again. Here she failed for the same reason. She then descended into the little gully between the bricks and easily removed the wad. When she again left the nest, I replaced the paper, and on her return she went through the same performance as at first. Again I replaced it, but the *third time she went at once into the gully and removed the obstruction.* This she did three times in succession. Comment is hardly necessary. The evidences of memory and ratiocination are too patent to be denied. Some members of another family, distantly related to the *Helicidæ*, the limpets, show evidences of intelligence, inasmuch as they have a very accurate memory of direction. Limpets, when at rest, live at certain fixed domiciles. When hungry, they leave these homes in search of food, but invariably return to them as soon as they have satisfied their hunger. One very pointed instance of this homing sense is given by Hawkshaw, a most careful and exact observer. A limpet had made a clearing on a sea weed covered block of chalk. In the center of this clearing was a pedestal of flint which projected an inch or more. On the top of this flint pedestal the limpet had taken up its abode. The cleared space had several hollows where the animal could have easily sheltered itself, but it preferred to return to its exposed home after each of its excursions.[8]

Not many years ago, a French exhibitor with a trained company of fleas passed through the country. These insects

[8]Hawkshaw: Journal Linn. Soc., Vol. XIV, p. 406.

had been taught to march and counter-march, to dance, to feign death, to pull miniature coaches, etc., etc. While this does not evince voluntary ratiocination, it shows that fleas think and are capable of receiving instruction. "When we consider the habits of ants, their social relations, their large communities, and elaborate habitations, their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence."[9]

When Lubbock says that the ant ranks next to man in the scale of intelligence he does not err. The superior intelligence of the ant has been recognized and commented on by man since the very inception of history. The wisest man of his day, King Solomon, uses the ant to point a moral. He considers her intelligence and industry worthy of emulation, and says to the sluggard: "Go to the ant, consider her ways and be wise." This one factor, intelligence, and the faculty of intercommunicating intelligently, makes a colony of ants a *perfect* society. Their social relations make it a model republic. Ants are true socialists; communists of an ideal type. Their's is a patriotism sublimely grand in its total self abnegation. The commonwealth is everything—individual weal is not considered. Man is susceptible to individual attachments which form the basis of his happiness. The affection of ants, on the contrary, is a patriotism that is extended to the whole community, "never distinguishing individuals, unless, as in the instance of the communal mother, connected with the furtherance of the common good."[10] Ants can undoubtedly communicate. A short while ago I crushed a pismire in the track usually taken by the members of a colony inhabiting the hollow of a beech tree standing in my yard. A soldier ant came along presently and, smelling the blood of his murdered companion, was seized with a panic terror, and rushed away into the nest. He shortly returned with thirteen companions and made a slow and careful reconnoissance of the dead body and its surroundings. Then all of them examined

[9]Lubbock: Ants, Bees, and Wasps, p. 1.

[10]Kirby and Spence: Entomology—"Perfect Society."

the corpse, and, having satisfied themselves that their sister was dead, returned to the nest. In a few moments a large worker-ant, accompanied by two soldier ants, came out and proceeding to the body, picked it up and carried it down the tree to the ground. They then went beneath the grass and I lost sight of them. Their every action seemed to me to be governed by an almost human intelligence. The discoverer of the murder hurried into town, gave the alarm, and, quickly gathering some of his companions, went out in search of the murderer. . On discovering that their companion was dead and her slayer absent, they came back to town and sent out a burial party.

The ant is the only animal except man, which has slaves and domestic animals. Their intelligence is so highly developed that they make a perfect success in rearing their cattle and in capturing their slaves. The cattle of the ants are of the order *Aphididæ.* The herdsmen of these aphidian cattle can be seen patroling the shrubs on which the aphides are grazing. On them devolves the care of the herds. They bring them out in the morning and carry them back at night. They gather the eggs of the aphides, carry them into a specially built nursery, attend them carefully until the young aphides are hatched out, and then carry them to the shrubs most liked by them for food. Some strange sense enable them to recognize one another—an ant of the same species, but coming from another nest, is immediately recognized as a stranger and at once attacked. If the eggs of one ant colony are hatched out in another of the same species, the young ants are at once known to be strangers and intruders. This far transcends our intelligence. What mother could recognize her infant if it were born in the dark and she had never seen it? Again, if the *larvæ* of ants are removed, hatched outside of the nest, and then returned, the ants at once recognize them as kinsmen and receive them into the nest.[11] That ants and bees do communicate intelligently is no longer denied. Their means of communication is not defi-

[11]Lubbock: Ants, Bees, and Wasps, p. 119, et. seq.

nitely known, but it is the opinion of most scientists that it is through their antennæ.

I once saw wonderful evidences of this power of intelligent communication while watching a battle between *Lasius niger* and *Lasius flavus.* The black ants were on a foray; the booty in question being a large herd of aphides owned by the yellow ants. The yellow ants had a commissariat department and an ambulance corps. I frequently saw them drop to the rear during the battle and partake of refreshments. Those slightly wounded were also attended to by the ambulance corps. The black ants were in light marching order, and had neither of these conveniences and necessary adjuncts. These ants seemed to be governed by a high order of intelligence in this battle. The yellow ants repeatedly sent back to their village for reinforcements and in this instance were victorious. They were not so fortunate, however, in a second battle I witnessed, a short time afterward. Their antagonists were of the same species as in the first battle, but from a different colony. In this second battle the yellow ants were all slain, and their herds of aphides carried off by their conquerors.

The bee ranks next to the ant in point of intelligence and I have witnessed numerous instances of ratiocination in these interesting little animals. My bee-house is built of brick, without windows and has only one small door. The hives are made of glass and covered with thick curtains of muslin. This renders observation very easy. On one occasion I noticed that from some cause, a comb had become detached and was in danger of falling to the floor. The bees had noticed this before it had become apparent to me, and had begun to provide against disaster. They rapidly built a broad, thick support of wax between the endangered comb and the one next to it, thus securing it firmly. They then reattached the detached comb securely to the roof of the hive. When this had been done, they took away the temporary support and used the wax elsewhere. When men see a wall out of plumb and in danger of falling, they use like methods to prevent disaster. De Fravière says that bees have a number of tones which they emit from the stigmata of thorax and abdomen and by which they communicate information.[12] When a bee arrives with important news she emits several shrill notes and taps a comrade with her antennæ ; this comrade passes the news to another, this to another and so on throughout the hive. If the news is pleasing all remains orderly, but if the news presages danger, great excitement arises. The news of danger is always carried first to the queen as the most important person in the community.[13] I have heard these tones and believe with De Fravière that bees communicate information in this way. The queen emits a tone which is different from those of the workers. When the queen makes a progress through the hive while laying eggs, she frequently emits this cry. As soon as the workers hear it, they bow their heads and remain quiescent for several seconds. Both ants and bees show great affection for their young. They feed and cleanse them and assist them in every way possible. The young ant is shown all of the devious pathways and corridors in the habitation by the older ants, and her first visit into the world is made with several chaperones.

There is a spider peculiar to this locality (Daviess Co., Ky.) which I have never seen elsewhere and which I have not seen described. This spider spins two webs; one is a trap set for the procurement of her food, the other is built for the gratification of an æsthetic feeling hardly to be expected in an animal so low in the scale of animal life. This latter web is generally spun in the angle formed by two walls, and always where the early morning sun can shine on it for several hours. Through the center of the web, reaching from one extremity of its long diameter to the other, the spider spins a ribbon of silk about an inch broad. This ribbon is very beautiful. The mesh is as closely woven as silk itself, and shines in the sunlight like a band of silver. As soon as the sunlight falls upon this web, the spider makes her appearance and walks slowly up and down her glittering roadway. She is not at all timid and I have watched her for hours at her strange performance. She irresistibly reminded me of some well dressed woman who

[12] Romanes : Animal Intelligence, p. 158.

[13] Ibid.

was out for a morning walk. She never left this ribbon to secure food, though I tempted her frequently with insects. After an hour or two of promenading, she would leave this web and go to her trap-web, which is generally situated near her place of amusement. This she kept up day after day until the duties of maternity called her elsewhere. I have never seen the male. There is but one other instance in the animal kingdom where an animal builds a special place of amusement. That animal is the bower bird, of which mention will be made further on.

Curiosity is largely developed in birds. The blue jay is the most curious as well as the most voluble of all birds. I have been able to differentiate twenty-three distinct utterances in the language, if I may use the word, of the jay. On one occasion, I left a glass jar containing three newts, on a large block of sandstone in my front yard. It had not been there long before a jay flew down to examine it. One of the newts made a quick motion, and uttering a cry of surprise the jay flew to a tree overhead. He remained quiet for an instant, as if in profound thought. He then uttered his assembly call and birds of all kinds came hurriedly flying up in answer to it. In a few moments I noticed in the surroundings trees, jay-birds, wood-peckers, sap-suckers, cat birds, song sparrows, orioles, mocking-birds, blackbirds, pee-wees and flickers. They made a terrible outcry, but suddenly became silent, when the jay, which had called them together, flew down to the rock. Several of his most courageous brethren immediately followed him. He went up to the jar, and made a careful examination of it and its contents, all the while uttering a low querulous monologue. Suddenly he uttered three loud, peculiar cries and flew away. The assembly then dispersed. On another occasion I noticed a jay sitting silent and absorbed on the roof-tree of a grape arbor. He appeared to be watching something beneath him very intently. On focusing him in my glasses, I discovered that he was in a state of great excitement and trembling all over. I noticed the direction of his gaze and soon saw the object of his regard. A large male cat was stalking a hare and was just crouching to make his spring. He sprang at the hare, but his jump fell short, and the hare bounded away in safety. And then the jay-bird seemed to be fairly overcome with delight. He trounced himself up and down, screaming with sarcastic laughter. He seemed to be jeering and ridiculing the cat to his fullest extent, and the cat seemed to understand him. He dropped his tail and disappeared in the bushes. The jay uttered one last note of derision and then flew away.

I once saw a very young cockerel come up behind an elderly hen and suddenly embrace her. When she discovered the youth of her assailant, her surprise, indignation and wrath was perfectly apparent and very laughable. Birds show a distinct individuality in nest building. No two pair of birds, even of the same species, build nests alike. To the casual observer they appear alike, but to the careful and experienced nest hunter, there is a marked originality in each nest. The general forms are the same, but each pair of architects leave the impress of individual genius on their particular nest. Three pairs of cardinals have been nesting in my garden for several years. If shown the nest, I can tell the pair of birds which built it. Wallace gives an instance of original nest building. Several pairs of bullfinches were taken to Australia when quite young. When they came to build their nests, they built them totally unlike those of the English bullfinch. They were long and round, like those of the oriole, only the entrance was at the bottom.[14] Some birds have developed æsthetic feeling and have a well marked love for the beautiful. Certain humming birds decorate their nests with beautiful pieces of lichen which they fasten on the outside. Feathers and various colored mosses are used for the same purpose.[15] Darwin asserts that the curious structures of the bower birds are pleasure houses, built by the birds for their own amusement and sports.[16] These bowers are not nests and are never continuously occupied by the birds. The nests are built in the jungle some distance from the bowers. The birds

[14]A. R. Wallace: Darwinism.

[15]Gould: Birds of Australia, Vol. I, p. 442.

[16]Darwin: Descent of Man, pp. 92, 406.

first build a platform of sticks and twigs, all of the knots and short twigs being turned toward the ground, thus giving a perfectly smooth floor. The bower, an oblong, oval structure, open at both ends, is then erected on this platform. This is also made of twigs, with all projections turned outward. The entrance to this bower is decorated with feathers, bones, shells, mosses and, in fact, any gaily colored article which the bird can procure. Evidences of intelligence in the higher orders of animals are so patent that even the most casual and superficial observer can see them. The cat, the horse, and the dog are nearer to man in his daily life than any other animal, and instances of their intelligence are very numerous.

I present here a letter of Mr. J. Gibson Taylor, Owensboro, Ky., in which he relates a remarkable instance of ratiocination in a dog. "The dog, a water spaniel, had gone after a stick flung upon the ice of a pond about twenty feet distant from shore. The water was about five feet deep. The ice gave way. The dog went under the water several times in swimming about the enlarged space made by attempting to regain the surface of the ice, which gave way under his weight. He became thoroughly chilled by much confused swimming about in a circle, seeking some point at which the ice would bear his weight. I reached a limb to him and calling him by name shortly got his attention. He placed his paws upon the ice and seemed to listen intently as I extended the limb toward him, the ice, meanwhile, sinking under his weight as he looked at me. He caught the limb between his teeth and I assisted him by pulling him toward me upon the thicker ice inshore. Finally the ice became strong enough, about 15 feet from shore to sustain his weight. So, still with his teeth locked on the stick, I pulled him on the thicker ice and across the surface to the shore."

Here the dog, fully seeing his danger, and understanding the purport of the stick thrust out to him by his master, grasped it with his teeth, and held on until he was dragged into safety. Could man do more or reason better?

NOTES ON A COLLECTION OF MOLLUSKS FROM NORTH WESTERN LOUISIANA, AND HARRISON COUNTY, TEXAS.

By T. Wayland Vaughan.

INTRODUCTORY REMARKS.

For several years, while resident in Louisiana, I busied myself in trying to bring together as good a local collection of the mollusks of the region as possible. During the past summer, while at work on the *Louisiana Geological Survey,* I continued my collecting, obtaining many specimens of land-shells, and a few fresh-water shells. Through the kindness of Mr. George Williamson, of Grand Cone, La., of Mr. O. B. Lewis, of Burk Place, and Messrs J. D. and J. E. Bailey, of Summerfield, coupled with my own efforts, it is likely that I have obtained more species from this section than anyone else. In view of this it seems highly probable that a few notes on this collection would be of passing interest to conchologists.

The largest part of the section that these remarks apply to is included between Ouachita River on the east, a line through Alexandria on the south, and the Texas and Arkansas lines, but I have transgressed these lines in speaking of a few specimens collected to the south of it in St. Landry Parish, and have included in the discussion, as the title denotes, Harrison County, Texas.

This list undoubtedly does not contain all of the species found in this region, for a few species originally described from this section have not been rediscovered. Undoubtedly, many more species of *Cyrenidæ, Pupidæ,* and other families will be found later. It is worthy of notice that the collecting of my friends and myself have brought to light no species of that large family *Pleuroceridæ* (*Strepomatidæ*) that is found in such large numbers in the southern States east of the Mississippi River. Some species of this family have been noted from Louisiana.

In the identification of my species I have to acknowledge gratefully the assistance of Messrs Wm. H. Dall, Chas. T. Simpson, Wm. A. Marsh A. A. Hinckley, R. E. Call, and Dr. V. Sterki. Either Mr. Simpson or Mr. Marsh, or both, have examined specimens of most of my *Unionidæ*, and Dr. V. Sterki has examined nearly all of my *Pupidæ*. It has been my good fortune to examine a good many of Lea's and Conrad's types at the Smithsonian Institution and at Philadelphia Academy of Natural Sciences, and I have been able to use the works found in the library of the Museum of Comparative Zoology at Harvard University, so that I think most, if not all, of the identifications are entirely trustworthy.

To my friends who have aided me in collecting, and to those who have helped in the matter of identification, my sincere thanks are extended. To Dr. Otto Lerch, Geologist of Louisiana, my thanks are especially due for enabling me to do collecting throughout the summer.

NOTES ON THE TOPOGRAPHY AND CLIMATE OF NORTHWEST LOUISIANA.

In order that the physical surroundings of the mollusks herein noted may be better understood, it appears to be justifiable that a few notes on the topography and climate of the section will be in place.

Probably there is no portion of the United States so misunderstood from a topographic standpoint as northwest Louisiana. Most of the people who visit the state go to New Orleans, which stands from eleven to forty feet above the sea level, in almost the flattest portion of the inhabitable part of the State, and immediately jump to the conclusion that the whole State a jungle of swamps and alligators. It is undeniable that a large portion of the State stands very little above mean tide-water, and that swamps and alligators do abound, but the northwestern portion of Louisiana is moderately hilly. The mean level of the country, from Shreveport to Monroe, is about 400 feet above the sea level, the elevation reaching on the hills from 150 to 300 feet higher. If one starts at Shrevesport, which is between 198 and 227 feet above the sea, and goes to Monroe, he will, after passing out of flat river bottom, cross a strip of level country about ten to fifteen miles wide, that forms a kind of shelf alongside the river bottom. After this one goes into the hills—topped with red-sandy clay, red-sandy or red-clay soils. These hills are the products of erosion out of a past plain, and Mr. L. C. Johnson compares them to the buttes of the west. Some of them rise rather abruptly, others gently; some attaining a height of from 80 to 150 feet above the general level of the hill lands. One hill called Leatherman's Mountain, is said by Mr. Johnson to reach an elevation of 700 feet, or about three hundred feet above the general level. The vegetation of these hill lands is mostly oaks, where the soil is not very sandy, but when much sand is present, the short-leaf pine (*Pinus mitis*) abounds.

As one proceeds south from Arcadia, at something like thirty miles distant from that place, the red sandy clays give place to pure white sands, that bear luxuriant forests of the long leaf pine (*Pinus palustris*), though as one nears Alexandria, which is 85 miles further south than Arcadia, the sand is somewhat redder, but still contains little or no clay. In the country whose surface is made up of these deep white sands, the lands wash badly, and hills rise very steeply to a height of 75 to 100 feet above their bases. These sandy hills are all clothed with an almost uninterrupted forest of that most majestic tree, the long leaf pine. It is absent only in the small "hollows" between the hills, and in the calcareous prairie lands.

Scattered through the southern part of Bienville Parish, through Winn, Grant, and Catahoula Parishes, are spots of calcareous lands, that are usually prairies of several acres in extent. These lands usually belong to the *Jackson* and *Vicksburg* horizons, though the spot of the lime-lands in northern Nachitoches Parish belongs to the *Claiborne, Ostrea sellæformis* being found there in great abundance. There is a hill of crystalline limestone near Winfield, La., that is *Cretaceous*. These lime-lands seem to present especially good conditions for the development of the land shells. By far the majority of the species of the land shells collected were found associated at one place or another with these calcareous lands. The need of lime for the growth of the shells easily accounts for this. *Bulimulus dealbatus* and *Helicina orbiculata* were found in abundance only on these soils.

All of the chief streams, large bayous, as well as rivers, flow in a general southerly direction. The two main streams are Red River and Ouachita River. "A dividing ridge, frequently noticeable only on closest inspection, runs almost central between the rivers, dividing the Ouachita and Red River system eastward and westward" (Lerch). Thus, certain of the bayous flow into Ouachita River, such as Cypress and Corney, and others flow into Red River, such as Dorcheat, Black Lake Bayou, Bayou Bodeau, etc. Bayou Pierre is on the west side of Red River.

One of the most noteworthy things about these streams is that they are subject to great periodical overflows. Thus, in the summer of 1891, I remember rolling up my trousers to my knees and wading across Bayou Dorcheat, but in the spring of the following year, when Red River was so overflowed as to wash away much of the railroad track, steamboats took passengers down the Dorcheat and up Red River to Shreveport.

Another feature of Red River is the flat, basin-like reservoirs, called lakes, that are found on either side of it. In many cases it is impossible to find any banks to these lakes, so gradually does the land slope toward them. There is a stream always flowing through the middle of them, and, in consequence of an insufficient outlet, the water accumulates at the lower portion of the stream. The high water in these lakes is caused either by back-water from the river, or by a large amount of water being brought by the stream that opens into them.

The bottoms or beds of these lakes and bayous are usually very soft, and collecting is thus rendered abominable, it often being a continuous process of wallowing in the mud. Sometimes a firm foundation may be found to stand on, but it is the exception. In Red River one usually sinks waist-deep in the soft mud. The bottom of the smaller creeks is usually somewhat firm. The small creeks in the sandy hills of the long leaf pine region have beautiful, firm, white sand bottoms, and the water is so clear that the fishes can be seen darting hither and thither, even when they are of considerable depth.

As to climate, the following data taken from Dr. Otto Lerch's "Preliminary Report upon the Geology of the Hills of Louisiana, etc." (1892), may be of interest.

Mean Temperature at Shreveport, La., for each Month the past Twenty Years, from 1871 to 1890, inclusive.

Jan.	Feb.	Mar.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual mean.
45.8	51.5	58.1	66.1	73.3	79.9	82.7	81.5	74.8	65.4	54.2	49.5	65.2

The latest frost in the spring ranges from Feb. 14 to April 9; it usually occurs the latter part of March or within the first few days of April. The earliest frost ranges from October 7 to November 18—it usually comes toward the latter part of October. The highest temperature in the summer ranges from 91° F. to 107° F.; ordinarily it is between 98° F. and 104° F. In winter the temperature rarely falls below 12° F.

Total Precipitation at Shreveport, La. Average of each Month the past Twenty Years, from 1871 to 1890, inclusive.

Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual mean.
4.93	4.62	4.74	5.55	4.47	3.69	3.74	2.05	4.30	3.52	4.88	4.81	4.30

As one goes south and nearer the seashore from Shreveport, corresponding changes in the temperature, etc., take place.

LAND MOLLUSKS.

LIMACIDÆ.

ZONITES.

Zonites (*Hyalina*) *arboreus* Say, extremely abundant, being found under damp rubbish throughout the section.

Zonites (*Hyalina*) *indentatus* Say, is not so abundant as the preceding species, but is found almost everywhere the conditions of snail life are satisfied.

Zonites (*Hyalina*) *minisculus* Binney, is found rather commonly throughout the section.

Zonites (*Conulus*) *Sterkii* Dall, was collected under damp leaves near Mt. Lebanon.

Zonites (*Conulus*) *fulvus* Draparnaud, is found in many places, but is not very abundant.

Zonites (*Mesomphix*) *lævigatus* Pfeiffer, is found in many localities, and was collected in abundance in trash found near branches and along the creek bottoms.

Zonites (*Mesomphix*) *demissus* Binn., was collected at several places in Bienville Parish, at Grand Cane, and on the calcareous prairies of Winn Parish. Not very abundant.

Zonites (*Mesomphix*) *intertextus* Binney, abundant under trash along creek bottoms. The specimens are usually more depressed than the figure in W. G. Binney's Bulletin 28 of the U. S. Nat. Mus., but the specimens collected in Red River bottom in Rapides Parish were quite as much elevated.

LIMAX.

Limax, sp. A species of *Limax*, that seems to be *L. campestris* Binney, was collected in the early part of 1891 abundantly around Mt. Lebanon after light showers. The extremely dry summer of '91 seemed to have almost exterminated them, so that after that spring I could not find any more specimens, and did not determine the species certainly.

Limax flavus Linn. was collected under some logs near the depot at Washington, St. Landry Parish.

PHILOMYCIDAE.

PHILOMYCUS.

Philomycus carolinensis Bosc. Abundant in damp places.

HELICIDÆ.

PATULA.

Patula alternata Say, abundant throughout the section.

Patula perspectiva Say, was collected at Columbia, near Rosefield, in Catahoula Parish, and near Ville Platte, in St. Landry Parish. Is not very abundant.

PUNCTUM.

Punctum pygmæum Draparnaud, near Mt. Lebanon. Rare. Dr. Sterki considered a specimen that I sent him this species.

HELICODISCUS.

Helicodiscus lineatus Say, found in many localities. Not very abundant.

POLYGYRA.

Polygyra leporina Gould, found in many localities in small numbers.

Polygyra texasiana Moricand, found near Tullos, La., in calcareous prairie, and in the Red River drift at Shreveport and Alexandria.

Polygyra dorfeuilliana Lea, abundant at Mt. Lebanon, and is found in many other places.

Polygyra espiloca Rav. A single specimen was collected on Catahoula Prairie, and some others were found near Ville Platte.

STENOTREMA.

Stenotrema monodon Rackett, var. *fraternum* Say, found in abundance throughout the section. The variation in size, and degree of compression of the spine is great.

Stenotrema labrosum Bland, calcareous prairie at Tullos, and in the Red River drift at Alexandria.

TRIODOPSIS.

Triodopsis inflecta Say, was collected in a good many places, but is not very abundant.

Triodopsis obstricta Say. I have collected specimens in the river drift at Alexandria and Shreveport. At Alexandria I also found some live specimens. Mr. Geo. Williamson has found the species rather abundant around Grand Cane.

Triodopsis vultuosa Gould, found abundantly around Mt. Lebanon, and in many other localities.

MESODON.

Mesodon thyroides Say. Both the more typical *thyroides* and Gould's variety *bucculentus* are abundant at many localities.

Mesodon albolabris Say. Some specimens, though somewhat small, for this species seem best placed when referred to it. Not abundant.

Mesodon divestus Gould. Grand Cane, La. These specimens do not fit anything else, and Mr. Harper, of Cincinnati, has so determined specimens sent him by Mr. Williamson. Since we are agreed independently, I feel safe in the identification.

BULIMULUS.

Bulimulus dealbatus Say, found by the thousands on the calcareous prairies of Winn and Catahoula Parishes. Mr. Lewis collected it around Burk Place, Bienville Parish.

PUPIDÆ.

STROBILA.

Strobila labyrinthica Say, abundant wherever there is damp trash.

PUPA.

Pupa curvidens Gould, Mt. Lebanon, La., and near Bienville, also from river drift at Alexandria.

Pupa pentodon Say, river drift at Alexandria.

Pupa milium Gould, river drift at Alexandria.

Pupa sp. Calcareous prairie lands, Winn Parish, La.

Pupa fallax Say, found in nearly every portion of the section. Often very abundant.

Pupa armifera Say, throughout the section, but not so abundant as *P. fallax*.

Pupa contracta Say, throughout the section. Abundant.

Pupa procera Gould, rather abundant on the calcareous prairie lands of Winn Parish, found also in the Red River drift at Alexandria.

VERTIGO.

Vertigo ovata Say, river drift at Alexandria.

SUCCINEIDÆ

SUCCINEA.

Succinea avara Say, Mt. Lebanon; calcareous prairie lands of Winn Parish. On these lime prairies dead specimens are found several inches beneath the surface of the ground. I imagine that they crawl into cracks in the ground during the dry summer months and are entombed.

Succinea grovesnorii Lea, Jonesville, Texas; Boyce, La., and Bayou Pierre. These specimens are obtained in the damp rubbish immediately above the water's edge. They seem almost semi-aquatic.

HELICINIDÆ.

HELICINA.

Helicina orbiculata Say, found by the thousands on the calcareous prairies of Bienville, Winn and Catahoula Parishes, and very abundantly in the river drift at Shreveport. This species has a well-established reputation for its variability, and in Louisiana its reputation is well-sustained.

FRESH-WATER SHELLS.

AURICULIDÆ.

CARYCHIUM.

Carychium exiguum Say, found in the damp leaves on the borders of many streams. This form could more appropriately be considered a land shell.

LIMNÆIDÆ.

LIMNÆA.

Limnæa columella Say, abundant in the ponds near Burk Place, La.

Limnæa humilis Say, Bayou Pierre, and Boyce, La.

PLANORBIS.

Planorbis trivolvis Say, var. *lentus* Say, abundant throughout the section.

Planorbis dilatatus Gould, found in nearly all of the smaller streams.

Planorbis bicarinatus Say, in the ponds around Burk Place.

ANCYLUS.

Ancylus obscurus Haldeman, found in nearly all of the smaller streams throughout the section.

PHYSIDÆ.

PHYSA.

Physa heterostropha Say, found in all of the streams and ponds throughout the section.

PALUDINIDÆ.

CAMPELOMA.

Campeloma decisa Say, is as general in occurrence as *Physa heterostropha*. The form called *C. coarctata* by Anthony is found abundantly in many localities. This species is extremely variable, but the forms intergrade too well to separate them into several species.

VIVIPARA.

Vivipara subpurpurea Say, found abundantly in nearly all of the larger streams and lakes. The specimens show great variation, but are too well known to conchologists to need special notice.

Vivipara intertexta Say, Flagon Bayou, Rapides Parish, Lake Satt, pond near Jonesville, Texas. I have specimens from three other localities in Louisiana, showing that the species is widely distributed in the State, but I have never obtained it in large numbers, so it would be considered scarce.

HYDROBIIDÆ.

AMNICOLA.

Amnicolo cincinnatiensis Anthony, Bayous in Claiborne Parish, and Lake Bisteneau. It is extremely abundant in Lake Bisteneau.

Amnicola sayana Anthony, Cross Lake at Shreveport. Not very abundant.

UNIONIDÆ.

UNIO.

Unio anodontoides Lea, is extremely abundant in many of the bayous and lakes. It was collected in Cross Lake, Caddo Lake, Red River at Shreveport, Lake Bisteneau, Corney Bayou, Bayou Pierre, etc. It was found most abundantly in Lake Bisteneau, the species from Red River at Shreveport were the most perfect. Although this species exhibits some variation in size and relative thickness of the shell, the variation is rather slight when compared to the great amount of some other species.

Unio gracilis Barnes, is not very abundant. In Caddo Lake a fine lot of young specimens were collected. It was also found in Cross Lake, Red River (at Shreveport), Dorcheat Bayou, Corney Bayou, Bayou Pierre, and Lake Bisteneau.

Unio purpuratus Lam. This handsome *Unio* is rather abundant. It was collected in Cypress Bayou (Texas), Caddo Lake, Cross Lake, Corney Bayou, Dorcheat Bayou, Bayou Pierre and Lake Bisteneau. The most perfect specimens were in Caddo Lake; here a considerable number of perfect young were obtained. The largest specimen was a dead valve from Dorcheat Bayou, it being about six inches in length. A large number of specimens were collected from little pockets that had been formed alongside Corney Bayou. The characters of this species are very constant.

Unio lævissimus Lea, Caddo Lake, Red River at Shreveport. Rather rare. Some beautiful young were obtained in Caddo Lake.

Unio nigerrinus Lea. Localities: Corney Bayou, Cypress Bayou, La., Dorcheat Bayou and creek near Rosefield. This species is rather abundant. The largest specimens were obtained from Dorcheat Bayou, where the shells, besides being larger than those of the neighboring streams, have thick, somewhat massive, shells.

Unio haleianus Lea. A single specimen was collected by Mr. O. B. Lewis, at Burk Place, in a small creek. I collected a specimen in Castor Bayou, Catahoula Parish, that I take to be of the same species.

Unio mississippiensis Conrad, is abundant in the ponds and creeks throughout the section. It was found in Dorcheat Bayou and in Bayou Pierre, but is usually not abundant in the larger streams. The species does not present very much variation.

Unio hydianus Lea, is found in all of the larger bayous in which I collected—Dorcheat, Corney, etc. The specimens are very numerous. The variation is great, from individuals that are sub-compressed, to those that are very much inflated. There is a marked tendency to become much inflated in old age forms. The number and size of the rays vary much, some specimens have wide rays, others narrow rays, and still others are scarcely rayed at all. This species, on account of its enormous amount of variation, is one of our most attractive and instructive forms.

Unio approximus Lea. A specimen of this species was found in a small creek in Rapides Parish. We think that we are not alone when we consider the difference between *hydianus* and *approximus* almost nominal.

Unio obtusus Lea, was collected by Mr. O. B. Lewis in a branch near Burk Place, in Bienville Parish. Mr. C. T. Simpson so determines a specimen that I sent him, and from Lea's figures and descriptions I would so consider it.

Unio parvus Barnes, is found in a good many of the bayous. It is almost impossible, if not entirely so, to separate this and the three following species, but a good many of my specimens seem undoubtedly *parvus*.

Unio texasensis Lea, abundant everywhere that I collected *Unionidæ*, except in Red River, Cross Lake, and a few very small creeks. These specimens can be gathered by thousands. The variation is enormous, from elongated to rather short; from thin to rather thick shelled, etc.

Unio bairdianus Lea, is considered a synonym of the above. It is abundant in the creeks of the section.

Unio bealei Lea, were collected in the creeks around Mt. Lebanon. This form is extremely close to *texasensis*.

Unio camptodon Say, is found abundantly in the smaller streams throughout northwestern Louisiana. It seems to thrive best in small creeks and brooks that flow moderately rapidly, and have sandy bottoms. This species is so very abundant that, possibly excepting *Unio texasensis*, we are inclined to call it the most abundant species. Its range of variation is extremely great, and from the large suites that we obtained of it and the three following species, it seemed to us that we could trace their intergradation.

Unio declivis Say. Corney and Cypress Bayous in Claiborne Parish, near Mt. Lebanon, and near Jonesville, Texas. Mr. Williamson sent me a specimen with pink nacre.

Unio symmetricus Lea, in the creeks and bayous near Grand Cane. I have a good many specimens through the courtesy of Mr. Geo. Williamson, of Grand Cane. This species and *jamesianus* are, without doubt, synonyms, though a typical *symmetricus* can be distinguished from a typical *jamesianus*. I have seen Lea's types at the U. S. National Museum, and believe these to be pretty typical.

Unio jamesianus Lea, is abundant in the brooks and small creeks around Jonesville, and Port Caddo in Texas. Its habits closely resemble those of *camptodon*, with which its seems to connect by intermediate forms.

Unio lachrymosus Lea, is one of the most abundant of the species found in the section. Specimens were collected in Lake Bisteneau, Caddo and Cross Lakes, and in Bayous Dorcheat and Corney. The specimens are found in large numbers. The amount of variation is considerable, some specimens having a great number of pustules, while others have relatively few. Some specimens are much more compressed than others. The largest and heaviest specimens were from Caddo Lake.

Unio asper Lea, Corney Bayou, is found in other localities most likely; shows some variation in the number of pustules.

Unio pustulosus Lea, is not very abundant. Is found in most of the lakes and principal bayous. It is most abundant in Dorcheat Bayou. The specimens from this place are somewhat more inflated than most of the specimens that I have seen from the more northern States. Some of the variations of *pustulosus* approach very near to *turgidus*, and I am inclined to the opinion that these two forms connect by intermediate examples.

Unio schoolcraftii Lea. Corney Bayou. Not very abundant.

Unio nodiferus Conrad. Corney Bayou. Not very abundant. These specimens seem almost fac-similes of those in the Philadelphia Academy of Natural Sciences collection from Neches River, Texas.

Unio turgidus Lea. Dorcheat Bayou. Somewhat abundant in this stream.

Unio pustulatus Lea. Caddo and Cross Lakes, Lake Bisteneau. It is abundant in the two first lakes. It varies very much in the amount of the development of the pustules.

Unio houstonensis Lea, is found in the three larger lakes and Bayou Pierre.

Unio trigonus Lea. Cross Lake, Bayou Pierre and Dorcheat Bayou. This species and the next two form a most interesting and a somewhat perplexing set of forms.

Unio cerinus Conrad, is found abundantly in nearly all of the bayous and the larger creeks throughout northwestern Louisiana. Many hundreds of specimens were obtained from Corney Bayou. It varies enormously, and undoubtedly grades into the next species.

Unio chunii Lea. Corney Bayou, Dorcheat Bayou, Cross Lake. It is somewhat abundant in Corney Bayou. It varies greatly, sometimes being arcuate on the base, almost hooked as the posterior margin is approached. The sharpness of the posterior ridge from the umbo varies much, as does the amount of inflation of the valves, forming, it seems to me, perfect gradations into *cerinus*.

Unio cuneus Conrad. Corney Bayou. Rare.

Unio cornutus Barnes. Caddo Lake, Cross Lake, Bayou Pierre. Not very abundant, and very constant in its characters.

Unio castaneus Lea. Corney Bayou, Cypress Bayou, Dorcheat Bayou. It is very abundant in these streams. The specimens from the two first are very small and somewhat compressed; those from Dorcheat are the largest that I have ever seen. These latter specimens are much thickened anteriorly are much inflated in that portion, but are compressed posteriorly. The male individuals are rather pointed behind, and the females are truncated.

Unio elegans Lea. Caddo Lake, Cross Lake, Corney Bayou, and Bayou Pierre. Very scarce.

Unio donaciformis Lea, in the larger Lakes and Bayou Pierre. Very scarce.

Unio plicatus Lea. Bayou Pierre. Mr. Williamson sent me the only specimens that seem to me undoubtedly this species.

Unio perplicatus Con. Ouachita River, Bayou Pierre.

Unio multiplicatus Lea. Caddo Lake, Cross Lake, Dorcheat Bayou, Bayou Pierre. The finest specimens were from Cross Lake, near Shreveport. These would rival some of the monsters from Spoon River, Ill., and seem entitled to the name *heros.*

Unio undulatus Barnes, Bayou Pierre. Mr. Williamson has sent me some specimens that seem best placed under this species, though they could, without especial violence, be called *multiplicatus.*

Unio boykinianus ? Lea. Dorcheat Bayou. I collected one specimen that has been so identified by Mr. A. A. Hinckley. I have seen specimens of the species in the Philadelphia Academy, and have looked up Lea's figure, and think that my friend is about as nearly right as can be in some of these delicate matters.

Unio trapezoides Lea, abundant in the larger lakes and bayous. I have also received specimens from the Ouachita River in Union Parish. In Caddo Lake this species is the most abundant. I collected many hundreds there. Some of the largest specimens, however, were from Cross Lake. This species seems to like the larger bodies of water where it has a considerable extent of rather level bottom of somewhat soft mud to dwell in. The characters of this species are, in the main, rather constant. The amount of inflation varies a good deal, as also does the postero-basal angle in sharpness ; and the posterior ridge from dorsal to basal margins varies in its acuteness. There is a considerable variation in the distinctness of the folds, but the trapezoidal outline, the black epidermis, the purple nacre remain constant, the variations being of essentially one type of structure.

Unio tuberculatus Lea. Corney Bayou, Dorcheat Bayou, Bayou Pierre, Cross Lake. It is rather abundant in the two first localities. Some of the specimens from Corney Bayou had the posterior portion very much elongated. Both the purple-nacred and white-nacred varieties were found.

Unio gibbosus Barnes. Corney Bayou. A small, compressed variety was found in great abundance in this stream.

Unio rotundatus Lamarck. Cross Lake, Bayou Pierre. This species is rather rare in Cross Lake, but, judging from the number sent me by Mr. Williamson from Bayou Pierre, it must be very abundant there. It is found abundantly in southern Louisiana. It appears that when northern Louisiana is reached, the northern extension of the species is being approached. A specimen of this species was collected on the border of Cross Lake, September 26, 1891, supposed to be dead. It was laid upon my table to await a convenient opportunity for washing and putting away. On November 18, I tried to prize the valves open, but they would not yield. The animal was cut out, and its heart was seen to be still beating. The mussel had lived almost two months on my table, out of the water.

MARGARITANA.

Margaritana confragosa Say. Caddo Lake, Lake Bisteneau, Cross Lake, Corney Bayou, Bayou Pierre. The species is rare everywhere, but is most abundant in Caddo Lake, where I collected about one dozen specimens.

Margaritana complanata Barnes. Corney Bayou. Rare. Out of a great many thousand specimens of *Unionidæ* from Corney, I obtained only two of this species.

ANODONTA.

Anodonta tetragona Lea. Dorcheat and Corney Bayous. Not abundant.

Anodonta stewartiana Lea. Lake Bisteneau and in a pond near Jonesville, Texas. Rare.

Anodonta gigantia Lea. Pond near Shreveport, and in a pond in Claiborne Parish. Near Shreveport, in a sequestered pond, into whose surface the sunbeams filtered through the willows, I made a rich " find " of a bushel of these *Anodontas.* They were the most beautiful specimens of the genus that I have seen, many being a most beautiful but subdued green—all as thin as egg-shells.

Anodonta corpulenta Cooper. Caddo Lake, pond near Shreveport, Bayou Pierre. Not abundant. This *Anodonta*, with the two mentioned just above, have a wonderfully close resemblance, and I would not like to undertake to never get them mixed up. I am inclined to believe that they are *naturally* mixed up, and that it is *artificial* to try to draw sharp lines between them.

Anodonta opaca Lea. Cypress Bayou, Black Lake Bayou, Corney Bayou, ponds around Jonesville, Texas; around Grand Cane; and I have received some good specimens from southern Arkansas. The finest specimens were from Jonesville, some being about six inches long, and with an epidermis of a beautiful polished mahogany color. This is by far the most common of the *Anodontas* in the section. At one time I had two hundred and fifty specimens from *one* bayou. The variation is enormous. The color is from mahogany to green, the form may vary from an elongated oval to a short oval, or the base may be arcuate, the size may vary in what appears to be adult specimens from two to five inches. Yet in spite of all this variation with a good suite of specimens, one readily sees that it is all the same species, for every intermediate form exists.

Anodonta suborbiculata Say. Caddo Lake. Very rare. This is such a handsome species that one wishes it could be found wherever he collects, but he is disappointed in Louisiana. In Caddo Lake a few small specimens are found.

CYRENIDÆ.

PISIDIUM.

Pisidium variable Prime, found in many of the small branches. Near Port Caddo, Texas, not far from Cypress Bayou, small peat mosses have formed between the bases of some of the hills. These mosses are fed by springs. In small holes over this moss hundreds of this *Pisidium* can be collected by pulling up the moss and other aquatic or semi-aquatic plants and examining their roots.

SPHÆRIUM.

Sphærium contractum Prime, in the ponds and creeks around Jonesville, Texas, and in Cross Lake, near Shreveport.

Sphærium fabale Prime, in nearly all of the smaller streams of northwest Louisiana, and is often found in the greatest abundance. It is the most common species of the genus in the section.

Sphærium transversum Say. Dorcheat Bayou and Lake Bisteneau.

There are, undoubtedly, many other species of the *Cyrenidæ* in the section. We have collected immature examples of other species, but there is too much doubt attached to their identification to justify entering them on this list.

Cambridge, Mass., July 16, 1893.

TRENTON AND SOMME GRAVEL SPECIMENS COMPARED WITH ANCIENT QUARRY REFUSE IN AMERICA AND EUROPE.

BY H. C. MERCER.

The recent Trenton gravel discussion impresses upon us, two important points:

(a) The proved fact that in the fashioning of his larger stone blades, the modern North American Indian continually scattered his quarry sites, with forms like the Trenton forms.[1]

(b) The assertion that the Trenton specimens (see collection at Peabody Museum, Cambridge, Mass., Figs. 4 and 5,) may not have been found in place, but in talus, or where they had "slipped down," and that if in place, they did not prove a paleolithic culture, since if, as is possible, they were "rejects or wasters" dropped at quickly abandoned "workshops" on the uninhabitable river shore, the camp-site of the man who made them, with his "finished implements" and culture-telling traces, would probably have existed elsewhere higher up the bank.

In the demand for renewal of evidence which has grown out of the argument, we not only ask whether the Trenton objects are really found in place, whether they are "finished implements," and whether the old river shores are analogous to modern quarries where the gravel man would leave no more definite trace of himself than a "waster;" but, turning to Europe, whence the discussion has drawn its first inspiration, we wonder what effect the study of American Indian

[1] For a study of the "unfinished implements" made by modern Indians, at Flint Ridge, Licking Co., Ohio, see a paper by Gerard Fowke in the Smithsonian Report for 1884, and papers by W. H. Holmes upon the aboriginal quarries at Piney Branch, D. C.; and in Garland County, Arkansas, in American Anthropologist for Jan. 1890 and Oct. 1891. The Unpublished Report for 1892 of the Department of Archaeology of the University of Pennsylvania contains a discussion of similar facts discovered in the summers of 1891 and 1892 at Durham, Saucon Creek, Vera Cruz, and Macungie, in Eastern Pennsylvania.

quarries is to have upon the question there. We inquire not unnaturally—

Are the *European* objects really found in place?

FIG. 1.

Chemin de Poste quarry, Abbeville (upper and oldest terrace), showing the unstratified "Limon rouge" resting upon stratified layers. Workman holds "axes" about where he says he found them in the "Limon rouge," December, 1892.

Do the Trenton specimens really resemble them?

Are the European specimens finished implements?

Have European archeologists overlooked the fact that there are later Stone Age quarries abroad, which, like the American sites, tell the story of blocked out "wasters" resembling gravel forms?

Postponing a few words of suggestion as to the first three questions, I venture here, on the strength of several recent visits to the Somme Valley, to discuss the last four, and first the question of

POSITION IN UNDISTURBED GRAVEL.

It is well-known that the Somme having cut its valley through the secondary chalk of northern France, had, in Quaternary times, washed up beds of gravel at bends, notably at Abbeville and Longpré, and at St. Acheul and Montieres (suburbs of Amiens). It was in these that Boucher de Perthes, after a long battle, was allowed, in 1859, to have really found his "haches" or "coups de poing" in place.

Visiting Abbeville in November last, and securing the kind assistance of M. G. d'Ault du Mesnil, a well-known geologist and paleontologist and member of the Ecole d'Anthropologie, who, as an inhabitant of Abbeville, had devoted much study to the gravels, I examined all the exposures near the town, then those of St. Acheul and Montieres, and finally the cuts at Chelles where the Marne has done the same work.

The sand and gravel pits (see Fig. 2, infra) A, Leon; B, Chemin de Poste; and on the open land, "Champ de Mars"

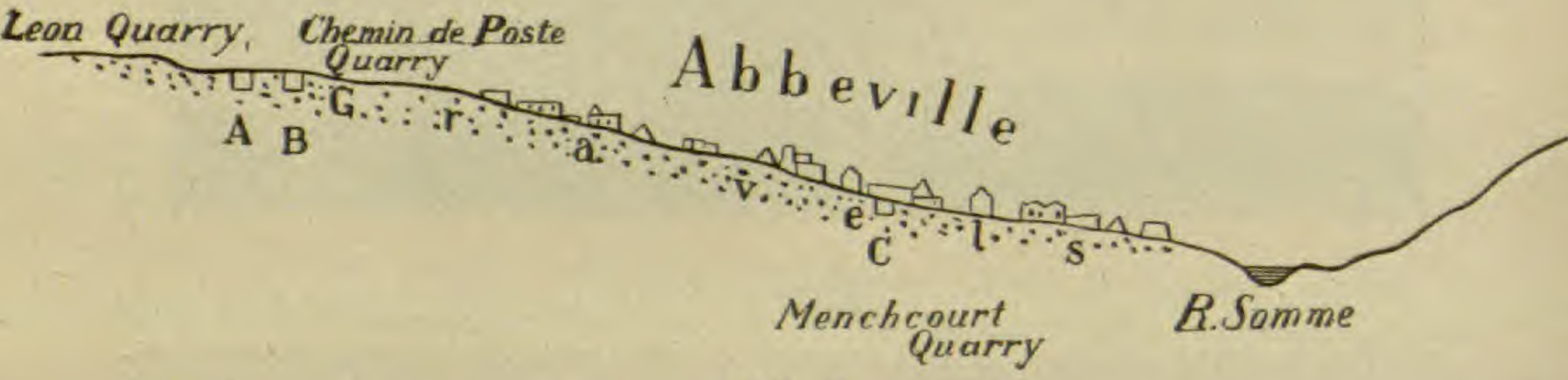


FIG. 2.

Diagram showing the general relative position of the Quaternary gravels to the River Somme at Abbeville (Dept. Somme) France, and A the Leon, B the Chemin de Poste, and C the Menchcourt sand and ballast quarries, from which chipped specimens and fossil bones have been obtained.

behind the town, are about a mile from the tide-less fresh-water Somme, and about 40 meters above it. They are holes dug in gardens and grass fields, on an exceedingly gentle slope, and their position avoids the difficulty of comparatively modern talus encountered at the celebrated Trenton bluff, just as a well or cellar dug in the middle of the latter city would.[2] C is the Menchecourt quarry near the river. A and B might stand as well for the St. Acheul pits if Abbeville were Amiens, when C would do for Montieres.

The gravel pits A and B, at Abbeville, will serve as types. The cuts, now about 10 to 18 feet deep, were, at places, clean and fresh, and showed veins of sand in white, yellow and red, and layers of large flint nodules, round by nature and packed in gravel, the whole overspread by the "Limon rouge," an unstratified layer 3 to 6 feet thick, of sand, gravel and weather-broken flint splinters.[3] Classed as the last phenomenon of quaternary times, this "Limon rouge," tinted brownish red by atmospheric agencies, had, said geologists, rolled like a pudding over all the gravel area, from the uppermost or oldest terrace or bed, to the lowest or latest.

The difference between these exposures and those at Trenton was striking. There, where all stones were water-worn pebbles, and but few constituted blade-material for primitive man (argillite), here, scarcely any were water-worn, and nearly all were blade material (flint). In Trenton there was no fossil-preserving chalk; but here the presence and chemical effects of chalk were everywhere apparent.

[2] There is a "Puit" at the Leon Quarry, where at hole formed by decomposition in the underlying chalk, an area of about 75 feet square has settled down 4 or 5 feet. The stratification of the sunken area is somewhat jarred, but its line of faulting clearly marked against the clean cut layers to the right and left. The danger of replacement as well as those of changed water-courses anciently filled up, root holes, uprooted trees, confront the student here as everywhere. Well might he use caution, even were he in a hole 100 yards from the bluff's edge at Piney Branch, at the bottom of a trench 200 feet from the "quartz workshop talus" at Little Falls, or down in the Trenton sewer.

[3] This phenomenon of weather splintering can easily be seen still at work. Many nodules yet unbroken, show on their surface discolored lines fringed with dendrites, marking planes of internal decay which have so weakened the mass that it falls at once into angular pieces on being struck a good blow.

My first object after observing my height above the river and the colored lines of stratification, with their inference of a valley-filling flood, was to note all evidence in proof of the quaternary age of the gravels, and of the occurrence in them of the chipped specimens and fossil bones that had made the spot famous.

I carefully examined every cut at the Leon, Chemin de Poste, and Menchecourt quarries, and afterward searched those at St. Acheul and Chelles, and the Archeological Museum of the University of Pennsylvania now contains three apparently artificial chips, which I then found in place; (1) Museum number 11456 with 3 facets on one side, showing the bulb of percussion, and well worn or worked on the edges, found and photographed in place 1½ meters below the surface at the Chemin de Poste quarry; (2) Museum No. 11454 apparently artificial with 6 facets on one side, in place 2½ meters below the surface at the Chemin de Poste quarry, and (3) Museum No. 11456, a thin flake showing the bulb and concentric circles of percussion, at the Leon quarry 2 meters below the surface. But the flint nodules of Abbeville flake very easily when struck against each other, and when we realize that the gravel deposits have been "ravined" by streams in past time, that cavities have been formed in the chalk, into which the flints have fallen with more or less suddenness and force, and that the original deposition of the strata must have been accompanied with some jostling of nodules, we need not attribute every flake showing the bulb of percussion, to the hand of man.

These specimens though far more artificial looking than many that have been proved artificial by surrounding circumstances must therefore be classed as doubtful, and we will not perplex ourselves with an analysis of their position in its exact relation to unstratified Limon Rouge and the stratified beds beneath.

Beyond these possible traces of human handiwork, I found nowhere a fossil or "coup de poing" in place.

However, at the Leon quarry, a workman showed M. du Mesnil myself 3 typical leaf-shaped specimens, recently found, he said,

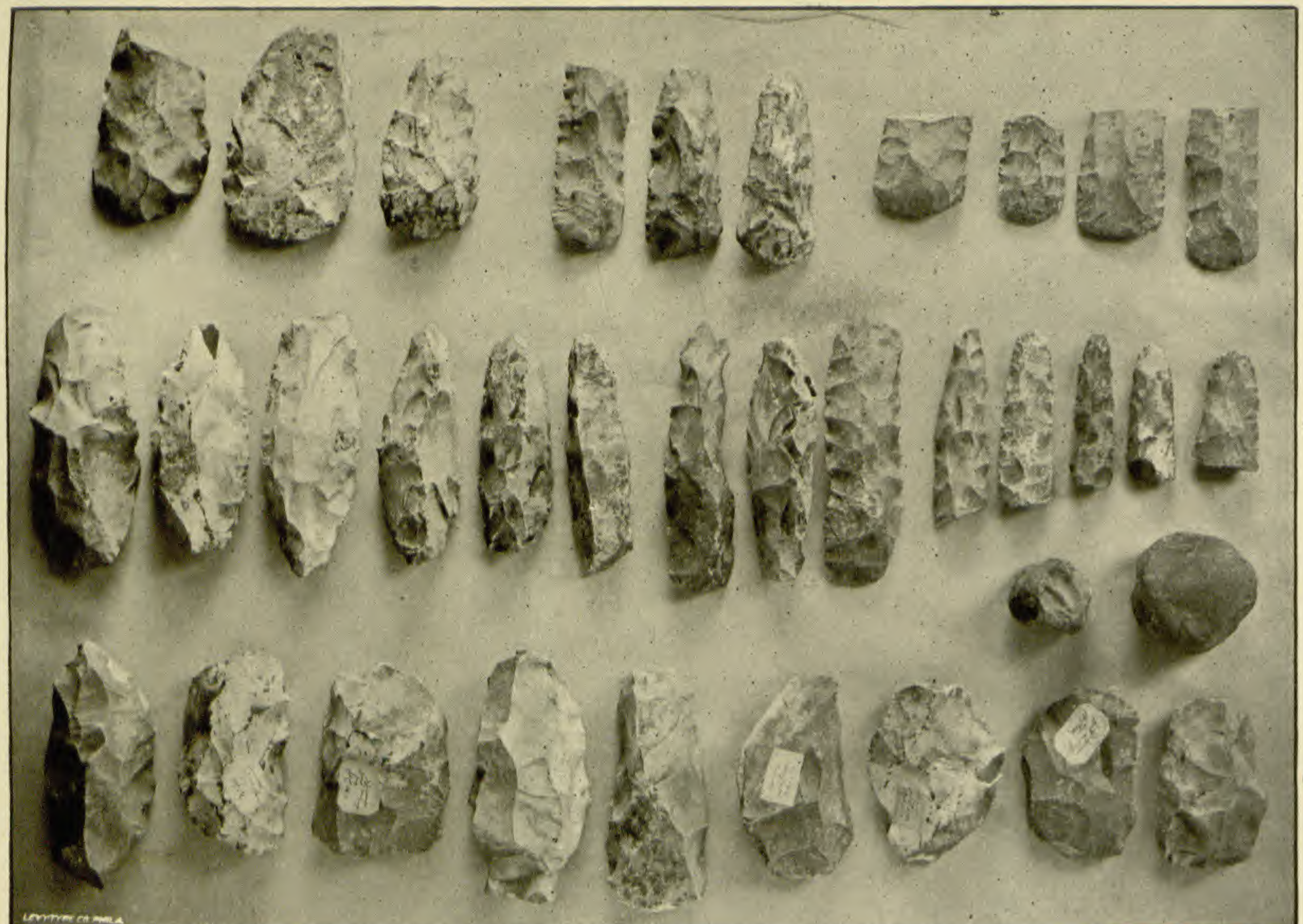


FIG. 6.

Series of specimens from the Neolithic quarry at Spiennes (near Mons, Belgium.)

A. Results. Long thin blades worked toward a point.

B. Results. Chipped Celts—Round cutting edge specialized.

a. Blocked out forms tending toward class A. b. Blocked out forms tending toward class B.

C. Hammerstones and inchoate masses, intent indeterminable, often resembling the ruder forms from Abbeville, American quarry refuse, and Trenton specimens.

by him, one of which was covered with white patina, and three months later (on a second visit), sold me an elephant's tooth at the quarry (for 2 francs). Another laborer at the Chemin de Poste quarry sold me (for 4 francs) four chipped specimens (2 patinated), and again, three months later, 8 (for 5 francs) found by him, he said, in the " Limon rouge " at the spots indicated (see photograph, figure 1). At the Boulevard quarry at St. Acheul, I bought of a third workman, at least a dozen broken "axes" and chips, some of them well patinated, together with the bones of a *Bos primiginius* (for 5 francs).[4] A fourth quarryman, at Chelles, where two tables in the foreman's shed were piled with " axes" and the teeth and bones of the *Rhinoceros tichorinus, Elephas primiginius, Equus caballus* and Reindeer recently found, it was said, and reserved as the property of the company; sold me at his house a number of patinated chips and " coups de poing," together with three teeth of the *Equus caballus* (for 5 francs).

Nothing so distinguishes the Delaware from the Somme Valleys; nothing so eliminates, from the study of the latter, the doubts as to readjustments and talus, the possibilities as to river levels and distant glaciers, which perplex the American investigator, as the presence of these fossils, thus luckily preserved by the chalk, and in sufficient numbers, it seems, to convince all men of science who have visited the spot. Though I found none with my own hands, it would have been hard to believe that those I saw at the quarries, in the Du Mesnil collection, at St. Germain, and in the Boucher de Perthes Museum, at Abbeville, had come from the surface or from anywhere else than the gravels themselves.[5]

[4] One of the flint " axes " he laid aside, saying that it was an imitation.

[5] Beyond these, thus labelling the beds in general as quaternary, the closer study of the bones had enabled paleontologists, I was told, to make out an evolution in the fauna of the valley, and distinguish three divisions or terraces—an upper, the oldest, marked by the prevalence of the *E. antiquus, Rhin. merkii*, and the advent of man; the middle marking the decadence and extinction of the *Elephas antiquus* and the *Rhin. merkii*, the prevalence of the *Rhin. tichorinus*, and the appearance and great increase of the Mammoth; and a lower, the latest, represented by the extinction of the Mammoth and the prevalence of the Reindeer.

The Carriere de Leon, Port St. Gilles, and Chemin de Poste quarries now represent the upper; the Balastiere du Chemin de Fer the middle, and the Menchecourt quarries the lower terraces.

The cut at Moulin Quignon and most of the exposures worked by Boucher de Perthes are at present covered.

As to the artificially chipped flints (see Fig. 3), twelve of those obtained by me were patinated with the brown, yellow, red and white patina that no art can adequately reproduce, for the forged patina is a crust, the real a decomposition into the stone.[6] To prove that they, like the fossils, came from the gravels, no evidence was wanting save that of a personal discovery.

COMPARISON WITH TRENTON SPECIMENS.

Did the Trenton forms resemble these French objects? was the next question. Figure 3 (omitting the so-called Mousterian flakes specialized on one side, and the thin, knife-like flakes and hammer stones from the upper beds) gives the three

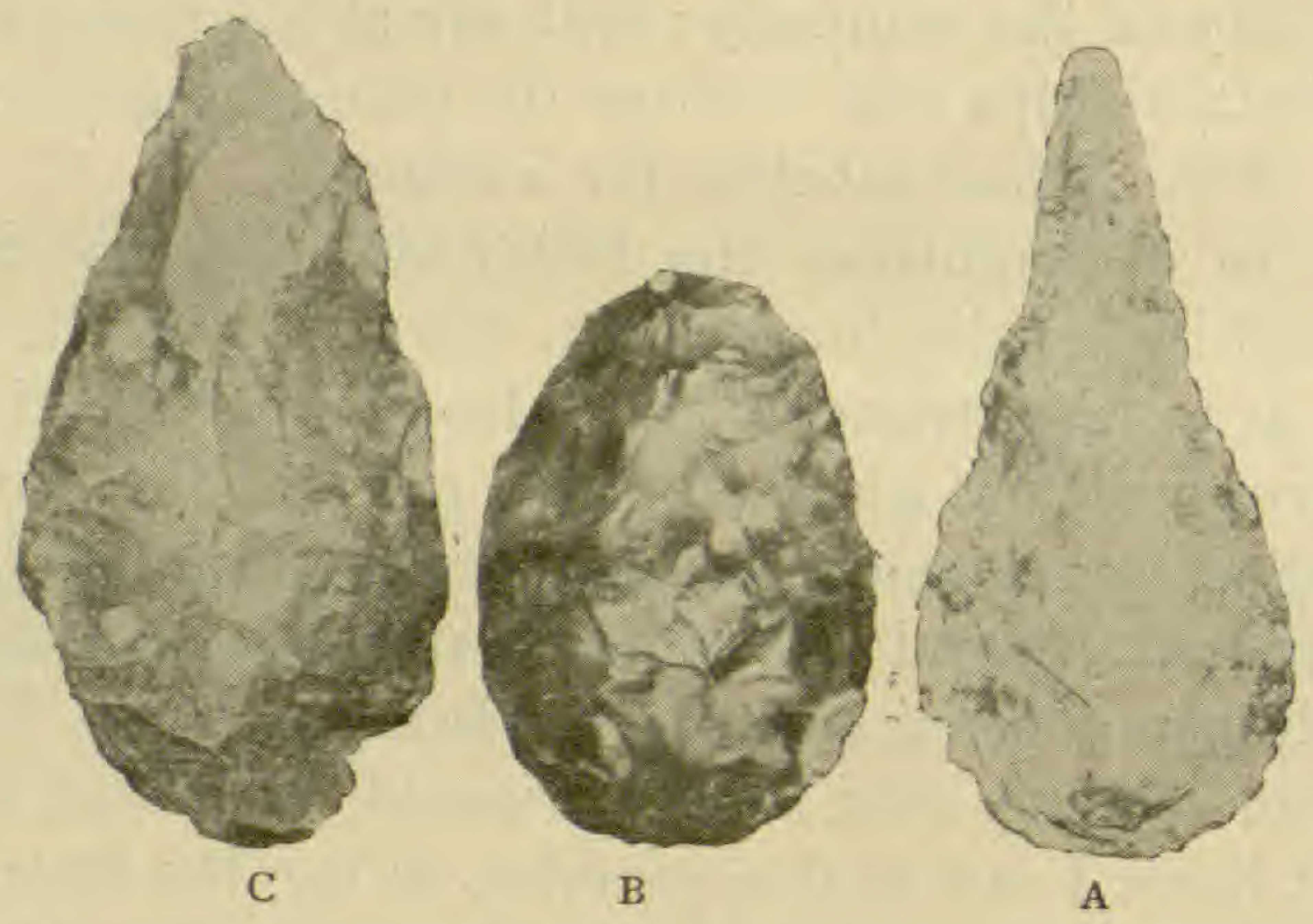


FIG. 3. ¼

Typical specimens of flint from the Somme gravels at Abbeville. D'Ault du Mesnil collection. (Photographed by the kind permission of M. G. d'Ault du Mesnil.)

A. Specialized only at the point. Rude at the base.

B. Specialized all round. Leaf-shaped.

C. Unspecialized. Resembling usual Trenton forms.

[6] Some "forging" of specimens has been carried on in the Somme Valley, as the drawers full of imitations at St. Germain, and the specimens shown me in the Du Mesnil collection prove. M. du Mesnil has even detected skillful attempts at imitation of white patina at Amiens. He informed me that my unpatinated specimens were genuine. But they can be eliminated from the evidence without depriving it of much force.

important shapes found in the Abbeville pits. Figs. 4 and 5 present fifteen representative specimens from Trenton, in the Abbott collection at the Peabody Museum, Cambridge, Mass.

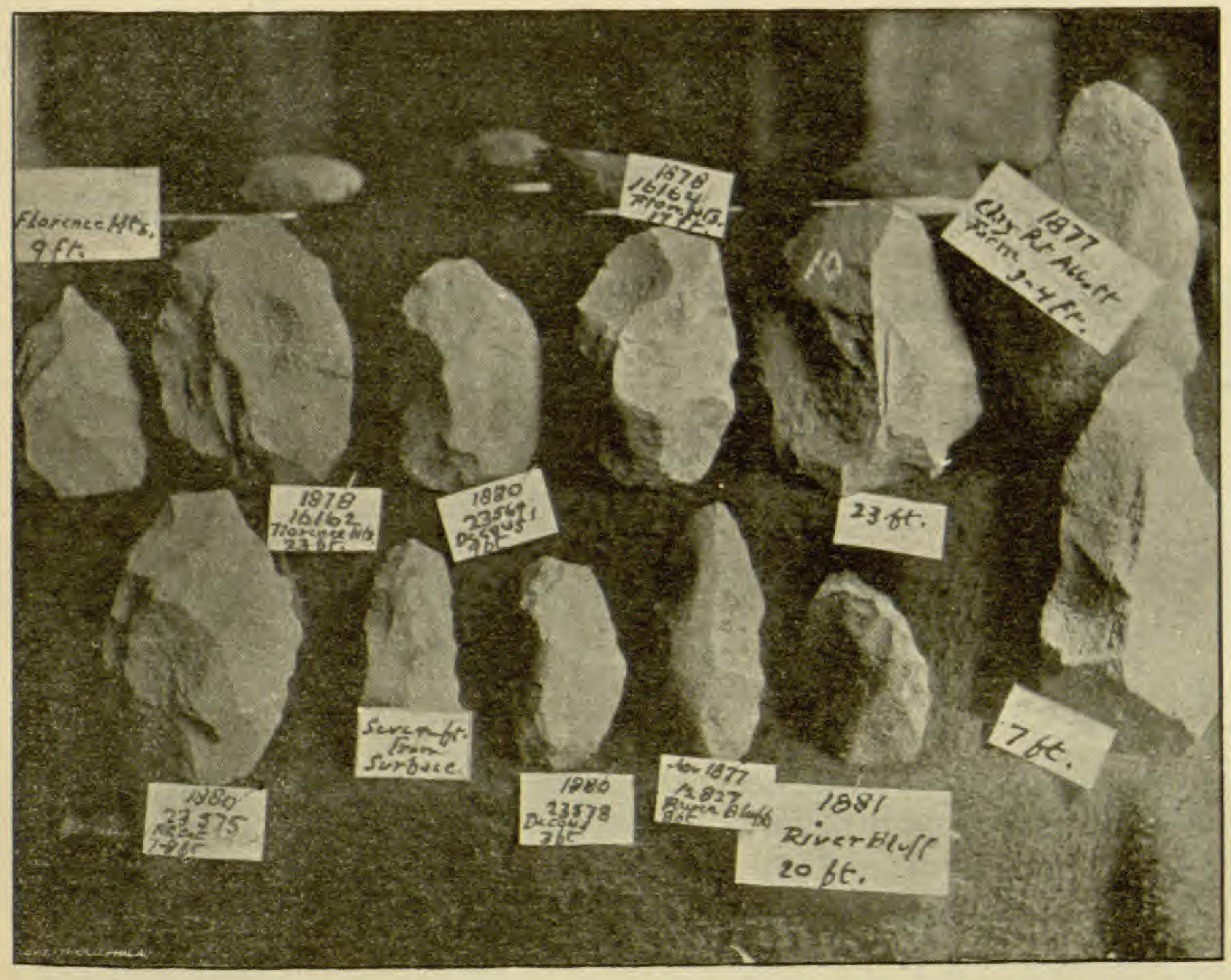


FIG. 4. $\frac{2}{7}$

Trenton specimens of argillite from the Abbott collection, Peabody Museum, Cambridge, Massachusetts (photographed by kind permission of Professor Putnam, and Dr. C. C. Abbott, in September, 1893). Tickets show catalogued number of specimens, date of discovery, site, depth in Trenton gravels, etc., as stated in the Museum records.

The Trenton forms generally resemble C, Fig. 3. None are so finely worked as B (the duplicate of our heavier cache specimens[7]), while A, the most striking of all the "coups de poing,"

[7] As, for instance, the 8185 flint blades arranged in sets of about 15, in mound 5 of the Hopewell group on the north Fork of Paint Creek, Ross Co., Ohio, discovered in 1847 by Squier and Davis and fully exhumed in 1891 by Mr. W. K. Moorehead (Primitive Man in Ohio, p. 189) or the 6107 similar blades, similarly placed, found by Dr. J. F. Snyder in 1890 in a mound on the right (Illinois) river bank near Beardstown, Brown County, Illinois. (See The Archeologist for Oct., 1893.)

scarcely worked at the large end where the nodule surface often remains, and finely specialized into a narrow point at the other, is, with the exception of the three specimens in Fig. 5, (the only ones of the kind from Trenton with a record as to depth and position), unlike anything in the described Trenton series, nor is it fairly duplicated by any of the American quarry or workshop discoveries that I have seen.

In the Boucher de Perthes Museum there are (down stairs) 48 specimens of A, (Fig. 3) and 47 of B. In the British Museum, 192 British specimens of A (Fig. 3) and 30 of B. Of C there are 32 in the Boucher de Perthes, and 97 (from Britain) in the British Museum, and the fact that these latter, save in material, are exactly resembled by the Trenton forms and American quarry specimens, brings us to the next question.

IMPLEMENTS FINISHED AND UNFINISHED.

Are the European specimens finished implements? In attempting to answer which the following facts offer some suggestion.

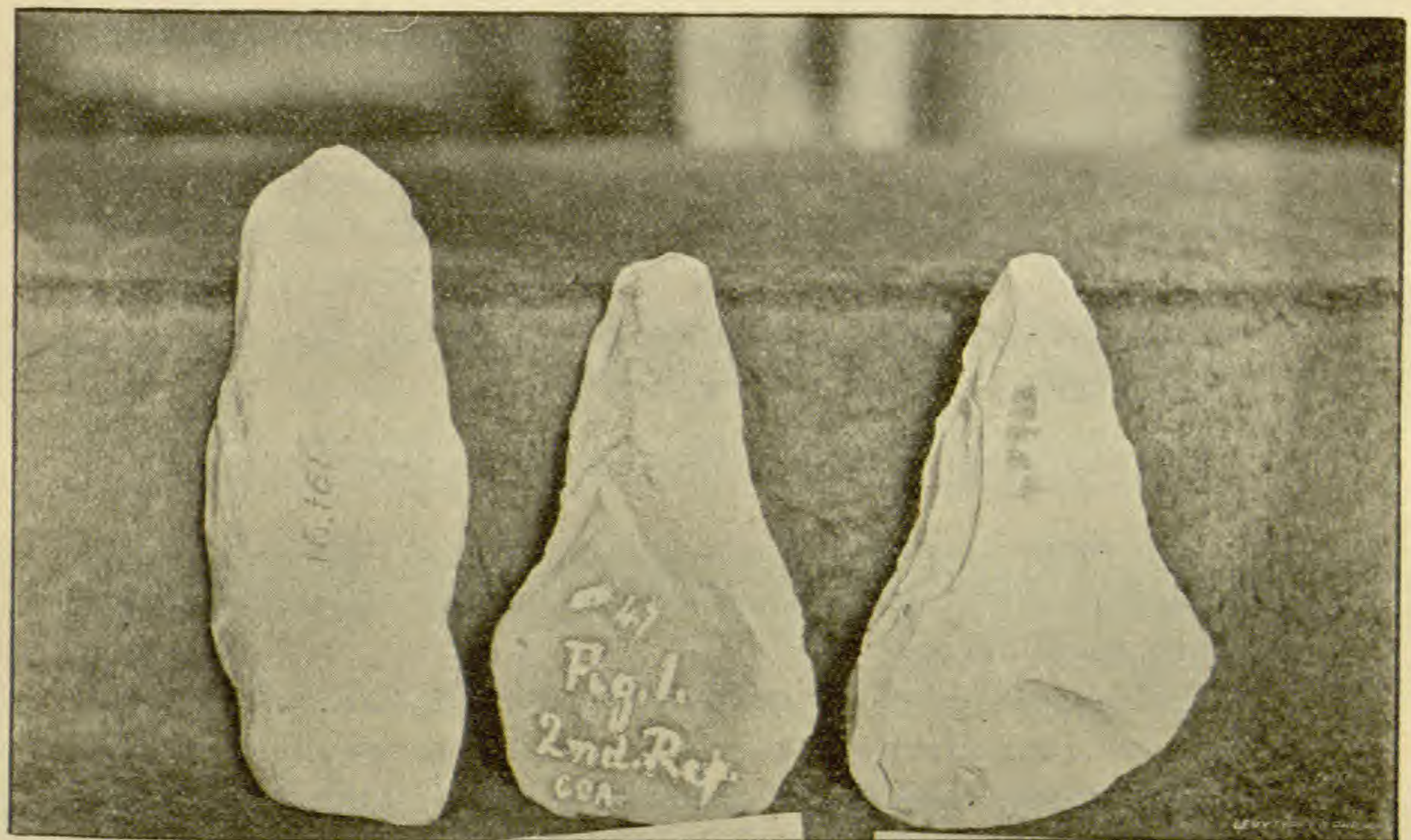
Of the 48 French (Boucher de Perthes, Abbeville) examples of A (Fig. 3), all very rude and unworked at base, where 28 retain the pebble surface, 29 are quite unmistakably specialized at the point; and of these 29, 10 look freshand unused, while 19 seem to show signs of use or water wear. Of the 152 British (Museum) A's, 96 are unmistakably specialized at the point, while very rude, and generally showing nodule surface at the base.

Eleven of the 47 French B's (well-specialized all around, 3 to 5 inches long), show signs of use or rolling.

Of the 32 French C's about 14 look rolled or used, and of the 97 British C's (of which W. G. Smith's unused-looking specimen resting on the elephant bone, in the "Paleolithic floor" case, is one), about 20 are made, not of flint, but of red quartzite.

Water, rather than use, may have rolled and nicked the edges of any of these flints (except, perhaps, W. G. Smith's) since they were made, and if we must eliminate these battered cutting edges (which I did not look for in the British cases) from the pros and cons of a gravel specimen, whether in Europe or America, nothing remains for the student but analogy with stone implements from other regions.

Judged by this, the 77 French and British B's might have to be left out, because they resembled American cache forms. But the 19 French and the 152 British A's, rude masses tapering to fine points, could not, until some ground of doubt is suggested, escape the category of finished implements.



No. 16161.	No. 11752.	No. 45913.
4 feet from surface,	Gravel of Trenton	R. R. cut, 7 feet.
R. R. cut, 1878.	bluff, 7 feet.	May, 1888.

FIG. 5. ½

Three Trenton specimens (Abbott collection, Peabody Museum, Cambridge, Mass.), rude at base and worked to points, resembling (though lacking the specialization of the latter) the rough based pointed forms from Europe (see FIG. 3, A). The labels on the margin give the Museum record.

As to the position of these forms in the Somme gravels, M. du Mesnil makes a statement which, though contradicted by

[8] Five of the 47 French are little ones, from 2½ to 3 in. long, also well-specialized. The 30 British specimens of B are much ruder than the French. There are also 5 or 6 little French specimens, 2 to 2½ in. long, of the rude pattern C. Eighteen French or 56 British look like blocked out or unfinished forms of A.

certain archeologists is of the greatest interest to the American student—that while A and C begin at the oldest layers and continue through the newest, B only begins in the middle stratum (with the Mammoth), to continue thenceforth with the others to the top.[9]

Granted the correctness of this observation, the student of American quarries would be tempted to call C, when lying as it does in the later beds, at or near the more perfect forms, a " waster or reject," a preliminary step in their manufacture.

When found alone, however, in lower strata of the same gravel, he must fairly ask whether it does not represent an earlier stage in the process of stone chipping, when the savage, unskilled to proceed farther in the then experimental art, would have halted and treated as a finished tool, the same form which later, where finer work was understood and required, he would have cast aside as a " reject."

This brings us to the last question :

THE " WASTER " OF THE EUROPEAN (" NEOLITHIC") QUARRY.

Are there late Stone Age quarries abroad, which, like the American sites, tell a story of bocked out " wasters " resembling gravel forms ?

At Grimes Graves (near Brandon, Suffolk, England) Canon Greenwell found, in 1880, surface conditions resembling those at Macungie, Lehigh Co., Pennsylvania).[10] After digging 40 feet down into an ancient pit, he discovered horizontal galleries, and in them several chalk cups, a phallic figure cut in chalk, and pick-axes made of stag antlers, on one of which was the

[9] The opponents of this statement say that B has been found in the oldest layer. Its advocates, that when such has seemed the case, the specimens tumbled down through the ravining of streams. Unfortunately, it appears that in the demonstration of these points, few exact records have been kept of the stratigraphic position of specimens discovered. None, as far as I could learn, had been photographed in place, and probably not one in fifty was found by a scientific observer with his own hands. "We need," said M. Reinach, in the St. Germain Museum, "a kind of hermit to live in the quarries, and pounce upon specimens as workmen find them."

[10] See Notes on Exploration of Aboriginal Jasper quarries in the Lehigh Hills in 1891–92 (Popular Science Monthly, September, 1893.)

muddy imprint of a human hand. Cissbury (near Worthing, Sussex, England) explored by Col. A. Lane Fox, in 1867–75, repeated in general these discoveries.

At Grand Pressigny (near Tours, France), the fields are scattered with nuclei and thin flakes of flint worked from neighboring rock in situ, and no doubt there are hundreds of other European quarries yet unexplored, illustrating the handicraft of peoples living in times geologically more recent than the drift.[11]

But Spiennes (near Mons in Belgium) will suit our purpose. Here M. M. Cornet and Briart saw, in 1868, a railway cut expose pits and horizontal burrows as at Grimes Graves and Cissbury, in one of which, at a depth of 8 or 10 feet, a fire-site and potsherds were found. The surface and slope of the chalk hill along the little valley of the Trouille, though talus hides the pit profiles, and the surface depressions are level, is still littered thick with refuse, which is, if we may believe European archeology, the work of a man who could make pottery and polish stone tools, and who, as compared with the Drift savage of the Somme is, geologically speaking, a modern individual.

I visited Spiennes in March, 1893, and, after seeing a neighboring collection, and carefully examining the refuse-covered area and several piles of " pierres taillès " in adjoining gardens, gathered with my own hands and obtained from peasants on the spot, a fairly illustrative series of the chipped forms of the quarry.

Figure 6, omitting nuclei and unworked chips, represents the types of the collection (142 specimens in all, including 4 hammer-stones).

Again, as in the American quarries, the story of partly finished implements preceded by " wasters " and inchoate forms,

[11] I. e., according to the European classification, the men of (a) the cave period, (b) the neolithic period, (c) the bronze period.

The paleolithic cave men, who, as we are told, never polished stone, polished bone, and scratched outlines of animals on bone, superior in realistic skill to anything done in the Bronze and Neolithic Ages. At Solutre, they chipped long, thin blades, equal to fine Mexican and Californian specimens, and at the quarries and workshops where these were fashioned, the American student might expect to find a set of " wasters " very familiar in appearance, yet certainly "paleolithic."

is plainly told. The considerably specialized results of the stone chipper's work at Spiennes, are shown in the two groups, A and B.

Of A—a long, narrow blade, worked to a point—I have 7 broken examples, and of B—the chipped celt—worked to a round cutting edge, 8 specimens likewise broken. Both A and B are plainly ushered in by a series of rude, less-specialized shapes, group a (of which there are 36) tending toward A, and group b (of which I have 35) tending toward B.[12]

When we come to group C, representing a series of inchoate masses, 19 in number, too little worked to be classified with the rugged relatives of either A or B, we realize a self-evident fact often before forced upon our attention. Having descended too far in the scale of chipped forms, we have lost our bearings. Judgment by type is at an end. Inference is dangerous. We have reached the point where the fortunately-discovered hearth, the blackened potsherd, or half-eaten bone must help to tell the tale—the point where all stones flaked but of a few chips, like "all cats in the dark," are alike.

And the fact that this group C, from Spiennes, certainly runs into and resembles the rude drift forms from the Somme (Fig. 3, C) the American quarry-refuse specimens above noted, and Trenton Specimens (Fig. 4) means but little, when we observe, as we must, that the most specialized forms from the Spiennes quarry (Fig. 6, A and B) and Drift (Fig. 3, A and B) are quite unlike. Here we infer, if we may infer anything from the shape of worked stones, that where the quarry man was aiming at a thin, elongated blade, or a celt with round cutting edge, the Drift Man was working out a broad, leaf-shaped form, or the unique massive ended "coup de poing."

[12] Two broken, polished celts, (group B) were obtained by me from a peasant at Nouvelles, 1½ miles away. But a peasant at Spiennes spoke of finding polished celts near the pits. So does Canon Greenwell, quoting M. M. Cornet and Briart in Journal of London Ethnological Society, 1871, p. 433.

The above numbers are given as they, from my own observation, seem to show roughly the relative proportion among the refuse, between the more finished and rude forms.

SUMMARY.

To sum up the above conclusions. A visitor, though refusing to take anything on authority, could find no fair reason to doubt that the French implements are found in place in the Somme gravels associated with quaternary fossils, as asserted by European writers. The whole question is simplified by the frequency of bones.

The Trenton specimens, though resembling the ruder and less specialized French types, never duplicate the specialized forms. The shape alone of the remarkable "coup de poing"

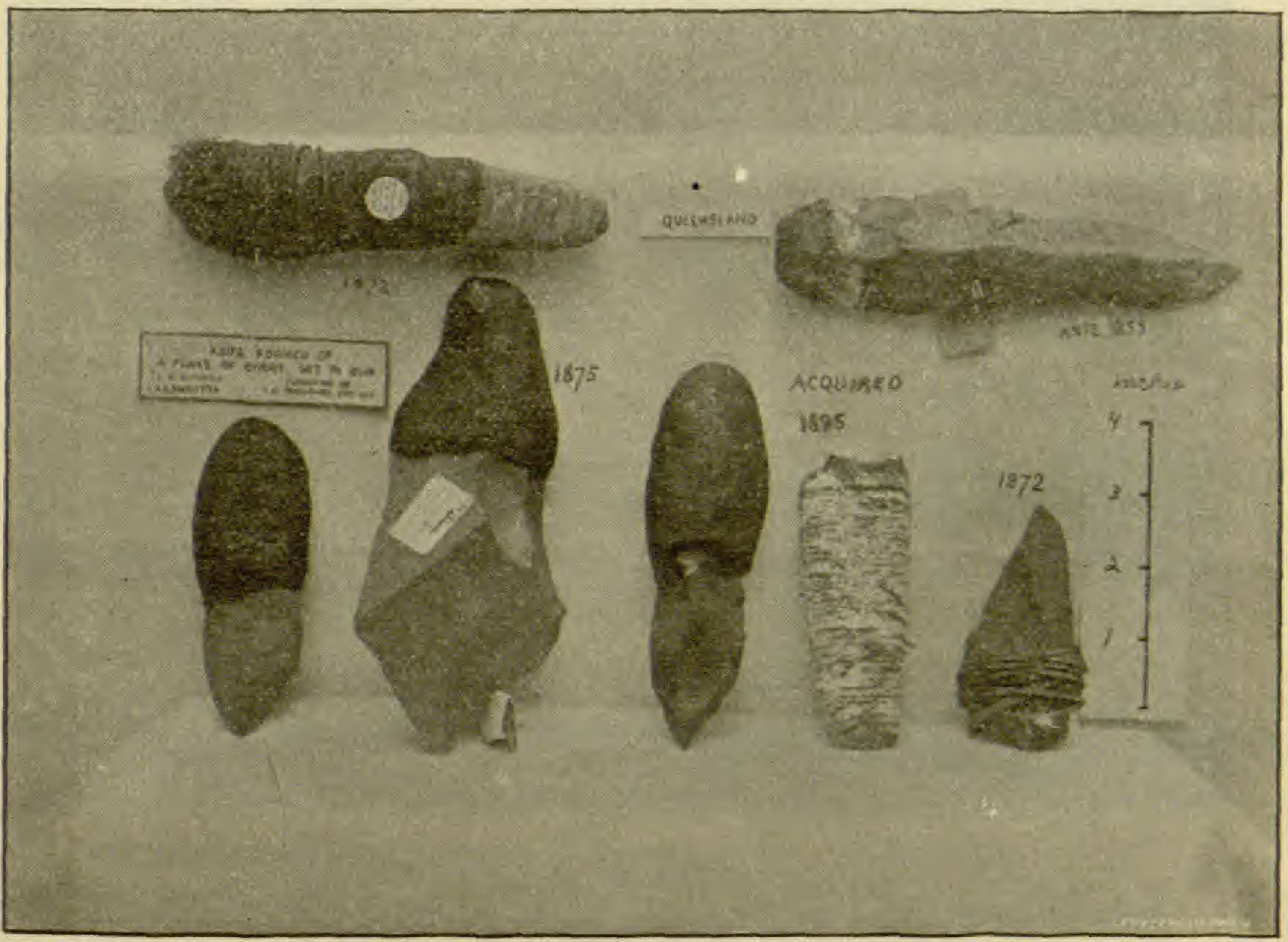


FIG. 7. $\frac{2}{7}$

Australian stone flakes (un-pecialized) set in gum handles and used as knives. (Photographed by kind permission of Mr. C. H. Read, British Museum).

(Fig. 3, A) separates it from all Trenton specimens (except the three in Fig. 5). But its best examples are well-specialized, as is its more familiar leaf-shaped companion (Fig. 3, B), while none of the Trenton specimens are so.

Judged by the American quarry standard, certain of the above-mentioned ruder French forms (Fig. 3, C) might be classed as "rejects" thrown aside by the Drift Man in the fashioning of his finer blades (A and B).

The European neolithic quarry of Spiennes, like the American quarries, illustrates the production of "wasters" in the fashioning of large stone implements. But, in its more specialized results, the chipped celt and the long, narrow blade,

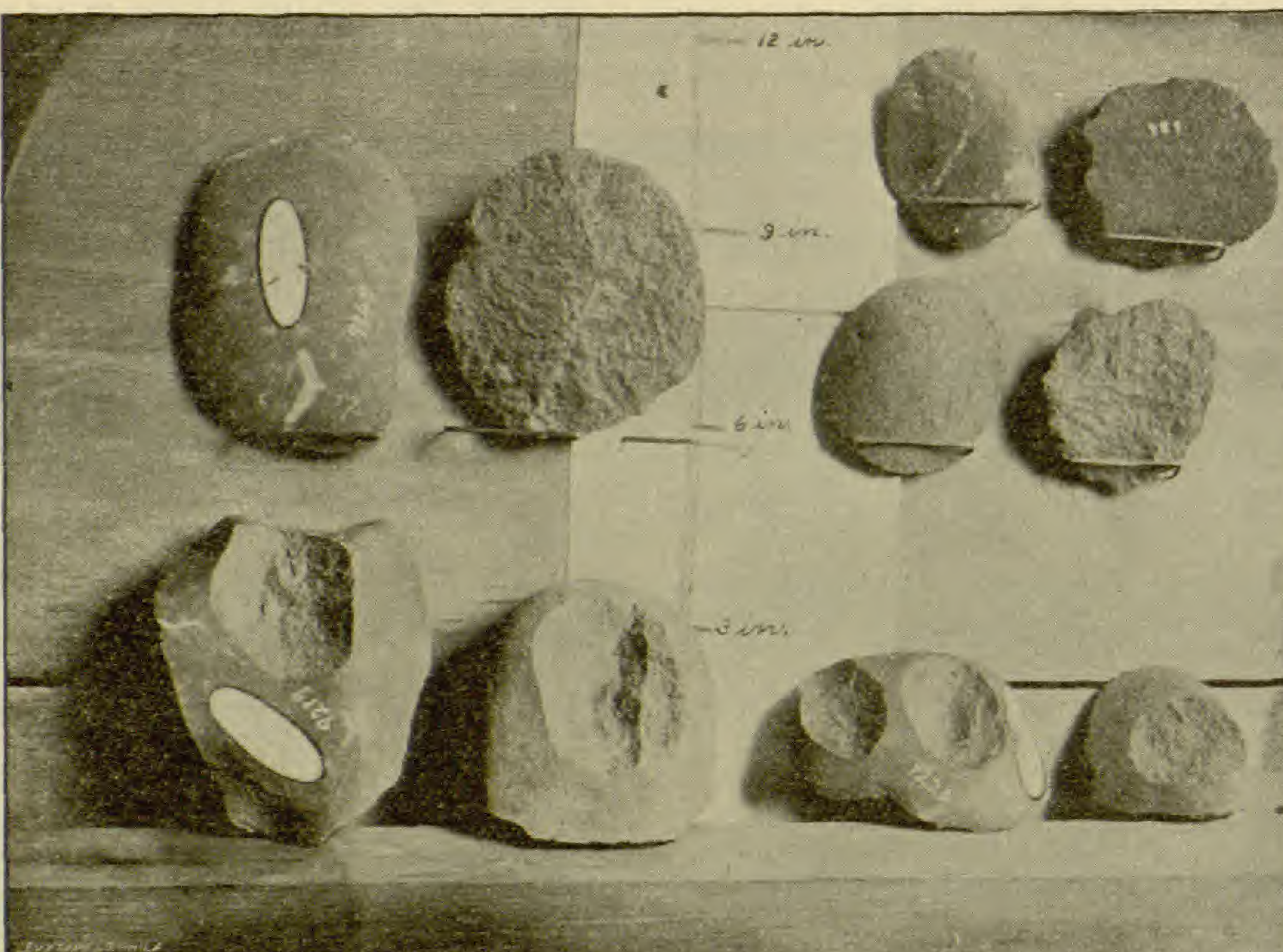


FIG. 8. $\frac{4}{15}$

Stone discs (resembling the "Teshoas" seen by Dr. Leidy in use among the Fort Bridger Shoshones as hide scrapers, in 1870) and river pebbles from which similar discs have been chipped. Found at Indian surface village sites in Delaware and Susquehanna Valleys in 1892.

it offers no resemblance to the leaf-shaped "hache" (Fig. 3, B) and the massive-ended "coup de poing" (Fig. 3, A) of the Somme drift.

While making these comparisons, we have realized that the light thrown upon the subject by the study of American quarries, important as it is, by no means settles the manner by which all peoples in an age of stone made their blade-like implements, or gives us a universal clue to a "finished implement" wherever found.

We must bear in mind (1) that the Easter Island hafted obsidian splinters (Fig. 9) and the Australian unworked flakes (Fig. 7) set in masses of "black boy" gum, for use as knives, hammering tools or saws, prove that specialization is not a universal test of a finished implement. Though as "finished" as arrow-heads, who would call them so when the mounts had rotted? And who could distinguish the white flint flakes used recently by the Andamanese to shave their heads,[13] or the Admirality Island knife-chips of obsidian minus the gum, from "quarry refuse."

(2) That the "Teshoas" used as scrapers by the Shoshones (observed near Fort Bridger by Dr. Joseph Leidy in 1870),[14] of which I have found duplicates in the Delaware and Susquehanna Valleys, together with the pebbles from which it appears that they have been knocked (see Fig. 8)[15], are, though finished implements, not specialized, and illustrate a phase of pebble chipping not noted in the study of quarries.

(3) That the above-mentioned Easter Island hafted splinters, (See Fig. 9) though again finished implements, could not have been preceded by "turtlebacks" in their manufacture, and that the Jasper flake exhibited in the National Museum (see Ray Collection and Smithsonian Report, 1886, part 1, plate XX) as the starting point for arrow-head making among the north-west coast Indians, would probably not have looked like a "turtleback" or "quarry reject" if cast aside after partial working.

I found several little "turtlebacks" at the Jasper quarry at Macungie (about one inch in length), while the well-worked end of a small blade protruding from a shapeless mass at the Saucon Creek quarry, seemed to evidence a procedure not

[13] See Observations by Col. A. Lane Fox, Journal of the Anthropological Inst. of Great Britain, etc., May, 1878, p. 446.

[14] See Hayden's U. S. Geological Report for 1873.

[15] See paper on "Pebbles Chipped by Modern Indians, as an Aid to the Study of the Trenton Gravel Implements," Proc. Am. Ass. for Adv. of Sci., Vol. XLI, 1892, p. 287.

involving the production of "quarry rejects" of leaf-shaped form. And it seems hard to escape the conclusion that if in some American cases the finished arrow-head or small blade is the fit survivor of a family of leaf-shaped "rejects;" in others (as certainly in the Mexican flake arrow, worked only on one side), it sprung from the nearest available chip, no more resembling the ovate quarry forms and Trenton specimens than would a bit of ill-worked bottle glass cast aside by California Indians.

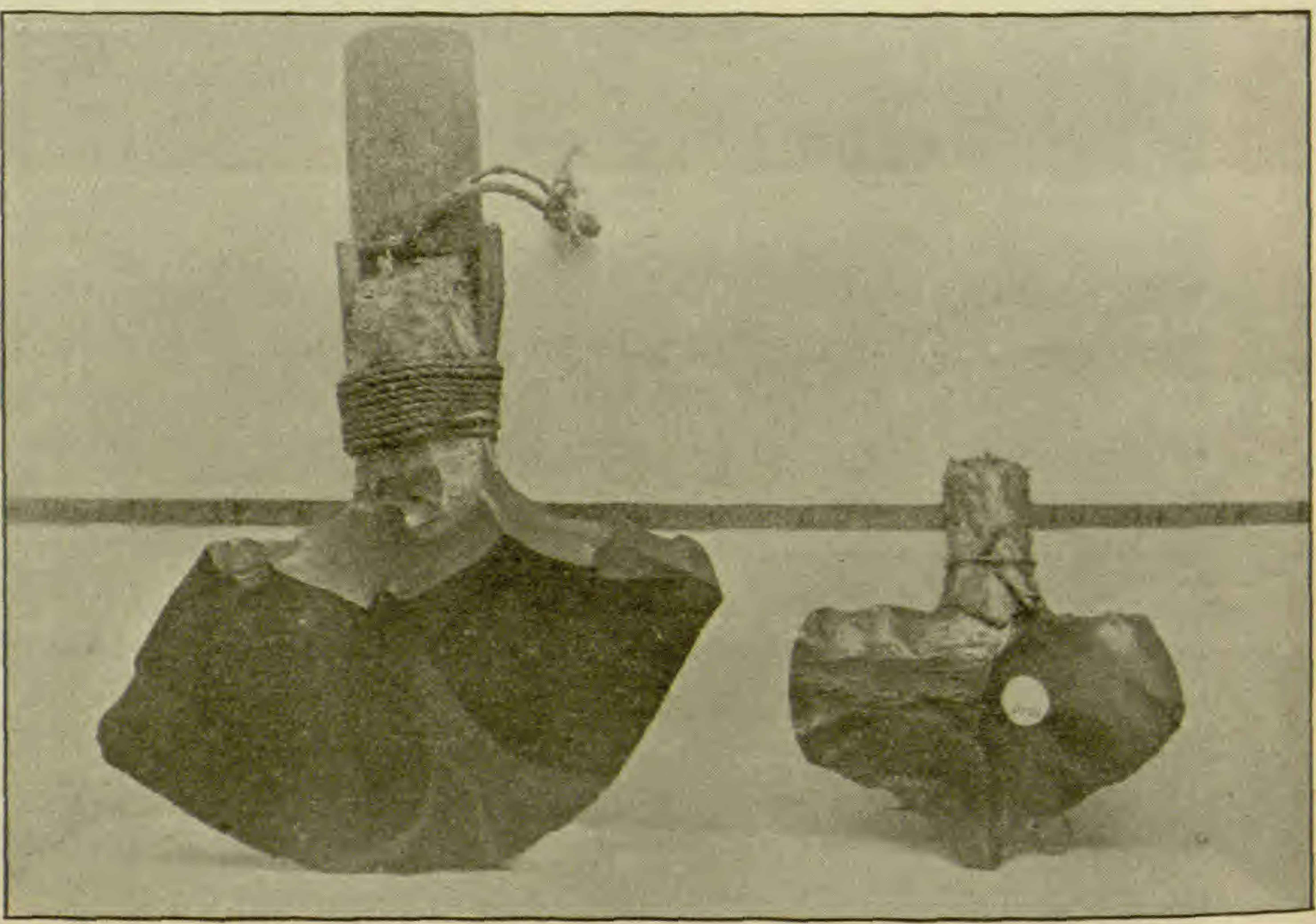


FIG. 9. $\frac{2}{7}$

Rude hafted flakes of obsidian from Easter Island.

(Photographed by the kind permission of Mr. Charles H. Read, British Museum).

EDITORIALS.

—It has always been recognized that scientific research is greatly furthered by the exchange of the various objects with which that research is concerned. For the transmission of objects of Natural History from one country to another, the mails have offered a cheap, speedy and reliable means. Heretofore, through the laxity with which the regulations on the subject have been enforced, it has been possible to enter such objects in the mails of the Universal Postal Union as samples of merchandise and under the rates of postage therefor. From official information lately received from the Post Office Department of the United States it appears that such a rating is entirely unauthorized by existing provisions, and that objects of Natural History may be mailed to countries of the Union only at the rates required for letters. The United States Post Office Department also states that it had recently submitted a proposition to the countries composing the Postal Union, to modify the regulations so that such specimens might be received into the mails at the same rates as samples of merchandise, but that a sufficient number of those countries had voted against the proposition to defeat it. The countries which voted negatively are Austria, Bolivia, British India, Canada, Germany, Great Britain, Guatemala, Hungary, Japan, Norway, Portugal, Russia, Spain, Sweden, Tunis, Uruguay, Venezuela.

The Academy of Natural Sciences of Philadelphia has therefore resolved to address the various scientific bodies, with which it is in communication, in those countries whose Governments have voted against the proposition, and to request those scientific bodies to memorialize their respective Governments in favor of the same. The following circular has been prepared.

The Government of having voted in the negative, this Academy respectfully requests the favorable consideration of this question by your Society, and begs that it take such steps as it deems advisible to inform the Postal authorities of of the manifest advantages to scientific research which would result from the adoption of the proposed modification, and to request those authorities to take such steps as may result in the adoption of the same. The letter rate for postage (Universal Postal Union) is ten times that required for samples of merchandise; such a rate for specimens of Natural History is virtually prohibitive. This Academy would respectfully urge upon your honorable Society prompt action on this matter if it meets with that approval which we so strongly desire.

President, Recording Secretary.

As the above list of countries includes all the great powers of Europe excepting France and Italy, the necessity for the proposed action is evident.

—WE have received the first number of a new geological periodical, "The Glacialist Magazine," published in London. The editorial corps includes the names of some well-known and able geologists, one of whom is an American. That this journal will be well edited we have no doubt, but we have some doubts of the propriety of adding another to the list of geological magazines now in existence. These number, in the United States alone, without counting more general scientific periodicals, five, the new one being the sixth which asks for a subscription. The probability obviously is, that unless they can be circulated gratuitously, new journals must fail of sufficient financial support. Such subscriptions as they receive are more or less likely to be withdrawn from existing journals, so that these may become impoverished. Geologists should rather concentrate than divide their publications.

—THE able geologist, Mr. W. T. McGee, has been appointed Director of the Bureau of Ethnology at Washington. Mr. McGee's important contributions to Geology are well-known, and we therefore fail to see the propriety of his transfer to another field where he has been until recently unknown. We say until recently, for he has become recently unfavorably known in Anthropology for an unparliamentary review of Professor G. F. Wright's book. This appointment was, of course, made by officials who were, we suppose, unacquainted with the facts in the case. We can only say that appearances would have been saved by a greater delay in the appointment; and anthropology would have been benefited by a longer apprenticeship on the part of Mr. McGee.

SOME TIME ago the Legislature of the State of Arkansas passed a resolution, which, declares that the pronunciation of the name of the state is Arkan*saw* and not Arkan*sas*. Persons who are in a position to know, are aware that this resolution expresses the custom of the people of the State, and of the countries immediately adjoining, while in the east and elsewhere, the name is pronounced Arkansas, so as to agree with the pronunciation of the names of the States of Texas and Kansas. These customs have been fixed for a long time, for we find in Lewis and Clark's narration of their expedition, which was published in 1823, the name spelled Arkansa. It is evident that this spelling according to the French pronunciation expresses that which long custom has made correct in English, and it therefore seems that it should be adopted in geographies and on maps, so that the confusion resulting from the pronunciation of the names Texas and Kansas may not be perpetuated. The case is quite different with regard to the native pronunciation of the name Missouri, which is Mizzoura. This is not supported by any linguistic reason, and is provincialism which time will probably abolish.

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WICKERSHAM, J.—Is it "Mt. Tacoma" or "Rainier?" Extr. Proceeds. Tacoma Acad. Sci., 1893. From the author.

RECENT LITERATURE.

Iowa Geological Survey.[1]— The first annual report of the Iowa Geological Survey just issued is unusually attractive in appearance, and presents an interesting array of papers. That by Professor Calvin deals with some phases, of the, as yet, imperfectly known Cretaceous deposits occurring in Woodbury and Plymouth counties, and contributes important information concerning them. These deposits in the area studied consist of soft sandstone interstratified with bands of ferruginous nodules and variegated, often parti-colored, clays, overlaid by white, or yellowish chalk, in part indurated into beds of soft fissile limestone. White, in his report of 1870, termed this chalk the Inoceramus bed, from the great numbers of *Inoceramus problematicus* found in it, while the lower beds were called the Woodbury sandstone and shales. Professor Calvin, mainly on paleontological evidence, separates the latter into two divisions, the lower of which, chiefly sandstones containing impressions of leaves belonging to species of plants resembling our modern forest trees and with animal remains exceedingly scarce, he correlates with the Dakota group of Meek and Hayden. The second division, principally shales containing impressions of valves of marine molluscs associated with the vertebræ of bony fishes and the skeletons of marine saurians, is the Fort Benton group of the same authors, while the chalk represents their Niobrara group. The few molluscan remains found in the beds of the Dakota group are related to brackish water species and imply that the beds were laid down in an estuary, or at least in a region where the sea was shallow and large volumes of fresh water were poured into it.

The beds of the second division show a gradual change in the conditions of deposition owing to the deepening of the sea and the shifting of shore line farther east. True marine molluscs, and fishes and reptiles occupied the region, and left their skeletons to be buried in the finer mud that characterized the deposits then slowly accumulating in the open sea.

During the succeeding epoch where the chalk and shell-bearing limestones were forming, the water, by subsidence of the ocean bed, had become deeper, and the shore-line of the Cretaceous sea attained its farthest extension eastward probably reaching as far as the Mississippi

[1] First Annual Report for 1892, with Accompanying Papers. 8vo. 472 pp. with ten plates and twenty-six figures. Samuel Calvin, State Geologist, Des Moines, 1893.

in northwestern Iowa. Inoceramus multiplied over the sea bottom as oysters, if undisturbed, would crowd a modern oyster bed. Sharks disputed possession with the bony fishes and marine saurians. Everything betokens a deep, clear, open sea that spread away from the shore line in Iowa, over all the intervening plain, to the present site of the Rocky Mountains. Recent excavations and cuttings have shed much light on the Iowa Cretaceous and the present survey which will doubtless add much to our knowledge of this important group of rocks. There are two formations in Iowa, probably belonging to the Cretaceous, whose exact stratigraphical relations are at present doubtful, viz.; the Fort Dodge gypsum deposits and the Nishuabrtua sandstone.

The assistant state geologist, C. R. Keyes, contributes several papers the most important of which is on the classification of the Iowa formations. While in large part merely a summary of the work done upon these rocks in recent years by various workers, it also presents someimportant considerations derived from the author's personal investigations In the revision of the classification, some needed changes in nomenclature appear, as St. Croix for Potsdam, Oneota for Lower Magnesian, etc. The attempt to correlate the Iowa rocks with the New York section is wisely abandoned. In the classification of the Lower Carboniferous, the formations included between the Kinderhook below and the St. Louis beds above are grouped together under the term Augusta. These beds comprise what Williams[2] called the Osage group, a name here shown to be inapplicable.

It is in his discussion of the Coal Measures, however, that the author departs most widely from the generally accepted views of Iowa geology. After some general considerations of the Coal Measure deposits, he calls attention to the two classes of sediments generally recognized, viz.; marginal or shore deposits, and those laid down in the open sea. In the Coal measures, as elsewhere, the first of these is characterized by rocks predominantly clay, shales and sandstones with practically no limestones. The sandstones often form great lenticular masses, sometimes deeply channelled on the upper surface, the excavations being filled with Coal Measure clays. These and many other phenomena attest a constantly shifting shore line and the shallow waters. The fossils are nearly all brackish water forms or shore species. On the other hand, the second class of deposits above mentioned is made up largely of calcareous shales with heavy beds of limestone. The former are chiefly composed of strictly open sea forms.

[2] H. S. Williams, Bul. U. S. Geol. Surv., No. 80, p. 109.

As the conditions of deposition were evidently those of a slowly sinking sea shore, the marginal deposits or Lower Coal Measures practically underlie the open sea formations or the Upper Coal Measures. Hence in the use of the terms Lower and Upper, though allowable in a general way, it must be remembered that along any particular plane the two series of deposits are contemporaneous and their separation therefore would be represented by an oblique rather than a horizontal plane. Under this view the author proposes to divide the Coal Measures or Pennsylvanian series into (1) the Des Moines stage, representing the marginal deposits, thus including all the coal, and (2) the Missouri stage representing the marine deposits. These correspond essentially with the Lower and Upper Coal Measures as ordinarily given. The coal seams are shown to have but a limited extent generally, and to be nearly worthless for correlation purposes. The seams vary from a few inches to seven or eight, and even ten feet in thickness, the average of the seams now worked being between four and five feet. They are not disposed in continuous layers over the whole area as commonly supposed, but in numerous lenticular masses from a few yards to several miles in extent. Being confined to the marginal areas they are associated principally with the sediments characterizing that class of deposits, and have a slight seaward slope. They were laid down over an ancient eroded surface with hills and vales, ridges and gorges, and overlap Lower Carboniferous, Devonian, and even Silurian rocks. The paper is illustrated with numerous figures and diagrams showing graphically the structure of the Iowa coal field, and the essential differences between the views here advanced and those commonly held.

Other papers of value are presented by S. W. Beyer, H. F. Barie and G. L. Houser. That of Mr. Beyer treats of an interesting discovery of eruptive rock in a deep well at Hull, Iowa, at a depth of seven hundred and fifty-five feet, interstratified with beds of sandstone constituting what was considered to be Sioux Quartzite.

Additional facts bearing upon this occurrence of eruptive rocks in Iowa will be looked for with interest.

As a whole the report shows marked wideness of taste and care in its makeup, though the proof reader evidently mislaid his glasses at certain points, or was it the typo who failed to note the corrections?

C. H. G.

Correlation Papers—The Newark System.[3]—This essay, prepared by Mr. I. C. Russell as a bulletin, is the sixth of the series of

[3] Bulletin of the United States Geological Survey, No. 85. Correlation Papers—The Newark System. By I. C. Russell, Washington, 1892.

Correlation Papers issued by the U. S. Geological Survey. Originally Mr. Russell intended to cover the entire Jura-Trias of North America, but circumstances compelled him to restrict his attention to those of the Atlantic border. This particular body of rocks the author calls the Newark System, a name proposed by W. C. Redfield in 1856, giving as a reason that it is the oldest specific title not implying opinion as to geologic age. These rocks extend from North Carolina to New Brunswick and Nova Scotia, but not to Prince Edward's Island, as has been asserted. They occur in narrow belts trending parallel to the application folds, covering an area of 10,000 square miles. It is Mr. J. Russell's opinion that the evidence now at hand bears out the theory that these detached areas are remnants of a once broad terrace which has been broken by orographic movements and greatly eroded.

The sedimentary rocks of the Newark System, consisting chiefly of sandstone and shale, were deposited in tide-swept estuaries, while the carbonaceous shales and coal seams originated in basins more shut off from the seas. The trap rocks are a part of the great system of dikes and sheets which intersect the surrounding crystalline and paleozoic rocks. The evidence of glacial action during the Newark period, Mr. Russell thinks is weak.

In discussing the relations of the Newark system to other terranes the author refers to the difficulty of correlating the rocks of America with those of other countries, and concludes that biological phenomena as a means of correlating, can be safely used only after the relative age of the strata has been determined from physical phenomena. Paleontologists of the Vertebrata will not concur in this view, for the vertebrate fossils indicate conclusively that the formation contains at least the representation of the upper member of the Trias or the Keuper. This was first definitely pointed out by E. D. Cope in 1866.[4]

The volume is accompanied by a very full bibliography, and is illustrated by many handsomely executed colored and uncolored plates. The colors of the geological maps are in general accordance with those in use by geologists.

Spalding's Guide to the Study of Common Plants.[5]—It is a pleasant thing to take up a new book and find our expectations not dis-

[4] Proceedings of The Philadelphia Academy, pp. 249–50, 290. This reference is omitted by Mr. Russell from his table of determinations on p. 17, but is included in the Bibliography on p. 170.

[5] An introduction to Botany. By Volney M. Spalding, Professor of Botany in the University of Michigan. Boston, U. S. A. D. C. Heath & Co., Publishers, 1893, pp. XIII 246.

appointed. The author of the little work before us has for many years been a successful teacher of Botany in one of our great State Universities, and has had not only the experience which his own teaching has brought him, but he has seen much of the results of botanical teaching in the high schools which annually send up their graduates to the University. The book is intended for use in such preparatory schools and was prepared in answer to frequent inquiries from high school teachers.

The leading thought in the book may be gathered from the following sentence in the chapter addressed to the teacher. "In order to use these exercises successfully it will be necessary to adopt the laboratory as distinguished from the text-book method of instruction."

Two short chapters are given to the discussion of the proper outfit for a botanical laboratory for high schools.

One of these includes lists of works of reference under several heads: "Laboratory Manaels," "Structural and Physiological," "Morphological and Systematic," "Floras," "Cryptogamic Botany," "General," and "Current Literature." The lists are well made and the author well says the books named "ought to have a place in any respectable school library."

The other chapter under this head gives good suggestions about the laboratory itself, the tables, microscope (small "Continental" stands recommended), glassware, regents, etc.

Then follow laboratory studies of seeds, growth of plants from the seed, root, leaf, flower and fruits. These serve to train the pupil to close observation. He then takes up the careful study of plants representing the natural groups of the vegetable kingdom. Thus the "Seaweeds and their Allies" are represented by pond scum (*Spirogyra*) and green felt (*Vaucheria*); mosses and liverworts are taken next, followed by ferns, horsetails, club-mosses, the pine family, the grass family, etc., though Monocotyledons and Dicotyledons, ending with the Compositæ. The treatment reminds one of that in Arthur, Barnes and Coulter's "Plant Dissection," of course much simplified.

The author has adopted a modification of Eichler's sequence of the families of the flowering plants. Very properly, too, he makes a distinction between "families" and "orders" (. 241).

The book will, if used by our high schools, do much to improve the quality of botanical teachings below the colleges and doubtless will stimulate some of our colleges also to better work than they have been doing.

CHARLES E. BESSEY.

Annual Report of the United States Geological Survey, 1889-90. Part I.[6]—This quarto volume of 757 pages constitutes a record of the geological work of the survey for the years 1889–90. It comprises the report of the Director, giving a general account of the progress of the work during those years, appended to which are the administrative reports of the chiefs of branches and divisions, and two scientific papers by members of the survey. Both of these papers, the first by Mr. W. J. McGee on the Geology of Northeastern Iowa, and the second by Mr. A. J. Phinney, on Natural Gas Districts in Indiana, are the result of observations extending through a number of years. The illustrations are numerous and excellent.

The Report of the Death Valley Expedition.[7]—This report is No. 7, of the series "North American Fauna" published by the U. S. Agricultural Department. It embraces the following special reports. Birds by Dr. A. K. Fisher; Reptiles and Batrachians by Dr. Leonard Stejneger; Fishes by Dr. C. H. Gilbert: Insects by Dr. C. V. Riley assisted by Drs. S. W. Williston, P. R. Uhler and Lawrence Bruner; Molluscs by Dr. R. E. C. Stearns; Desert Trees and Shrubs by Dr. C. H. Merriam; Desert Cactuses and Yuccas by Dr. C. H. Merriam; and the Localities by T. S. Palmer.

The expedition was under the direction of Dr. C. H. Merriam, Director of the Department of Animal Industry, who deserves much credit for the inception and execution of the plan. As a report of a single exploration, it is second to none of those sent out at various times by the Government, if thoroughness of work and importance of results to geographic, climatic, and hypsometric distribution be considered. The report on Mammalia which is yet to be issued, will be by Dr. Merriam, and we may anticipate that much of interest will be brought to light by its author, who is here in his favorite field.

The geographic distribution of the numerous species met with, is stated in terms of the system already adopted by Dr. Merriam in his report on the distribution of life in Arizona.

In this system Dr. Merriam[8] discards the usual divisions, which

[6] Eleventh Annual Report of the United States Geological Survey to the Secretary of the Interior, 1889–90. By J. W. Powell, Director, Part I, Geology, Washington, 1891.

[7] The Death Valley Expedition: A Biological Survey of parts of California, Nevada, Arizona and Utah. Part II, North American Fauna, No. 7. Washington, 1893.

[8] The Geographic Distribution of Life in North America with special Reference to the Mammalia; Proc. Biol. Soc., Washington, VII, p. 11. April, 1892.

were first proposed by Baird, added to by Cope, and divided by Verrill and Allen, which correspond in great measure with the geological divisions of the continent, and which are in part divided by lines approximately meridianal. He regards the primary faunal divisions as corresponding in great measure with parallels of latitude. Thus his Sonoran region includes the Sonoran and Austroriparian of Cope, which thus extends from the Pacific to the Atlantic Ocean. But he recognizes the two divisions as of distinct though subordinate value, calling them respectively, the arid and humid districts. He does not adopt the Pacific nor the central regions. Dr. Merriam admits that his system does not express the relations of the aquatic vertebrates. But a system which does not take these into account must be defective. Moreover it is not difficult to show that the Batrachia and Reptilia as well as the fishes sustain the system of Baird and Cope, and Dr. J. A. Allen has shown in a review of Dr. Merriam's paper (published in the Auk) that the birds do also. The geologic history of the continent has had everything to do with the origin of this distribution of life, so that the system which conforms to it is likely to be the correct one.

In regard to the birds observed during the Death Valley Expedition of 1891, Mr. A. K. Fisher writes as follows:

"Baird's woodpecker (*Dryobates scalaris bairdii*) was quite common among the tree yuccas on the Mohave Desert at Hesperia, and its range was extended northward to Vegas Valley, Nevada, and the valley of the Santa Clara, in southwestern Utah, by Dr. Merriam. The vermillion fly-catcher also was secured in the same valley, though previously unknown north of Fort Mohave, Arizona. The Texas nighthawk (*Chordeiles texensis*) was found to be a common summer resident in all the valleys east of the Sierra Nevada from Owens Valley, California, to St. George, Utah, where Dr. Merriam secured the eggs. It was taken also in the San Joaquin Valley, California, near Bakersfield. Scott's oriole (*Icterus parisorum*) is another species whose range was carried northward from a short distance above our southern border in California to about latitude 38°, where it was common in places among the tree yuccas, and also on the slopes of some of the desert ranges as high as the junipers and piñons. Costa's humming-bird (*Claypte costæ*) was very common whever water occurred throughout the desert region, ranging northward nearly to latitude 38°, and eastward to the Beaverdam Mountains, Utah. Its nest was frequently found in the low bushes and cactuses on the hill sides near springs and streams.

"The discovery that the gray-crowned finch (*Leucosticte tephrocotis*) breeds in the southern Sierra and in the White Mountains is especially interesting both because its breeding range was previously unknown, and because no species of the genus had been recorded from the Sierra Nevada south of about latitude 40°, while the present species was common nearly to the 36th parallel.

"Most satisfactory results were accomplished in working out the distribution of Thurber's junco (*Junco hyemalis thurberi*) a recently described race whose range was not definitely known. In the Sierra Nevada it was common from the Yosemite Valley, the most northern point visited by any member of the expedition, to the southern end of the range, and in the desert ranges eastward to the Grapevine and Charleston Mountains, where its place was occupied, in winter, at least, by its more eastern representative, Shufeldt's junco. The little black-chinned sparrow (*Spizella atrigularis*) was found to be not an uncommon summer resident on the slopes of several of the desert ranges and also on the east slope of the Sierra Nevada as far north as Independence Creek in Kearsarge Pass. This was a great surprise, as heretofore the species has been recorded within our limits only along the southern border, and its presence was not suspected, until a specimen was taken in the Panamint Mountains in April.

"Le Conte's thrasher (*Harporhynchus lecontei*) contrary to our expectations, was a common resident throughout the principal desert valleys from Owens Valley at the east foot of the Sierra Nevada across southern California and Nevada to southwestern Utah, where it was found nearly to the summit of the Beaverdam Mountains." Its range was found to correspond nearly with that of the curious bush *Larrea mexicana* in our limits.

An interesting result is the discovery that the California condor (*Cathartes californianus*) is not so rare nor so near to extinction as has been supposed. A considerable number of individuals were seen by members of the expedition, mostly on the eastern side of the southern Sierra Nevada. Now that bisulphide of carbon is taking the place of strychnia for the destruction of mammalian pests of agriculture, it is to be hoped that the slaughter of this magnificent bird will be stopped, and that it will continue to add dignity to the noble scenery in which it dwells, as long as the country itself continues.

The determinations and descriptions of the Reptilia and Batrachia of this report are the work of Dr. Stejneger of the U. S. National Museum, and they are accompanied by field notes by Dr. C. H. Merriam. In the work of Dr. Stejneger, we see the ornithologist in herpetology. The critical quality of the work both as to the structural characters, and the literature, is beyond all praise; but species splitting is carried to a length hitherto unknown in the science, and the nomenclature is reduced to a system which takes in all names, provided they got printed, no matter how.

The identification of some of Baird and Girard's type specimens, and hence species, is a service for which herpetologists will be grateful, and Dr. Stejneger places in the hands of naturalists the means of determining their value. That they will often disagree with his conclusions as to species, is to be expected. Thus by his own showing *Sceloporus magister* is not a different species from *S. clarkii*, although he thinks it is; nor *Hypsiglena texana* Stejneger sp. nov. from *H. ochrorhynchus;* nor *Bufo halophilus* from *B. columbiensis.* I have examined the series of Crotaphytes in the National Museum with the view of ascertaining the standing of the recently described *C. baileyi* Stejn. and *C. silus* Stejn., and I cannot see in them more than poorly defined local races of the *C. collaris* and *C. wislizenii* respectively. The same is true of *Callisaurus ventralis* Hallow., as compared with *C. dracontoides.* In nomenclature, we have all the nomina nuda of Fitzinger revived, and all the unclassical spellings of original authors carefully preserved. Thus we find Pituophis for Pityophis, Bascanion for Bascanium, and bi-seriatus for biseriatus. Such acumen directed to the proper spelling of names would be a material gain to science in this country.

Forty-four species of Reptiles were procured by the expedition, and twelve species of Batrachia. None of them are regarded as new[9] to science excepting a Rana, which is called *Rana fischerii.* This appears to be very close to the *R. onca,* with which it should be further compared. The notes on the habits of the species by Dr. Merriam are very interesting and add much to the value of the paper. Before passing to the fishes, I pause to correct a misapprehension into which Dr. Stejneger has fallen, and which involves the veracity of the writer of this review. In adopting the name *pipiens* for the *Rana virescens,* he remarks that Garman has shown that the former is the correct name, and that he is therefore not responsible "as one might be led to believe from Cope's treatment of the matter," for the use of the second name (*virescens*). The paragraphs in which the reasons for the employment of the name *virescens* are set forth in my Batrachia of North America, were copied directly from MS. furnished me by Mr. Garman. Mr. Garman changed his mind after the publication of my book.

The region explored is not rich in fishes, but a good many specimens and species were obtained. The most important result is the discovery

[9]The new species described in the report are from adjacent regions.

of a new species of Cyprinodontidæ which is nearly related to the Oristias of the elevated Lake Titicaca of Peru, which is the type of a new genus called by Professor Gilbert, Empetrichthys. As in the Peruvian genus there are no ventral fins and no lateral line, and the very large pharyngeal bones are fused below. This fish inhabits the inhospitable waters of the Amargosa River, which, while not elevated like the Peruvian lake, flows through a region of similar geologic age. Another interesting discovery is that of the rare *Lepidomeda vittata* in a stream on the western side of the Colorado drainage in Nevada, far from the only locality previously known, which is the Colorado Chiquito of Arizona on the eastern drainage.

In an introduction to the report on insects, Mr. Riley makes the following remarks:

"Taking first the Coleoptera, which represent by far the larger part of the collectings, they have for the most part been carefully compared with the national collection, and I have had the assistance, in the verifications, of Mr. M. S. Linell and Mr. E. A. Schwartz, both well acquainted with our North American Coleoptera. As the chief localities from which the beetles were obtained do not exceed seven, the list has been arranged in tabular series to prevent repetition of localities. This arrangement at once shows that the collection comprises some 258 species, representing 170 genera in 39 families. Of the total number of species arranged according to localities, twenty-eight (a) are of general distribution in North America, i. e., they cross the whole continent, and among them are six cosmopolitan species, while only a single species *Bradycellus cognatus* found in the Argus Mountains, belongs to the circumpolar fauna. About fifty of the species are widely distributed throughout the more arid regions of the west, and about twenty species belong more properly to the fauna of maritime or upper California. The bulk of these species, as will be noted, were collected in San Bernardino County. Deducting the three sets of species and a few others, e. g., the genera Homalota, Scopæus, Scymnus and Cryptophagus, of the distribution of which very little can be definitely said, there remain about 140 species which are more or less characteristic of the Sonoran fauna. Some nineteen species are undoubtedly new.

"In the Heteroptera the list represents merely the species that were readily determinable, while the balance, including the more interesting forms, have been referred to Mr. P. R. Uhler, of Baltimore, Maryland, who has kindly reported on them, with definitions of the new genera and species.

"In the Homoptera, as will be noticed, there are some interesting new species, especially in the family Psyllidæ, but until they are carefully compared I do not feel justified in making any remarks upon them, nor have I time just now to characterize the undetermined forms which I prefer to do in connection with the very many new species in the National Collection to which I have already given much study."

Mr. S. W. Williston prefaces a report on the Diptera as follows:

"That the larger part of the collection of Diptera from Death Valley and the adjoining regions sent me for determination by Professor Riley should be new to science is not strange, inasmuch as they are, for the greater part, members of families which have been but little studied in America. The collection is of considerable interest as adding three European or African genera hitherto unrecorded from America, among which the wingless Apterina is the most remarkable. After a careful search I have found it necessary to describe two new genera —one among the Dexiidæ, the other an Ephydrinid."

The Land and Fresh Water Shells were examined and reported on by Mr. Robert E. C. Stearns, who refers to the more important ones in the following language.

"The more interesting forms obtained were the two species heretofore referred to Tryonia, until recently regarded as obsolescent or absolutely extinct, but which were found to be living, as elsewhere remarked.' *Helix magdalenensis,* another interesting species described from examples collected in the Mexican State of Sonora in 1889-90 by Mr. Bailey, of Dr. Merriam's Division of Biological Exploration, was detected by Fisher and Nelson several degrees of latitude farther to the north than the habitat of Bailey's original examples and at a very much higher altitude. This latter, by its presence at this northerly station, contributes to our previous knowledge and data bearing upon the relations between the geographical distribution of species and environmental conditions or influences; and two fresh water forms, not before known, were added to the Molluscan fauna of the region traversed by the expedition."

This report is one of the valuable results of the establishment of the Division of Animal Industry of the Agricultural Department. We hope that the recent reductions in the force of the Department by the present Secretary has not affected the efficiency of the Division, as science in general and Agriculture in some of its aspects, would materially suffer.—E. D. Cope.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Laurentian of the Ottawa District.—In a paper recently published by Mr. R. W. Ells, the author shows that certain modifications of the arrangement of the Laurentian strata as laid down in the geological map of Canada, 1866, must be made. While it is as yet hardly possible to estimate correctly the thickness of the strata, there is no doubt that it has been overstated. The Anorthosite masses north of St. Jerome which had been placed in the upper Laurentian have been shown by Dr. F. D. Adams to be of intrusive origin. The limestones in both the Trembling Mountain section and the region between the Anorthosite area and Gatineau River in nearly every case occupy well defined synclinals.

The succession of strata in ascending order as revised by Mr. Ells is as follows:

1. Reddish-gray gneiss without distinct signs of bedding.
2. Reddish orthoclase gneiss showing a well stratified arrangement of beds.
3. Grayish and rusty gneiss passing into a regular crystalline limestone.
4. A series of schistose rocks, highly metamorphic, described in earlier reports as the Hastings series.

In conclusion the author calls attention to the fact that under the present arrangement of the Laurentian of Quebec the parallelism with the rocks of the system as displayed in southern New Brunswick is very close. (Bull. Geol. Soc. Am., 1893.)

Relations of the Laurentian and Huronian Rocks North of Lake Huron.—This paper is an extension of one published by the author, Mr. A. E. Barlow, in 1890, and contains some further observations on the nature of the contact between the Huronian rocks of Lake Huron, described by Logan and Murray, and the Laurentian gneisses. As a result of his investigations, Mr. Barlow is convinced of the irruptive nature of this Laurentian gneiss and of its magmatic condition at a time subsequent to the petrification of the Huronian sediments. The following facts have led to this conclusion :— (1) The diverse stratigraphic relations of the two rocks along their line of junction. (2) The alteration of the sedimentary rocks along the line of junction. (3) The inclusion of angular fragments in the mass of the gneiss which are clearly referable to the adjacent sedimentary strata. (4) The occurrence of gneissic intrusions distinctly irruptive. (5) The absence of limestones, slates or quartzites, or any species of rocks indicative of ordinary sedimentation. (6) The general character of the rock itself. (Bull. Geol. Soc. Am., 1893.)

The Carboniferous Glaciers of Central France.—In a note on the geogeny and stratigraphy of the coal-measures of central France, M. A. Julien discusses the various problems to whose solution the key is given by the discovery of the glacial origin of the breccia in the coal-measures: (1) the cause of the glaciers of the coal-measures; (2) their centers of dispersions; (3) the direction of the glaciers for each basin; (4) the precise relative age of the breccia.

The cause of the glaciers is the elevation, at the beginning of the Upper Carboniferous period, of Alpine masses forming part of that chain which Mr. Marcel Bertrand designated, a few years since, the Hercynian chain. The formation of this chain caused the elevation of central and western Europe and displaced the carboniferous ocean as the Alpine chain, at the close of the Miocene epoch, expelled the Helvetian sea. In both cases these extensive orogenetic movements were accompanied by an enormous development of the internal activity of the globe resulting in the breaking out in Europe of that series of porphyritic volcanoes of the Permo-carboniferous epoch, and of trachytic and basaltic eruptions toward the close of the Tertiary. It is not, then, at all strange to find traces of Permian and Carboniferous glaciers since the conditions which produced the more recent glaciers were present also during those earlier periods.

With the aid of a careful lithological inventory of each basin, one can infer the height of the original mass, and the direction of the flow of the glaciers. For instance, those entering the basin of St. Etienne came from the north.

In regard to the relative age of the breccia, the author concludes that the Coal-measures of the basins of Epinac, Blauzy, Brassac, Langeac, Commentry, etc., are synchronous, that their formation has been simultaneous, and that they differ from each other only in having their upper beds more or less worn down by erosion.

M. Julien is thus led to synchronize, in spite of conflicting floral testimony stated by M. Grand 'Eury, the beds of Rive-de Gier, Valfleury and Fouillouse, those of Epinac, Colombier, and Marais, at Commentry, of Combelle and of Chalède in the basins of Brassac and of Langeac all of which were in existence before the glacial formation in its maximum extension. For similar reasons, he synchronizes also the upper beds in the great sterile plain, such as those of St. Etienne, Grand-Moloy, and Sully, those of Blauzy, the upper bed of breccia of the Carboniferous terrain of Meaulne, and the beds of Brassac and of Marsange.

M. Julien also considers the extensive bed of Commentry parallel with the three divisions of St. Etienne (Revue Scientifique, Sept., 1893).

Quicksilver Ore Deposits.—An important paper by George F. Becker, intended for the use of mining engineers. The first section treats of data from observation, the second of theoretical inferences as to the transportation and precipitation of the ore and of the form of the deposits. In this connection the recent advances in the study of osmosis is pointed out. In closing, the author gives a brief résumé of recent developments in various parts of the world, in which he embodies the results of the investigations of Professor A. Schrauf on Idriä and Mr. P. de Ferrari, on the mines of Monte Amiata.

Statistical tables accompany the paper compiled from Monograph XIII of the U. S. Geological Survey. (Extract from Mineral Resources of the United States, Calendar Year, 1892.)

The Discovery of Miocene Amphisbænians.—No fossil remains of Amphisbænians so far have been made known. Mr. J. B. Hatcher, so well known to paleontologists, had the good fortune this summer to procure two small Lacertilian skulls, in the White River Beds of South Dakota, which when shown to me, I at once recognized as belonging to the Amphisbænians. Professor W. B. Scott of Princeton College, for which Institution the collections were made by Mr. Hatcher, had the great kindness to allow me the publication of this very interesting find; and I give to-day a short description of the principal characters of the skulls, which will be followed soon by a full account with figures.

1. The larger skull, which measures 13 mm., from the middle portion of the condyle to the anterior end of the premaxillary, and 5½ mm. at its transverse diameter between the posterior ends of the maxillaries is so close to Rhineura Cope, from Florida, that I am not able to place it with the present material in another genus.

The nostrils are inferior in position. The single premaxillary is widely separated from the frontals by the large nasals, which are distinct, and extend to the border of the muzzle, overroofing the nostrils. The prefrontal is large, placed between parietal, frontal, and maxillary, forming the superior border of the orbit; the jugal is exceedingly rudimentary, only connected with the maxillary; there is in all living Amphisbænians no postorbital arch. The squamosal is not free. One tooth on premaxillary, 6 pointed teeth on each maxillary. It is distinguished from the modern *Rhineura floridana* Baird, by the more slender form of the skull, and may be called *Rhineura hatcherii.*

2. The smaller skull measures only 10 by 5½ mm. It is at once distinguished from all living Amphisbænians by the presence of a postorbital arch, and the very peculiar prefrontal.

The nostrils are inferior in position. The single premaxillary nearly touches the paired frontals behind. Premaxillary, nasals, frontals nearly meeting in one point. The nasals are distinct and extend to the border of the muzzle, over-roofing the nostrils. Prefrontal very small, placed between maxillary and frontal; separated from the orbit by a descending process of the frontal, which forms the anterior border of the orbit. Jugal complete forming a distinct postorbital bar; it is in connction with maxillary, frontal, and parietal. Squamosal well developed and free. One small tooth on premaxillary and 4 on each maxillary.

This form represents a new genus and a new family of the Amphisbænians, which may be called HYPORHINA and HYPORHINIDAE. The species may be named *Hyporhina antiqua.*—G. BAUR.

Walker Museum, The University of Chicago.

On Symmorium, and the Position of the Cladodont Sharks.—In a paper recently read before the Philadelphia Academy I have described a shark from the Coal measures of Illinois under the name of *Symmorium reniforme.* The genus Symmorium is a Cladodont which differs from *Cladodus* Agass. in having the axial elements of the pectoral fin fused with each other and with the proximal basilar elements, into a single piece.

The specimens on which this genus is founded throw much light on the structure of the Cladodont pectoral fin, and through it, on the question of the evolution of this organ among fishes. The fin basis described is mostly well preserved, and clear as to details of structure. It confirms the characters ascribed by Traquair to the pectoral fin of a Cladodus from the Lower Carboniferous of Scotland,[1] the only important difference being that in the latter the metapterygium is dis-

[1]Geological Magazine, Feb. 1888, p. 82.

tinctly segmented, while in the Symmorium this element forms a single piece, except possibly at the extremity. According to Traquair there is an "oblong" proximal segment of the metapterygium "whose anterior portion seems to have absorbed the bases of one or two adjacent radials." In *Symmorium reniforme,* all the basals (radials of Traquair), are fused at their bases with the metapterygium. The basals are also more numerous than in Dr. Traquair's shark, for he says "some small radials are seen attached to the preaxial side of the first two segments—none on the others." My specimen agrees with Traquair's in the absence of basals (radials) from the post-axial side of the metapterygium, where indeed they are not to be looked for.

The structure of the paired fins here pointed out, sustains the views already announced by Dr. Bashford Dean[2] in a recent paper, and this author is to be congratulated that the view which he has put forth, is so fully sustained by the material in my possession. One hypothesis which he holds requires further confirmation; viz, that the metapterygium is formed by the fusion of the basal elements. The extensive fusion seen in the later genus Symmorium as compared with the earlier genus Cladodus, supports his position so far as it goes, but the origin of the primitive metapterygium is not thus explained.

My observations on Symmorium, together with those of Traquair, Jækel, and Dean, show that the median axis of the archipterygium is not propterygial or mesapterygial, but is metapterygial. This greatly simplifies the conception of the history of the Selachian fin, where the metapterygium supports the greater number of the other segments. It shows that the Ichthyotomi are not elements in the phylogeny of the sharks,[3] but form a side branch. It is further to be observed that the essential distinction now discovered between the metapterygial and other elements of the paired fins, must be maintained in our future studies of them. A clear distinction between baseosts and axonosts in the paired fins has been hitherto wanting. For the present it may be convenient to regard the metapterygial elements as axonosts, and those which have originally been branches of that axis, as baseosts. The scapular base of the Selachian fin consists then of one axonost and two baseosts. The typical Actinopterygian fin will have as its scapular base, according to Gegenbaur's homologies, baseosts only, the metapterygial (axonost) elements having entirely disappeared.

It results from the preceding observations that the Cladodontidæ must be removed from the Ichthyotomi where Dr. Woodward placed

[2]Transac. N. York Academy of Sciences, 1893, April, p. 124.

[3]See Proceeds. Am. Philos. Soc., 1892, p. 280.

them, and be relegated to his order of Acanthodii. The definitions of the three orders of Elasmobranchii derived from the fins, will then be as follows; those of the second and third being the same as given by me in the NATURALIST for 1889, (October, p. 854).

Paired fins ptychopterygial,	*Acanthodii.*
Paired fins archipterygial,	*Ichthyotomi.*
Paired fins basilo-metapterygial,	*Selachii.*

The term ptychopterygium is introduced to describe the paired fins of the Acanthodii, in which the basilar or radial elements spring directly from the body wall; the axial elements when present, being within the body wall. This structure is primitive, and sustains the view of Thacher, that the paired fins have originated from a lateral fold.—E. D. COPE.

Geological News.—Paleozoic.—During a recent geological exploration in the neighborhood of Mount Lambie in New South Wales, Messrs E. F. Pittman and T. W. E. David found several specimens of *Lepidodendron australe* in rocks of true Devonian age. This is an interesting discovery since, although surmised, it is a fact which has not hitherto been proved. (Proceeds. Linn. Soc., N. S. W., 1893.)

Among the important recent discoveries is that of fine larval trilobites in the Lower Helderberg formations south of Albany, New York. These specimens are referred by C. E. Beecher to the genera Acidaspis and Phaëthonides. They represent early stages of these genera when the animals had no thoracic segments, and when the separation between the cephalon and pygidium was not distinctly marked.

As a result of the study of these forms Mr. Beecher is confirmed in the idea suggested by Woodward and Edwards that the Trilobita may be considered as ancient or protoisopods. (Am. Journ. Sci., Aug., 1893.)

——According to Mr. C. S. Prosser the fossiliferous zone underlying the Oneonta sandstone in Chenango and Otsego Counties, New York, is not the top of the Hamilton but belongs in the Portage stage. The writer bases his opinion on faunal data. (Am. Journ. Sci., Sept., 1893.)

Mesozoic.—A femur found in 1838, at Slingaby, Yorkshire, has recently been identified by Dr. Seeley. He refers it to a small species of Omosaurus with the specific name *phillipsi.* This is the third species of this genus found in England. (Yorkshire Philosph. Soc. Report, 1892.) Mr. R. T. Hill has published a list of the invertebrate fossils collected or obtained by him from the beds of the Trinity Division in Arkansas and Texas. Of the 34 Mollusca described, 12 represent new species. The families of Foraminifera, Echinodermata, Vermes, Molluscoidea and Arthropoda have one species referred to each, of which the first only is known; the others are either indeterminate or new. (Proceeds. Biol. Soc Wash., 1893.)

The jaw of a new carnivorous Dinosaur from the Oxford Clay of Peterborough, Eng., is figured and described by Dr. Lydekker in the Quart. Journ. Geol. Soc., Aug., 1893. It is of large size and solid structure, and appears to be nearly allied to the Thecodontosauridae. It differs from the described genera of that family by the marked deflection of the mandibular symphysis. Dr. Lydekker accordingly refers it to a new genus under the name *Sarcolestes leedsii.*

Professor T. R. Jones notes the discovery of 15 fossil Ostracoda, 13 of which are new, from the Upper Cretaceous series of Wyoming and Utah. Nearly all represent either fresh water or estuarine forms. Professor Jones has described and figured these interesting specimens in the Geol. Mag., Sept., 1893.——At a recent meeting of the London Geol. Soc., Mr. E. A. Walford described some forms of Bryozoa from the spinatus zone of the Middle Lias near Banbury, Eng. The new material shows the opercular aperture, and the opercula *in situ* with appendages and supraoral ovicells characteristic of the Cheilosiomata. In addition he found giant cells (cistern cells) of form quite dissimilar from the ordinary zooecia and probably reproductive. The name Cisternophora is suggested for the genus of which several forms were described (Geol. Mag., Aug., 1893.)

Cenozoic.—Captain F. W. Hutton questions the propriety of the name, *Dinornis queenslandiæ,* given by C. W. DeVis in 1884 to a struthious femur found at King's Creek, Darling Downs. Captain Hutton is inclined to refer the fossil in question to the Casuariidæ since it possesses the posterior projection of the trochanterial surface, a character lacking in the Dinornithidæ and Apterygidæ, but present in the femora of both the Cassowary and the Emu. (Proceeds. Linn. Soc., N. S. W., 1893.)

The skull of a Lemuroid mammal found in the shell-marl in the south-west coast of Madagascar has been determined by Dr. Forsyth Major to be that of a gigantic Lemurid related to the extinct genus Adapis as well as to the existing Lemurids. The brain-case is small, the thickening of the bones of the skull is very remarkable. The tritubercular molars and premolars approach closely some Malagasy Lemurids. Dr. Major names this new form *Megaladapis madagascariensis.* (Proc. Roy. Soc., 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Trachytes and Andesites of the Siebengebirge.—In the course of a discussion on the geological relations of the trachyte and andesite of the Siebengebirge, Grosser[2] describes the various occurrences of these rocks and gives an outline of their petrographical characteristics. The trachytes he separates into typical, andesitic and aegerine varieties, and the andesites into trachytic and basaltic kinds. In the typical trachytes hornblende phenocrysts are frequent, but crystals of this mineral in the groundmass are unknown. Among the andesites the trachytic variety is noted for the absence of dark components from the groundmass and their rarity among the rock's phenocrysts. The basaltic andesite is rich in iron minerals, both as phenocrysts and as constituents of the groundmass. The order of eruption was trachyte, andesite, basalt.

A Variolitic Dyke in Ireland.—A variolitic dyke from Annalong, County Down, Ireland, resembles in the hand-specimen the variolites from Mt. Genévre. Cole[3] mentions it as consisting of devitrified glass, often containing skeleton crystals of magnetite, augite and plagioclase, and enclosing spherulites that are much larger toward the center than at the edge of the dyke. Thin selvages, 1 cm. in thickness, with very small spherulites scattered through them, exist on the sides of the dyke. Beyond these there is an abrupt transition to material containing the large spherulites. The selvages evidently cooled and lined the walls of the crevice now occupied by the dyke, before the interior filling consolidated; for not only is the transition between the substances of the two portions sharp, but the spherulites of the interior mass have in some cases grown from the line separating the two portions.

The Chemical Nature of Eruptive Rocks.—Lang[4] has returned to his study[5] of the chemical nature of eruptives. After a critical examination of many fresh specimens, the author concludes that the mineralogical nature of igneous rocks cannot be determined from

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

[2] Min. u. Petrog., Mitth., xiii, p. 39.

[3] Sci. Proc. Roy. Dub. Soc., 1892, p. 511.

[4] Min. u. Petrog. Mitth., xiii, p.115.

[5] Cf. AMERICAN NATURALIST, 1892, p. 334.

their chemical composition, but that types with the same general chemical relationships possess the same general mineralogical character. The author also gives his views on the relationships existing between the various rock types, as based on their calcium and alkali ratios, and, while not so stating it, he shows that the emanations from an eruptive center are consanguinous.

Norites in the Eastern United States.—Along a shear zone in the norite of Avalanch Lake in the Adirondacks, Kemp[6] finds what he believes to be a schistose phase of the rock in which several new minerals have been developed. The massive norite consists chiefly of plagioclase, with a little hornblende, enstatite and magnetite. In the schistose rock, which is much more basic than the norite, are broken pieces of plagioclase, shreds of hypersthene, grains of green monoclinic pyroxene, pink garnet, greenish-brown hornblende, biotite and magnetite, of which both the monoclinic pyroxene and the garnet are supposed to have been produced from the hypersthene and the plagioclase of the original norite. The schist resembles an eclogite. The same writer[7] records the discovery of a new occurrence of norite or of hypersthene gabbro at Artsdalen's quarry in Bucks County, Pa. It is associated with a limestone which is the matrix of a large number of metamorphic minerals. It is thought that this limestone may be a block brought from below by the eruptive. The region surrounding the quarry is underlain by pre-Cambrian rocks, but it is almost without exposures. The occurrence of norite here is interesting as affording a link connecting the otherwise separated Baltimore and Cortland areas of basic eruptives.

The Ottrelite Conglomerate of Vermont.—Reference has already been made in these notes to the discovery of an ottrelite conglomerate[8] in the Green Mountains of Vermont. Whittle[9] has now given us in more detail the description of its occurrence, and adds to this many items of interest concerning the dynamic schists associated with it. Among other things connected with the minerals of the conglomerate he mentions the secondary enlargement of clastic tourmaline grains and describes the alteration of microcline pebbles into quartz, sericite, biotite and albite. In one microcline there are many inclusions of limonite and rhombs of siderite. As the sericite grows it clears

[6] Amer. Journ. Sci., Aug., 1892, p. 109.
[7] Trans. N. Y. Acad. Sci., xii, p. 71.
[8] AMERICAN NATURALIST, April, 1893, p. 382.
[9] Bull. Geol. Soc. Amer., iv, p. 147.

the microcline of these, so that around each grain of the mica is a zone of pellucid feldspar, and on both sides of veins of the sericite are clear borders of microcline entirely free from inclusions of any kind.

Chalcedony and other Silicious Spherulites.—A well-illustrated article by Levy and Meunier-Chalmas[10] treats of various forms assumed by the molecule Si O_2 in the production of spherulites. Chalcedony has heretofore been regarded as a mixture of quartz and opal. The present authors have had an opportunity to study some excellent specimens of silica spherulites and concretions from the gypsum beds in the Paris Basin. Chalcedony and two new forms of silica, called by the authors quartzine and lutecite, are the components of these concretions. All three of these substances are fibrous forms of the same mineral, which is positive and biaxial, with an optical angle varying between 20°–35°. Thus they are different from quartz. The distinctions between the three varieties rest upon their habit. Chalcedony is elongated parallel to the base of the crystals, and quartzine parallel to the plane of their optical axis, while the lutecite fibers are elongated in a direction making an angle of 29° with the optical axial plane. The relation of the long axis of each variety to the optical constants of the mineral is carefully worked out, and the appearances of thin sections of their groupings are illustrated by eight beautifully executed photographs.

Petrographical News.—Andrea and Osann[11] ascribe the existence of a porphyry breccia at Dorsenheim near Heidelberg to the crushing of porphyry by faulting and the cementing together of the fragments thus made by siliceous material.

A series of high dipping crystalline schists near Salida, Col., is regarded by Cross[12] as having originated by the alteration of great flows of basic and acid lavas erupted in Algonkian time. Though the rocks are now hornblende and micaceous schists, some of them still present a few of the structural features of diabases and porphyries.

Danalite from Redruth, Cornwall.—Tetrahedra of danalite at Redruth, Cornwall, are associated with quartz and arsenopyrite. Miers[13] mentions them as projecting from a layer of massive danalite with a thickness of from a quarter to half an inch. Some of the crys-

[10] Bull. Soc. Franç d. Min., xv, p. 159.

[11] Mitth. gross. Badisch. geol. Landesanst, ii, p. 365.

[12] Col. Sci. Soc., Jan. 2, 1893.

[13] Miner. Magazine, x, p. 10.

tals measure 30–50 mms. across. They are almandine-red in color, are translucent, and have a light pink streak, a hardness of 5.5 and a density of 3.350. An analysis gave :

SiO_2	FeO	MnO	ZnO	BeO	CaO	S	Total
29.48	37.53	11.23	4.87	14.17	tr	5.04	=102.62

corresponding to R.S. 7RO. $3SiO_2$.

Mirabilite Changed to Thenardite.—Two crystals of mirabilite implanted on a mass of rock-salt from Aussee, Salzkammergut, that has been in the possession of the University of Vienna six years, have, in this time, so changed that they now consist simply of a thin shell composed of a crystalline aggregate whose inner surface is completely drusy. Within this crust there is usually a hollow, but occasionally a part of the hollow may be filled by a group of crystals like those forming the shell. These crystals are determined by Pelikan[14] to be *thenardites* of a short pyramidal habit, bounded by the planes P. $\frac{1}{3}$P, $P\bar{\infty}$, $\frac{1}{3}P\breve{3}$ and $\infty P\breve{3}$, with an axial ratio of $a : b : c = .5970 : 1 : 1.2541$. The crystals had been kept during the six years in an air-tight enclosure at a nearly uniform temperature, so that the change from their original condition must have been due solely to the influence of the small amount of moisture within the enclosure.

Mineralogical News.—Crystals of the rare *uranatile* from Schneeberg, Saxony, and from the Joachimsthal, Bohemia, have been measured by Pjatnitzky,[15] who concludes that they are triclinic and not orthorhombic as Zepharovich supposed. Their axial ratio $a : b : c =$ .6257 : 1 : .5943. The mineral has a citron or sulphur-yellow color, with very weak dichroism. *Uranophane*, according to the author, should not yet be considered a species. Its chemical composition is the same as that of uranatile, but its crystallization has not yet been determined.

The rare plane $2O\infty$ has been detected by Pelikan[16] on salt crystals from Stannia, Galicia. Upon examining sections of *halite* from this locality, the author discovered in them many inclusions of petroleum zonally arranged. The cavities in which the oil is contained are either pear-shaped or are negative crystals, entirely or only partially filled with the liquid, which must have been under greater pressure at the

[14] Min. u. Petrog. Mitth., 1892, xii, p. 476.

[15] Zeits. f. Kryst., xxi, 1892, p. 74.

[16] Min. u. Petrog Mitth., xii, p. 483.

time of its imprisonment. From the distribution of these inclusions the author concludes that the crystals were first cubes, then tetrahexahedra (2O∞), and finally cubes, as at present.

Jannetaz[17] has made an analysis of the black garnet *pyreneite*, now the subject of so much discussion[18] in Europe, and has found it to consist of:

SiO_2	Al_2O_3	FeO	MgO	CaO	Total
39.4	10.0	18.6	1.0	31.21	= 100.21

It is thus neither melanite nor grossularite, but is intermediate in composition between the two. Its density is 3.7

Miers[19] has succeeded in obtaining some excellent though tiny crystals of *orpiment* by dissolving in hydrochloric acid the marl in which nodules of this substance are found at Tajowa, Hungary. Under the microscope the little crystals appear with the orthorhombic symmetry. oP is the plane of their optical axes. Their axial angle for sodium light is 70° 24′ in air.

The same mineralogist[20] has repeated Gmelius' analysis of *helvite* from Schwarzenberg, and has obtained this result:

SiO_2	FeO	MnO	BeO	Al_2O_3	CoO	S	Total
31.85	4.26	42.47	14.25	.74	3.16	4.81	= 101.54

Dumortierite is recorded by Gonnard[21] as occurring in the feldspar of a granite vein cutting the gneiss in a quarry at Ternières, Francheville, Dept. of the Rhone, France.

The same writer[22] figures a few new types of *natrolite* crystals from the Puy-de-Dôm, and describes[23] the occurrence of crystals of *analcite* in the fissures of the porphyry at Agay, Canton Hyères, France.

Brazilite, analyzed by Blomstrand,[24] has the following composition:

ZrO_2	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Alk	Loss	Total
96.52	.70	.43	.41	.55	.10	.42	.39	= 99.52

Experiments in Crystallization.—Hundt[25] has repeated Vogel-

[17] Bull. d. l. Soc. Franc. d. Min., xv, p. 127.

[18] AMERICAN NATURALIST, Oct., 1892, p. 849. Ib., Apr., 1893, p. 385.

[19] Miner. Magazine, x, p. 24.

[20] Ib., x, p. 10.

[21] Bull. Soc. Franc. d. Min., xv, p. 230.

[22] Ib., p. 221.

[23] Ib., p. 231.

[24] Neues Jahrb. f. Min., etc., 1893, I, p. 89.

sang's experiments on the crystallization of sulphur from its solution in carbon bisulphide thickened with balsam, and has discovered thereby some new facts regarding the phenomena connected with the formation of crystals. He finds the globulites aggregating into *liquid* spherules of sulphur that may remain liquid for several days. Grains of sulphur that are melted on a glass plate may also remain in a liquid condition for a long time—in some instances, three months—before they solidify. Upon agitation with the point of a needle they immediately become solid. The author declares that there is no tendency among the globulites to arrange themselves into definite groups, as Vogelsang reported to be the case. In the largest drops, however, they may take definite positions, whereupon the entire drop may be made to crystallize by shaking or agitating with a needle point. The formation of crystallites is contemporaneous with that of the globulites, the latter giving rise to the large drops, which, upon soldifying, become spherulites, and the former growing into microlites by the accretion of *invisible* particles. The crystallites do not grow by the addition of globulites. These bodies add themselves to the large drops, and never to the small, solid embryo crystals.

Miscellaneous.—A couple of *slags* from the lead ovens of Raibl, Austria, have been examined chemically by Heberdey.[26] The composition of different portions of the various specimens were carefully worked out. In one specimen crystals of a lead-zinc *olivine* were found, the analysis of which yielded:

SiO_2	PbO	ZnO	MgO	FeO	CaO	Total.
16.62	61.50	18.16	1.99	1.69	tr	= 99.96

Their density is 5.214 and axial ratio $a : b = .8592 : 1$. In an appendix to his main article the author gives the results of analyses of the limestone in which the galena smelted in the furnace occurs. One of these analysis yielded: $CaCO_3 = 53.50$; $MgCO_3 = 46.51$; Fe, Tl, Li = traces.

Dunnington and Whitlock[27] communicated the results of an analysis of a *black soil* from a point in the valley of the Red River of the North, about fifteen miles south of Winnipeg, Manitoba, and Corse and Baskerville[28] the results of analyses of *glauconite* sand from near Han-

[25] Mitth. d. miner. Inst. d. Univ. Kiel. B 1. H. 4., p. 310.

[26] Zeits. f. Kryst., xxi, 1892, p. 56.

[27] American Chem. Journal, 14, 1892, p. 621.

[28] Ib., p. 627.

over Court House, Virginia. Analyses follow (I, black soil; II, glauconite):

	Sand	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	CO_2	P_2O_5	K_2O	Org.	H_2O
I	59.82	5.45	.64	7.14	4.00	.61	.61	.03	.37	.13	1.91	12.49	6.86

	Quartz	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O		Total
II	2.76	47.45	7.33	12.03	9.43	.57	2.90	5.75	.42	9.85	=	98.49
	8.22	43.34	6.62	15.16	8.33	.62	.95	4.15	1.84	10.32	=	99.55

Schwartz has treated in a comprehensive essay[29] the history of the observations on *reciprocal changes* produced in polymorphous bodies under different conditions of temperature, and has, in addition, given the results of some independent observations of his own. The substances that have been experimented upon are: AgI, KNO_3, NH_4, NO_3, $AgNO_3$, Rb (NO_3), boracite, perchlorethane, tetrabrommethane, and copper, nickel, zinc and cobalt, sodium-uranyl acetates.

Ch. Friedell[30] has examined carefully a specimen of the meteoric iron from Cañon Diablo, Arizona, and, as a result of his study, has concluded that particles of black diamond (carbonado) are disseminated through its mass. A combustion of the residue obtained upon treatment of the iron by acids leaves no doubt but that the material consists principally of carbon.

[29] Gekronte Preisschr. Univ. Goetinger, 1892.

[30] Bull. Soc. Franc. d. Min., xv, p. 258.

BOTANY.

Kuntze's Revisio Generum Plantarum, Etc. III.—Professor MacMillan was perhaps right in saying that the present upheaval in botanical nomenclature was signalized rather than caused by the appearance of the first two parts of Dr. Kuntze's work in 1891. That is, it was the chaotic state of nomenclature which caused Dr. Kuntze to write his book, not Dr. Kuntze nor his book which caused the chaotic state of nomenclature. But while this is undoubtedly true, it cannot be denied that Dr. Kuntze's work has so thoroughly exposed the condition of things and thereby caused such extraordinary activity in nomenclature, that whatever good results from the present movement must be attributed almost wholly to the influence of his work. For, while the present upheaval, to use Professor MacMillan's apt term, was probably inevitable, and the state of nomenclature was such as to make it only a matter of time, yet Dr. Kuntze and the years of patient research culminating in his work must be recognized as the immediate cause.

But Dr. Kuntze has not been content to rest here with the movement fairly started. With admirable zeal he has followed up his first advantage, and in the third part of his work—or rather the first division of it—which appeared in August, he has shown that unlike most reformers, he can not only start a revolution but can guide it as well.

In the *Botanische Centralblatt* for June, 1893, appeared a preliminary sketch of what is set out more fully in the first sections of the third part of his work. He gave a list of all the reviews of the first two parts, and all the works dealing with nomenclature, and all propositions for reform from the appearance of his work to May 1893, together with brief criticisms of each. Now he brings together all the critiques of his book, quoting them in full, all the propositions for reform, and the material parts of all articles, etc., dealing with nomenclature, and appends a critical commentary. The critiques number about forty, and with the other articles, etc. commented upon make a list of fifty seven. It may be doubted if such a symposium has before been brought together on such a subject. Not only is it valuable of itself, but it must convince the most skeptical of the extent and significance of the movement Dr. Kuntze has set on foot.

In one respect Dr. Kuntze has a great advantage over his reviewers He has devoted more time to the subject and knows more about it in all its details than probably any man living. Consequently anyone attempting to criticize him does it at the peril of having a multitude of facts cited to him of which he had been but dimly conscious or of which he had never dreamed. Though one may not be able to agree with Dr. Kuntze as to many points, he must admit that a perusal of his commentary shows him fully able to cope with any of his adversaries and that he rarely comes out "second best." It should be added that this method of setting out the arguments of his opponents in full is in happy contrast with the far too common practice of criticizing single extracts without giving the context to show what they mean.

The Berlin propositions, particularly the notorious proposition 4, are well criticized in three languages, so that no one can mistake Dr. Kuntze's meaning. Dr. Kuntze in this and in the polyglot circulars sent to the members of the Madison Congress has shown that he is in earnest, and botanists owe him no little gratitude for the pains he is taking to secure a right termination to the movement.

In this connection his remarks on the Genoa Congress are noteworthy. He is perhaps a little too severe in his objections to the use of the Italian language by the Congress. It may be that to ask botanists to add Italian to the rather heavy list of languages they must know is too much. But the Italian botanists have certainly merited the recognition, and law or no law, if they keep on at their present gait, we shall be obliged to know something of their language. Besides we do not all have to wield foreign languages with the ease with which Dr. Kuntze handles them to be able to understand sufficiently the most of what a botanist has to say. But Dr. Kuntze's criticism on the international character of the Congress is well taken. It is folly for any Congress which is not international in composition to attempt international legislation. No laws will be observed till they are enacted by an assembly whose jurisdiction is beyond question and whose composition commands the respect of all countries.

The remaining sections discuss the orthographic license, supplementary resolutions to the Paris Code, "1753, *die Nomenclatur der Unbewussten,*" and "1737, *die Neue Compromiss in spe.*" These last two sections are devoted to the important question whether 1737 or 1753 shall be the starting point of nomenclature. 1735 which he first proposed, and which has a certain logical foundation in its favor, he now gives up for 1737 as a compromise. This is wise. The 1737 names where they differ from the names of 1735 are a great improvement on them. He gives a list of the changes necessitated in the names given in parts I and II by his new starting point. This list is a considerable one, and as the 1737 names brought in are quite often those in common use lately, it gives new strength to his position by practically removing one of the commonest objections made to it. It has been noted by several that the changes demanded by the 1735 starting point were not so frightfully numerous as they have been represented. The changes in so-called current names (for in the last ten years at least we have had no really stable current names) required by the 1737 starting point are comparatively few, and in this his compromise has an advantage. American botanists have preferred 1753, and that date has served as the basis for the nomenclature of several American publications, and gained considerable foothold. I shall not at this time discuss the relative advantages of the two dates, but shall merely observe his arguments. To change from 1753 to 1737 would require no very great number of alterations, and one may well be satisfied with either date, provided absolute fixity is attained. Of the points he makes against the 1753 starting point the strongest one is this. He charges that in the *Species Plantarum* of 1753 there are a number of *genera vitiosa* which represent an undetermined number of modern genera, while the genera of 1737 to 1748 are mostly clear. There are even, he says, monotypic genera in 1753 which under one species comprehend several modern genera. This is a charge of considerable weight and he cites several examples in support of it. The other objection, that in starting with 1753 we become entangled in the question of determination of Linnæan species, is also not without weight. Our starting point ought to be free from any entanglements which will allow botanists in time to come to overhaul accepted names under the guise of enforcing the law and question their validity.

In calling the nomenclature of 1753 the nomenclature of the ill-informed, or as he translates it "badly instructed," botanists, he is perhaps right in the sense in which he means it. It was, he says, taken up by persons who were not fully acquainted with the circumstances. But few besides Dr. Kuntze were fully acquainted with the circumstances till the appearance of his book made it in some degree possible without years of special study.

The succeeding section is a discussion of signs for growth, etc. with a suggested international code. The most remarkable thing about this code is its elaborateness. It provides signs for nearly every conceivable form of growth, and, if it gets into use, it will necessitate constant reference to the key, as it would be no small task to memorize it. While such signs are very convenient, it may be doubted whether there is any advantage in so elaborate a system.

The remainder of the book is taken up with the "*Codex Nomenclaturæ Botanicæ Emendatus,*" the Paris code amended and supplemented. This is given in German, English, and French in parallel columns. Most of Dr. Kuntze's amendments are already well known from the discussion in the introduction to parts I and II. This *Codex Emendatus,* whether adopted *in toto* or not, must serve as the basis for any future emendation of the Paris Code. The "leaks" have been pointed out by Dr. Kuntze, and must be stopped—whether in his way or in some other.

A few points in his discussion of orthography may be noticed. He proposes to translate the Greek *upsilon* always by *i* instead of *y* except in a few cases where *u* stands for it, as *Cupressus.* He also proposes to eliminate the *h* in Greek words except in the combinations *ch, ph,* and *th.* To these and a few other propositions of the sort, I think it may fairly be said that they rest almost wholly on "*Bequemlichkeitmotiven.*" It will be hard for botanists with classical training to yield to them. The tendency to revolt from such rules, if they can be adopted, will always be strong. No rule founded on convenience or on anything but *right* can be sure of enduring observance. Dr. Kuntze has taught us this thoroughly already.

But aside from such details, Dr. Kuntze deserves only thanks for what he has done. Botanical nomenclature bids fair to have in him a second father.—ROSCOE POUND.

ZOOLOGY.

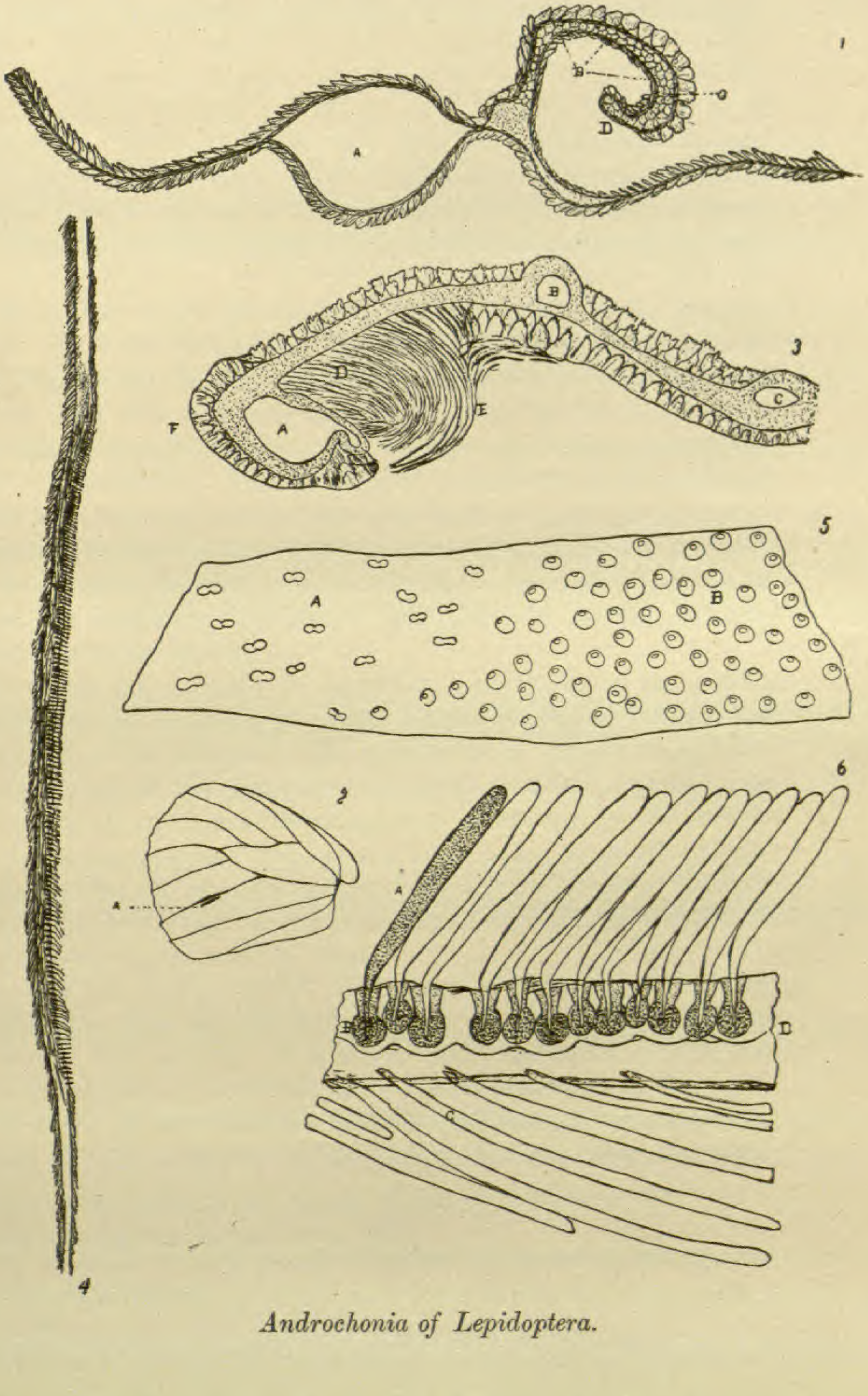
How Young Flickers are Fed.—An interesting account of a brood of young flickers is given by Mr. William Brewster in *The Auk*, July, 1893. During three days observation, Mr. Brewster saw only the male parent, which, however, was very attentive to his charge. Alighting on the trunk of the stump containing the nest, the flicker would utter a peculiar call, a low anxious *woi* or *wó–ă*, addressed, apparently to the young, to which they would reply with a burst of clamor, and almost immediately their wide opened mouths would appear at the top of the burrow. Standing on the edge of the hole, the parent selected one, and bending forward and down drove his bill to its base into the gaping mouth which insantly closed tightly round it, when the head and bill of the parent were worked up and down with great rapidity for from one to one and a half seconds, the young meanwhile never losing its grasp. These up and down motions were rapid, regular, and not unlike those of a wood-pecker engaged in drumming. They also suggested the strokes of a piston. If interrupted during the pumping process, the flicker would often feed the same young twice or even thrice in succession, but this never happened when the first period of contact was of normal length.

Four young were generally fed at each visit, with a brief interval of rest between the operations. During this interval the parent would open and shut his bill, run out his tongue, and work the upper portion of his throat as if tasting and swallowing something. The inference was that this was for the purpose of regaining the particles of food which had failed to lodge in the throat of the young.

The time spent at the nest rarely exceeded half a minute, while the foraging expeditions occupied from twenty minutes to an hour. The flicker's return was so stealthy that the writer, although on the watch, frequently did not see him until he appeared at the nest. His bill was always closed up to the moment of contact and there was no evidence that he carried food in his mouth. In fact, it was clear that he *swallowed* all the food obtained and afterward supplied it to the young by a process of *regurgitation*. Of what the food consisted, the writer was unable to discover without killing one of the young, to which mode of settling the point he was extremely averse.

Forsyth Major and Rose on the Theory of Dental Evolution.—In the NATURALIST for June, 1893, Professor H. F. Osborn

PLATE XXII.



Androchonia of Lepidoptera.

has stated the manner in which Kükenthal and Röse defend the theory that the complex dental crowns of the later Mammalia, are the result of the fusion of a number of primitive, distinct, simple reptilian teeth. Professor Osborn and myself have shown that the history of mammal dentition indicates the opposite process to have taken place; viz, the gradual accession of cusps to a simple primitive cusp, by a process of complication. The well known fact that the dental cusps become more numerous and display greater modifications with the passage of geological time, is opposed to the idea supported by the authors cited.

Dr. Röse has recently endeavored to explain[1] the origin of the dentition of the elephant. As is well known, the transverse crests are laminiform, and reach the number of twenty-three in the *Elephas indicus.* It is also well known that as we pass backward in time we find in the earliest known proboscidians, posterior molar teeth with only four, and even two transverse crests. This fact is one of many which distinctly negatives the fusion theory. Dr. Röse's explanation is truly extraordinary. He declares the complexity of the molar of *Elephas* to be due to a reversionary inheritance of a reptilian dentition, and fusion of the dental elements of the same. Thus the farther removed from the ancestral Reptilia we get, in time and in character, the stronger becomes the hereditary tendency! This seems to be the *reductio ad absurdum* of the theory.

Dr. Forsyth Major makes an interesting contribution to the subject in a paper in the Proceedings of the London Zoological Society,[2] on the dentition of the Sciuridæ. He announces his disbelief in the tritubercular origin of the placental mammalian dentition, and supports the view that all the forms, including the tritubercular, are the descendents of a multitubercular type, as now found in the Multituberculata. He believes that the superior molars of the squirrels support his contention, as he thinks that he can trace them better from a multitubercular than from a tritubercular origin.

I have stated as is my belief, as long ago as 1883,[3] that the Glires were descended from the Tillodonta, and no reason has since appeared to invalidate this opinion. It was strikingly confirmed by the discovery that there were no Glires in the Puerco fauna, while Tillodonta are not rare. In the Tillodont dentition we have all the materials necessary for the evolution of the glirine dentition along the usual

[1]Morphologischen Arbeiten von Schwalbe, Strassburg i. E., 1893, p. 173.

[2]Proceeds. Zoolog. Sci. London, 1893, p. 179.

[3]Extinct Rodentia of North America, AMERICAN NATURALIST, p. 380; Op. cit. 1885, p. 347 more definitely.

lines. Dr. Forsyth Major appears to have overlooked this aspect of the case, and it will be necessary to dispose of this theory before progress in any other direction can be made.—E. D. Cope.

Effects of Temperature on the Coloring of Lepidoptera.—In Insect Life, Vol. III, p. 481, is given the following resumé of a series of temperature experiments conducted by Mr. Merrifield in pedigree moth-breeding, begun in previous years, on the pupa of *Selenia illustraria* and *Ennomos autumnaria.*

By careful and long continued experiments Mr. Merrifield has demonstrated the possibility of producing artificially from a single brood of a moth, subject to seasonal dimorphism, four distinct "temperature" varieties, viz.: summer markings with summer coloring, summer markings with an approach to spring coloring, spring markings with summer coloring, and spring markings with spring coloring. The conclusions reached as a result of this series of experiments are that the coloring and markings of the moth are affected by the temperature to which the pupa is exposed, the marking being chiefly produced by long continued exposure; that the coloring is affected chiefly during the stage before the coloring of the perfect insect begins to show; that a low temperature during this stage causes darkening, a high temperature producing the opposite effect, a difference between 80° and 57° being sufficient to produce the extreme variation in darkness caused by temperature; a further lowering of temperature having no further effect; that nearly the full effect in coloring may be produced by a range of temperature of from 76° or 80° to 65° in *autumnaria,* and from 73° to 60° in *illustraria;* that dryness or moisture during the entire pupal period has no appreciable effect on the coloring of the adult.

A general conclusion which the author ventures to suggest—provided we accept the theory of Professor Weismann, that existing forms of North American and European Lepidoptera have come down from a glacial period—is, that "icing" the pupa causes the insect to revert to its earlier form, and that experiments of the nature here recorded might be of material assistance in tracing the evolution of the markings on the wings of the most highly developed forms.

In a supplementary note Mr. Merrifield adds that it is possible to cause either the summer or winter form to take on the coloring of the other, and produce from moths from the summer pupa, specimens that resemble those from the winter pupa, but not *vice versa.*

The details of these experiments can be found in Part I, Trans. Ent. Soc., London, 1891, pp. 155–167.

Fish Acclimatization on the Pacific Coast.—The attention of fish culturists is called to the remarkable results of the experimental introduction of food fishes to the west coast of the United States. In 1871, the California Fish Commission deposited 12,000 young shad in the Sacramento River, and after that the United States Fish Commission carried on the work until 1886, during which time 609,000 young shad were placed in the Sacramento River, 600,000 in the Williamette, 300,000 in the Columbia, and 10,000 in the Snake River. Two or three years later a few mature examples were obtained in the Sacramento River, and, by degrees, marketable fish were obtained along the entire coast of the United States north of Monterey Bay. In 1887, they were abundant in some rivers, common in most of them, and occasional ones were found everywhere along this long coast line. In 1892, the catch was estimated at 660,000 pounds. A careful estimate places the total value of the shad catch on the Pacific coast to date at $145,000, representing over 3,000,000 pounds, while the aggregate outlay for all purposes connected with the introduction of the fry was less than $4,000.

The history of the striped bass, *Roccus lineatus*, is similar to that of the shad. In 1879, about 150 fish a few inches long were deposited at the mouth of the Sacramento River by an agent of the U. S. Fish Commission coöperating with the California Commission. In 1882, another plant of 300 fish was made in the same region. As a result of these two small plants, the species soon became distributed along the entire coast of California. The rapid growth of individuals, and the equally rapid distribution of the species indicate the special adaptability of the waters of the region to this fish.

In commercial importance the striped bass ranks high. Large quantities are taken for market in San Francisco Bay with seines and gill nets. The average weight is eight to ten pounds, but fish weighing forty pounds are not scarce. The aggregate yield to date is nearly 100,000 pounds with a value of $18,000. The cost of introduction was not more than a few hundred dollars. In both of these cases cited the investment of the people's money has proved most satisfactory. (Science, Aug., 1893).

ENTOMOLOGY.[1]

The Androchonia of Lepidoptera.—In general all the scales of Lepidoptera are modified hairs and originate as papillæ-like protuberances on the surface of the wing. In structure they are at first double walled closed sacs, but soon flatten out and striæ appear; in greatest numbers on the outer surface. The arrangement on the wing may be regular or irregular. The coloring is a matter of some interest and may be due to the refraction of light on the finely ruled surface, or a pigment located between the two walls of the sac and away from direct contact with the air. But it is not the object of this paper to discuss the ordinary scales of Lepidoptera.

More than 50 years ago Bernan Deschamps observed other scales on the butterflies and from their shape called them plumules. The name was not a good one however, and has since fallen into disuse. The name androchonia was substituted and it is now the one by which the so-called scent-scales or hairs of the *male* Lepidoptera are known.

The androchonia are found in the same way as the ordinary scales, from papillæ which rise on the surface of the wing. As regards their occurrence they may be massed together in patches or scattered irregularly over the surface. If in groups they are always concealed by the large imbricated scales that seem to be congregated at that point to protect them. Often, however, they are protected by being located in a pocket or fold of some portion of the wing, as for example, in one tribe the Hesperidi, they are located underneath the reflexed margin of the fore-wings. This is their location in *Eudamus tityrus* where the marginal vein is folded back until it no longer forms the outermost edge of the wing.

In the common milk-weed butterfly (*Danais archippus*) they are located at the dark spot on the second pair of wings near the first venule of the median vein. In this case they are protected by a proliferation of the membrane of the wing which forms for them a pocket. On the second pair of wings in *Thecla calamus* they are simply collected in one region on the surface and protected by large scales which are very prominent at that point. When scattered irregularly over the wing they are always underneath the large scales and therefore well shielded.

The androchonia are very much smaller than the ordinary scales and can easily be identified. Some are black or brown but usually they are devoid of color. The color given to the patches where they occur-

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

is usually due to the coloring of the large scales that are for their protection. The androchonia vary much in form, many of them being simply hair-like, others feather shaped or rod-like with a plumed tip. In structure they are much softer than the ordinary scales and consequently much more pliable, which later property serves a very efficient purpose in their concealment. There is often a canal extending from the base to the tip of the scale where it may find a direct outlet or disappear in the spongy mass found at the end of a large variety of these androchonia.

At the base of many are found the true ball and socket joints like that in the ordinary scales.

It has been shown by Weisman that the wings of the Lepidoptera do contain living tissue and this would allow the production of odors through local scent glands. This arrangement has often been conjectured but it seems that either no attempts have been made at a systematic study of the subject or the attempts have ended in failure. The trouble was no doubt due to a lack of care in the preparation of the material for study. It was found after repeated attempts that the best results were obtained by hardening the freshly removed wing in alcohol, infiltrating with collodion and preparing serial sections by the use of a microtome.

The results of careful study and repeated observations on many series of sections of various Lepidoptera has shown the androchonia to be the outlet of certain glands located in the tissue of the wing beneath the androchonia bearing surfaces. The glands in sections were very prominent and no doubt of their genuineness could be entertained. One especially prominent was found beneath the androchonia in the wing of *Danais archippus.* The character of the surface of the wing above the glands is often very interesting, it sometimes being covered with a great number of papillæ from the end of which the scent scales project; or it may be like the ordinary surface of the wing. In the former case the androchonia are quite small and but one to each papilla, at the base of which we find the gland. This gives the scent scale the appearance of a small rod placed in a flask. In the tissue of the wing we find numerous canals ramifying in various directions. The material elaborated by the local glands and distributed upon the surface of the wing by the androchonia is that which gives to many of the Lepidoptera their characteristic odor.

Müller has been able to recognize more than 30 distinct odors in different patches of these scent scales. The use of the odor is no doubt in many cases for protection, but it must also assist in sexual selection.

This study was undertaken at the suggestion of Professor J. H. Comstock, to whom I am indebted for the material examined.

M. B. Thomas,
Wabash College.

Description of Plates.

Fig. 1.—Transection of wing of *Danais archippus* showing the location and arrangement of the androchonia.
" 1*a*.—First venule of the median vein.
" 1*b*.—Androchonia bearing surface.
" 1*c*.—Glands below the surface and in the tissue of the wing.
" 1*d*.—The proliferation of the wing for protecting the surface.
Fig. 2.—Hind wing of male *Danais archippus.*
" 2*a*.—Location of androchonia (nat. size).
Fig. 3.—Transection through the marginal vein of the fore-wing of *Eudamus tityrus* showing location of androchonia in the pocket formed by folding over the marginal vein.
" 3*a*.—Marginal vein.
" 3*b and c*.—Other veins.
" 3*d*.—Location of androchonia.
" 3*e*.—Large scales on the wing that protect the androchonia.
" 3*f*.—Edge of the wing.
Fig. 4.—Transection of the hind wing of *Thecla calamus* at the place where the androchonia are congregated.
Fig. 5.—View of surface of the wing of *Thecla calamus* giving the arrangement and abundance of the scent scales as compared with the ordinary one. (6) Androchonia.
" 5*a*.—Ordinary scales.
Fig. 6.—Trans. of wing androchonia surface on the wing of *Thecla calamus.*
" 6*a*.—Androchonia.
" 6*b*.—Glands at the base.
" 6*c*.—Ordinary scales.
" 6*d*.—Wing in section.
Fig. 7.—Trans. of wing of *Thecla calamus,* showing the androchonia with large gland at base.
" 7*a*.—Androchonia.
" 7*b*.—Surface of wing.
" 7*c*.—Tissue of wing.
Fig. 8.—Gland.
Fig. 9.—Androchonia.
Figs. 10 and 11.—Androchonia in trans-and longisection.

Figs. 12–21.—Various kinds of androchonia and scales, showing relative sizes.

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Fleshy Cecidomyiid Twig Gall on Atriplex canescens.—Numerous fleshy tumor-like twig gall, were found on *Atriplex canescens,* May 13, 1892, on mesa back of college grounds, near Las Cruces, New Mexico. One gall that was opened disclosed two cecidomyiid pupæ in separate cells within. This gall, with its occupants, was placed in alcohol. Other galls were pinned and allowed to dry. The latter, on being opened nearly a year later, disclosed a cecidomyiid larva, several cast pupal skins, and in one cell a transformed hymenopterous parasite. From the alcohol gall the following description is drawn.

Gall.—Length, 12 mm.; width, 4½ to 6½ mm. Rather oblong, more or less irregular in shape, fleshy when green, tumor-like, formed on one side of twig, which is itself involved in the gall. Pale greenish in color, sometimes more or less reddish as noticed in the dried galls. Outer skin of gall smooth. Two cavities inside, each about 2 by 3 mm. in diameter.

One specimen. This cecid may be called *Cecidomyia atriplicis.*

The dried galls show the twig plainly, not involved in the gall. They are red to greenish in color, surface naturally wrinkled and somewhat roughened, with sections of the thin bark of the twig showing upon the surface, but I am inclined to consider them the same as the above. This opinion is induced by the similar character of the occupants. The cells also are similar in size and shape, several in each gall according to size of latter. Some of the smaller dried galls are more rounded in shape.—C. H. TYLER TOWNSEND.

Trichodactylus xylocopæ in California.—Some little time ago I received from Mr. D. W. Coquillett, Los Angeles, California, an interesting parasite of *Xylocopa*, and which proved on examination to be *Trichodactylus xylocopæ.*

As I know of no previous record of this Acarid, or any in this genus, being recognized in America, it seems worth while to mention it in the *Naturalist.* The specimens were taken from a Carpenter Bee and mounted in balsam by Mr. B. W. Griffith. The bee Mr. Coquillett says agrees with specimens named for him by Prof. Riley as *Hylocopa æneipennis.*

Doubtless this parasite could be found on *Xylocopa* in other localities and related species on *Osmia* and other related bees.

HERBERT OSBORN.

ARCHEOLOGY AND ETHNOLOGY.

Explorations in the Delaware Valley.—Mr. H. C. Mercer has made the following report to the department of Archeology and Paleontology of the University of Pennsylvania, on the progress of field work.

The study of the ancient argillite quarries at Gaddis' Run, Bucks County, Pa., discovered May 22, 1893, and bearing directly on the problem of the antiquity of Man in Eastern North America, is of great importance, because

(*a*) These quarries, unlike the jasper mines in the Delaware Valley, recently proved to be the work of modern Indians, are workings by some ancient people in *argillite* (metamorphosed slate with conchoidal fracture), the same stone with which numerous observers assert that Man living on the lower Delaware, at the time of the melting of the great glacier, made his rude implements; because

(*b*) Granting that glacial man, obtaining his material either at this first outcrop of the rock on the right river bank above his habitat, or from erratic ice-born masses in the river bed, chipped argillite implements at Trenton 7 to 10,000 years ago, we may here learn whether the quarries were the work of the modern Indian, or of an older race —of a stone chipper ignorant of stone polishing, (Paleolithic Man), or of a stone chipper who could also polish stone, (Neolithic Man), and because

(*c*) The quarries, if the work of the Neolithic Indian, may show us to what extent the use of argillite was continued into recent times, and whether, as at the jasper quarries of Durham, Vera Cruz, Macungie and Saucon Creek, the chipped refuse is scattered with " wasters " or blocked out blades resembling in form the supposed more ancient specimens found in the glacial gravel at Trenton.

The sum of $19.25 of the $25 subscribed for exploration by the Board since the last meeting of the American Committee, has thus far resulted in the ascertaining by shafts of the extent of the quarried area, the mapping of the 19 ancient pits and 12 workshops, the study of the quality and fracture of the native stone, the cleaning out of one of the pits and trenching of 2 refuse heaps by shaft A, 21 feet by 15 feet 7 inches by 7 feet deep, and shaft G, 28 feet by 7 feet 6 inches by 3 feet 9 inches deep, discovering 279 chipped leaf-shaped forms and

145 hammer stones, 4 fire sites, and 6 large blocks pecked upon their sides to split with the grain.

The method of quarrying, probably without digging implements, and of fracturing the loose masses without fire, has been studied, while many conditions bearing on the relation of the place to the neighboring river beaches, other possible quarries and the Indian village site at Lower Black's Eddy remain to be examined.

As yet no positive relic of the modern Indian (unless we except 3 hammer stones with pecked sides) has been found, though nothing suggests the labor of a race more ancient, nor intimates that the chipped forms, which have not yet been compared with the Trenton specimens, were finished implements.

The International Congress of Pre-Historic Archeology and Anthropology held its Eleventh session at Moscow Russia, August, 22–30, 1892.

The papers read were as follows:

GEOLOGY AND PALEONTOLOGY IN THEIR RELATION TO PRIMITIVE MAN.—On the composition of the quaternary deposits of Russia and their relation to the works resulting from the activity of prehistoric man, *S. Nikitine.*——A review of the post tertiary deposits in connection with the finding of traces of prehistoric culture in the north and east of European Russia, *Th. Tschernyshev.*——Remarks on the caverns of Oural, *O. Clerc.*——On the remains of a paleolithic epoch in the neighborhood of Krasnoïarsk gouv. de Ienisséisk, Siberia. *J. Savenkov.*——The Russian steppes, ancient and modern, *W. Dokontchaïev.*——On the remains of *Ursus spelæus* and of a fossil *Ovibos* found in Russia, *D. Anoutchine.*

PREHISTORIC ARCHEOLOGY (except Kourganes and Goroditchtschés). ——A comparison of the primitive industries of France and Asia, *G. Chauvet.*——The latest conclusions concerning prehistoric archeology in Bohemia and its relations with eastern Europe, *Lübor Niederle.*——A study of the barbarian sculptures belonging to the Visigoth epoch in middle France, *C. Barriere—Flavy.*——On nephrite, *Count Cassini.*——On the questionable objects of nephrite found in the Oural *O. Clerc.*——Marks of gnawings on paleolithic and neolithic bones, *Prince Poutjatine.*——The paleolithic epoch in the neighborhood of Novgorod, *B. Pérèdolsky.*

KOURGANES AND GORODITCHTSCHES.—Goroditchtschés of bones in northern Russia, *A. Spitzine.*——Deposits of stone implements in the district of Jarausk, gouv. de Viatka, *P. Krotov.*——The "Jalnik" of

Iuriévo, in the district of Borowitchi, gouv. de Novgorod, *B. Përèdolsky.*——On the shield cups of the ancient Scythians, *N. Brandebourg.*

ANTHROPOLOGY.—The question of race in Anthropology, *M. Topinard.*——Brain weights of individuals of various Causcasian tribes, *N. Guiltchenko.*——European races and the Aryan question, *Kollman.*——Notes on some skulls, artificially deformed, found in Russia, *D. Anoutchine.*

PREHISTORIC ETHNOGRAPHY.—Contributions to the prehistoric ethnography of central and northeastern Russia, *J. Smirnov.*——Vestiges of Paganism in the region between the headwaters of the Oka and the Don, *N. Troïtzky.*——Notes on the questions;—1. Of the co-existing customs of sepulture and incineration. 2. Of certain stone statues called " Kamennya baby, " *A. Ivanovsky.*——What is the oldest race in Russia? *A. Bogdanov.*

MICROSCOPY.[1]

Methods of Preparing Molluscan Ova.[2]—The results of my work for the first three months were not promising and it was not until I had hit upon my present methods of preparing surface views of the entire ova that any detailed study of the cleavage could be made. Since I owe most of my results to this method and since I am convinced that it may be profitably employed in the preparation of the surface views of many different objects I believe it merits a detailed description.

The ova were fixed in many different fluids—Kleinenberg's Picro-sulphuric, Picric acid in sea water, Merkel's, Perenyi's, Flemming, stronger and weaker, Auerbach's, Corrosive sublimate, Chromo-formic, Chromo-acetic and absolute alcohol—but none of these methods for a moment compare with the first named, i. e. Kleinenberg's stronger picro-sulphuric. The ova were left in this for a length of time varying from fifteen minutes to one hour and were then gradually transferred to 70% alcohol. They were left in this until all traces of picric acid had been washed out and were finally preserved in 95% alcohol. During the first year of the work many of the preparations were ruined by becoming very dark, owing I think to the extraction of tannin from the corks. This trouble was afterward avoided by using rubber corks, or better still by coating ordinary corks with a thin layer of paraffin.

As a result of many experiments with almost every one of the common staining fluids, I found that the best method of preparing surface views of the whole egg or embryo was the following:—(1) Transfer the object gradually from alcohol to water. (2) Stain from five to ten minutes in a solution of Delafield's (Grenacher's) Hæmatoxylin diluted about six times with distilled water and rendered *slightly* acid by a trace of HCl. (3) Dehydrate and clear in oil of cedar or cloves. (4) Mount in Balsam supporting the cover glass so as to prevent crushing. By occasionally softening the balsam with a drop or two of xylol and slightly moving the cover glass the objects can be rolled into any position desired.

By this method wonderfully beautiful surface preparations were obtained showing with remarkable clearness not only the nuclei and cell boundaries but also the caryokinetic figures and in many cases the archoplasmic spheres and centrosomes. One very considerable advan-

[1]Edited by C. O. Whitman, Chicago University.

([2]Extracted from a paper to be published later on the development.)

tage of this method is that the preparations were permanent—in fact they become better with age instead of degenerating. All the preparations from which the figures were drawn are still in existence and can be consulted at any time.

I have employed this method with almost as good results in the preparation of surface views of the embryo chick and English sparrow and also with considerable success on other molluscan eggs and embryos as well as those of annelids and echinoderms.

—E. G. CONKLIN, Delaware, Ohio.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Congress Auxiliary of the World's Columbian Exposition of 1893. THE PHILOSOPHICAL CONGRESS.—August 21st.—R. N. Foster, Chairman, Henry M. Lyman, Vice-Chairman, L. P. Mercer, A. N. Waterman, Paul Carus, Louis J. Block, H. W. Thomas, Melville E. Stone, Committee on the World's Congress Auxiliary on Philosophy.

Addresses of welcome by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and Countries. Upon the conclusion of these opening ceremonies the Congresses of the several general divisions of the Department assembled in the halls assigned to them and proceeded as designated in their respective programmes.

Address of welcome. Hon. Charles C. Bonney, President World's Congresses. Address introducing philosophy to the audience. R. N. Foster, Chairman of the Committee of Organization.

August 22nd, Kant's Fallacy Respecting the Principle of Causation, W. T. Harris, LL. D., United States Commissioner of Education, Washington, D. C. Teleology in the Modern Philosophy of Nature, Professor H. N. Gardner, Smith College, Northampton, Mass. Present Prospects of Philosophy in Europe, Professor W. Luteslawski, University of Kazan, Oriental Russia. Faith as a Faculty of the Mind, What it Reveals and What it Commands, Professor Thomas Davidson, Keene, Essex County, N. Y. Inquiries into Relations between form of Hand and Character, Francis Galton, F. R. S. London, England. Gioberti and the Synthetic Principle of Philosophy, Brother Azarias de La Salle Institute, Brothers of the Christian Schools, New York City. The Two-Fold Nature of Knowledge, Imitative and Reflective, Professor Josiah Royce, Ph. D., Harvard University, Cambridge, Mass. On the Reconciliation of Science and Philosophy, Professor John Dewey, Michigan University. The Debt of the Moderns to Plato, Thomas M. Johnson, A. M., Osceola, Mo. Ethics of Hegel, Professor J. Macbride Sterrett, Columbian University, Washington, D. C. The Æsthetic Consciousness, Professor J. Steinforth Kedney, M. A., Faribault, Minn. The Underlying Principles of Thomistic Philosophy, Brother Chrysostom, Professor of Mental Philosophy in Manhattan College, New York City. Philosophy and Industrial Life, Professor J. Clark Murray, LL. D., McGill College, Montreal, Canada. A New

Non-tentative and Economic Method of Solving Equations, President J. W. Nicholson, A. M., Louisiana State University, Baton Rouge. Significance of the Realistic Movement in Art and Literature, L. J. Block, LL. D., Chicago. Ethical Aspects of Pessimism, Miss Louise Hannum, Ph. D., Ithaca, N. Y. Insufficiency of the So-called Cosmic Philosophy, Professor Geo. H. Howison, University of California, Berkeley, Cal. Is there a Science of Psychology? Professor Paul Shorey, Ph. D., Chicago University. The Illuminati, Mrs. Mary H. Wilmarth, Chicago. Idea and Purpose of Plato's Republic, Professor H. K. Jones, Jacksonville, Ill. The Duty of Philosophy, Paul Carus, Ph. D., Chicago. Common Sense, Science and Philosophy, Professor B. C. Burt, M. A., Ann Arbor, Mich. The Notion of Duty in Modern Ethics, President J. G. Schurman, Cornell University, Ithaca, N. Y. Philosophy of Education, Professor J. E. Bushnell, Kee Mar College, Hagerstown, Md.

The Congress on Psychical Science.—August 2st.—Ellicott Coues, M. D., Chairman. Richard Hodgson, LL. D., Vice-Chairman. Ernest E. Crepin, Lyman J. Gage, D. Harry Hammer, D. H. Lamberson, J. H. McVicker, Hirman W. Thomas, D. D., B. F. Underwood, General Committee on a Psychical Science Congress.

Addresses of welcome, by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and countries. Opening Address by the Chairman, Professor Elliott Coues. Human Testimony in Relation to Psychical Phenomena, Richard Hodgson, LL. D. A Brief Critical History of the Spiritualistic Movement in America since 1848, Giles B. Stebbins. Spiritualistic Interpretation of Psychical Phenomena, Rev. Minot J. Savage. A Description of Psychical Phenomena in Brazil, Professor A. Alexander. Elementary Hints on Experimental Hypnotism, Walter Leaf, Litt. D. Contributions to the Bibliography of Periodical Literature Relating to Psychical Science, Spiritualism, etc., Benj. B. Kingsbury. Personal Investigations in Psychical Science, M. C. O'Byrne.

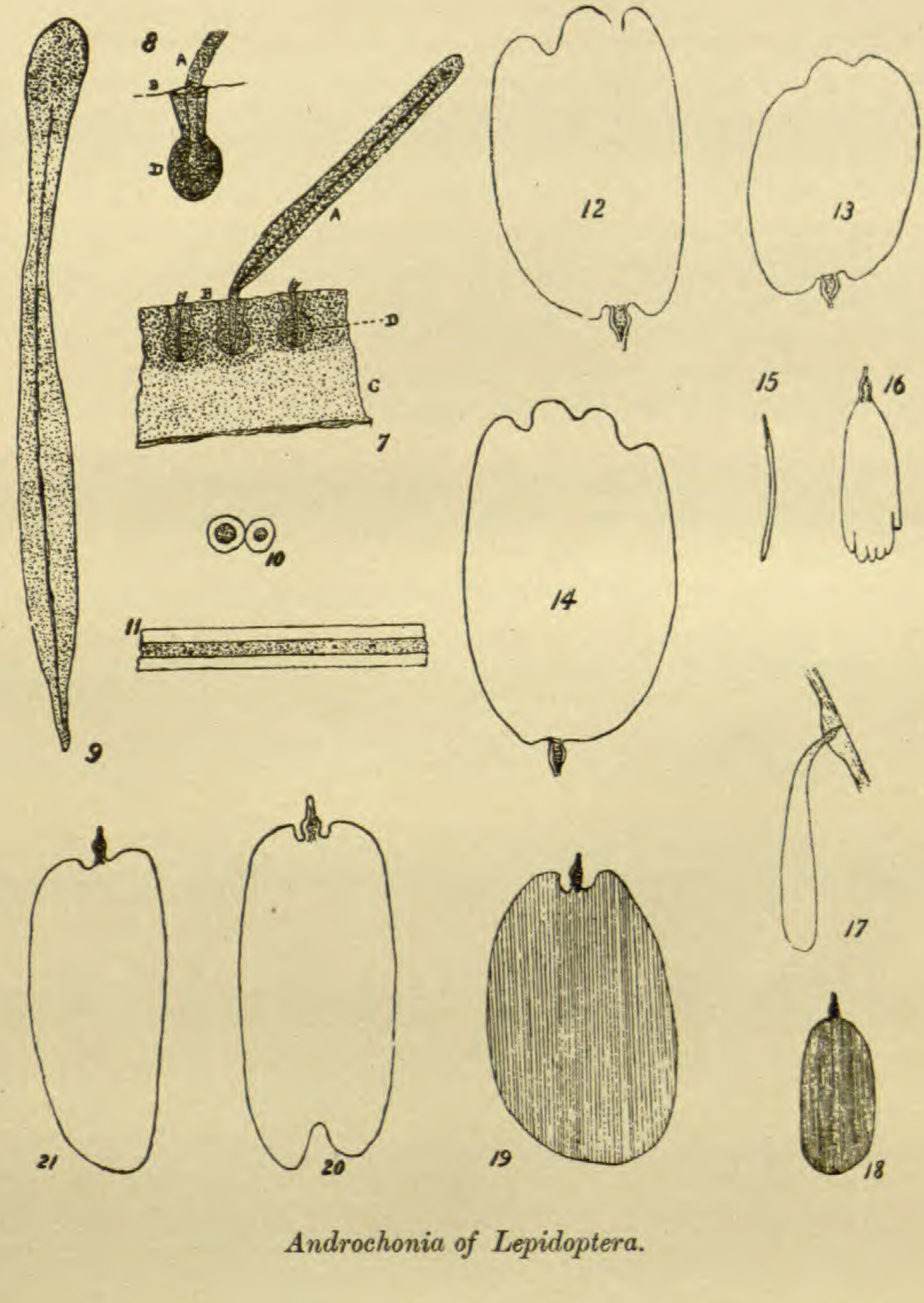
August 22d.—Outline of a Project for a General Union for Experimentation in Psychical Phenomena, Dr. Xavier Dariex. Experimental Thought-Transference, Frank Podmore, M. A. The Question of Phantasmal Apparitions, L. Deinhard. Programme for Experimental Occultism, Baron Carl Du Prel. Psychism amongst the Ancient Egyptians, Rev. W. C. Winslow. Psychic Facts and Theories Underlying the Religions of Greece and Rome, Dr. Alexander Wilder. Veridical Hallucinations as a Part of the Evidence for Telepathy, Professor and Mrs. Sigwick. Some Experiments in Thought-Transference and Their Significance, Dr. A. S. Wiltse. Critical Historical Review of the Theosophical Society, Wm. Emmette Coleman. Madame Blavatsky and M. Solovyoff, Walter Leaf, Litt. D. Certain Experiments with the Sphygmograph, John E. Purdon, M. D. Scientific Evidence of the Theory of Reincarnation, Capitano Ernesto Volpi.

August 23d.—The Relation of Consciousness to Its Physical Basis, Professor E. D. Cope. The Subliminal Self, F. W. H. Myers, M. A. Report on the Case of Miss Mollie Fancher, Judge A. H. Dailey. Thought and Its Vibration, Mrs. Hester M. Poole. Experiments with the so-called Divining Rod, Professor W. T. Barrett, F. R. S. E. Dreams, Considered from the Standpoint of Psychical Science, Edmund Montgomery, M. D. On Automatic Writing (so-called), Mrs. Sara A. Underwood. Experimental Crystal Gazing, Mrs. Janet E. Runtz-Rees. On the Alleged Movement of Objects without Mechanical Contact, Professor and Mrs. Elliott Coues. The Religious Significance of Psychical Revelations, Mrs. Elizabeth Lowe Watson.

August 24.—Theories Regarding Automatic Writing, B. F. Underwood. Memory in Relation to Psychical Experiences, Charles Whedon. On the Difficulty of Making Crucial Experiments as to the Source of the Extra of Unusual Intelligence Manifested in Trance-Speech, Automatic Writing and other States of Apparent Mental Inactivity, Professor Oliver J. Lodge, F. R. S. Hypnotic Suggestion, C. G. Davis, M. D. Evidence Favoring the Theory of the Dual Nature of the Human Mind, T. J. Hudson. The Etiological Significance of Heterogeneous Personality, Dr. Smith Baker.

August 25th.—Official Report of the Milan Committee on Experiments with Eusapia Paladino. Translated from the French, with M. Aksakof's Manuscript Additions and Corrections, Professor Elliott Coues. Remarks on Professor Charles Richet's "Notes on the Milan Experiments," Pofessor Elliot Coues. Further Remarks on the Milan Experiments, Dr. George Finzi. Possibilities of a Future Life, Miss Lilian Whiting. Short Account of Some of the Most Remarkable Psychical Phenomena I have Observed, Señor Alfonso Herrera. Notes of Personal Experiences, Madame E. Van Calcar. Exhibition of "Spirit-Photographs" Known to be Spurious, and of Others Which have been Supposed to be Genuine, with Remarks, Professor Elliott Coues. The Evidence for Man's Survival of Death, F. W. H. Myers, M. A. Papers written by absent authors were read by proxy.

PLATE XXIII.



Androchonia of Lepidoptera.

CONGRESS ON GEOLOGY.—August 21–26.—General Committee of the World's Congress Auxiliary on a Geological Congress: Josua Lindahl, Chairman; W. R. Head, E. Andrews, Victor C. Alderson, Oliver Marcy, T. C. Chamberlin, Chas. W. Rolfe, J. P. Iddings, R. D. Salisbury. Committee of Geological Section of American Association for the Advancement of Science: T. C. Chamberlin, Chairman, H. S. Williams, G. K. Gilbert, R. D. Salisbury, J. C. Branner, J. F. Whiteaves, C. D. Walcott, N. H. Winchell, E. A. Smith, W J McGee, G. H. Williams.

Addresses of Welcome by the President of the World's Congress Auxiliary and others. Responses in behalf of different Congresses and countries. Methods of Teaching Geology, Miss Mary Holmes, Ph. D., Rockford, Ill. Physical Geology, Miss Mary K. Andrews, Belfast, Ireland. Chemical Geology, Miss Louise Foster, Boston, Mass.

August 22.—Granites of Massachusetts and Their Origin, Mrs. Ella F. Boyd, Hyde Park, Mass. Artistic Geology, Mrs. S. Maxon-Cobb, Boulder, Colo.

August 23.—The Geology of Ogle County, Mrs. C. M. Winston, Chicago. The Fossils of the Upper Silurian, Mrs. Ada D. Davidson, Oberlin, Ohio.

August 24.—Crinoidea and Blastoidea of the Kinderhook Group as Found in the Quarries near Marshalltown, Iowa, Jennie McGowen, A. M., M. D., Davenport, Iowa. The Evolution of the Brachiopoda, Miss Agnes Crane, Brighton, England.

August 25.—The Mastodon in Northern Ohio; Post Glacial or Pre-Glacial, Miss Ellen Smith, Painesville, Ohio. Paleontology, Miss Jane Donald Carlisle, England.

August 26.—Glacial Markings, Miss Thomson, Newcastle England.

August 24.—Address of Welcome by the President of the Auxiliary, Hon. Charles C. Bonney. The General Geology of Brazil, Dr. O. A. Derby, Director of the Geological Survey of Sao Paulo. The General Geology of Venezuela, Dr. Adolph Ernst, Special Delegate from Venezuela to the Columbian Exposition. Pre-Cambrian Rocks of Wales, Dr. Henry Hicks, London, England. The Classification of the Rock Formations of Canada, with Special Reference to the Paleozoic Era, Henry M. Ami, Geological Survey of Canada. The Cordilleran Mesozoic Revolution, Dr. A. C. Lawson, University of California. The Pre-Paleozoic Floor in the Northwestern States, Professor C. W. Hall, University of Minnesota. Distribution of Pre-Cambrian Volcanic Rocks along the Eastern Border of the United States and Canada, Professor George H. Williams, Johns Hopkins University.

August 25.—Huronian versus Algonkian, Dr. A. R. C. Selwyn, Geological Survey of Canada. On the Migration of Material during the Metamorphism of Rock Masses, Alfred Harker, St. John's College, Cambridge, England. Wave-like Progress of an Epeirogenic Uplift, Warren Upham, Geological Survey of Minnesota. Eruptive Phenomena of Brazil, Dr. O. A. Derby, Geological Survey of Sao Paulo. Genetic Classification of Geology, W J McGee, Bureau of Ethnology. Precious Stones and Their Geological Occurrence, Dr. George F. Kunz. The Extent and Lapse of Time Represented by Unconformities, Professor C. R. Van Hise, U. S. Geological Survey. The Phylogeny of Plants, Professor Lester F. Ward, U. S. Geological Survey. The Phylogeny of the Classes of Vertebrates, Dr. O. Jækel, Berlin, Germany. Restoration of Clidastes (illustrated), Professor S. W. Williston, University of Kansas.

August 26.—Glacial Succession in the British Isles and Northern Europe, Dr. James Geikie, Geological Survey of Scotland. Glacial Succession in Sweden, Hjalmar Lundbohm, Geological Survey of Sweden. The Succession of the Glacial Deposits of Canada, Dr. Robert Bell, Canadian Geological Survey. Glacial Succession in the United States, Dr. T. C. Chamberlin, University of Chicago. Pleistocene Climatic Changes, Warren Upham, Geological Survey of Minnesota. Evidences of the Diversity of the Older Drift in Northwestern Illinois, Frank Leverett, U. S. Geological Survey.

The Congress on Zoology.—August 28.—Stephen A. Forbes, Chairman, Oliver S. Westcott, Vice-Chairman, Edward A. Birge, Secretary, George W. Peckham, William A. Locy, Edward G. Howe, B. F. Quimby, Committee of the World's Congress Auxiliary on a Congress on Zoology. The History and Evolution of American Zoology and the Status and Tendencies of Zoological Science in America, Dr. G. Brown Goode, Director U. S. National Museum, Washington, D. C. The Geographical Distribution of American Animals, Mr. J. A. Allen, Curator of Departments of Mammalogy and Ornithology, American Museum of Natural History, New York. The Effect of Glaciation and of the Glacial Period on the Present Fauna of America, Mr. Samuel H. Scudder, Cambridge, Mass. Preliminary Account of the Formicidæ of the North American Fauna, Professor C. Emery, University of Bologna, Bologna, Italy.

August 29.—Lacustrine Zoology: Methods and General Results of Its Investigation, Professor Dr. F. A. Forel, University of Lausanne, Morges, Switzerland. The Plankton of the Muskoka Lakes, Ontario, Professor R. Ramsay Wright, Professor of Biology, University of Toronto, Canada. The Origin of the Subterranean Animals of America, Professor A. S. Packard, Professor of Zoölogy and Geology, Brown University, Providence, R. I. The Ichthyology of the World's Columbian Exposition, Dr. Tarleton H. Bean, U. S. Fish Commission, Washington, D. C.

August 30.—The Zoological Museum, Mr. F. W. True, Curator of Mammals, U. S. National Museum, Washington, D. C. The History and Special Features of the Economic Entomology of the United States, Professor J. H. Comstock, Professor of Entomology and General Invertebrate Zoology, Cornell University, Ithaca, N. Y. The Special Problems of American Economic Entomology, Dr. C. V. Riley, Chief of the Division of Entomology, U. S. Department of Agriculture, Washington, D. C. The Ornithology of the World's Columbian Exposition, Dr. Frank N. Chapman, American Museum, Central Park, New York City. The Entomology of the World's Columbian Exposition, Professor H. E. Summers, University of Illinois, Champaign, Ill.

August 31.—Undergraduate Courses and Post-graduate Methods in Zoology, Professor E. L. Mark, Hersey Professor of Anatomy, Harvard University, Cambridge, Mass. Kinetogenesis, or the Relation of Motion to Organic Evolution, Professor E. D. Cope, Professor of Mineralogy and Geology, University of Pennsylvania, Philadelphia, Pa. Energy in Relation to Organic Evolution, Professor J. A. Ryder, Professor of Comparative Embryology, University of Pennsylvania, Philadelphia, Pa. Observations on the Loss of Weight in the Tadpoles of Amphibia Anura during the Period of Metamorphosis, Professor Lorenzo Camerano, R. Museo d'Anatomia Comparata, Turin, Italy. Mammalology and Mammalian Taxidermy at the World's Columbian Exposition, Professor L. L. Dyche, Professor of Comparative Anatomy, University of Kansas, Lawrence, Kas.

September 1.—The Cellular Basis of Heredity, Professor E. B. Wilson, Department of Biology, Columbia University, New York City. Continuity of Organization the Basis of Heredity, or the Organism and the Cell, Professor C. O. Whitman, Head Professor of Biology, University of Chicago. Zoological Psychology and the Development of Mind, Professor C. Lloyd Morgan, Professor of Animal Biology in University College, Bristol, England. Zoological Nomenclature as a Means to a End, Dr. Elliott Coues, Washington, D. C. On Zoological Nomenclature, Dr. Charles Girard, Paris, France.

THE INTERNATIONAL CONGRESS OF ANTHROPOLOGY.—August 28-September 2.—Local Committee of Organization.—F. W. Putnam, Chairman, C. Staniland Wake, Secretary, Edward E. Ayer, James W. Ellsworth, H. W. Beckwith, Frederick Starr, Stephen D. Peet. Executive Committee.—Daniel G. Brinton, President, Franz Boas, Secretary, W. H. Holmes, Representative of American Association Adv. Science, W. W. Newell, Representative of American Folk-Lore Society, Otis T. Mason, Representative of Anthropological Society of Washington, Alice C. Fletcher, Representative of the Women's Anthropological Society, Louis A. Lagarde, Representative of United States Army Medical Museum, and the Presidents and Secretaries of the Sections of the Congress.

August 28.—Addresses of Welcome by the President of the World's Congress Auxiliary and others. Reponses in behalf of different Congresses and countries. Address by the President of the Congress, Dr. Daniel G. Brinton. Subject: The Nation as an Element in Anthropology. Physical Anthropology of North America, Franz Boas Anthropometry of North American School Children, Gerald M. West. Crania from Cuban Caves, Carlos de la Torre. Trepanning in Ancient Peru, Manuel A. Muñiz. On the Anthropological Laboratories of the Department of Ethnology at the World's Columbian Exposition, Franz Boas, H. H. Donaldson, Joseph Jastrow.

August 29.—The Discovery of an Artificially-Flaked Flint Specimen in the Gravels of San Isidro, Spain, H. C. Mercer. The Aboriginal American Mechanics, Otis T. Mason. A Résumé of Archæological Investigations in the Champlain Valley, G. H. Perkins. Anthropological Work at the University of Michigan, Harlan I. Smith. The Mexican Calendar System, Mrs. Zelia Nuttall. On the Antiquity of the Civilization of Peru, Emilio Montes. Cave Dwellers of the Sierra Madre, Carl Lumholtz. Orientation, A. L. Lewis. The Tumuli of Hampshire as a Central Group of Mounds in South Britain, J. S. Phené. The Collection of Games in the Anthropological building, Stewart Culin, J. G. Bourke, Frank Cushing.

August 30.—Alleged Evidences of Ancient Contact Between America and Other Continents, Daniel G. Brinton. Bark Cloth: The Primitive Textile, Walter Hough. Love Songs among the Omahas, Miss Alice C. Fletcher. Primitive Scales and Rhythms, J. Comfort Fillmore. A Peculiar Observance of the Quichua Indians of Peru, G. A. Dorsey. Customs among Natives of East Africa, Mrs. M. French Sheldon. Secret Societies among the Wild Tribes, Stephen D. Peet. The Anthropological Collections in the Government Building. A Critical Study of Flaked Stone Implements, W. H. Holmes. An Industrial Exhibit based on Linguistic Stocks, Otis T. Mason. Museum Collections to Illustrate Religious History and Ceremonies, Cyrus Alder. Illustrations of a Zuñi Dramatic Ceremonial, Frank Cushing.

August 31.—Ritual regarded as a Dramatization of Myth, W. W. Newell. The Ritual of the Kwakiutl Indians, Franz Boas and George Hunt. The Walpi Flute Observance; a Study of Tusayan Cermonial Dramatization, J. Walter Fewkes. On the Folk-Lore of Precious Stones, G. F. Kunz. The Fall of Hochelaga; a Study in Folk-Lore, Horatio Hale. The Coyote and the Owl; Tales of the Kootenay Indians, A. F. Chamberlain. Legends of the Bella Coola Indians, Fillip Jacobsen. The Villas of the South Slavs, Friedrich S. Krauss. The Collections of American Archæology in the Anthropological Building. North American Archæology, F. W. Putnam. The Cliff Dwellers, Frank Cushing. Mexican Archæology, Mrs. Zelia Nuttall. Central American Archæology, Manuel M. de Peralta. South American Archæology, G. A. Dorsey. Cache Finds from Ancient Village Sites in New Jersey, Ernest Volk.

September 1.—The Historical Study of Religions; Its Method and Scope, M. Jastrow, Jr. An Ancient Egyptian Rite, Illustrating a Phase of Primitive Thought, Mrs. Sarah Y. Stevenson. On the Sacerdotalism of the Veda, with a Special Reference to the Vedic Hymns, M. Bloomfield. A Chapter in Zuñi Mythology, Mrs. Matilda C. Stevenson. The Religious Symbolism of Central America and its Wide Distribution, Francis Parry. Paper (subject not announced), Grant Bey. Paper (subject not announced), Crawford H. Foy. North American Ethnology, Otis T. Mason. Paraguay, Emil Hassler.

September 2.—The Present Status of Our Knowledge of American Languages, Daniel G. Brinton. Classification of Languages of the North Pacific Coast, Franz Boas. Notes on the Phonology of the Kootenay Indian Language, A. F. Chamberlain. The Affinities of the Egyptian and Indo-European Languages, Carl Abel. Study of the Papuina Language of Central America, Raoul de la Grasserie. The Ethnological Collection in the German Village, Ulrich Jahn. The Pre-Malay Culture of the Malay Peninsula,——Wildman.

The Congress of Evolutionists.—September 27th 28th, and 29th.—Committee on Organization. Benjamin F. Underwood, Chairman, Lloyd G. Wheeler, Secretary, Professor E. S. Bastin, C. Staniland Wake, J. R. Cummings, Professor E. R. Boyer, Rev. J. Vila Blake, Professor E. G. Cooley, Franklin H. Head, Rev. Jenkin L. Jones, Dr.

Bayard Holmes, Thomas Whitfield, Judge A. N. Waterman. Committee on Programme and Correspondence.—Dr. Lewis G. Janes, Chairman, James A. Skilton, General Secretary, Professor E. S. Bastin, William Potts, J. W. Alfred Cluett, Edward P. Powell, Dr. Robert G. Eccles, Rev. Minot J. Savage, Professor John Fiske, Daniel Greenleaf Thompson, Dr. Martin L. Holbrook, Benjamin F. Underwood, George Iles, Duren, J. H. Ward, Ph. D., Rev. John C. Kimball, Lloyd G. Wheeler.

September 27th.—Opening Address by the Chairman. The Progress of Evolutionary Thought, Benjamin F. Underwood, Illinois. Social Evolution and Social Duty, Herbert Spencer, England. Remarks, By James A. Skilton, New York. Constructive Evolution, Edward P. Powell, New York. Remarks, By Mrs. Celia P. Woolley, Illinois, and Others.

September 27th.—Origin of Variations—Effects of Use and Disuse, Professor Edward D. Cope, Ph. D., Pennsylvania. Evolution of Muscle Fibre—A Microscopical Study, Martin L. Holbrook, M. D., New York. Present Status of Biological Science, Professor Edward S. Morse, Massachusetts. The Inheritance of Acquired Characters—A Botanical Study, Professor E. S. Bastin, Illinois. Weissman's Theory Reviewed, Edmund Montgomery, M. D., Texas. The Marvel of Heredity and its Meaning, Rev. John C. Kimball, Connecticut. Herbert Spencer's Contribution to the Theory of Evolution, Edwin Hayden, Michigan. Charles Darwin—the Man and his Work, Duren J. H. Ward, Ph. D., Pennsylvania. The Poets of Evolution, Mrs. Sara A. Underwood, Illinois. Asa Gray, and America's Contribution to Botanical Science, Professor T. J. Burrell, Illinois. Edward Livingston Youmans, Instructor of the People, Hon. John A. Taylor. The Life-Work of Richard A. Proctor, Miss Mary Proctor, Florida. Emerson, the Prophet of Evolution, William J. Potter, Massachusetts.

September 28th.—The Relativity of Knowledge—Spencer's Unknowable, Benjamin F. Underwood, Illinois. The Relations of Feelings, Herman Gasser, M. D., New York. Evolutionary Psychology as Related to Education, Professor Almon G. Merwin, Ph. D., New York. Constructive Forms of Intuition, John E. Purdon, M. D., Dublin. Psychology in its Relation to Æsthetics, Harvey C. Alford, South Dakota.

September 28th.—The Evolution of the Social Body, Rev. A. N. Somers. Evolution as Applied to Disease in the Progress of Social Development, Bayard Holmes, M. D., Illinois. The Evolution of the Modern Family, Mrs. Florence Griswold Buckstaff, Wisconsin. The

Beastliness of Modern Civilization—Evolution the Only Remedy, Miss Mary A. Dodge ("Gail Hamilton"), Maine. Evolution and the Fair, John H. Copeland, Texas. The Evolutionary Basis of Social Economics, Professor George Gunton, New York. The Relation of Evolution to Political Economy, Charles S. Ashley, New York. Some American Problems of Evolutionary Economics, James A. Skilton, New York. Universal Economic Progress, as Related to Ethical Economy, Alfred W. Smith.

A Symposium of Brief Papers on the following Questions: I. Does the doctrine of evolution, in its sociological aspects, in your opinion, offer wise suggestion for the solution of the grave social and economic problems of our time. II. What, in your judgment, in accordance with such suggestion, should be the next step taken, in our own country, looking toward the solution of these problems? Professor John Fiske, Massachusetts; Edmund Montgomery, M. D., Texas; R. W. Shufeldt, Washington, D. C.; Rev. Myron Adams, New York; Star Hoyt Nichols, New York; F. M. Holland, Massachusetts; Benj. B. Kingsbury, Ohio; T. B. Wakeman, New York; Robert Matthews, New York; L. R. Klemm, Ph. D., Washington, D. C., Bayard Holmes, Illinois, and Others.

September 29th.—Involution and Evolution, Professor Elliott Coues, Washington, D. C. Abstract of Paper on Monism (translated), Professor Ernst Haeckel, Jena, Germany. Evolution of Cosmic Matter, R. G. Eccles, M. A., New York. The Law of Evolution in the Spiritual Realm, Wm. Emmette Coleman, California. The Knowable and the Unknowable, Sylvan Gray, New York. Philosophy and the Aoctrine of Evolution, Raymond S. Perrin, New York. Evolution Optimistic, W. Alfred Cluett, New York. Influence of the Doctrine of Evolution on Ethical Sanctions, Rev. Minot J. Savage, Massachusetts. Intellectual Relations of Morality, C. Staniland Wake, England. Herbert Spencer as a Teacher of Ethics, Rev. Jenkin Lloyd Jones, Illinois. Professor Huxley's Surrender, Dr. Lewis G. Janes, New York. The Evolution of Morality, Rev. H. A. Simmons, Minnesota. The Morals of Evolution, James T. Bixby, Ph. D., New York. The Relations of Evolutionary Thought to the Belief in Immortality, Dr. Charles T. Stockwell, Massachusetts. The Evolution of the Old Testament Religion, Rabbi Emil G. Hirsch, Illinois. The Evolution of Apostolic Christianity, Rev. Howard MacQueary, Michigan. Christianity, in the Evolution of Religious Thought, Rev. Frank N. Riale, Ph. D., New York. The Future of Religious Evolution, Edward P. Powell, New York. The Higher Evolution, Celestia Root Lang, Ohio.

SCIENTIFIC NEWS.

The death is announced of Prof. Alexander Strauch, director of the Zoological Museum of St. Petersburgh, and author of several works on Zoology. Prof. Strauch was an authority on reptiles.

According to the Revue Scientifique Dr. R. Lydekker started early in August to La Plata, to visit the Natural History Museum of that city. As they go by invitation from M. Moreno, the direcrto of the museum, they will have an opportunity of studying the rich paleontological collections from southern Patagonia which the institution has acquired during the last few years.

Mr. W. F. C. Gurley has been appointed director of the Geological Survey of Illinois by Gov. Altgeld. Mr. Gurley is the author of several papers on paleozoic paleontology, and has a very valuable collection of fossils.

Prof. E. D. Cope has been appointed Professor of Comparative Anatomy and Zoology in the Biological School of the University of Pennsylvania; and Prof. A. P. Brown Professor of Geology and Mineralogy in the Auxiliary Medical Faculty of the same institution.

W J McGee has been appointed Director of the Bureau of Ethnology of the United States.

The distinguished French physician, Charcot, is dead. He had an immense practice in Paris and France, and he will be long known for his researches in hypnotism.

In view of the recent meeting of the Pan-American Medical Congress in Washington, D. C., and of the prospective meeting of the Coggress of American Physicians and Surgeons in Washington, D. C., in May, 1894, the Executive Committee of the Association of American Anatomists think it advisable to postpone the next meeting of the Anatomists from December, 1893, until May, when the Association will meet as an integer of the Congress.

A work in folio on the Forest Flora of New South Wales is in preparation, and will soon be issued by the Forest Department of that province. It will be published in quarterly parts, each containing five plates, with their corresponding letter-press of descriptive matter. The illustrations will be in color, and show natural sized flowering branchlets of each species, together with their fruits, barks, etc. Judging from the title page, the work will be an exceedingly beautiful addition to a library.

A volume of scientific memoirs in honor of the late Sir William Macleay has been published by the Linnean Society of New South Wales, and by Dulau & Co., London. It is a royal quarto of 290 pages, with a portrait and forty-two plates and comprises the following papers: The Hon. Sir William Macleay, Kt., F. L. S., M. L. C.; Contributions to our Knowledge of Ceratodus, Part I.—The Blood Vesssels, Prof. W. Balwin Spencer, M. A. (Plates i–v); The Pliocene Mollusca of New Zealand, Prof. F. W. Hutton, F. R. S. (Plates vi–ix); A Monograph of the Temnocephalæ, Prof. W. A. Haswell, M. A., D. Sc. (Plates x–xv); On an apparently New Type of the Platyhelminthes (Trematoda ?), Prof. W. A. Haswell, M. A., D. Sc. (Plate xvi); Observations on the Myology of *Palinurus edwardsii* Hutton, Prof. T. Jeffery Parker, D. Sc., F. R. S., and Josephine G. Rich (Plates xvii–xx); Observations upon the Anatomy of the Muzzle of the Ornithorhynchus, Prof. J. T. Wilson, M. B., Ch. M., and C. J. Martin, M. B., B. Sc. (Plates xxii–xxiii); On the peculiar rod-like Tactile Organs in the Integument and Mucous Membrane of the Muzzle of Ornithorhynchus, Prof. T. J. Wilson, M. B., Ch. M., and C. J. Martin, M. B., B. Sc. (Plates xxiv–xxvi); On *Parinacochlea fischerii* Smith, C. Hedley, F. L. S. (Plate xxvii); On the Geographic Relations of the Floras of Norfolk and Lord Howe Islands, Prof. R. Tate, F. L. S., F. G. S., etc.; Notes on an Undescribed Acacia from New South Wales, Baron von Mueller, K. C. M. G., M. & Ph. D., LL. D., F. R. S. (Plate xxviii); Description of a New Hakea from Eastern New South Wales, Baron von Mueller, K. C. M. G., M. and Ph. D., LL. D., F. R. S. and J. H. Maiden, F. L. S., F. C. S. (Plate xxix); A Description of some of the Weapons and Implements of the Alligator Tribe, Port Essington, North Australia, R. Etheridge, Jun. (Plates xxx–xxxv); New Nematodes from Fiji and Australia, N. A. Cobb, Ph. D. (Plates xxxvi–xlii).

The annual Excursion of the Geological Society of France for 1893 covered the region at the Nothern base of the Eastern Pyrenees. The region presents a great deal of interest to the Geologist and is remarkably complex, embracing Archean, Mesozoic and Cenozoic beds of several systems.

The Naturalist attached to the Antarctic Sealing and Whaling fleet that recently sailed from Dundee, Scotland, have returned and sent in their reports. They had few opportunies of landing on the supposed Antarctic continent, but they obtained specimens of Eruptive and Schistose rocks, and some fossils of Jurassic age.

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THE

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NOTES ON THE COCHINEAL INSECT.

By T. D. A. Cockerell.

The following notes have been put together in the hope that they may tend towards a better understanding of the genus *Coccus*, as now restricted. Notwithstanding the voluminous literature on the subject of cochineal, it cannot be said that the insect producing this substance is adequately known to entomologists, or that the affinities of the genus in which it is placed are altogether well understood.

At the outset we have to inquire, what is *Coccus cacti?* According to Watt (Dict. Econ. Prod. India, Vol. II), it was discovered by the Spaniards in Mexico in 1518, but was not made known in Europe until 1523. The name *Coccus cacti* seems to have been applied to it as early as 1651 by Hernandez, but of course the species is now credited to Linné.

Coccus cacti Linné, as understood by its author, is simply the cochineal-producing insect found on cacti in Mexico. It need hardly be said that minute details, such as are now considered of generic and specific importance in the Coccidæ, were not taken into account in the definition of the species.

In the present century, however, it began to be suspected that there was more than one species. Signoret, writing about twenty years ago, mentions three segregates from the old *C. cacti*, namely, *C. tomentosus* Lam., *C. bassi* Targ., and *C. sylvestre* Thierry de Meronville. These, he says, are supposed species, based on specimens from Mexico, presenting differences in color and the amount of cottony matter.

In the same work (Essai sur les Cochenilles) Signoret gives a definition of *C. cacti* which may be taken as fixing the strict application of the name. Properly, therefore, the insect is *Coccus cacti* L., sens. Sign., and its principal characters are as follows:

Female. Dark red-brown, 6 to 7 mm. long, 4 wide, 2 to 3 high, with a great quantity of white cottony matter. Segmentation distinct. Back more or less keeled. Antennæ short, conical, 7-jointed, the four basal joints short, wider than long; joint 7 as long as the two before it together. Larva with 6-jointed antennæ.

Male. Red-yellow, legs and antennæ brown. Antennæ 10-jointed, hairs on antenna knobbed.

In Ashmead's Generic Synopsis of the Coccidæ, the genus *Coccus* forms a tribe Coccini, distinguished from the tribe Acanthococcini by no very tangible characters. It is stated that the male is apparently without ocelli (see however, Signoret's figure) and the adult ♀ lacks the bristles on the anal ring. Maskell (New Zealand Scale Insects) had earlier placed *Coccus* in a subdivision by itself, defined thus: "Adult females active, covered with mealy secretion; antennæ of seven joints; no hairs on anogenital ring. Eyes of male not facetted."

The question as to there being two or more species, after being answered in the negative by Signoret, was again raised in 1884 by Lichtenstein. This entomologist had received specimens from Mexico which he considered to be the *Coccus tomentosus* Lam.; but he not only regarded this species as distinct from *cacti,* but transferred it to *Acanthococcus*—a genus known hitherto only from Europe and New Zealand.

The nomenclature of the Cochineal insects, according to the latest researches, is, therefore:

Tribe COCCINI. Genus COCCUS L., Sign.

Coccus cacti L., Sign.

Tribe ACANTHOCOCCINI. Genus ACANTHOCOCCUS Sign.

Acanthococcus tomentosus (Lam.) Licht.

So the genus *Coccus* would still remain monotypic, were it not that in 1888 Mr. Douglas described a *Coccus agavium*, found on *Agave*—not a cochineal insect. It is true that the recent literature contains some other nominal species of *Coccus*, such as *C. laniger* W. F. Kirby, 1891, but in so placing them, their authors have reverted to the Linnean use of the term, ignoring genera as now defined.

From an examination of cochineal insects from Jamaica, Mexico, and New Mexico, I have come to the conclusion that the above-mentioned definition and classification need entire revision. This conclusion may be wrong, and was only reached with much hesitation—but it seems sufficiently clear after considering all the evidence.

The specimens examined are:

1. From the Parade Garden, Kingston, Jamaica, on *Opuntia*: =*Coccus cacti* L.

2. From Silao, Mexico, on *Opuntia tuna*, from Dr. A. Dugès: =*Coccus tomentosus* Lam.

3. From Guanajuato, Mexico, from Dr. A. Dugès:=*Coccus tomentosus* Lam.

4. From Las Cruces, New Mexico:=*Coccus confusus* n. sp.

The Silao insect is Lichtenstein's *Acanthococcus;* there can be no doubt about this as Lichtenstein had his specimens from Dr. Dugès, who assures me they are the same. All the others, however, are strictly congeneric with this, and therefore either *Acanthococcus tomentòsus* is a *Coccus*, or all belong to *Acanthococcus*.

Acanthococcus, as stated above, has been recorded from Europe and New Zealand. Maskell sinks the genus as a synonym of *Eriococcus*, which he defines thus:

"Adult female enclosed in an elongated sac of white or yellow felted cotton; body elongated, segmented; anal tubercles conspicuous; feet and antennæ present; several rows of conical spines on dorsal surface. Antennæ of six joints." The anogenital ring is also said to have hairs.

This does not precisely agree with *C. tomentosus*, but on comparing that insect with the published descriptions of *Eriococcus* spp., the affinity is evident.

The Jamaican specimens agree very closely with *Coccus cacti*, but are certainly of the same genus as *tomentosus.* If they are not *C. cacti,* they represent a new species exceedingly like it—a view of the case which seems wholly untenable.

The conclusion, therefore, at which I arrive is that *Coccus,* as typified by *C. cacti,* is a genus very near to *Eriococcus,* and not by any means to be separated as a different tribe. Also, that the cochineal insect includes three or more closely allied species or races. It will be useful to consider the characters in detail.

COCCUS L., Sign.

Adult Female.

Size.—*Coccus cacti,* according to Signoret, is from 6 to 7 mm. long. *C. tomentosus,* from Guanajuato, varies from 3½ to nearly 5 mm. in length.

Shape.—The species are broadly oval; the keel seen by Signoret is more due to shrinkage in drying than anything else. *C. tomentosus* may be described as hemispherical, with the hind end a little pointed.

Color.—All give the characteristic cochineal color, and so far as this is concerned, I see little difference. *C. tomentosus* placed in caustic soda without heating, gives a beautiful reddish-violet color; on boiling, this turns bright crimson. This was observed in Guanajuato specimens; of Silao examples I noted that heated in caustic soda they gave a magenta color, very strong, which, by transmitted light, was bright violet, like logwood staining.

C. confusus, boiled in soda, gave a very fine, bright carmine.

The under surface of *C. tomentosus,* where free from secretion, appears dark purplish in the living insect. Signoret says *C. cacti* is dark red-brown; those from Jamaica are better described as dark greyish. In Ency. Brit., 9th Ed. (1877), the ♀ of *cacti* is described as dark brown. *C. cacti* has been introduced in Madeira, and I found it there on *Opuntia* in 1879. I have a water-color drawing made of it at the time, and it is represented as dark bluish-gray, not at all reddish.

Secretion. The secretion is better described as cottony than mealy. As noticed by Signoret, it differs in the several races.

and these differences cannot be held to have generic value. In *C. confusus* and the Jamaican *C. cacti*, the secretion is profuse, so that the individuals are hidden in it, and separated with difficulty. In the Madeira *C. cacti*, it is much more sparse, allowing the gray color of the females to be seen. In *C. tomentosus* it forms a sac covering the insect, after the manner of *Eriococcus;* in the smaller specimens, part of the body below is free, but larger ones are entirely covered by secretion. The individuals of *C. tomentosus* in their woolly sacs, are easily separable from one another.

Activity.—Maskell writes for *Coccus*, "adult female active;" as against the stationary females of *Eriococcus*, etc. This supposed character is valueless; the final state of female *Coccus* is one of inactivity.

Antennæ.—The antennæ are very small, and show plain evidence of degeneration. In *C. cacti* from Jamaica I could plainly see the seven joints; the first large, the second broad and very short, the third longer but still broader than long, the fourth perhaps as long as the third but not so broad, the fifth and sixth about as broad as long, and the seventh decidedly longer than broad, rounded, emitting two or more hairs. All this agrees excellently with Signoret's *cacti*.

C. tomentosus also shows seven joints, practically as in *cacti*, except that the fourth joint is longer in proportion. *C. confusus* has the antennæ more degenerated, five-jointed, all the joints broader than long except the last; third shortest, last emitting about seven hairs.

Legs.—In *C. confusus* I found all the legs present and well-developed, though small. Femur about as long as tarsus and tibia; tibia decidedly *shorter* than tarsus. In *C. tomentosus* the legs are stouter than in *confusus*, the tibia about as long as the tarsus, but if any difference, the tibia is the shorter. Femur very stout, and about as long as tarsus and tibia. The tibia is broader than the tarsus; the claws large. The usual knobbed hairs at end of tarsus are present.

Truncate Spines.—The skin of all three species shows numerous truncate processes, which no doubt represent the spines of the larva and of the species of *Eriococcus*. These processes consist of two parts, a broad ring-like basal part, and a cylindrical sharply truncate terminal part. In *C. confusus* these processes are decidedly more slender than in *C. tomentosus*, the latter being characterized by their great thickness. In *C. cacti* from Jamaica they are also thick, practically as in *tomentosus*.

Grouped Orifices.—Little groups of glands, like those of the Diaspinæ, are seen among the spines. These groups are compact and very clearly circumscribed, and are quite obvious in *C. cacti* (Jamaica) and *C. confusus*. In the latter, some groups are of three orifices only, but usually there are many, perhaps averaging about 15.

Viviparous Habit.—*C. confusus* was found to have the body full of well-formed larvæ. *C. tomentosus*, from Silao, which had been long in alcohol, were full of larvæ.

Immature Stages.

Color.—The young of *C. tomentosus* are reddish-purple.

Antennæ.—I found 7 joints in the second stage of Jamaican *C. cacti*. In *C. confusus* there *seem* to be 7 joints in the larva, but two are, perhaps, to be considered false joints; these are in joints 1 and 3. The second, first and fifth (or last) are about equal, the third and fourth shortest. The last four joints emit hairs, one on the fifth being especially long. The antennæ of *C. confusus* appear to degenerate with the growth of the insect.

In the larva of *C. tomentosus*, I found the antennæ 5-jointed, the proportions of the joints as in *Confusus*. The false joint in joint 1 is noticed, but it is evidently not a true joint. Joints 3 and 4 have a peculiar shape, concave on one side, convex on the other. The last joint has four hairs, two of which are long.

The larva of *Coccus* is commonly said to have 6-jointed antennæ. According to Signoret's figures, that of the ♀ has 6 joints, that of ♂ only 5.

Legs.—The legs are, of course, much better developed in the larva than the adult, in proportion to the size of the insect. In the leg of a larva of *C. confusus*, I noticed two strong bristles on the inner side of tarsus, and one at distal end of tibia. Tibia shorter than tarsus, but not so much so as in the adult, thus reversing the usual order of events.

In *C. tomentosus* I noted, legs of larva with long claws, and longer tarsal hairs, tibia shorter than tarsus. In Jamaican *C. cacti*, second stage, I noticed the length of the claws.

Rostral Filaments.—In the very young larvæ of *C. confusus* and *C. tomentosus*, the rostral filaments are coiled like the spring of a watch, and very conspicuous.

Anogenital Ring.—The absence of hairs on the anogenital ring is given as a generic character of *Coccus;* but these hairs, about six in number, were plainly seen in the second stage of Jamaican *C. catci.*

Spines.—All three species have in the larva distinct rows of spines, which run longitudinally down the back, just as Signoret figures for *Capulinia sallei.* In *C. tomentosus* I found two parallel dorsal rows, and two rows on each side of the anterior part of the body, joining to form one row on the posterior half. These spines have sharp points, differently from the truncate processes of the adult.

Male Sac.—In *C. tomentosus*, this is white, elongated, about 1½ mm. long. In Jamaican *C. cacti* it is quite similar.

Adult Male.

Size.—In *C. tomentosus* the body is about 1 mm. long.

Color.—The male of *C. cacti* is said to be red-yellow (Signoret) or deep red (Ency. Brit., 9th Ed.). A male of Jamaican *C. cacti*, after being boiled in soda, showed the thorax and genitalia pale brownish, the abdomen pink. In a male not so treated, the wings were observed to be white, appearing granulose, about half their length extending beyond the body.

In a living male of *C. tomentosus*, the body was dark purple-red, the wings whitish subhyaline, the veins not colored. Crushed under a cover-glass, the body gave a brilliant magenta color.

Caudal Filaments.—The abdomen of *C. cacti* from Jamaica emits two very long filaments. *C. tomentosus* also shows a pair of long white filaments.

Antennæ.—These are 10-jointed, as observed in Jamaican *C. cacti*, and *C. tomentosus*. The two first joints are comparatively short. I noted of *C. tomentosus*: joint 2 subglobose, 3 longest, fusiform; 4, 5 and 6 fusiform, equal, distinctly shorter than 3; 7 *slightly* shorter than 6; 7, 8, and 9 subequal; 10 about as long as 4. Joints with whorls of hairs. Antennæ dark reddish, but last joint pale pink. The Jamaican *C. cacti* showed about the same, but 4 longer than 5. I saw no knobbed hairs.

Signoret says the antennæ of *cacti* are brown, and in his figure the fourth and fifth joints are longer, if anything, than the third.

Legs.—I noted of *C. tomentosus*: claw long and straight; digitules very slender, filiform, hardly knobbed. Tarsal knobbed hairs well-formed, rather stout. Tibia and tarsus with a row of strong short spines on inner side. Tarsus about two-thirds length of tibia; tibia a little shorter than femur; trochanter with a long hair.

Scutellum.—The scutellum in Jamaican *C. cacti* exhibits a distinct median longitudinal furrow.

Conclusions.

1. Pending the discovery of new facts proving otherwise, I would propose to unite the tribes Acanthococcini and Coccini under the latter name.

2. The genus *Coccus* may be re-defined as consisting of species which have rows of dorsal spines in the larva, truncate dermal processes in the adult female, antennæ 7- or 5-jointed in the ♀, 10-jointed in the ♂, 5- or 6-jointed in the larva, and in the ♀ more or less abundant cottony secretion. The absence of bristles on the anogenital ring of the adult ♀ may also be cited; it was on this ground that Dr. Riley, to whom I sent *C. tomentosus*, objected to its inclusion in *Acanthococcus*, the latter genus having the bristles.

3. The cochineal insect, as commonly understood, may be taken to include three closely allied species, *C. tomentosus* Lam., *C. cacti* Linn., *C. confusus* Ckll., separated by the characters given above. Former records of the occurrence of *C. cacti*

must be held more or less doubtful until specimens are re-examined.

4. *Coccus* may be held to include only the cochineal insects. *Coccus* (*Gymnococcus* Dougl.) *agavium* seems seems to belong to a separate genus, and may be known as *Gymnococcus agavium.*

5. *Capulinia* seems to be a very closely allied, but still more degenerate genus.

Agricultural Experiment Station, Las Cruces, New Mexico, October 22, 1893.

BACTERIOLOGY IN ITS GENERAL RELATIONS.[1]

BY H. L. RUSSELL.

(*Continued from page 859.*)

Quite naturally, the practical application of bacterial research has been primarily directed along the lines of medicine and the industrial activities. In any new branch of scientific progress, this is almost invariably the case. Our interest in the subject is largely measured by what it is worth to us, and in proportion as it fills this function do we estimate the importance of its study. The results that have already been accomplished in bacteriology have not however been entirely confined to the applied side of the subject. The cause of pure science has also been greatly advanced in various ways. The correlation of any branch of science with allied subjects is to-day so intimate that any discovery in one, often furnishes valuable suggestions in kindred lines of research. It is in this light that we may consider the effect that bacteriology has had upon the greater subject of biology, taken in the pure not the applied sense, and if possible point out some of the lines which seem to promise a rich fruitage from a general biological standpoint. It can hardly be expected that so young a member of the biological family could as yet have contributed much to the common fund that all its workers are striving to accumulate, yet it may with justice be said that the circle of its influence has widened much beyond its own particular sphere. Perhaps the most valuable of the contributions to its sister branches has been in its *technique.* This influence has been most strongly marked in the closely related departments of botany. The excessive minuteness of bacterial forms and the ubiquity with which these organisms are distributed made it absolutely necessary that some reliable means of pure cultures should be introduced before much real advance could be made in this subject. In bacteriology; this

[1]Delivered before the Biological Club of the University of Chicago, Feb'y, 1893.

found its greatest development in the employment by Koch, of gelatin as a transparent solid medium for the isolation and cultivation of germs. Some features of this method had been anticipated by other workers, especially Klebs.

This method enables the experimenter to isolate the form he desires to study from any mixture of different species, and by cultivating it in sterile media, a pure culture derived from a single germ can be obtained which is made the basis of definite morphological and physiological study. Brefeld's methods of studying the morphology and developmental history of the fungi are essentially the same as the bacteriological culture methods. He first obtained his pure cultures by dilution until he had a single germ. Later he added the use of gelatine or other transparent ingredients as a means of isolating and fixing the developing organism. The results of these studies which now fill ten large quarto volumes, are among the greatest contributions to mycology, that this century has produced. He refused to admit the validity of the classic descriptions that had been based upon material gathered under natural conditions, maintaining that the systematic part of the science was full of errors, that had arisen from the examination of imperfect mixed growths, and the separation of different growth-forms into individual species.

Basing his opinion upon the only scientific foundation, that we must know the *complete* life history of a form before we can intelligently study its phylogenetic affinities, he made his observations upon pure cultures grown from a single spore in sterile nutrient media. These he kept from the original spore until in many cases the fruiting process had been completed. By this method he was able to settle definitely many disputed points concerning the value of certain form-genera and species. These conclusions of Brefeld, based upon the single cell, pure culture method, have revolutionized the entire classification of the great group of fungi and the theories as to the phylogenetic affinities of different groups have been greatly modified. Hansen adopted the same method in his study of ferment organisms, more especially the yeasts, and this plan of pure culture growths has settled many controversies in the biology of this imperfectly understood group. Beyerinck applied the gelatin method in the isolation of algæ and succeeded in cultivating a number of free unicellular forms, some symbiotic species in certain hydra and paramœcia, and a number of the gonidia in lichens. So far all attempts to apply the isolation methods of solid media to animal life have proven futile. Strenuous efforts have been made upon such parasitic forms as the malaria plasmodium and other parasitic protozoa, but as yet these experiments have not been successful.

With respect to tinctorial methods, bacteriology has been of service. The art of staining to bring out structural differences more clearly has been systematically developed in the latter half of the present century. The discovery of aniline colors in the seventies gave an additional impulse and the names of Koch, Ehrlich, and Weigert will always be associated with the rapid advance and development of this branch of biological technique. The necessity of staining in order to differentiate bacteria in animal tissue has been so imperative, that much time and effort have been expended in order to improve the old, and discover new processes. The success of these efforts has been stimulating in other lines of work, and has materially advanced the general knowledge of stains.

Koch in 1878, was one of the first to apply photography to the study of microscopic preparations. The application of this process by means of photograms for class demonstration, and the obvious advantages that it possesses for accurate illustration are apparent. The recently completed photomicrographic atlas of bacteria by Fränkel and Pfeiffer exemplifies the degree of excellence that has already been attained in this branch.

In the study of bacterial forms, the old types of microscopes were entirely inadequate. The necessity of improved instruments, in regard to definition and resolution to work out the structure of these "infinitely little" organisms, acted as a healthy stimulus on the art and science of lens making. The perfected instrument of to-day, with its homogeneous immersion, the Abbe condenser, and the apochromatic objective, are largely the result of the demand of bacteriologists. These points suffice to show the influence that the study of the bacteria has exerted upon the technique of other lines of biological thought.

Has it been able to any extent to aid in the solution of any of the general questions that have from time to time engaged the attention of all students of living phenomena? In considering this, reference will be made mainly to those lines that are of special importance in the theoretical problems of biology. As has been previously stated, the main results of bacteriology as yet are found in applied science, but the germ theories of fermentation, of nitrification, of sewage filtration, of nitrogen fixation, of the etiology of contagious diseases and of inflammation are monumental witnesses of the value of this department in the realm of pure science.

Bacterial methods in the hands of the illustrious Pasteur were the means of combatting and effectually routing the heterogenists from their defence and proving beyond the shadow of a doubt, the accuracy and universality of the Harveian motto "*Omne vivum ex vivo.*"

Since the discovery of the laws, which are the foundational basis of the doctrine of evolution, every department of natural science has paid tribute to it, adding fact upon fact, and broadening the basis of the principles, formulated by the observant Darwin. Morphology and physiology in both branches of biology, as well as pathology, have furnished their quota of proof in this grand advance step in knowledge. Has bacteriology contributed its contingent to the general result on this and other vital problems? Does the testimony of the infinitely little corroborate that of the higher and more complex forms of life?

The advantages of this group as types for study on many questions of this nature, have not as yet been generally appreciated. The practical side of the subject has naturally presented the most attractive phase, and even the systematists have found but scant encouragement for their labors, except for the utilitarian purpose of species determination.

The number of observers who have made this group of organisms a subject of special study with reference to general biological laws have been but few. Valuable data have however, often been obtained in an incidental way. The possibilities, which this group of organic life offers for the study of many of these general problems, are so noteworthy that it seems worth while to call attention to them more in detail. In selecting forms for the study of certain questions, the biologist chooses, as far as possible, the primitive generalized types upon which to base his observations. Specialization of form and function complicate the conditions and render it more difficult to apprehend the fundamental truth. In this respect bacteria occupy a unique position. Morphologically considered, they are a lowly organized and generalized type, while functionally, they possess a marked degree of specialization.

With our present appliances but little difference can be detected in form between many species that possess widely divergent physiological functions, so that species are often found that are morphologically similar and their dominant physiological function may be expressed either in pigment production, fermentative action, or in an infectious malady.

A certain degree of adaptability in an organism is also necessary if we are to subject it to prolonged experimentation. Many plants and animals are so susceptible to any modification in their surroundings that they cannot well be utilized for purposes of experimentation, a slight change often being sufficient to produce a cessation of the vital functions. Bacteria possess an adaptability not to be found in any other class of organisms. With a large proportion of these forms, the range in temperature of the limits of growth far exceeds any of the higher forms of life.

The majority of species are able to vegetate between 10° C. and 50° C. while exceptional ones grow at the freezing point and others thrive at a temperature of 70° C. This tenacity of life, far surpassing all other forms of animate nature, is as distinctive in the chemical as in the physical environment of these germs.

Another peculiar characteristic, that renders them of especial value from an experimental standpoint, is their rapidity of multiplication. A single cell is the progenitor of millions in twenty-four hours. We can therefore accumulate the effect of certain external influences upon an almost infinite series of generations within a limited time. The time element, which in higher forms of life often necessitates the extension of experiments over a period of years owing to the relative slowness of reproduction, is here minimized to such an extent as to be brought entirely within the limitations of a single observer. By a rapid successive transference of cultures to fresh media, we can secure the effect of an experiment covering an immense number of generations within a limited space of time. Of course, the absence of sexuality in the reproductive process narrows the sphere of investigation, but there is no valid reason why as valuable results may not be obtained by experimental work on problems of variation and heredity as have been already accomplished with asexually propagated plants, like the sugar cane, banana, and potato. The objection that might be raised, that the morphological and physiological characters are more plastic, and therefore more easily modified than higher specialized forms of life, seems to be answered when we take into consideration the number of generations that intervene between the original type and the establishment of a pronounced variety. The gardener is able to modify the constitution of his plant by cultivating it under special conditions for a few years to such an extent that he produces a horticultural variety in a limited number of generations. The bacteriologist in his "microscopic horticulture" finds it far more difficult to modify his species to the same extent in a limited number of generations.

The ease with which experimental conditions can be modified in the manipulation of bacteria is also a valuable factor. The physical and chemical environment can be so rigidly controlled that the variability of conditions which is so disturbing a factor in experimental work on higher forms is practically excluded.

These are some of the evident advantages that bacteria possess for experimental research in evolutionary biology. It may be proper in this connection to state a few of the results which have been obtained in this field and which bear more or less directly upon some of the more general questions of biological importance. As has been before intimated, so little direct attention has been given to this subject, that we are scarcely able to predict what results may be expected from the study of these problems from a bacteriological standpoint.

But few laws in nature have a wider expression than that of variation. In fact, it may be said to be co-extensive with life itself. Among the higher complex forms, no two individuals are exact counterparts of each other, but as one passes from the higher to the lower forms of life, the individual differences gradually become obliterated in the more generalized types, and a greater uniformity seems to prevail among the different members of the same species. In such simple protoplasmic elements as the bacteria, all individual variation is concealed, yet, it is presumably present, and were our facilities for recording such infinitesimal variations, sufficient, we would be able to detect structural and functional differences in each cell.

It is too early for us yet to say, whether the evidence that bacteriology may yield will be in favor of the "innate tendency of species to vary," or whether we are to regard variation as an "expression of the influence of environment." An almost untrodden field is before us which lends itself readily to experimental conditions and it is highly important that we interrogate Nature through the medium of investigation upon her more minute, as well as her larger forms of life.

Structural modification expressed either in change of external form or internal characters is usually made the basis for specific differences, so that classifications have been built more upon morphological, than upon physiological characters. A modification then of characters possessing a morphological value would be indicative of a profound change in the constitution of an organism. How far this would be appreciable in the case of bacteria is not definitely settled. A certain amount of form variation, (much more in some species than in others) is to be seen when different media are used for cultivation. Whether these manifestations are merely modifications due to nutrition or not, it is difficult, if not impossible to say. The question may fairly arise, whether they are due to variations in the food medium or are they entitled to the dignity of varieties and species in the taxonomic sense.

Reproduction is considered one of the most complex and deep seated phenomena of organic life. If we are able experimentally to change the inner constitution of an organic structure to such an extent as to permanently modify its reproductive function, we may justly conclude that a profound change in the original type has been induced. This has been done in the case of the anthrax fever germ. The bacillus that causes this malady is characterized by the ease with which endospores are produced. With a favorable temperature and free oxygen, spores are formed in the vegetating filaments in the course of from 24 to 36 hours. Roux succeeded in producing an asporogenous race of this bacillus by growing them in a nutrient culture medium to which potassium bichromate had been added in the proportion of 1 to 2000. He also succeeded in modifying this reproductive function by the use of phenol. Cultures containing 6 parts of phenol in 10,000 produced endospores in a normal manner, while those seeded in 20 parts to 10,000 were destroyed. Between these limits, the cultures maintained their vitality and grew, but in no case formed spores. When these asporogenous cultures were re-seeded into normal media, they vegetated in a normal manner but did not form spores, although the conditions were most favorable for the process. Behring succeeded in obtaining the same results by the use of rosolic acid. What these observers accomplished by the strict control of cultural conditions, Lehmann observed under more natural conditions. He found that certain cultures that had been cultivated in Koch's laboratory for many generations on gelatine exclusively had lost their ability to produce spores, but their virulence had not been impaired in the least degree. They could not be distinguished from the normal spore-bearing forms in any other than this particular. He tried to modify these varieties, and when the asporogenous type had been grown on a medium suitable for spore production, like potato, for a series of generations, he finally succeeded in producing forms that contained minute spherical refringent bodies, which in some cases externally resembled true endospores, but *biologically* differed from them materially as they were destroyed by heating for two hours at 60° C while the normal endospores are among the most resistent bodies known. This is a well authenticated instance, where the morphological character of reproduction has been modified, while the salient physiological features of the germ remained constant. This change had evidently been brought about through the influence of exterior conditions, and so deeply had the inner constitution of the germ been affected that it transmitted the character to its progeny although the normal conditions of development did not favor its production.

Were we to admit the evidence of physiological variation, we would find abundant proof among the bacteria that this group of organisms were more or less profoundly modified in their functional characters. Physiological variations have so far received but slight attention at the hands of biologists, but in bacteriology the truth of De Varigny's words that species must be defined not only by means of their anatomical characters, but also in terms of physiological differences, has been amply confirmed. Bacteriology has been forced to add physiological to the morphological diagnosis in the study of these minute forms.

That there is a variation in the characters of certain forms in a perfectly natural state is readily seen in the case of some contagious diseases like cholera. It is known that the peculiar individualities of the cultivations isolated from the different epidemics are so marked, that an expert can tell at a glance whether the culture in question descended from the germ found in the Naples outbreak, or in Egypt, or from India. As one epidemic is often the result of the transference of germs from another, and the two germs therefore more or less related, it is reasonable to infer that environment has much to do with their modification. But we are not confined to the evidence of physiological variation as afforded by examples under natural conditions. These conditions are too fluctuating and variable. It is only under rigid experimental control that we can obtain positive proof on this question.

The most noteworthy changes are those that show a decided modification of the physiological function of virulence. Nearly every species belonging to the pathogenic class is subject to greater or less variation in this respect. Anthrax fever, the classic example in bacteriology, has been shown by the experiments of Chauveau to vary in virulence to such an extent that from the original virulent culture, varieties or races have been grown that possess every shade of virulence from the deadliest type to that which is perfectly innocuous. These attenuated types maintain their newly acquired function in a perfectly constant manner, so that we have races of the germs that are christened " mouse anthrax," because they are pathogenic for mice only; others less attenuated are able to kill guinea pigs or rabbits, while still others are virulent for all classes of susceptible animals.

With many germs the variation of this functional property occurs quite readily in cultures under ordinary conditions, as in the case of pneumonia and hog cholera, where all degrees of virulence may be found. Sometimes abnormal conditions of environment seem to be necessary to produce the variation. These modified forms may persist only so long as the artificial conditions are maintained, reverting to the original type when restored to their normal environment, or in some species the constitutional characters of the germ are so changed that they are perpetuated although the conditions favorable to atavism are present. What is true concerning the variation of the pathogenic function is likewise true in regard to other physiological characteristics.

The chromogenic property of certain forms has usually been considered of diagnostic value, but in some instances spontaneous sports occur, as in *Bac. pyocyaneus* α and β, where the only observable difference is that the pigment produced in one is a bluish green, while in the other it is a fluorescent green, and quite distinct from the first. This species has been modified artificially so that the color producing power of the organism has been permanently abolished. From other chromogenic species like *Bac. prodigiosus*, the germ that causes "bleeding bread" and *Bac. cyanogenus*, that which provokes the disturbance known as "blue milk," varieties have been produced by constant selection and cultivation of cultures in which the color producing quality of the germs entirely disappeared. Laurent modified the chromogenic function of the Kiel water bacillus by exposing it to direct sunlight for a limited time. The suppression of this peculiarity was transmitted from generation to generation so that a perfect albinotic variety was formed. The color property was also lost when cultivated at blood heat and was not regained when continued cultivation was carried on at lower temperatures. These examples indicate the plasticity of this physiological function of color production and show the influence that is exerted upon the germ by a continued subjection to certain experimental conditions.

The objection may be raised that these cases that show a change in the various vital functions do so because their vitality is impaired and that the variety so produced is merely a degenerated and weakened type. While this may be true in certain cases, it does not detract from the value of such experiments as throwing more light upon the question of environmental influence. Besides, the rule is by no means general that loss and abatement of physiological function is correlated with degeneration. We have numerous instances among the pathogenic forms where greater luxuriance in growth is to be noted in connection with the mitigation of the powers of virulence as for instance in tuberculosis where cultivation on media containing glycerin-agar diminishes the virulence of the form while it increases the powers of growth. This can be explained as a case of partial reversion of the species, specialized in the direction of the pathogenic property to an ancestral saprophytic mode of existence.

The zymogenic, or fermentative function of bacteria has also been experimentally modified. The cultivation of the lactic acid bacillus, the germ causing the souring of milk, for a time in non-fermentable solutions, entirely destroys the property of decomposing the sugar in the milk and converting it into lactic acid. When grown continuously on solid media it likewise loses the power to peptonize or liquefy gelatin, a character of such importance that it is used as a basis for classification.

This variation of function is very marked in the case of some of the marine bacteria.

One Mediterranean species, *Bac. halophilus*, grows only with the greatest difficulty on media that contains less than the normal percentage of salt in sea water, while on media made with sea water it thrives luxuriantly. Constant cultivation however on ordinary media finally so changed its habits that in the course of twenty generations, it flourished as vigorously when supplied with fresh as with salt water.

Another case has recently come under my notice that presents even a more marked change. *Cladothrix intricata*, a common form in the Mediterranean mud was first isolated some 18 months ago. It then manifested no particular preference as to the amount of salt necessary for development, growing equally well on fresh as on salt water media. Since its isolation, it has been kept in stock on agar made with distilled or tap water. This season when an attempt was made to transfer it again to sea water media, it failed to grow. At first, I thought the original stock culture dead, but examining it microscopically I found that all vegetative forms had died, leaving innumerable spores. Seeding an ordinary agar tube from this spore-bearing stock, within 24 hours a copious characteristic growth of the germ was obtained. A second attempt to transfer the germ from the fresh culture, containing only *vegetative* forms was equally unsuccessful. In this instance, not only had the organism lost the ability to germinate when supplied with salt water food but even the vegetating bacilli died when introduced into this medium. This might not be surprising in ordinary terrestrial or fresh water saprophytes, but in a form originally a marine species, it shows a marked modification of nutritive conditions.

Examples like the above indicate that physiological and morphological modifications are so closely related to the environment of the species that it seems almost impossible to avoid the inference that there is some direct connection between them. Our ability to so rigidly govern the experimental conditions makes the case much stronger for these conclusions, than in those cases where the variations occur spontaneously. Whatever may be the true cause, or causes, that lead to variation among species, it cannot be denied that experiments from all classes of organic life will be valuable in adding to the store of observed facts, and thus giving us a broader basis upon which more accurate generalizations can be made. The evidence already at hand from the realm of the bacteria is promising enough to lead to the conviction that continued experimental work with reference to the problems of variation will be fruitful in results.

Few problems in biology are more prominent in the discussions of to-day than those pertaining to the subject of heredity. Among the different phases of this subject none hold a more important place than the doctrine of the transmission of acquired characters. The difficulties of the question are largely increased by our inability to define exactly what is meant by an acquired character. Under ordinary conditions, it is not easy to sharply differentiate between a variation brought about by an inherent tendency of the organism to vary, and one that is impressed upon the organism from without. We have however in the phenomena of artificial immunity, whereby a susceptible animal is rendered refractory toward a specific disease germ, a favorable field for the study of this problem. Artificial immunity is *par excellence* an acquired characteristic, as it is a deep seated and permanent change in the constitution of the animal that is produced through the influence of an exterior force. Several instances are on record that claim the transmission of acquired immunity in animals from the parent to the young. Chauveau found that the artificial immunity conferred upon goats was transmitted to their progeny but these cases are not pertinent to the problem of the transmission of an acquired character, for the possibility of a direct transference of the immunity by means of the body fluids is not excluded. All cases of the so-called transmission of artificial immunity that are conferred upon pregnant animals are open to the same objection. That the immunizing substance does permeate the entire body so that even the secretions are affected has been recently proven by the experiments of Ehrlich. He has recently shown that young mice may acquire immunity against that toxic alkaloid, ricin, by being nourished upon the milk of their mother, which has been artificially immunized. He obtained similar results with the tetanus bacillus, by immunizing a mother mouse with serum from a horse when the young were 17 days old. In 24 hours, one of the suckling young was infected with virulent tetanus spores from which it experienced no ill effect, while a control died in 26 hours. Two and three days after the mother had been immunized, other of the young were also tested, and it was found in these cases that the immunity was also transmitted from the mother to her progeny.

If the injection of the immunizing substance into the body of an animal can so permeate the tissues as to reappear in the secretions in 24 hours, it would seem highly probable that the immunity claimed to be transmitted by inheritance might be regarded as passing directly from the mother to her young rather than by means of the germ plasm.

The same objection applies to those cases where infectious diseases are claimed to have been transmitted. Wolff has recently subjected all of these cases to the closest examination, and he finds that only in a very limited number is there any probability that infection is ever transmitted from parent to progeny. In numerous cases of so-called inherited disease, he has actually determined lesions of the placenta, that allowed a direct passage of the germ. He claims that in no case has it been thoroughly proven that disease has been transmitted by the germ-plasm, although it is possible that either male or female generative cell may be diseased, and thus an infection, which he calls *conceptional* may take place.

Ehrlich has recently made some very interesting observations that have a direct bearing upon this question of acquired characters. They possess the advantage of approaching the subject in a fundamental manner, and while they are not numerous enough to justify general conclusions, they are of great interest as indicating what may be expected from a further study of this subject.

In this case, he experimented with ricin and abrin, those toxic vegetable alkaloids that are so closely related to the poisonous products of bacterial growth. The question at issue in his experiment was, whether the male or the female cell, if either, possessed the ability to transmit artificial immunity to its progeny. His methods were, to first pair a highly immunized male rabbit with a normal susceptible female, and determine whether the progeny possessed any immunity against the toxic substance. In this series of experiments, he found that the descendants invariably succumbed when inoculated with the ordinary fatal dose. From this it is evident, he says, "that the idioplasm of the sperm is not in condition to transmit acquired immunity."[2] He then took up the more complex problem of the inheritance of maternal immunity. The problem in this case is more difficult because we cannot tell with certainty whether the immunizing substance passes to the fœtus by the way of the germ plasm, or directly through the fœtal membranes. This difficulty is partially obviated if the immunity is conferred before fertilization of the egg occurs. But here another disturbing factor arises and that is to confer a permanent immunity for extended periods of time. Repeated tests with these alkaloids demonstrated the permancy of the immunity as very marked in this case, so that they were well suited for experiment on this question. He instituted another series of experiments on rabbits, by pairing an immunized mother with a male of normal susceptibility. Here he found a well pronounced immunity conferred upon the progeny for a certain length of time. At the age of three or four weeks, the young were able to stand ten times the dose that was ordinarily fatal, but in a month and a half it had almost entirely disappeared, and in three months the animal yielded readily to the injection of the normal lethal dose. No

[2]Since this was written, Tizzoni and Centanni have published (Cent. für Bakteriologie, Bd. XIII, No. 3.) the results of a similar series of investigations with rabbits on hydrophobia in which they arrive at a contrary conclusion. Their results are however not uniform but they are of interest in this connectiom as showing how important this field is from an experimental standpoint.

permanent immunity was therefore conferred by the mother. The temporary immunity can be explained on the assumption of the direct transmission of the anti-toxic substance to the young. He continued the test by pairing animals that were descendants from the progeny of immunized ancestors, but in no case were the descendants refractory toward the toxic substance. These results, although not conclusive upon the disputed question because not continued for a sufficient number of generations, are extremely interesting and go to show that the field of bacterial science offers wide and valuable opportunities for lines of investigation upon problems that have a general biological bearing.

Allusion has been made, and this in only the most cursory manner, to some of the more salient lines of work, and it requires no prophetic vision to see that an experimental field which is so suggestive in its infancy as this has proven to be, must in the future yield a rich harvest to patient systematic investigation.

THE COLOR VARIATIONS OF THE MILK SNAKE.

BY E. D. COPE.

The Milk Snake, *Ophibolus doliatus* Linn., ranges in North America over the Eastern, Central and Austroriparian districts, and is absent from the Sonoran and Pacific districts. It is found also in the humid regions of Mexico and Central America, as far as the Isthmus of Darien. Beyond this point it does not occur, but a very similar snake (*Opheomorphus mimus*) is found in New Grenada.

I have called attention to the color variations of this species in a brief paragraph in the introduction to my check list of Batrachia and Reptilia of North America, 1875[1] and have given the characters of the color types, or subspecies, in an analytical key, in a Review of the Characters and Variations of the Snakes of North America, 1892.[2] It is only now possible to give a series of figures representing the North American color forms; a possibility for which I am indebted to the U. S. National Museum. Both Jan and Bocourt have given admirable figures of some of these, but they have thoroughly confused the nomenclature.[3]

The variations of this species are instructive as illustrations of the law of variation, in view of the question raised by the Neodarwinian school as to its promiscuous or definite character. Are variations multifarious or promiscuous as alleged by that school, or do they display a serial passage from a point of departure to a definite goal, as alleged by the Neolamarckians? Researches into the color forms of insects, as those by Eimer in Lepidoptera,[4] and Horn in Coleoptera[5] point to definite series of stages, and my own examination into the color patterns of

[1]Bulletin of U. S. National Museum, No. I, p. 4.

[2]Proceedings of the U. S. National Museum, XIV, p. 589–608.

[3]See memoir quoted at [2] for my synonymy.

[4]D. Artbildung u. Verwandschaft bei Schmetterlinge, Jena, G. Fischer, 1889.

[5]Proceedings of the American Entomological Soc.

the varieties of the lizard *Cnemidophorus tessellatus* and *C. guttatus*,[6] and those of Eimer on *Lacerta muralis*,[7] show distinctly the same phenomenon.

Before going further into the patterns of the *Ophibolus doliatus*, I give a synoptic key of them.

I. No yellow band posteriorly from orbit (a yellow half collar).

a. Dorsal spots or saddles (red) open at the side, their adjacent borders forming pairs of black rings.

Interspaces between red saddles open below; scales not black-tipped; front more or less black; first black ring on nape only *O. d. coccineus.*

Interspaces between red saddles closed by black spot below; scales black tipped; front black; first black ring complete. *O. d. polyzonus.*

Interspaces not closed; rings including first complete on belly; first yellow band crossing occipital plates; front black; scales not black-tipped *O. d. conjunctus.*

aa. Dorsal saddle spots closed at the sides below.

b. Saddles closed by a single black tract on the middle of the belly; no spots between the saddles.

Dorsal spots undivided medially; front black; first black ring complete *O. d. annulatus.*

Dorsal spots divided longitudinally by a median black connection; front black *O. d. gentilis.*

bb. Inferior borders of saddles separate and not confluent with each other.

Saddles completed on gastrosteges; no alternating spots; no black collar *O. d. parallelus.*

Saddles completed on gastrosteges; spots opposite intervals forming a single series on the middle line of the belly *O. d. syspilus.*

Saddles completed above the gastrosteges; alternating spots which do not meet on the middle line of the belly *O. d. doliatus.*

[6]Transac. Amer. Philos. Soc., 1892, p. 27.

[7]Archives f. Naturgischichte, 1881.

II. A yellow band posteriorly from orbit, bounded below by a black or brown one.

a. Saddle spots closed laterally on gastrosteges; alternate spots entirely on gastrosteges.

A half collar behind parietal plates, no superciliary stripe *O. d. temporalis.*

aa. Saddle spots closed above gastrosteges; alternate spots on scales.

A half collar nearly or quite touching occipital plates, no bands; alternate spots largely on gastrosteges *O. d. collaris.*

Neck with longitudinal bands; alternate spots largely on gastrosteges *O. d. clericus.*

Neck with bands; alternate spots entirely on scales *O. d. triangulus.*

In figure 1 are represented vertical, lateral and inferior views of parts of the body of the subspecies *triangulus,* taken from a specimen in my collection from West Chester Co., New York, which I owe to the kindness of my friend Mr. T. H Mead.

The characters of this form are seen in (1) the presence of a light band extending from the posterior angle of the eye downward and backward, which is bounded by a black border above and below; (2) a black cross-band on the posterior border of the prefrontal plates; (3) chevron shaped mark with the apex on the posterior part of the frontal plate, whose limbs extend posteriorly as a band on each side of the neck, where they are fused together, and continue as a single, broad band for a short distance; (4) a series of lateral spots which do not extend beyond the scales on to the gastrosteges, and which alternate with the dorsal spots; (5) a series of spots on the ends of the gastrosteges which alternate with the last mentioned; (6) a series of spots on the centers of the gastrosteges which alternate with the spots mentioned under (5). The ground color in this form is gray, and the spots are a rich brown with black borders. The belly has a white ground color.

In fig. 2 we have the subspecies *clericus,* where the following modifications appear. The fusion of the limbs of the chevron is more complete, and the dorsal spots are more expanded transversely. They extend to within two or three scales of the gastrosteges, while in the form *triangulus* they are five scales distant. The alternate spots touch the gastrosteges. This figure is taken from a specimen in the Museum of the Philadelphia Academy from southern Illinois.

In fig. 3 we have an individual from Elmira, Illinois, which illustrates the characters of the form *collaris*. Here the chevrons are distinct from the first dorsal spot, whose anterior black border forms a half collar on the neck. This specimen is instructive, as it displays the last connection between the chevron and the first spot, in a black line on each side. This is wanting in the typical form.

The collar of ground color is complete in its anterior border as well as the posterior in the form *temporalis* (fig. 4), owing to the disappearance of the chevron. The transverse band on the prefrontals has also disappeared. The anterior extremity of the postorbital stripe is cut off, and consists of a spot of ground color. The dorsal saddle spots are wider, reaching the gastrosteges, while the intermediate spots are exclusively gastrostegal. The spots which alternate with them, have fused on the middle line. Fig. 4 is from a specimen from the State of Delaware.

In subspecies *doliatus* the postocular stripe has disappeared, and the chevron is replaced by a black patch on the parietal and temporal plates. In other respects this form is more like the form *collaris*. The dorsal saddle spots are separated by a row or two of scales from the gastrosteges, and their alternating spots are partly on the scales. The ground color in this form, as in the *temporalis*, approaches red. This is the form of the tier of states between latitude 40° and the Gulf States.

The subspecies *syspilus* is represented in fig. 7. The head pattern is like that of *doliatus* with the black patch more or less reduced—in the specimen figured being represented by a cross stripe. The dorsal saddle spots are more expanded than in any form yet encountered, their lateral borders being completed below the scales and entirely on the gastrosteges. The alternate spots now meet and fuse on the middle line of the abdomen, and the second series of alternating spots has disappeared. This is distinctively a southern form, extending west to central Oklahoma.

The dorsal saddles are so far extended in the next subspecies, *parallelus*, as to form two parallel stripes with a narrow strip of ground color between, on the middle line of the abdomen. The alternating spots have disappeared. In the specimen figured, which is from Florida, and is in the U. S. National Museum, the supraocular spots seen in *temporalis*, are indicated. The ground color is red. Black begins to appear on the head.

From the form *syspilus* two types of color modification may be traced. One of these brings the borders of the saddle spots together on the median line, forming a median black stripe; this is the subspecies *annulatus*, which belongs to western Texas and the adjacent parts of Mexico. The top of the head is black (fig. 9). In the other, the lateral borders of the saddle spots have disappeared altogether, so that the body is more or less completely encircled by pairs of black rings, the alternating spots having disappeared. This might be supposed to have resulted from a continuation of the process by which the alternating spots have disappeared, and the edges of the saddles been brought closer and closer together. The continued transverse extension of the spot color would finally obliterate the lateral borders completely, as actually occurs in this last form, the *coccineus* of authors, which is the common type of the Gulf Coast. But the black has not covered the head and muzzle of this form as in the *annulatus*. These regions are on the contrary red, as is the spot color generally, while the ground color is pale yellow.

A tendency to a development of black pigment in the saddle spots is seen in two other forms. The subspecies *gentilis* resembles *annulatus*, but has a black longitudinal dorsal band which divides each saddle spot in two equal halves. This is a rare form, only known from the Indian Territory. The common Mexican form (*polyzonus*) has the paired rings of *coccineus*, the black head of *annulatus*, but each scale of the red intervals is tipped with black.

The relations of these forms may be expressed in a tabular form as follows:

```
                        gentilis
        polysonus          |
            |           annulatus
        conjunctus         |
            |           parallelus
        coccineus         /
            |           /
        syspilus      /
doliatus    |
      \ temporalis
        \   |
         collaris
            |
         clericus
            |
        triangulus
```

The main series corresponds with a distribution in latitude, commencing with the *triangulus* of New England and New York, and passing gradually to the *coccineus* of the Gulf coast regions, and *polyzonus* of Mexico and Central America. The forms of the right hand column are (except the parallelus), from the central warmer parts of the continent. I think this series of color forms of the *Ophibulus doliatus* demonstrates three points. First; the series is determinate and not indeterminate. Second; the patterns have relation to latitude; the tendency being to make the spot color of the upper regions red, and to extend the area of this color more and more, as we proceed southwards. Third; so far as regards eastern North America, there is a diminution of size in passing from north to south; the *O. d. coccineus* being the smallest of the subspecies. In Mexico, the size is recovered, as the *O. d. polyzonus* equals in dimensions the *O. d. triangulus*.

EDITORIALS.

—DURING the past few years several institutions of higher education in the United States have begun the publication of the results of work done in their laboratories and seminars. Some regard this new departure with favor, while in the opinion of others it is a matter of regret. Of the aspects as related to Natural History alone we need to speak. The arguments against such publications are weighty. The literature on the subject is enormous; no less than 20,000 pages are required to contain the annual contributions of the world to zoology alone; and every new periodical adds just so much to the difficulty of keeping en rapport with the subject. Again with the multiplicity of periodicals there is a corresponding deterioration on the part of some in the quality of the matter published. With fewer chances for appearing in print the law of natural selection would weed out many a mediocre production.

On the other hand, these new journals have their strong points. America is lacking in facilities for the prompt publication of results. All of our publishing scientific societies are overwhelmed with papers, while our independent journals devoted to research are utterly inadequate to present more than a fraction of the papers of the better class. Combination between institutions to support new journals of the better class is apparently out of the question, while the persons who, like Professor Whitman and Mr. Allis, are willing to pay the deficit of a journal from their own pockets are lamentably few. To conduct investigations with no chance for the publication of the results obtained is discouraging. But since it is only by research that we can ever advance, every aid or encouragement to investigation should be welcomed. We can only hope that the editors of these new journals will exercise due critical care and that they will see to it that every paper published is an actual contribution to knowledge.

The bill recently introduced into the House of Representatives by Congressman Cogswell, appropriating 100,000 dollars for the extermination of the Gypsy Moth in Massachusetts seems to us pernicious. It is, if voted, sure to prove a precedent for further expenditures for the same purpose, for an unlimited term of years. The extermination of this pest is far from an easy task and for several years the State of Massachusetts has been sending good money after bad in its attempt

PLATE XXIV.

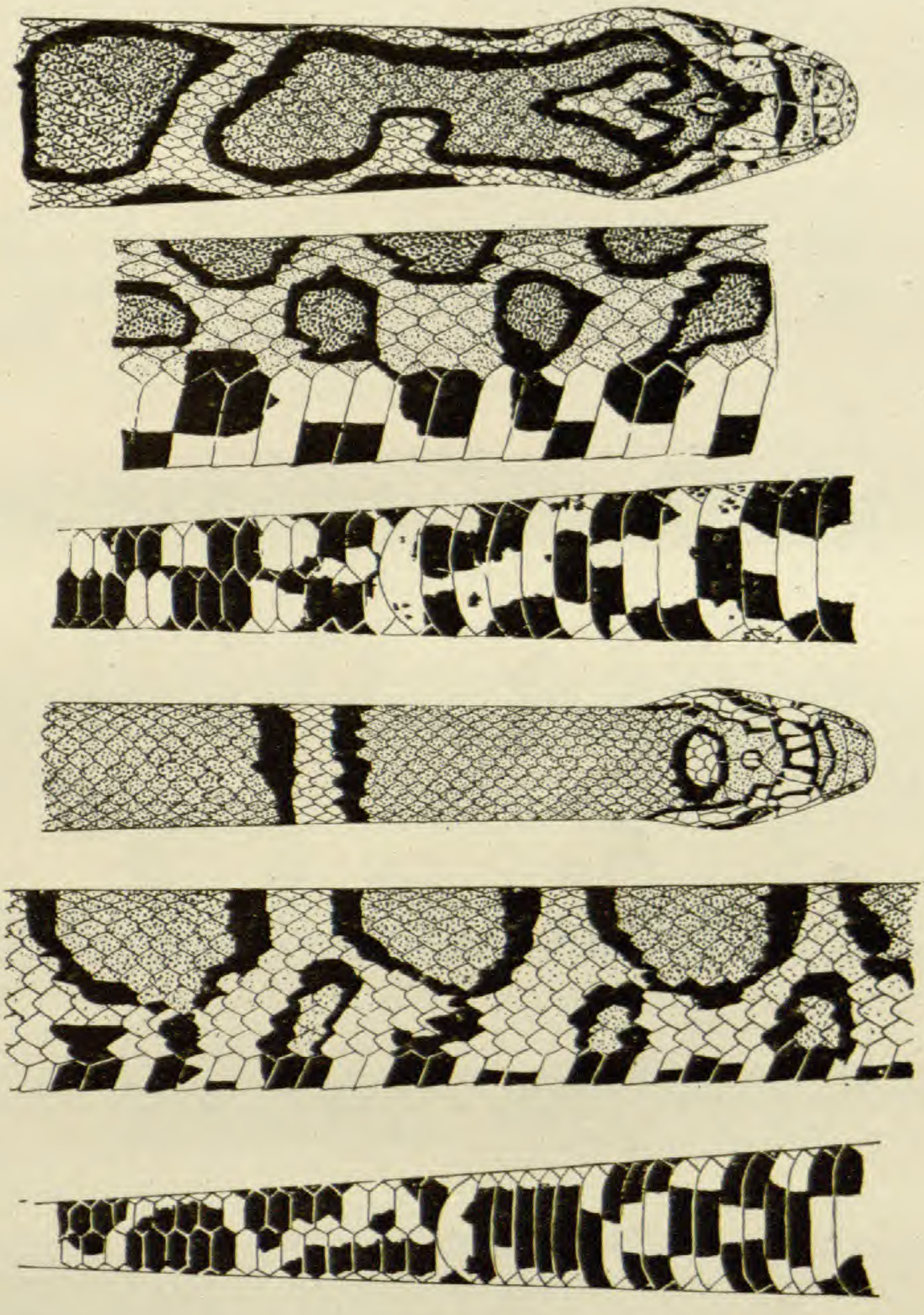


Fig. 1. *Ophibolus doliatus triangulus.*

Fig. 2. *Ophibolus doliatus clericus.*

PLATE XXV.

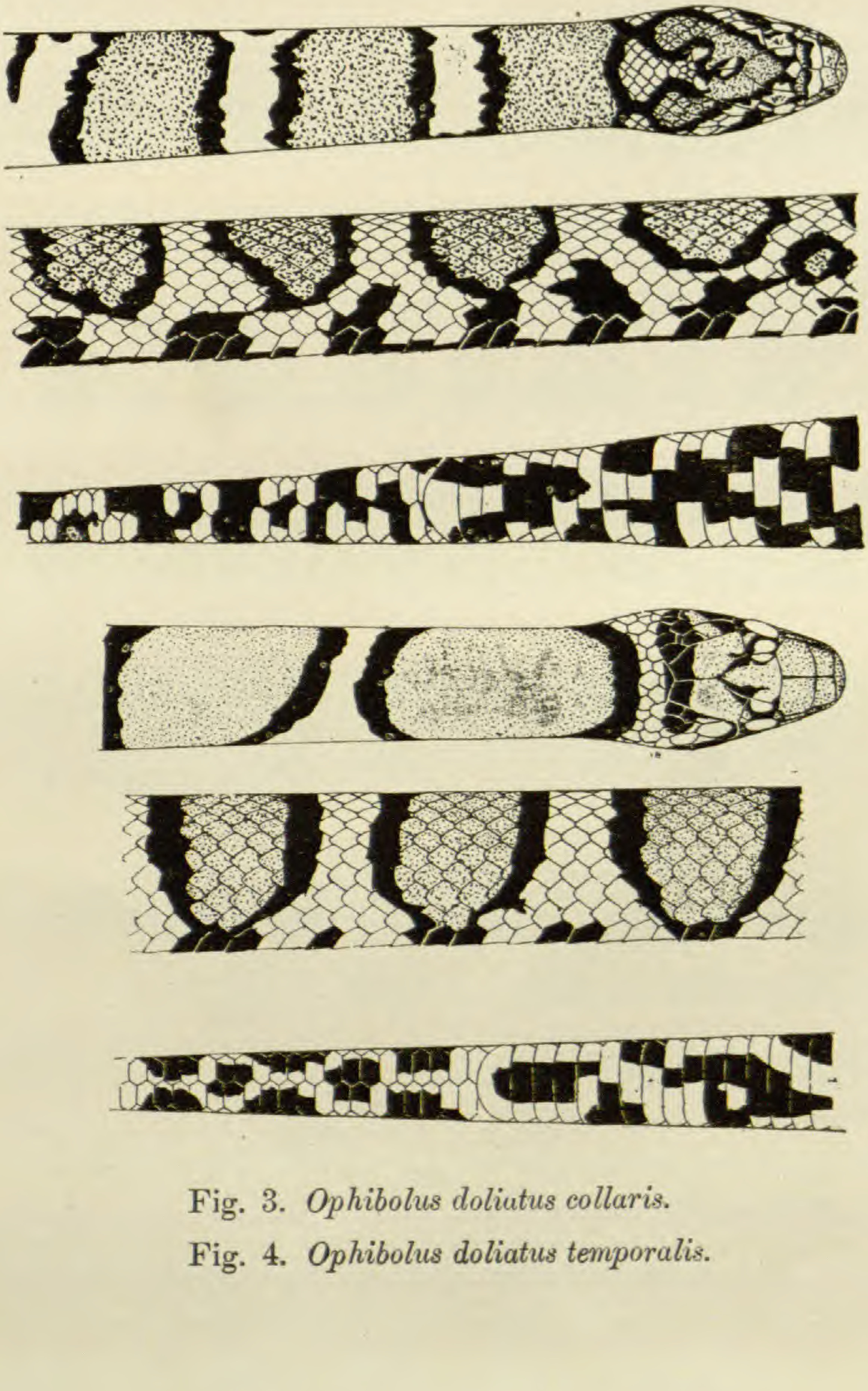
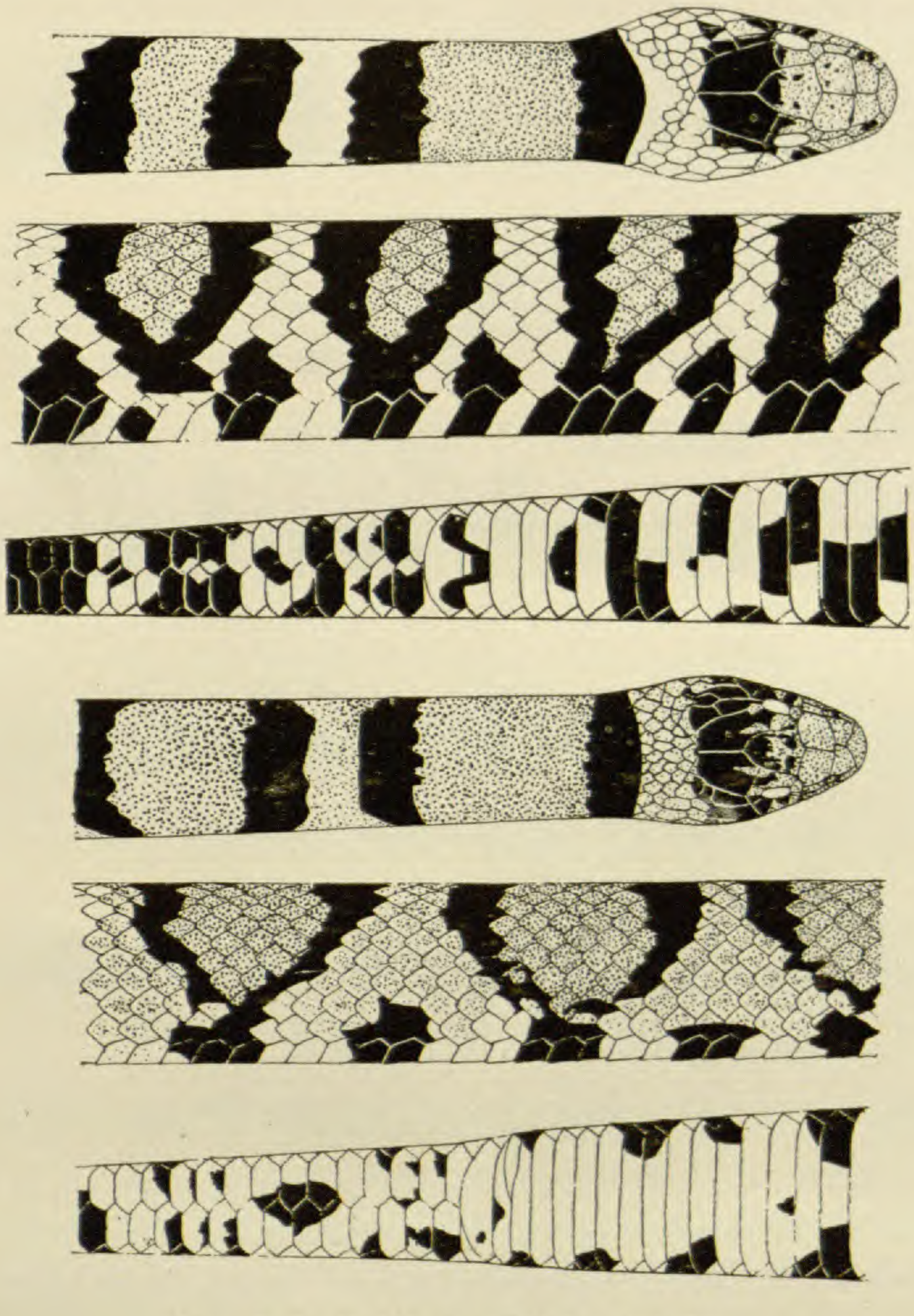


Fig. 3. *Ophibolus doliatus collaris.*

Fig. 4. *Ophibolus doliatus temporalis.*

PLATE XXVI.



Figs. 5–6. *Ophibolus doliatus doliatus.*

PLATE XXVII.

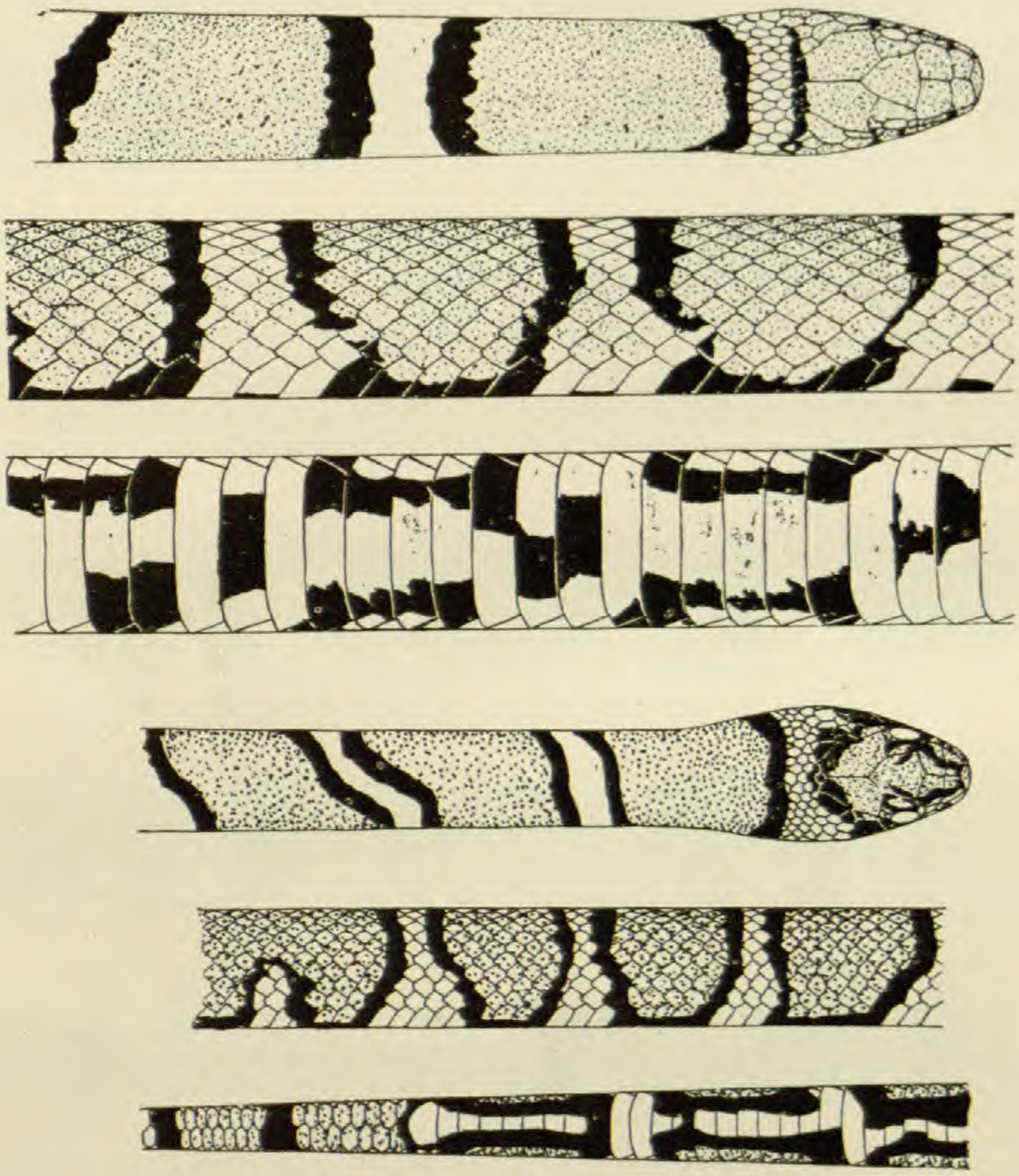


Fig. 7. *Ophibolus doliatus syspilus.*

Fig. 8. *Ophibolus doliatus parallelus.*

PLATE XXVIII.

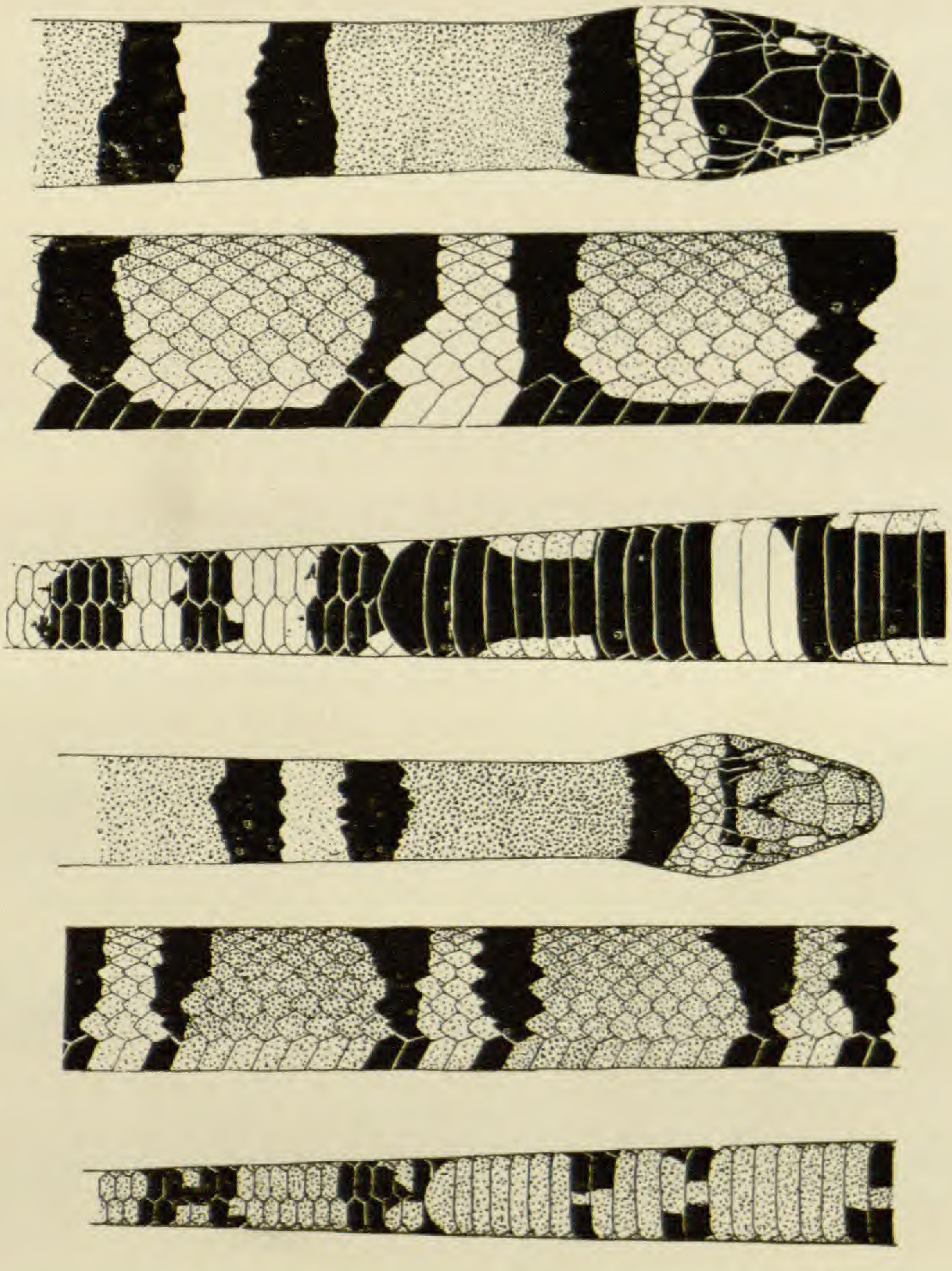


Fig. 9. *Ophibolus doliatus annulatus.*

Fig. 10. *Ophibolus doliatus coccineus.*

to accomplish the impossible task. Suppose for a moment that the various commissions were able to kill every moth except one pregnant female, and were then to rest from their labors. In a few years matters would be as bad as before. The Massachusetts commission have had nothing like such success. Their workmen have undoubtedly killed large numbers of these insects but each year shows the moth in a larger territory than it occupied the year before and extermination is no nearer than it was a dozen years ago. We do not wish to be understood as saying that the Gypsy Moth commission has done no good. It has checked the depredations as it can undoubtedly check them in the future. But this means, if the present methods are continued, a continual drain upon the treasury of the commonwealth which will only cease with that millennium which shall work a change in the morals of insects as well as of man.

In its future work the commission should employ as its head a trained entomologist who should devote his time, not to the hunting of Gypsy Moths in trees, hedge rows and garden patches, but in finding and introducing some natural enemy as has been so successfully done in the case of the Orange Vedalia in California. Moths, eggs, larvæ and cocoons will escape the most careful of field agents, but insect parasites will keep the pest in continual check and render the employment of an army of expensive workmen unnecessary.—K.

The numbers of the American Naturalist for the year 1893 were issued at the following dates, January, Jan. 11th ; February, Feb. 4th ; March March 8th ; April, April 5th ; May, May 25 ; June, June 15th ; July, July 24th ; August, Aug. 25th; September, Sept. 30th ; October, Oct. 31st ; November, Nov. 24th, December, Dec, 13th.

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RECENT LITERATURE.

Piersol's Histology.[1]—This text-book requires more than a passing notice. The four hundred illustrations, with the exception of a little over ten per cent. of them, are from original drawings by the author, and give to the book an air of originality that is refreshing.

This book is the only American Manual of histology that has yet been published that meets the requirements of modern methods of teaching. It is not overburdened with accounts of methods and descriptions of laboratory appliances, too numerous to be brought into an elementary course. About twenty pages at the close of the volume, are given up to the discussion of the best standard method of fixing, mounting, staining and embedding, that are used in histology, without giving a bewildering lot of detail that is more calculated to appal than to inform the beginner.

This course seems to the writer a rational one, and is a feature that will especially commend the book to students, who wish to get an actual working knowledge of histology.

The descriptive part is full, without being burdened with detail that is of no essential use to the beginner in acquiring an elementary knowledge of the subject. The important tissue-structures and relations of tissues, are indicated in the text with heavy-faced type, so that the student has before him the important points indicated to him by catch-words.

Without pretending to be a treatise on embryology, the subject of the development of the tissues and tissue-elements is dealt with fully enough for the purposes of a text-book especially intended for medical students. The original figures are derived very largely from preparations made from the human subject and the book, therefore, has an added value, from the fact that it is a new contribution to the iconography of the subject.

Sufficient attention is given to the most recent developments in cytology and in the histology of the nervous system, in both of which great recent advances have been made to bring it up to modern requirements. The volume is well gotten up and altogether reflects much credit upon the successor of Professor Leidy, who was, it may not be generally known,

[1] Text-book of Normal Histology, including an account of the development of the tissues and of the organs. By George A. Piersol, M. D., Professor of Anatomy, University of Pennsylvania. 8 vo, pp. 439, with 409 illustrations in the text. Philadelphia, J. B. Lippincott & Co., 1893.

the editor and translator of one of the very earliest text-books published in America on the subject of histology. That the successive occupants of the chair of Anatomy in the University of Pennsylvania should have taken such an important share in fostering the development of histological study in America, should be a matter of pride to all who are interested in scientific and educational progress.—R.

First Annual Report for 1892, Iowa State Geological Survey.[2]—A quarto volume of 474 pages containing the administrative reports, and accompanying papers illustrated by a number of maps and sections, some of them colored, and a number of photo-gravures. Of these papers Mr. Charles Keys contributes three: (1) A summary of the present knowledge of the Geological formations of Iowa; (2) An Annotated Catalogue of Minerals; (3) A Bibliography of Iowa Geology arranged in the form of a dictionary catalogue. The remaining three embody the observations of Mr. S. W. Beyer on the Ancient Lava Flows in the Strata of Iowa, Mr. H. F. Bain's studies of the Distribution and Relations of the St. Louis Limestone in Mahaska County, Iowa, and notes on Niagara Lime-burning Dolomites and Dolomitic Building Stones of Iowa by G. L. Houser.

The Paleozoic Group of Georgia.[3]—Dr. J. W. Spencer's report on the work of the Geological Survey of Georgia is confined to a detailed statement of the geology and economic resources of the Paleozoic Group developed in the northwestern Counties of Georgia. Under the head of Geology, the author gives the general characters of the systems of this group as exemplified in the region under discussion, the recent formations and evolution of northwestern Georgia, the physical features of the country underlaid by Paleozoic rocks, and the local geology of the different countries embraced in the Paleozoic belt. Under Economic Resources the distribution and modes of occurrence, and the character of red and brown iron ores, manganese and aluminum ores, coals,building and paving materials, variability of soils, and water-powers of the country are set forth. In the closing chapter Dr. Spencer gives a bibliography of Georgia geology and a statement of the progress of the survey.

The report is illustrated by 10 plates, 34 cuts, and a geological map.

[2] Iowa Geol. Survey, Vol. I, First Annual Report for 1892, with Accompanying Papers, Des Moines, 1893.

[3] The Paleozoic Group. The Geology of Ten Counties of Northwestern Georgia and Resources. By J. W. Spencer, A. M., Ph. D. F. G. S. (L. and A.) Report of the Geographical Survey of Georgia, Atlanta, 1893.

The Mesozoic Echinodermata of the United States.[4]—This volume, Bulletin No 97 of the U. S. Geological Survey, is the first of a series of reports on American fossil Echinoderms prepared by Dr. William B. Clark. It comprises a systematic review of the Mesozoic Echinodermata of the U. S. in which descriptions of moderate length are accorded the different species; a complete bibliography of the subject; a table showing the geographical range of the American species; and catalogue of the specific names.

Fifty plates illustrate all the species accompany the report, and, according to the author they show many details of structure not recorded in the descriptive portion.

The Flora of the Dakota Group.[5]—This memoir in quarto form was in preparation by Prof. Lesquereux at the time of his death. It was, however, so nearly completed that it has been published with but slight changes from the original wording. The work is limited to the description of fossil plants represented by a large number of specimens obtained at different localities of the Dakota Group, especially in Kansas, and to the evidence derived from the character of the plants in regard to their origin, their relations, and their places in the history of the vegetation of the world.

The original manuscript embraced descriptions and figures of 350 species of plants, but before it could be published, extensive additional collections were made in Kansas. This new material was identified and described by Prof. Lesquereux, and incorporated in the monograph. It added 110 species to the list, making in all 460 species now known from the Dakota Group.

The drawings which accompany the work are life size and occupy 66 plates.

A short account of the life and work of Prof. Lesquereux is given by the Editor in his preface.

Fritsch's Fauna of the Gaskohle of Bohemia.[6]—The important fauna of the Permian formation receives further illustration from the parts of Dr. Fritsch's great work last issued. The first and second

[4] Bulletin of the United States Geol. Surv., No. 97. The Mesozoic Echinodermata of the United States. By William Bullock Clark, Washington, 1893.

[5] Monographs of the U. S. Geol. Surv., Vol. XVII. The Flora of the Dakota Group. A Posthumous Work by Leo Lesquereux. Edited by F. H. Knowlton, Washington, 1892.

[6] Fauna der Gaskohle und Kalksteine der Permformations Böhmen's, von Anton Fritsch; Band II, H. 4, 1889 and Band III, Hefts 1 and 2, 1890, 1893. Prague.

parts now under review are occupied with the Ichthyotomous Elasmobranchii, while the third contains the Acanthodian Elasmobranchs and the Teleostomi of the superorder Actinopterygia.

The descriptions of Ichthyotomi cover several species which the author refers to three genera under the names Orthacanthus Agass. Pleuracanthus Agass. and Xenacanthus Goldfuss. The material at Dr Fritsch's disposal is excellent, and he elucidates thoroughly the structure of the fins of all these forms, and is able to identify the spines and teeth of the different species. We are enabled through the kindness of Dr. Fritsch to give a figure of the *Xenacanthus dechenii* from his work. Thanks to his labors the greater part of the skeleton of these remarkable forms is now well known. There remains some doubt whether the forms distinguished as different genera do not belong to a single genus, as the characters pointed out by Dr. Fritsch to be distinctive in the spines and teeth seem to be specific rather than generic, as has been already argued by Mr. Smith Woodward. If the divided terminal rays of the paired fins of *Xenacanthus dechenii* are not dermal, and only absent from the fins of the other forms by accident, as appears to be the case, then Xenacanthus must be regarded as a genus distinct from the other forms. Dr. Fritsch does not adopt the order Ichthyotomi, but his reasons for this course are not clear.

The subclass Teleostomi is adopted by Fritsch, who states that he does not regard the division of "Ganoidei" as well founded. In this he is in accord with views which I have advocated since 1871, in the face of almost universal opposition. I can only say that paleontologic discovery has long since demonstrated the correctness of this position, and its general acceptance cannot be long delayed. Fritsch remarks that Smith Woodward adopts my order of Ichthyotomi with a new definition, as though it were the division proposed by Cope. But he is evidently not aware that I redefined the order, on the basis of the discovery of the fin structure by Sauvage, in a synopsis of the Families of Vertebrata published in the AMERICAN NATURALIST for Oct., 1889, with which the later definition of Woodward in the Catalogue of Fishes of the British Museum (1891) nearly agrees.

The only form of Actinopterygian fish described, is the genus Trissolepis, which is referred to the Chondrostei. It possessed a raptorial dentition of acute teeth, and scales of both ctenoid, cycloid and ganoid forms, the last on the caudal region only. The following figure from Fritsch's work represents this interesting form.

Of Acanthodii, species of the genera Traquairia, Protacanthodes, and Acanthodes are described; the first two genera being new to science.

Machaeracanthus is also referred tothis order. The author accepts the reference of the Acanthodii to the Elasmobranchii.

Dr. Fritsch makes the important discovery of the scales of Ceratodus, which resemble those of the existing species.

The present work is the most important one of modern times in the amount of light which is thrown on the structure of the primitive fishes.—E. D. COPE.

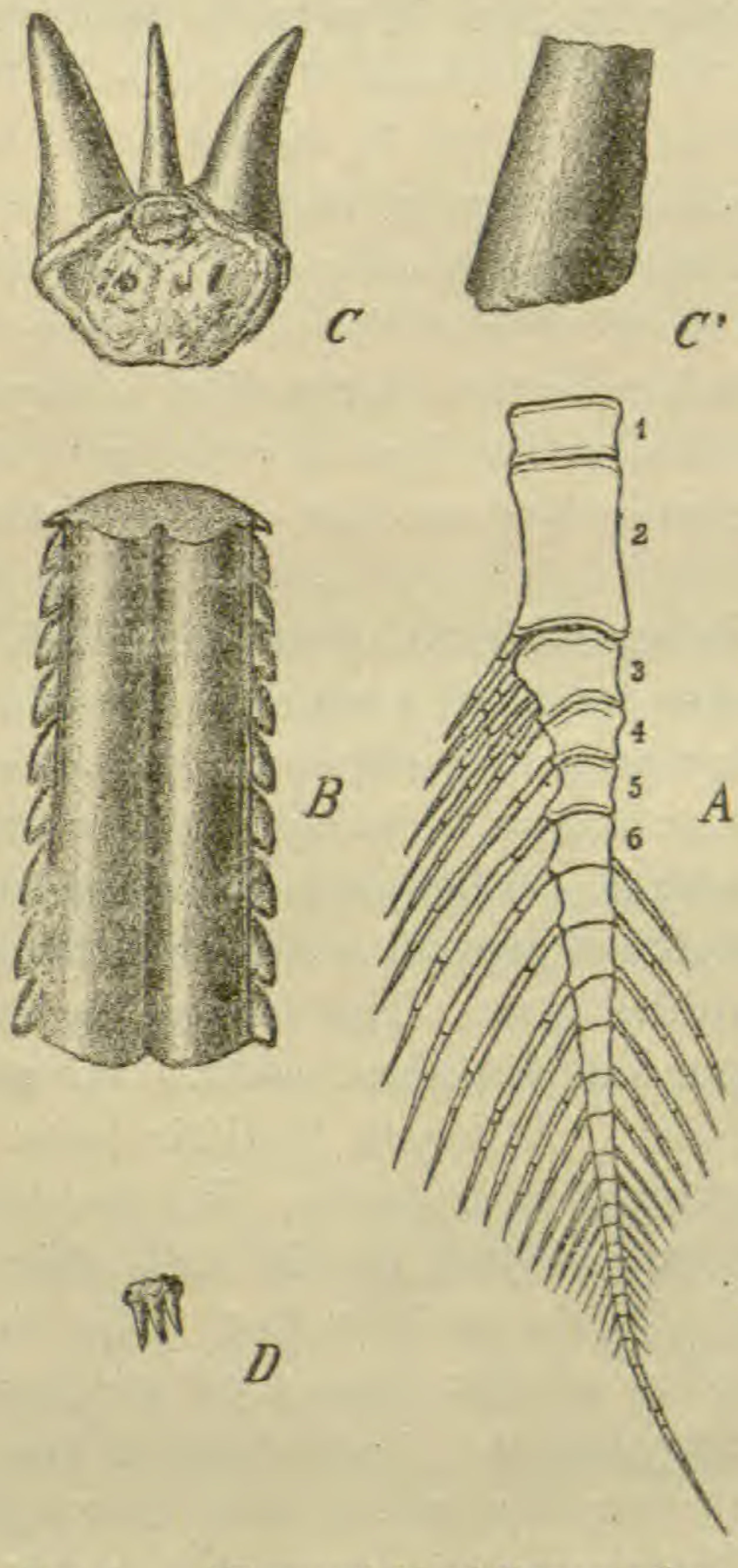


FIG. 1.—*A* Pectoral fin of Xenacanthus (Pleuracanthus). *B* Cephalic spine. *C* Tooth; *C'* Tooth magnified. *D* Gill prickles; all of Xenacanthus (Pleuracanthus).

EXPLANATION OF PLATES.

Plate XXIX. *Xenacanthus dechenii* Goldf; from Fritsch.
Plate XXX. *Trissolepis kounoviensis* Fritsch; from Fritsch.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Mud Avalanches in the Mustagh Mountains.—During a recent exploration in the Mustagh Mountains in India, Mr. W. M. Conway noticed the accumulation in the valleys, of debris consisting of stones as often rounded as angular, embedded in mud. In the Gilgit valley this accumulation reaches a depth of 1000 feet or more. The author claims that the work of filling up the valleys, not only in the Mustagh Mountains but all the deeply filled valleys characteristic of the Central Asian plateau, has been done by mud avalanches, and he gives the following interesting account of one of which he was an eye witness.

"We were just approaching the mouth of a deep, narrow nala that crossed our path when we heard a noise as of continuous thunder, and beheld a vast black wave advancing down it at a rapid pace. Some accumulation of water had got loose high aloft, and the flood was bringing the hill down with it. When we reached the edge of the nala the main mass of the stuff had gone by and only a thick, black stream of mud was rushing swiftly past. This became by degrees more liquid until it was no longer mud but black water. We waited for some time till the waters subsided. At length Harkbir found a way across the torrent by leaping from stone to stone. We had begun to follow him when Karbir, who was looking up the nala, shouted to us to come back, which we did with the nimblest feet. We were not more than out of the ditch before another huge mud avalanche came sweeping down. It was a horrid sight. The weight of the mud carried huge masses of rock down the gully, rolling them over and over like so many pebbles, and they in turn dammed back the muddy torrent and kept it moving slowly with accumulating volume. Each of the big rocks that formed the vanguard of this avalanche weighed many tons; the largest were about 10 feet cubes. The stuff that followed them filled the nala to a width of about 40 feet and a depth of about 15 feet. The thing moved down at about the rate of five miles an hour. When the front of the avalanche was gone, and the mass of stuff became shallower, the mixture was about half mud, half rocks, and flowed faster. Now and again a bigger rock than the average would bar the way; the mud would pile up behind it and presently sweep it on. Looking up the nala we could see the sides of it constantly falling in and their ruins carried down. Three times did the nala yield a frightful offspring of this kind, and each time it found a new exit into the main river below, and entirely changed the shape of the fan. The third avalanche was the largest of all, and fortunately left a causeway of stones, reaching almost across the nala, at our very feet. Some big fall must have presently taken place higher up and dammed back the waters, for the stream ran almost dry and we were enabled to cross the gully without difficulty.

"Assuming that one of the avalanches we saw travelled at the rate of only 7 miles an hour=200 yards a minute, and took only 7 minutes to pass any point, it would be 1400 yards long. Call its average width 8 yards, and average depth 2 yards, it would consist of over 10000 cubic yards of stuff. Suppose three-fourths of this to have been water, you get 2500 cubic yards of débris discharged by one of these avalanches, and we saw three come down a single gully, where others had fallen before we arrived and others fell after we left. 15000 cubic yards is a low estimate for the fall of that one day down that single and relatively small gully. One gully of this sort to every mile of valley is a minimum computation. It is easy to see then what a powerful element mud avalanches must be in determining the physical features of this region of the earth." (Geog. Journ., Oct., 1893.)

Cladodont Sharks of the Cleveland Shale.—The fossil sharks recently discovered in the Cleveland shale are of especial interest and importance because they show definitely the form of structure of these early Elasmobranchs. Professor E. W. Claypole has made them the subject of a paper in the American Geologist, May, 1893. The material now at hand represents four species of *Cladodus*, and two of *Monocladodus*. These genera are closely allied, but the absence of lateral denticles, in the opinion of the author, marks a generic difference. *M. clarkii* is distinguished by the fact that the teeth stand in pairs, one close behind the other. *M. pinnatus* is represented by a single specimen which is unique from the great strength of the ventral fins, whence comes its specific name. Both of these species are figured, together with *Cladodus sinuatus*, *C. clarkii*, and *C. rivi-petrosi*. Professor Claypole gives also an amended description of Newberry's *C. replerii*. The genus *Monocladodus* is very near to, if not identical with *Styptobasis* Cope.

The Neocene Sierra Nevada.—The observations recorded by Mr. Waldemar Lindgren in a paper on Two Neocene rivers of California appear to prove conclusively (1) that the Sierra Nevada in Neocene times, in the watersheds of the Yuba and American rivers, formed a mountain range as distinct as that of to-day, and that its first summit in general, coincided with the corresponding modern divide; (2) that the slope of this range has been considerably increased since the time when the Neocene ante-volcanic rivers flowed over its surface; (3) that the surface of the Sierra Nevada has been deformed during this uplift, and that the most noticeable deformation has been caused by a subsidence of the portion adjoining the great valley relatively to the middle part of the range. (Bull. Geol. Soc. Am., June, 1893.)

Geological News. Paleozoic.—In Notes on some Devonian plants from New York and Pennsylvania, Mr. Penhallow describes a new species, which he refers to the genera *Haliserites, Dictyotites* (gen. nov.) and *Psilophyton.* From the data afforded by these plants the author gives a fresh definition of the characters which distinguish *Haliserites* and reintroduces the *Dictyotites*, once used by Brongniart, but which had been abandoned by authors. (Proceeds. U. S. Natl. Mas., Vol. XVI, 1893.)

Mr. C. S. Prosser calls the attention of geologists to lists of fossils from eastern New York and Pennsylvania, with statements of their stratigraphic position, which show that the fossiliferous zone underlying the Oneonta sandstone in Chenango and Otsego counties, New York, is not the top of the Hamilton but belongs to the Portage stage. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

A new fossil sponge has been found in the shales of the Quebec group at Little Metis, Canada. It was probably of sac-like form and about 14 inches in diameter. Its walls consist of rhombic meshes made up of delicate spicules loosely twisted together and apparently branching at the angles. This sponge is the largest and most complex yet found in formations of so great age. Dr. Hinde proposes to place it in the new genus, *Palæssaccus.* (Bull. Geol. Soc. Am., Sept., 1893.)

Mesozoic.—In a contribution to the invertebrate paleontology of the Texas Cretaceous Mr. F. W. Cragin describes 151 species, of which 1 Cœlenterate, 17 Echinoderms, and 86 Molluscs are either new species or varieties. This collection belongs to the Museum of the Texas Geol. Surv. and comprises the Cretaceous fossils accumulated during the field work of four years. (Fourth Ann. Rept., Texas Geol. Surv. for 1892.)

The recent figures and descriptions of European Pterodactyls published by Professor Seeley have satisfied Mr. S. W. Williston that the generic characters of Pteranodon Marsh are included in those of Ornithostoma Seeley, and he accordingly states that the Kansas species hitherto placed in the genus Pteranodon may now be known under the earlier generic name of Ornithostoma, and the family as the Ornithostomatidæ. (Kansas Univ. Quart., Oct., 1893). In this same publication Mr. Williston gives a life size restoration of *Clidastes velox* Marsh based upon an unusually complete specimen of this Mosasaur from western Kansas.

Two new species of invertebrates *Ostrea munsonii* and *Radiolites davidsonii*, from the Caprina limestone of Texas are figured and described by Mr. R. T. Hill. In a preface to the descriptions the author states that this formation is of great interest from the fact that in it we have all the species of the aberrant Chamidæ and Rudistes known to occur in the United States, with the exception of Coralliochama of California and the *Radiolites austinensis*, forms common in the Upper Cretaceous of Alabama, Texas and Colorado. (Proceeds. Biol. Soc. Wash., 1893.)

Mr. W. M. Fontaine's examination of the collection of fossil plants from the Trinity division of the Comanche series of Texas results as follows: Equisetum, 1 sp. nov.; Ferns 1; Cycads 7, of which 1 is new; Conifers 10, 4 new, uncertain 4, of which 3 are probably new. The author considers the plant bearing portion of the Trinity to be somewhat older than the basal Potomac strata, but the difference in age is not great. (Proceeds. U. S. Natl. Mus., 1893.)

A small collection of fossil plants from the Kootanie group of Great Falls, Montana, has been examined by Mr. Fontaine. The specimens show nothing but ferns, conifers and one Equisetum. The conifers are badly preserved. Of the 9 ferns 5 are new, descriptions of which are given in the Proceeds. U. S. Natl. Mus., Vol. XV with plates. Cycads are rare in the Great Falls flora, none being found in the collection examined. The one figured in the paper mentioned under the name *Zamites montanensis*, was obtained from this field by Mr. Williams, and is described by Mr. Fontaine from a drawing. This collection confirms Dr. Newberry's conclusions that the Potomac group, the Great Falls group, the Kootanie group of Canada, and the Kome group of Greenland are all of the same general age.

Cenozoic.—In studying the Finger Lakes of Western New York, Mr. A. P. Brigham concludes that the basins are a composite resultant of valley erosion, glacial scoop, and drift barriers, with perhaps a slight element of orography. The deepening of the lakes to the southward is the result of the narrowing of the ice between contracting valley walls which increases the vertical pressure and hence intensifies the erosion. (Bull. Am. Geog. Soc., 1893.)

In a review of the knowledge of the paleolithic man in North America M. Boule remarks that the recent work of Mr. Holmes does not invalidate the discoveries of paleolithic objects in America, and particularly those of Dr. Abbott, which M. Boule considers to be "true finds" in every sense of the word.

It is suggested by Mr. F. W. Hutton that the Ostriches of Africa and South America have orginated in the Northern Hemisphere possibly as swimming birds—and the Gastornithidæ, which have relations with the Anatidæ, may be their ancestors. (Proceeds. Austral. Assoc. Adv. Sci., 1892.)

According to Dr. Du Riche Preller, the Engadine Lakes owe their origin to the subsidence or dislocation of the old divide of the Inn and Bargalia systems, and the consequent deflections to the south of the original Inn sources. From a powerful Alpine torrent the Inn was reduced to a small stream without sufficient volume or fall to carry away the deposits brought down by lateral torrents. These deposits accumulated and thus the lakes were formed by the weakened river being banked up at various points. (Geol. Mag., Oct., 1893.)

From the evidence of marine fossil shells in the Bowlder Clay on the Bay of Fundy just west of Saint John harbor, Dr. Robert Chalmers concludes that the height of the land on this part of the Bay during the Glacial period must have been 100 to 200 feet lower than at the present day, relatively to the sea. Also since the striæ on the rocks underneath the bowlder-clay indicate several ice movements varying in direction from S. 2° W. to S. 65° E. the formation of the lower bowlder-clay cannot all be due to one body of ice. (Bull. Geol. Soc. Am., 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Schists of Southern Berkshire, Massachusetts.— The sericite schists of southern Berkshire Co., Massachusetts, and northern Litchfield Co., Conn., contain phenocrysts of feldspar, garnet, staurolite, tourmaline, biotite, and ottrelite, imbedded in an aggregate of feldspar, quartz and sericite, which contains, besides the phenocrysts, a large number of metamorphic minerals. The large feldspars are often filled with secondary granophyre, and this mineral, the garnet and the tourmaline, are frequently built out by secondary enlargements. The core of the feldspar is so often bounded by crystal outlines that Hobbs[2] regards the mineral as having resulted from the recrystallization of the clastic grains of the original rock. The garnets, in addition to their peripheral enlargements, are often possessed of a rim of staurolite and magnetite crystals, supposed to be the product of reactionary action between the garnet and the surrounding minerals. The author believes the phenocrysts to have been developed by static metamorphism (simple pressing) from the constituents of a fragmental rock.

The Phonolytes of the Hegau.—The phonolytic rocks of the Hegau, Eifel, Germany, so well-known because of the beauty of their hauyne constituents, have been subjected to a comparative study by Cushing and Weinschenk,[3] who find them not all phonolites, as they have heretofore been regarded. The essential characteristic constituents of the group are sanidine, nosean, hauyne, nepheline, leucite, augite and aegerine, and the accessories, biotite, apatite and zircon. All the rocks are more or less porphyritic, with sanidine and the members of the hauyne group in two generations. Of the latter the larger crystals and those of the first generation are hauyne; the smaller, those of the second generation, nosean. The former are always more or less altered into zeolites, while the latter are usually fresh. Contrary to the general statement made with regard to these two minerals, the hauyne is not always blue nor the nosean colorless, but rather is the opposite the case. An important discovery made during the investigation is to the effect that nepheline is by no means common

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Bull. Geol. Soc. Amer., Vol. IV, p. 167.
[3] Minn. u. Petrog. Mitth., XIII, p. 18.

in the Hegau rocks. In a few of them the mineral is abundant in the usual form. In others it is only sparingly present, while in still others it is absent so far as could be learned. Consequently, the rocks fall into several classes. The Hohentwiel occurrences are of nosean-phonolites, in which nosean is abundant in the groundmass and nepheline absent. The specimens from Mägdeberg and Schwindel are nosean-ophyres (corresponding to the leucitophyres), in which nosean and nepheline are both present. At Staufen, two types were found, one a leucite-phonolite, and the other a true phonolite (nepheline-phonolite). The rock of Gonnersbohl is a hauyne-bearing trachyte or a trachytic phonolite. Each of these types is briefly described, and at the conclusion of the paper a few pages are devoted to an account of the tufa associated with them.

The Rock of a New Island, off Pantelleria.—An island, measuring one kilo. in length, and two hundred metres in width, was projected above the water off Pantelleria during the earthquake week beginning Oct. 14, 1891. The new island is an aggregate of loose blocks and solid lava, whose characteristics have been described by Foerstner.[4] The material in his possession was mainly a black pumi-

[4] Minn. u. Petrog. Mitth., XII, 1892, p. 510.

ceous basalt of the composition:

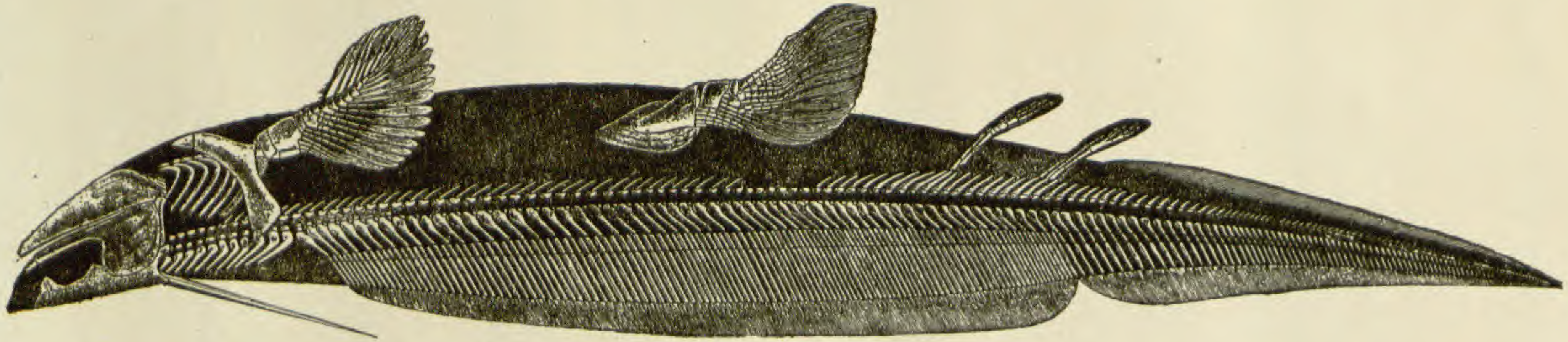
SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Feo	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total
44.64	5.86	12.74	4.21	11.17	.20	10.12	5.82	1.41	4.31	.51	=100.99

Attention is called to the large quantity of TiO_2 revealed by the analysis. Under the microscope the groundmass of the rock is seen to be a dark glass filled with highly colored microlites, and enclosing phenocysts of anorthite, olive-green augite, olivine and magnetite. The glass is sometimes in large quantity and at other times is present only in traces. The rock is a tachylitic basalt like that of Pantelleria and the other neighboring islands.

Petrographical News.—The pyroxenite of Duerne, Dept. of the Rhone, France, is an aggregate of orthoclase, pyroxene, oligoclase, garnet, and quartz. The structure of the rock varies from pegmatitic to granular. Its pyroxenic component is described by Gonnard[5] as light green in color, and as often possessing crystal outlines. It includes within its mass many crystals of sphene. Druses of vesuvianite line the walls of crevices in the rock, and galena is not an uncommon constituent of tiny veins traversing it.

[5] Bull. Soc. Franc d. Min., XV, p. 232.

PLATE XXIX.



Xenacanthus dechenii Goldf.

In the northern Hardt Mountains, near Obbersweiler, Waldhambach and the neighboring regions, are biotite and hornblende gneisses that are probably squeezed granites, schists and graywackes, altered by an intrusive biotite granite and cut by other granites, a kersantite dyke cutting the intruded granite, and a sheet of quartz melaphyre overlyng all these as a lava flow, the whole comprising the mass of the mountains. All these rocks Leppla[6] discusses in a recent article, describing the melaphyre as consisting of a groundmass of plagioclase and quartz enclosing phenocrysts of feldspar, red olivine pseudomorphs, quartz and bastite. The quartzes are all surrounded by aureoles of augite, just as are the quartz inclusions in many basic rocks.

In a monograph in the Kaiserstuhl in Baden, Knop[7] gives a general view of the geology, mineralogy and chemistry of this interesting volcanic region, in addition to statements concerning its hydrography, botany, history, etc. All the minerals known to the region are described at considerable length, and over a hundred and fifty pages of the book are devoted to descriptions of its interesting rocks, phonolites, andesites, tephrites, basanites, basalts, limburgites among the volcanics, and several others of sedimentary origin. The author treats the hill as an old volcano, and attempts to explain the variety in its products upon the Bunsen theory of mixed magmas.

A two-mica gneiss[8] constitutes the principal rock of the Valley of Miñor, Provice Pontevedra, Spain. On the peninsula of Santa Marta it is cut by a diabase with faintly pleochroic augite. At Monte Galeñeiro the micaceous gneiss is replaced by a hornblendic variety in which the prominent amphiboles are glaucophane and a green variety opaque to light vibrating parallel to *c*.

Chelius[9] describes very briefly several occurrences of nepheline basalt from the Odenwald, Germany, and records the analyses of the red gneiss of Steinkopf, of the dark biotite gneiss of Bockenrod, of basalt from the Häsengebirg near Urberach, of granite from the Melibocus massiv, and the results of silica and specific gravity determinations of many other rocks from the same region, among which may be mentioned malchite and alsbachite.

[6] Zeits. d. deutsch. geol. Ges., XLIV, p. 400.

[7] Der Kaiserstuhl in Breisgau. Ein naturwissenschaftliche Studie von Dr. A. Knop. Leipzig. W. Engelmann, 1892, p. 538 and fig. 89.

[8] Quiroga: Actas d. l. Soc. Esp. d. Hist. Nat., XXI, 1892, pp. 4 and 8.

[9] Notizbl. d. Ver. f. Erdk. Darmstadt., IV, 1891, H. 12.

Though the parallel growths of augite and hornblende, with the latter mineral surrounding the former, are common, the reversed phenomenon is rare. Hobbs,[10] however, has recently pictured an example of light green amphibole completely encircled by colorless augite from an augite-hornblende rock occurring at New Marlboro, Mass.

Analyses of American Minerals.—Several analyses of dodecahedral crystals of *aguilarite* from Guanajuato, Mexico, have been made by Genth and Penfield.[11] That from the purest material gave: Ag = 84.40 % ; Cu = .49 % ; S = 11.36 % ; Se (diff) = 3.75 %. The mineral is thus an argentite with an eighth of its S replaced by Se. *Metacinnabarite* particles disseminated through barite from San Joaquin, Orange Co., Cal., gave the same authors: Hg = 85.89 % ; S = 13.69 % ; Cl = .32 %. The mineral supposed to be *leucopyrite*,[12] from Alexander Co., N. C., is *lollingite*, whose composition is Fe = 70.83 ; Cu = tr ; As = 27.93 % ; S = 77 %. *Rutile* crystals with the habit of cassiterite are found in the quartz decomposition products of the orthoclase from West Cheyenne Cañon, El Paso Co., Col. They are iron black with a density of 4.249, and the composition: SnO_2 = 1.40 ; TiO_2 = 91.96 ; Fe_2O_3 = 6.68. The *quartz* decomposition products referred to yield, upon analysis:

SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	Loss		Total
96.63	.93	.85	tr.	.46	.95	=	99.82

Pieces of a large *danalite* crystal from the same locality, give:

SiO_2	BeO	CuO	ZnO	FeO	MnO	S.	Loss	Total—O
30.26	12.70	.30	46.20	6.81	1.22	5.49	.21	100.41

The danalite is associated with quartz, astrophyllite and a new yttrium calcium fluoride with a hardness of 4 and a density of 4.316. Its composition is: CaO = 19.41 ; $(Yt\,Er)_2O_3$ = 47.58, etc. The other minerals whose analyses are recorded by the authors, are: altered zircon (*cyrtolite*) from Mt. Antero, Col. ; *lepidolite*, from Tanagama Yama, Japan, and *fuchsite*, from Habershaw Co., Ga. The analyses of the lepidolite and fuchsite follow:

[10] Sci., Dec. 23, 1892, p. 354.

[11] Amer. Jour. Sci., Nov., 1892, p. 381.

[12] Bull. U. S. Geol. Survey, No. 74, p. 26.

	SiO_2	Al_2O_3	F_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O	H_2O	Fl	Cr_2O_3	CuO
L.	53.34	17.76	3.25	2.77	.05	.37	4.60	1.55	10.90	.65	7.78		
F.	46.73	29.00	2.59		3.03			.26	9.25	6.04		2.73	.14

Among some analyses[13] made in the laboratory of the University of Virginia are the following, which are of interest to mineralogists: *Cuproplumbite* from Butte City, Montana, analysed by De Bell, gave: Cu = 61.32; Pb = 18.97; S = 17.77; quartz = 1.58; corresponding to 5 Cu_2 S. Pb S. *Calamine,* from New River, Wythe Co., Va., yielded Jones: SiO_2 = 25.33; ZnO = 67.15; H_2O = 7.47; Total = 99.95. *Parantite,* from a pocket in a corundum vein of the Hiawassee Corundum mine, Hayesville, Clay Co., N. C., is associated with decomposed albite and various chlorites. It is in rounded blue-gray lumps, having a density of 2.75. Analysed by Berkeley, it gave:

SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total
47.54	34.03	17.23	1.82	1.02	= 101.64

North American Minerals.—Remarkably large crystals of *seleeuite* have been found by Talmage[14] in the drainage area of one of the side cañons of the Tremont River, Wayne Co., Utah. Gypsum in seams cuts through the sandstone and argillite of the region in great profusion. The largest crystals of the minerals were in a geode-like cave, left exposed as a hollow mound in the slope of a hill. The interior of the cave was studded with great columns and slabs, extending from its sides sometimes to a distance of 51 inches. Many of the crystals are transparent throughout their entire length.

Fairbanks[15] describes the *rubellite* and *lepidolite* of southern California as occurring in a pegmatite vein cutting norite near Pala, west of Smith's Mt, San Diego Co. Besides the feldspar and the quartz there are associated with the two minerals above mentioned: muscovite, hematite, and green and black tourmalines.

A few very fine *datholite* crytals from the Lacy Mine, Loughboro, Ontario, have been measured by Pirsson.[16] The manner of their occurrence is not certainly known, but they appear to be in a vein penetrating an eruptive rock. The crystals are described as the finest yet

[13] Amer. Chem. Jour., Vol. XIV, 1892, p. 620.
[14] Science, XXI, 1893, p. 85.
[15] Ib. XXI, p. 35.
[16] Amer. Jour. Sci., Feb., 1893, p. 100.

found in America. They are transparent, yellowish, and in size the largest measure 3 x 2.5 x 2 cm. Their habit is prismatic parallel to *a*, and each individual is bounded by many faces.

In and upon calcite crystals lining some of the geodes of Keokuk, Iowa, Keyes[17] announces the discovery of very handsome tufts and radiating masses of *millerite*.

Beds of specular *hematite*, intermixed with *martite*, are reported by Hill[18] as abundant at the junction of diorite and limestone in many localities within the State of Coahuila, Mexico.

Physical Properties of Minerals.—A series of new determinations of the specific heat of *boracite* at different temperatures is reported by Kroeker.[19] The materials experimented upon were four transparent crystals from Linneberg, one piece being from a large crystal with a cubical habit, and the others fragments of dodecahedral crystals. In all cases it was found that the specific heat of the mineral varies with the temperature, and that the increment of variation increases rapidly between 250°–270°. Below 270° the cubic and the dodecahedral crystal gave similar results, above this temperature the results are different. For details of the experiments the reader must be referred to the author's paper.

Two articles of interest to mathematically inclined physical mineralogists are the one by Pockels[20] on the changes effected in the optical characterists of *alum* and *beryl* by pressure acting in a single direction, and the other, by the same author,[21] on the elastic deformation of piezo-electrical crystals in the electrical field.

Traube[22] finds that the following compounds, all of which form dextro-rotatory solutions, are hemi-morphic, viz.: $Sr(SbO)_2(C_4H_4O_6)_2$, $Pb(SbO)_2(C_4H_4O_6)_2$, and $Ba(SbO)_2(C_4H_4O_6)_2+H_2O$. All are also tetartohedral—the strontium and lead compounds being the first examples of hemimorphic tetartohedral substances crystallizing in the hexagonal system, and the barium salt the first instance among tetragonal bodies.

[17] Amer. Geologist, XI, p. 126.
[18] Amer. Jour. Sci. XLV, p. 111.
[19] Neues Jahrb. f. Min., etc., 1892, p. 125.
[20] Neues Jahrb. f. Min., etc., B. B. VIII, p. 217.
[21] Ib. B. B., VIII, p. 407.
[22] Ib. B. B., VIII, p. 269.

One of the micas[23] in the Mte. Dorè trachyte is an *anomite* with an optical angle of 41°. When treated with boiling hydrochloric acid it loses its greenish color, with the extraction of its iron and magnesium, and becomes less strongly doubly refracting. After an hour's treatment it becomes colorless and uniaxial, when its optical sign is negative.

Having examined seventy-one uniaxial minerals with respect to their heat conductivity, Jannetaz[24] finds that only five contradict his law that the major axis of the isothermal ellipsoid is parallel to the direction of the principal cleavage, and the minor axis normal thereto.

Instruments.—Laspeyres[25] describes a modification of the setting of the condenser above the polarizer of the microscope, that enables the observer to change rapidly from converged to parallel light, even when an object is being examined. The lower nicol is in its usual position. The condenser is imbedded in a metal strip set into the stage, and sliding easily in a groove prepared for it.

A goniometer with two circles, enabling the operator to measure nearly all the planes on a crystal with one adjustment of the latter, is explained in detail by Goldschmidt,[26] who also illustrates its use by several examples.

[23] Bull. Soc. Franc d. Min., XV, 1892, p. 97.
[24] Ib. XV, p. 133.
[25] Zeits. J. Kryst., XXI, p. 256.
[26] Ib., p. 210.

ZOOLOGY.

The Molluscs of the Water Mains of Paris.—M. Locard has made a study of the malacological fauna of the water mains of Paris as represented in the material now in the possession of the Geneva Museum. The author finds that the collection embraces 44 species referable to 13 genera. Among them are four new species, *Dreissensia paradoxa, D. curta, D. tumida* and *Amnicola lutetiana.* Neither Unios or Anodontas are found. The author attributes their absence to the absence of fish to which the larvæ of these species are in the habit of attaching themselves.

M. Locard notices four modifications of the molluscs in the water mains of Paris from the original types whose habitat is in the waters supplying these mains. (1) Diminution of size, due to absence of light. (2) Decrease of coloration owing to the same cause. (3) Modifications of form, generally a lengthening of the shell, due to the mechanical action of a steady, rapid current. (4) Appearance of the shells. They are polished, brilliant, uniform, developing with regularity in a constant medium. (Revue Scientifique, Oct., 1893).

The Orthopterous Insects of the Galapagos Islands.—The various collections of orthopterous insects, the result of nine different explorations of the Galapagos Islands, have been examined by Mr. Samuel Scudder, and form the subject of a paper published in the Bull. Harv. Mus. Comp. Zool., Vol. XXV. The author notes the poverty of this Orthopteran fauna. In all there are but 25 species, of which 5 are cock-roaches, which can in no sense be considered endemic. The remaining 15 include 7 new species, and are all South and Central American in their affinities. A large proportion of the forms are incapable of flight, which can be accounted for only on the supposition that the Galapagos are of recent origin, and that the present Orthopteran fauna is derived from the chance advent of pregnant females from the nearest shore, or the shores which currents of the ocean practically make the nearest. The insect incapable of flight would stand the best chance of reaching the island, since it would have less inclination to leave its floating refuge, and thus the exceptional proportion of subapterous forms is explained.

An Axillary Pocket in Certain Chameleons.—In examining a collection of Reptiles sent from Madagascar to the Natural History

Museum of Paris, M. Mocquard discovered a pocket in the armpit of certain species of Chameleons, a character hitherto unnoticed. This pocket is formed by the invagination of the skin, and is about 4 mm. in depth, with an orifice of 2 mm. in diameter, varying slightly in size in different species.

This character appears to be constant in certain species only of Chameleons peculiar to Madagascar and the neighboring islands of Mauritius and Bourbon, for it does not appear in all of them, nor is it found in the Chameleons of the Continent, except in *C. vulgaris* in which a rudimentary pocket can be discerned. It is found also in *Rampheoleon spectrum*, a west African species, while not a trace of the character can be seen in *R. kerstenii*, which belongs on the eastern coast.

M. Mocquard considers this character of specific importance, and recommends its use in determining different species of Chameleons. (Compte-rendu Soc. Philom., Paris, July, 1893.)

The Origin of the Human Face.—In two short essays entitled The Origin and Evolution of the Human Face and Descent of Facial Expression, Dr. Alton H. Thompson gives a compilation of the literature of the subject with some original notes. His comments are intelligent and show a just appreciation of the idea of evolution. In the first essay the author keeps in view the point that the face and the brain were developed collaterally, and the high perfection of the face in man is due to his high brain development. The second essay is a contribution toward finding a scientific basis for the study of physiognomy and expression. Some of the varieties of feature of the human face are traced back to their animal origin, and the inheritance of emotional expression from the lower animals is touched upon. The essay is based on the facts of both phylogeny and ontogeny, and is an excellent synopsis of what has been written on the subject, to which several important original thoughts are added.

The Ground Squirrels of the Mississippi Valley.—In a paper recently published by the United States Department of Agriculture, Mr. Vernon Bailey describes the food habits and distribution of the five species of Spermophilus found in the Mississippi Valley. In addition, he summarizes the best methods of holding them in check, the preference being given to the use of bisulphide of carbon. The essay is handsomely illustrated. (Bull. No. 4, Div. Ornith. Mam. U. S. Dept. Agri., 1893.)

Zoological News.—Three new species of Annelids from the New Jersey coast are described and figured by Mr. J. P. Moore. *Clymnella elongata*, a tube dweller; *Eulalia lobulata*, so-called from the lobulated appearance of the peculiar tentacular appendages; and *Eracia brevicornis*. (Contributions Zool. Lab. Univ. Penna., Vol. I, 1893.

In a report on the Aquatic Invertebrate Fauna of Wyoming and Montana, Mr. S. A. Forbes describes and figures several new species and varieties. The list comprises 5 Cladocera, 1 Ostracoda, 8 Copepoda, 2 Rotifera and 1 Protozoa. The investigation of this fauna was made with a view to stocking the lakes of Yellowstone Park with game-fishes. During the years 1890 and '91, 66 localities were visited, and the material gathered amounted to 460 collection numbers. (Bull. U. S. Fish Commissioners for 1891).

VERTEBRATA.—The Zool. Dept. of the Michigan Agri. Exp. Station has issued an illustrated list of the Birds of that State prepared by Mr. A. J. Cook. The author has adopted the arrangement of the Am. Ornith. Union, and has appended, in parenthesis, the number of the species as given in Coues' Key and Check-List. A résumé of the species show that the bird fauna of Michigan includes the Boreal, the Transition and the Sonoran. The large lakes attract many birds that are usually maritime, while the prairies and woodlands in the southern part of the State afford a habitat for the prairie birds and a long list of woodland warblers. All species of doubtful occurrence have been excluded from the list. So far as observation permits, the author has given the food habits of the species described. An extensive bibliography appended to the introduction adds to its value to the Ornithologist.

Mr. Gerrit S. Miller calls attention to the rediscovery of the gopher —*Thomomys bulbivorus*—at Beaverton, Oregon. This animal, described sixty years ago by Richardson under the name *Diplostoma bulbivorum*, has been entirely unknown to naturalists until the present day. (Proceeds. Biol. Soc. Wash., Aug., 1893).

EMBRYOLOGY.[1]

Frog Eggs under Pressure.—Professor G. Born[2] describes some interesting experiments made upon cleaving eggs of the frog. The eggs were subjected to pressure by confinement between glass plates that pressed upon the jelly about the egg and flattened out the egg itself so that its diameters were as 2 to 3 or even, in extreme cases, as 1 to 2.

The eggs were put between the plates before fertilization and could thus be arranged carefully with reference to the relative position of the main axis of the egg and the surface of pressure. Glass strips between the glass plates kept these apart a certain distance, say 1·4 mm.

Under these conditions cleavage takes place and the medullary folds may arise and even close over.

If the eggs stand in their normal vertical position—i. e., with the dark side uppermost and the horizontal plates press then thus in a direction parallel to the chief or vertical axis of the egg, the following departures from the normal cleavage take place.

The third cleavage is not, as normally would occur, by a horizontal furrow at right angles to the first and second furrows, but by two vertical furrows on either side of and parallel with the first furrow. The planes of the 1st, 2d and 3d cleavages are thus all at right angles to the pressing plates. This is true also of the 4th cleavage which is accomplished by two planes parallel to the 2d cleavage plane and at right angles to the first.

In such eggs, kept under pressure, the blastopore and subsequently the medullary folds appear upon the under side of the egg; the ventral part of the embryo is upward in these compressed, fixed eggs.

If the eggs are arranged so as to be squeezed from the sides, are compressed between plates parallel to the main axis of the egg, which stands vertically, then the following unusual cleavage phenomena are seen.

The first plane being as usual vertical, is also at right angles to the pressing plates; the second is not vertical as normally would be the case, but horizontal. The third cleavage is often expressed by two planes parallel to the first, while the fourth may be parallel to the second.

[1] Edited by Dr. E. A. Andrews, Baltimore, Md.

[2] Anatomischer Anzeiger, VIII, Aug. 5, '93, pps. 609–627.

These departures from the normal might be due to the direct effect of the pressure acting upon the dividing nuclei or else to the secondary effects brought about through the change of form the egg suffers under the pressure.

While Pflüger was inclined to regard the pressure as acting directly, as determining the direction in which the nucleus could most easily elongate, the author thinks that the change of form of the protoplasm is the determining cause of the new arrangement of the cleavage planes. He thinks that these phenomena may be brought under the rule formulated by O. Hertwig, that in dividing the nucleus tends to get into the center of its field of action, the surrounding protoplasmic mass, and places itself so that its poles are toward the largest masses of protoplasm.

It is thus not the pressure which directly alters the position of the nuclear spindle but the forced change of form of the protoplasm of the cell which necessitates an adjusted position of nucleus and hence a subsequent change in the direction of the cleavage.

If the author succeeds in making out in detail this mass effect of these distorted cells we would seem to have additional reason for regarding the nucleus as of less value than the protoplasm in the determination of form.

Embryology of Chiton.—Dr. M. M. Metcalf studied the embryology of *Chiton marmoratus* and *C. squamosus* at Jamaica, where the Marine Laboratory of the Johns Hopkins University was located in 1891. An account of the breeding habits, methods of studying the small opaque eggs (use of hardening liquids, hypochlorite of soda to remove the chorion and yolk, etc.) and a detailed, illustrated description of the cleavage and gastrulation is given in the last number of the Studies of the Biological Laboratory, Baltimore, October, 1893.

The eggs were obtained from specimens kept in aquaria; both eggs and sperm are discharged for a period of two hours or more after a time of active, sexual excitement. The males and females, however, do not approach one another but seem to give off the sexual cells under the stimulus of some unknown influence.

The cleavage is described and figured in great detail chiefly from surface views of living eggs, and from reconstruction of sections up to the forty cell stage. The gastrulation also is given in detail and presents interesting features with reference to the slit like form of the blastopore in Peripatus. Later stages are reserved for subsequent work. In general the results here given confirm the work of Kowalevsky.

Lithium Monsters.—Curt Herbst[3] has continued his work[4] upon the action of salts upon echinoderm larvæ and publishes a full account, with careful figures, of the various abnormal or monstrous larval forms produced by the action of very dilute solutions of lithium chlorid.

Both Sphærechinus and Echinus give results though Asterius, and presumably other animals, act differently or not at all under the influence of this salt.

The eggs are fertilized and then put into sea water containing 2½% of the lithium solution. This solution itself is, however, very weak, only 3·8 g Li Cl to 100 cm hydrant water.

The blastulas that arise from these eggs have thick walls with the inner end of their cells much vacuolated at first, but as they enlarge become elongated vesicles with thin walls. This vesicle becomes constricted into two, more or less separate; one has a thicker wall and long cilia, the other a thinner wall and short cilia. Between the two an intermediate, connecting vesicle may subsequently be interpolated.

Now it is evident that one of the vesicles, the one with thin cells of long cilia represents the ectodermal part and the other vesicle, the thick walled one, the entodermal part of a gastrula turned inside out; for there are all transition stages between these double vesicles and what the author calls exogastrulæ. These are evidently gastrulas in which the entodermal tube protrudes as a closed, thick walled process just as would be formed if the entoderm grew outward instead of inward as normally happens.

Invagination being due to a rapid growth of a zone of cells on the vegetative side of the blastula we need but have the direction of growth changed, by the lithium salt, to produce such an exogastrula. If this zone of growth extend, under the influence of the salt, more and more over the vegetative side of the blastula there will result a more typical lithium larvæ, or stages between it and the exogastrula. Finally some cases arise in which it seems that this zone extends all over the blastula; such larvæ are mere single vesicles of entoderm! There is thus a conversion of what would normally form outside and inside, ectoderm and entoderm, of the gastrula, into what may be styled entoderm only.

The author thus agrees with Driesch in regarding the cells of the early larvæ as omnipotent in their capabilities; they may become

[3]Mitth. Zool. Sta. Neapel. II.

[4]See AMERICAN NATURALIST, March, 1893.

ectoderm or entoderm ; the idioplasm is not early divided qualitatively amongst the cells as Raux and as Weismann maintain. This same lack of differentiation is shown, the author holds, by certain other abnormalities sometimes produced when the embryos are subject to the action of lithium. Thus larvæ may be reared in which the arms and ciliated band are formed in abnormal places, from cells, apparently, which would not normally form such structures at all, i. e., cells have been induced to form what they would not be able to form were they really specialized.

From the wealth of observation upon the action of lithium at different stages of larval life exposed for different periods to this action we can select only one of the interesting facts that result, namely, that the action of this salt does not cease when the egg is removed from the salt into pure sea water. Under some conditions such eggs may continue to develop along the abnormal direction or may begin to form lithium larvæ, though as far as can be seen they are perfectly normal when removed from the salt into the sea water. Such facts militate against the author's former assumption of the direct action of these salts in modifying the osmotic penetrability of the egg protoplasm and show that the action is a more subtle, unknown one.

The author argues that the entoderm cells of the blastula have the property of taking up and holding the lithium salt to a greater extent than do the ectoderm cells. In some unknown way this is connected with their unusual mode of growth.

It is important to note that the eggs of different individuals react to quite different extents, different degrees, to the stimulus produced by the same amount of the lithium salt.

Mechanics of Embryology.—Hans Driesch[5] adds four more chapters to his six previous contributions to this subject.

The first treats of the results obtained when the eggs of Sphærechinus are put, about twenty-six hours after fertilization, into water that is kept for eighteen hours in a warm chamber heated at 30° C.

The larvæ that result are blastulas with a protruding tube on one side; in fact the increased temperature has brought about the same result as Herbst obtained by the use of lithium salt, the gastrulations begin in an inverted sense, the entoderm grows outward instead of inward. Such *exogastrulæ* when removed to cooler water continue to live and may form plutei with long entodermal tubes attached; in each case the entodermal tube, or more properly closed pouch, is divided

[5]Mitth. Zool. Station Neapel II. 1893.

into three regions as it would be if it grew inside the ectodermal vesicle or body wall.

The entodermal tract remains small—does not swell out as in the lithium larvæ—and ultimately shrinks and falls off.

In this way *anenteria* are formed, or plutei having no entoderm. Yet in these there is formed a small oral invagination without the presence of the entoderm. Such *anenteria* livéd a week, but did not regenerate the digestive tract.

The second chapter deals with the effects produced by water containing less than the normal percentage of salts. Eggs of Echinus as soon as fertilized, are put into sea water to which fresh water has been added in the proportion of 45·5.; after five minutes they are transferred to 40·10 and then 35·15 and so on to 25·25.

The eggs swell, cleave normally in 45·5 but abnormally in 40·10 and 35·15; while in 30·20 only the nuclei divide; in weaker solutions the eggs die. The abnormal cleavage above mentioned consists in the unequal size of the cells formed in the eight cell stage. Here there are 2 to 4 cells so small that they may be called micromeres. In the weaker solution, 35·15, there is added tbe shifting of the cells into a tetrahedral arrangement not otherwise present.

Having thus produced apparent micromeres by varying the percentage of salts in the sea water, the author regards the normal micromeres as not essentially different from the macromeres in their nuclei or idioplastic parts, but as merely a result of the activity of the protoplasm; protoplasm may be effected by external agencies so as to make micromeres when they are not predetermined by any character of the nuclei.

The third section takes up his previous conclusions as to the interchangeableness of the ectoderm and entoderm in their beginning. Not satisfied with the facts formerly relied upon to show that what would be ectoderm cells could form entoderm and vice versa, attempts were made to determine the relation between the position of the micromeres and the place of origin of the entodermal invagination. But the experiment failed, since the eggs revolved in the capillary tubes in which they were reared and so made conclusions invalid. A second series of experiments was successful in showing the independence of micromeres and entoderm and also in demonstrating that cells normally destined to form the vegetative side of a blastula could form a complete larvæ, while cells that should have formed the other half of the blastula could also form a complete larvæ.

These experiments consisted in shaking off one or the other sets of cells in the sixteen cell stage, after the egg membrane had been removed. At this stage there are eight equal cells, of the vegetative region, four large cells and four micromeres of the animal region. Complete pleuti arise when the micromeres are absent; when only some of the above 8 negative cells are present.

The facts in connection with the author's previous experiments upon compressed eggs show, he thinks, that the nuclei of a cleaving egg are equivalent and that the germ layers are not separated during cleavage by any qualitative nuclear divisions.

The presence of micromeres is shown to be unnecessary for the formation of an echinus gastrula.

(Some attempts to form fusions of cleaving eggs are mentioned here, though they were not successful; the eggs adhered (after treatment with chloroform) but eventually separated again).

The last chapter deals with some fundamental questions and results reached by this mode of investigation.

The outcome of all the author's work is in opposition to the views held by Roux and Weismann, for it is shown that the cleaving egg, at least in these echinoderms, is not differentiated as regards its nuclei which are all alike in quality. Not so the protoplasm of the eggs which the author maintains must be anisotropic from the first, must possess a differentiation in direction so that all of it, or a part of it when removed, acts like a stimulus in producing the first differentiation of form, which is the first difference between the ends of the main axis of the larvæ. When the larva becomes bilateral this is due to a like direct specialization in the protoplasm, finding its expression in the difference seen between the dorsal and ventral sides of the larvæ.

Some organs may owe their position directly to this determined axial condition, others may arise from more indirect causes, from stimul- that come either from other separate organs or from without the organi ism.

Cells become this or that according to their position; the organs arise as functions of the positions of the cells forming these organs. Thus is the peculiar half-dead embryo Roux obtained in the case of the frog; the cells are forced to remain in their original or normal positions by the presence of the dead half-embryo; if this were away the cells could rearrange themselves and so coming into new positions would form one complete embryo, not a half embryo.

The evolution of form in an individual is the result of stimuli and reactions of a complex interacting nature. These only are investigated in "entwicklungsmechanische studien." The primal origin of form lies in the ovum; the ontogeny is not true epigenesis but rather an evolution, since the protoplasm at the first has a tendency toward direction, is an-isotropic; this initiates the subsequent actions and interactions of parts.

This branch of biological study thus leads back only to something having determined form, not to a physicochemical starting point; the problems of morphology are not physicochemical problems.

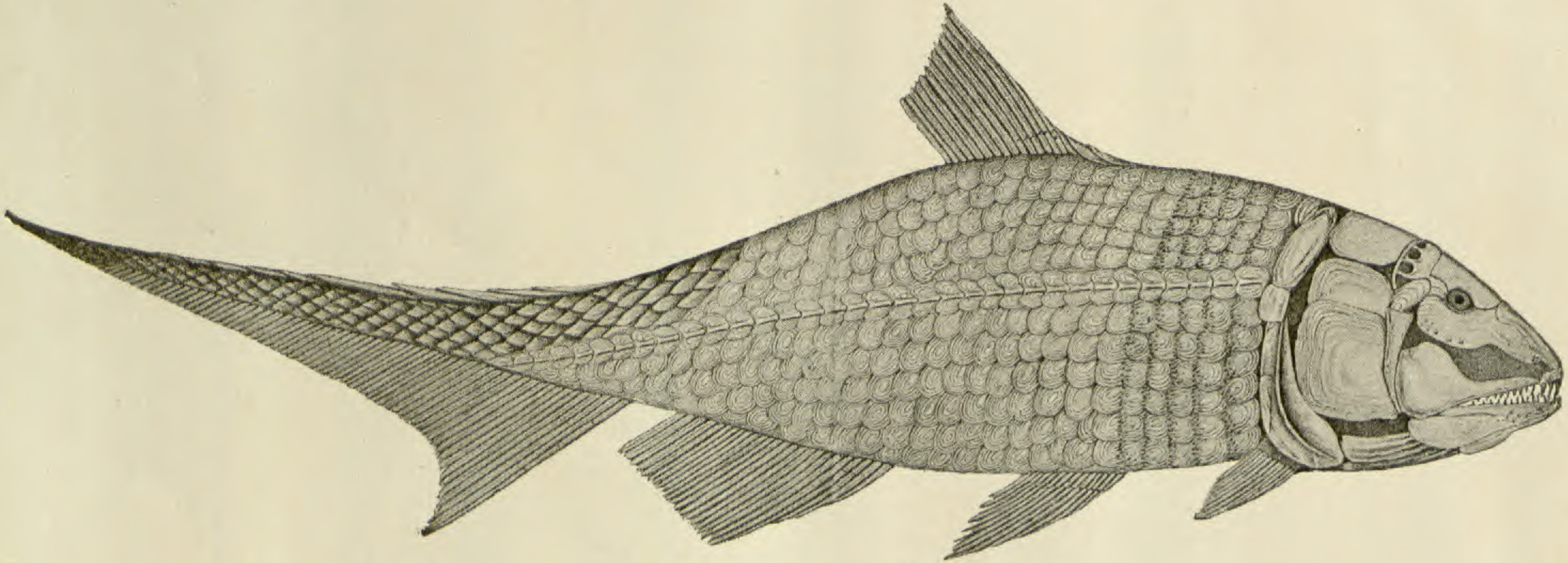
ENTOMOLOGY.[1]

Lycænid larva on Atriplex.—On July 6, 1892, I beat several small lycænid larvæ from *Atriplex canescens*, 12 miles north of Cedar Ranch, Arizona, on the stage road from Flagstaff to the Grand Cañon. The larvæ were of almost the same shade of color as the bush and leaves, of a very light whitish-green, thus easily escaping detection. If I am not mistaken they fed on the underside of the leaves.

Description of larva.—Length (in strongly curved position), 5 mm.; width, 2½ mm. Thirteen jointed, strongly curved (after immersion in alcohol), arched, broad, somewhat flattened, tapering to head, more rounded posteriorly. In color pale whitish-green, head shining jet black; a median dorsal, and two lateral rows (one on each side) of reddish spots, one spot to each segment, on segments 3 to 10; those on anterior segments much fainter usually, especially the lateral ones. Often a faint row of smaller spots ventrad of the lateral row. Head very small compared with other segments, hardly more than one-third the width of the prothoracic segment, within which it is usually retracted; subhemispherical in shape, convex dorsally, glabrous, well polished and shining. All the other segments thickly covered with minute short white spine-like tubercles, with a less number of similar black ones interspersed. These extend on the ventral portion, which is besides clothed with some short whitish hairs along sides and on prolegs. The anterior portion of dorsum of prothoracic segment is furnished with more numerous and larger short and stout black spines. Prothoracic segment subtriangular in outline from above, a little rounded in front, widening behind; segments 3 to 6 widening posteriorly, each wider than its predecessor; segments 7 to 10 about equal in width, a little wider than 6; 11 and 12 gradually narrowing from 10; 13 considerably narrower than 12 (in some specimens regularly narrowing from 12), rounded posteriorly, with a terminal somewhat narrower and partially free joint which bears the terminal or anal pair of prolegs. Segments 3 to 8 each gathered into a transverse, slightly curved, more or less hump-like ridge on dorsum, the prothoracic segment with a strongly anteriorly bent one, segments 9 to 11 hardly humped, segments 5 to 8 usually most strongly so. Eyes represented by five small glassy simple eyes, four of them arranged in a semicircle with the outside antero-dorsad, the fifth postero-ventrad of the four. Mandibles minute,

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

PLATE XXX.



Trissolepis kounoviensis Fritsch.

7-toothed (6-notched) on the very broadened and circular apical margin, brownish. Other trophi light colored. Spiracles somewhat raised, situated on side posteriorly of prothoracic segment, and on sides of segments 5 to 12, those on 11 and 12 situated higher up on dorsum and more removed from the lateral margin. Three pairs of short hook-like true or thoracic legs; and five pairs of fleshy prolegs, on segments 7 to 10 and terminal joint of 13.

Note.—The segment which is called a terminal joint of segment 13 may perhaps be regarded as the thirteenth segment. In this case the slightly hood-like or flap-like portion which projects over it from the twelfth segment would necessarily be regarded as a posterior development of that segment.

Described from 3 specimens. Color noted in life. Arizona. The special organs described by Mr. W. H. Edwards, in his second volume of the Butterflies of North America, as found on segments 11 and 12 of the larva of *Lycæna pseudargiolus*, are also present in the above larvæ on *Atriplex*. The median transverse opening on 11 is very plain, but the two retracted tubes on 12 do not show as plainly as figured by Mr. Edwards. These latter show very much more plainly in lycænid larvæ which I have taken in southern New Mexico on mesquite in May. —C. H. Tyler Townsend.

Honey Adulterations.—There has been in the past much difference of opinion among chemists and beekeepers concerning the detection of honey adulterations by chemical methods. To obtain more definite information on the subject Professor A. J. Cook recently had samples of a large number of kinds of honey analyzed by Professor H. W. Wiley of the U. S. Department of Agriculture, Professor R. C. Kedzie of the Michigan Agricultural College, and Professor M. A. Scovell of the Kentucky Agricultural Experiment Station. The results of these analyses are published in Bulletin 96 of the Michigan Station, and from them Professor Cook draws these conclusions:

1. That chemists can easily detect adulteration of honey by use of glucose, in all cases where it is likely to be practiced. The same would be true if cane sugar syrup were mixed with the honey.

2. That a probable method to distinguish honey dew honey from honey adulterated with glucose has been determined by these analyses. The right-handed or slight left-handed rotation together with the large amount of ash, and small amount of invert sugar indicate honey dew honey. As honey dew honey will never be put onto the market, this question is of scientific rather than practical importance.

3. As yet the chemist is unable to distinguish between cane suga syrup honey—by which we mean cane sugar syrup fed to the bees andr transformed by them into honey, and not cane syrup mixed with honey, which is adulteration pure and simple, though a kind not likely to be practiced—and honey from flowers. As the best cultivated taste cannot thus distinguish, this seems of slight importance. If it should prove to be important to be able to distinguish them it is probable that the chemist will discover the means, as chemistry has very delicate eyes, and can usually search out very slight differences.

North American Noctuidæ.—Professor Smith has furnished a striking example of his industry as a student of the Noctuidæ in his recent catalogue[2] covering 424 pages, which are nearly all devoted to the catalogue proper. The preface consists of a statement of the collections in America and Europe examined by the author, with explanations of the methods adopted in preparing the catalogue. This is followed by an index of authors and works cited, and the bulletin closes with a very complete index in which every name used in the body of the bulletin is included. This index covers 25 double-column pages in small type which will give some idea of the extent of the family and the completeness of the catalogue.

Recent Bulletins.—The entomologists of the experiment stations continue active in issuing publications concerning injurious insects. The subjects chosen cover a wide range, and while much of the matter consists of a republication of existing information—a legitimate function of the stations—a good deal of original knowledge is being brought out. In Bulletin, 32 of the West Virginia Station, Mr. A. D. Hopkins presents a catalogue of the Forest and Shade tree insects of that State. The list includes 494 species, only a part of them, however, being injurious, the others being parasitic or predaceous, or living under the bark of fallen logs. Mr. Hopkins has paid special attention to the Scalytidæ and is accomplishing valuable results in their study.

In Bulletin No. 24 of the Colorado Station Professor C. P. Gillette treats of "A few Common Insect Pests." The species discussed are enemies of cabbages, onions and other garden crops. A Thrips, doubtfully identified as *T. striatus* Osborn is reported to do serious injury to onions.

[2] A catalogue, bibliographical and synonymical, of the species of moths of the Lepidopterous superfamily Noctuidæ found in Boreal America. With critical notes, by John B. Smith, Sc. D., Bull. U. S. Nat. Museum, No. 44.

In Bulletin 98 of the Michigan Station Mr. G. C. Davis briefly discusses locusts (*Acrididæ*) and the Horn Fly (*Hœmatobia serrata*), while in Bulletin 96 of the same Station Professor A. J. Cook discusses Honey Analyses.

Professor J. B. Smith has recently sent out two bulletins from New Jersey. In No. 95 he announces that Brood XII of the Periodical Cicada is due in New Jersey next year, and is likely to appear all over the state, though more abundantly in the northern and eastern counties. He suggests that no pruning or budding be done this fall or next spring, leaving abundance of surface for oviposition. This is an excellent example of the value of entomological prognostication.

Bulletin 94 discusses "Insects injurious to Cucurbs" in a practical way that is sure to be appreciated by New Jersey farmers.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—June 10, 1893.—Mr. Wm. T. Davis exhibited specimens of *Iva frutescens* and read the following paper upon "The Influence of the Past Winter on the High-Water Shrub."

An examination of the High-Water Shrubs, (*Iva frutescens*,) during the past few days, has disclosed an interesting fact, which is no doubt entirely due to the severe weather of the past winter. A glance along the meadow creeks show, as yet, but a gray line of bushes with numerous short sprouts starting either at their roots or a few inches above them on last year's wood. On the 7th of May, 1892, while observing the sea-side finches, the High-Water Shrubs were noticed to be coming into leaf midway up the stems, and by the middle of May it was difficult to secure a good view of the finches owing to the number of leaves. This year there would be no difficulty, for even at this date they are as bare as in the winter, having retained their vitality for only five or six inches above the ground. Some of the dead *Iva* stems show evidence of being three or four years old, so there is this proof also that the past winter has been the hardest one for the species during at least that length of time.

Mr. Davis also read the following: "Local Notes upon the Opossum and Red Fox."

The opossum visitation, which was commented upon in these Proceedings for March 12, 1892, has in no wise abated, and during the past year quite a number were killed on the island.

No less than fourteen opossums have been taken at Watchogue and the neighboring hamlets within a short period. It was thought by the residents, that they were possibly imported on the railroad, as the completion of the bridge and the appearance of the opossums were so nearly coincident. However, the causes given in the Proceedings referred to above, are probably the correct ones. In the winter of 1891–92, a dog owned by Mr. George Marsac, who lives at Watchogue, caught two opossums, one of them under the piazza floor. This past winter, Mr. Marsac and Mr. John De Bau found four opossums in a hollow gum tree; Mr. George Decker and Mr. Marsac caught two others, and Mr. Orville Merrill, one; Mr. George Merrill, one; Mr. Smith one in his cellar, and Mr. Van Pelt, who lives near Bull's Head, found one in his chicken house. Mr. Drake, of Old Place, heard a disturbance in his chicken house last summer, and discovered, upon investigation, an opossum, which he promptly killed. On April 30, 1892, I found a very much decayed opossum in the woods near Watchogue, and even under such circumstances it had the peculiar fatty odor for which the animal is remarkable.

Mr. Gratacap has informed me of an opossum captured on Bement Avenue, West New Brighton, and Mr. Galloway, of one killed on the Leonard White place, in Middletown. One was secured on the Mc Andrew place last winter ; one on the Meissner place at Richmond by Mr. Lyle, and one in the Moravian Cemetery by Mr. Albert.

This spring, Mr. Samuel Henshaw showed me a dead opossum under an apple tree near the brook that crosses the Manor Road ; Mr. Joseph C. Thompson found one near Arrochar, and Mr. Perry Cornell, on the 9th of April, caught a twelve pounder in the old iron ore mines on the slope of Todt Hill.

From the above facts and those presented in the Proceedings of March 12, 1892, it appears that the opossum has become well established on our Island, and that thirty-six individuals have been captured during the last four years. Of course, the record can only be considered as partly complete.

In connection with the opossum visitation, it may be well to record a few memoranda concerning the foxes that have been found on the island within the last few years. In 1887 or '88, one was killed by Mr. Cole, who resides on the Amboy Road, near Oakwood. It was believed at the time to be the individual that escaped from the superintendent of the railroad. In July, 1890, the *Richmond County Standard* printed an account of the foxes that had been killed or seen in the vicinity of Richmond. It was believed that the original pair either escaped from the hunters of the Country Club, or from the captain of a canal boat, which had several on board, while discharging his cargo of coal at Richmond Creek. The animals destroyed many fowls on the Dedker and Latourette farms, and on the former of these places a young fox was trapped, the jaws holding him by the toes. In the morning, it was found that his mother had evidently been busy all night, as his shoulders were lacerated by her efforts to secure his release. Another fox was shot by Mr. Decker, while it was killing a Guinea hen.

Last summer, Mr. Freemans of Old Place, was on the meadows near his home engaged with some companions in surveying, when they discovered a family of foxes beneath a hay stack. The male ran away upon the approach of danger, but the mother and five young were finally secured.

The following paper, by Mr. Arthur Hollick, in the absence of the writer, was read by the title "Notes on the Geology of the New Railroad Cut at Arrochar."

In a previous contribution on the Cretaceous formation of Staten Island, (Proc. Nat. Sci. Assn. S. I., Jan. 9, 1892), I mentioned the discovery of Cretaceous fossils at Arrochar, and called special attention to specimens of *Cardium dumosum* Conrad, which were found in a seam or stratum of sandy clay, which I was inclined to think might represent the outcrop of more extensive strata not far below. Recent excavations for a new railroad cut in the vicinity led me to hope that the overlying Drift deposits might be penetrated to a sufficient depth to expose these strata, which, from the surface indications, we know can not be very far away. Several visits were made while the work was in progress, but it was not until last week that the excavation was completed and, fortunately for the geologist, the heavy rain of the 6th inst. followed immediately afterward and washed everything clean in a most gratifying manner, affording unusually favorable conditions for final observation during the past few days.

At the base are masses or beds of bluish, semi-plastic and sandy clay, from which extend upward irregular seams and smaller masses, interbedded with fine sands and gravels, in which "flow and plunge" structure is generally well marked. This series of deposits reaches the surface at about where the new Arrochar station is located, and from thence southward are all that is to be seen. The bowlder till thins out to a feather edge where the sands and clays come to the surface and gradually become thicker northward, until finally it is all that is visible in the cut. The deepest part of the cut shows the entire series from base to summit and give us a 50 foot section in a N. and S. direction, through the extreme edge of the terminal moraine. Irregular masses of clay, accompanied by water-assorted sands and gravels at the base capped by the unassorted bowlder till on top. The thickening of the bowlder till northward and the position of the underlying materal give a general appearance of north to northwestward dip for the entire series.

No positive evidence of any Cretaceous strata in place could be found, but on the other hand a large part of the sands and gravels are manifestly reassorted Cretaceous material. The characteristic ferruginous sandy clay concretions in which most of our Cretaceous fossils have been found are abundant, and the sandy clay stratum in which the *Cardiums* previously mentioned were found, may be traced into the cut, with its accompanying sands and gravels. It can no longer be regarded as an outcrop, as other similar seams or masses are quite prominent, interbedded with the sands and gravels. In some places coarse gravel and clay nodules are so cemented together with limonite that a firm conglomerate is formed. Iron is everywhere abundant. In some hand specimens of the conglomerate may be seen pyrite, magnetite and limonite and spring waters are impregnated with the sulphate. Acc tic iron sand may also been seen in places. Yellow Gravel or Pre-Glacial Drift is also, to a limited extent, a constitutent of the assorted material.

It is evident that only the upper part of the clay has been reached and this is very much disturbed and crumpled, portions having been torn off from the main mass below, forming the irregular beds or seams associated with the sands and gravels. The indications are that these were all deposited previous to the advent of the glacier which shoved them ahead and finally left them overlapped by the thin edge and flanked on the north by the mass of the bowlder till.

The character of the clay is not that of our ordinary bowlder clay, which is nearly always colored red from the prevailing constitutent—eroded Triassic sandstone and shale. These clays are bluish and the rock from which they were formed is not anywhere in evidence at the present time. The large amount of mica and the occasional fragments of mica schist, hornblende schist and granite which are to be found throughout all the underlying deposits at Arrochar may perhaps be accounted for on the theory of a belt of such rocks to the south and east of the serpentine ridge which has suffered decomposition and erosion and thus formed the source of supply for the bluish clay and micaceous fragments. Such a belt is theoretically present, for we know that it exists to the east of the serpentine at Tompkinsville and St. George. This theory is emphasized by the position of the clay which is beneath and older than the bowlder till and would thus have been formed independent of material from the red Triassic area which did not suffer extensive erosion until it had been overridden by the glacier. One lenticular basin of clay in the upper part of the till north of the morainal edge, deserves attention from the fact that the clay there formed is typical reddish bowlder clay, horizontally stratified and evidently undisturbed since its deposition, which must have been subsequent to the retreat of the glacier. This was the source from which the erstwhile brick yard at Arrochar obtained its material for the manufacture of building brick. The comparison between this red, horizontally stratified clay in the till above, and the bluish distorted masses beneath is striking.

One feature that will doubtless be noticed at once by everyone who examines the material in the moraine at Arrochar, is the quantity of soapstone and limonite ore contained in it, evidently due to the erosion of the serpentine ridge which near this point was crossed by the glacier.

Summarizing the results of our facts and observations we may picture to ourselves the former coastal plain, consisting of Cretaceous and later deposits, extending to the base of the serpentine ridge, with a belt of schistose or gneissic rocks around its base. On the advent of the glacier, advancing from the northwest these deposits were eroded and pushed ahead by the ice mass and assorted by the torrents which flowed from it, and which, on its retreat, left the deposits of the till, forming a superficial unassorted cap, composed of fragments of rocks from the north, in which the Triassic sandstones, shales and traps of New Jersey are the most abundant constituents. In the depressions of the till, local deposits of gravel, sand and clay would accumulate, colored with the prevailing red from the eroded Triassic rocks.

September, 9.—Dr. N. L. Britton showed a specimen of *Agrimonia mollis* as an addition to the flora of the Island. This and the commoner *A. striata*, have been included in manuals under *A. eupatoria* which is, however, a European species.

Mr. Arthur Hollick presented a piece of Triassic sandstone, found in the Drift at Arrochar, by Miss Grace Hollick, on which were casts of a plant stem.

Although Triassic shale and sandstone were among the most abundant of our Drift material this is the first specimen in which we have been able to identify any indication of a fossil. A carefully prepared drawing was submitted to Professor Lester F. Ward, palæobotanist of the U. S. Geological Survey, and was by him submitted to Professor Wm. M. Fontaine, who concluded that it was probably *Equisetum rogersi* Schimp. If so this is not only an interesting addition to our list of Drift fossils but is of interest also on account of its rarity in the Triassic of New Jersey, from whence it must have been derived. So far as I know New Milford is the only locality in New Jersey from which it has been reported.

Mr. Wm. T. Davis read the following miscellaneous memoranda and exhibited the specimens mentioned.

During the past summer the Periwinkle (*Littorina litorea*) has been found in some numbers alive on the shore at the Narrows, and also on the rocks at Princes Bay. In these Proceedings for January 14, 1888, Mr. Sanderson Smith, upon the finding of an empty shell at the Narrows by Mr. Hollick, gave an account of the southward migration of the species along the Atlantic Coast, noting its occurrence on Long Island, etc. This is the first record of its being found alive on our Island.

Mr. Leng recently collected in Augur Lake, near Keeseville, N. Y., a rare *Dytiscus* beetle, probably *D. harrisii*, which he brought home alive in a tin can as his alcohol bottle was not sufficiently large. Upon opening the can for the inspection of the insect, we were pleased to find a dark brown *Gordius* worm of unusual size. After carefully untwisting and unkotting the tangled creature, which took our united efforts, we measured it with a rule, and discovered that it was twenty-eight inches long. In Dr. Packard's zoology it is stated that hair-worms "live in ground-beetles and locusts," twisting around the intestines of their hosts.

The severe storms of the 24th and 29th of August blew many green hickory nuts from the trees, and in spite of their unripe condition the shell-bark nuts were promptly devoured by gray squirrels. Under one of the trees on Richmond Hill, there were many quarts of the outer green husks gnawed fine, and of the nuts from which the kernel had been extracted after the outer bitter covering had been wholly or in part removed. It appears from this that it is probably the firmness of their attachment to the end of the tree branches, and not their green husks, that prevent the unripe hickory nuts from often being eaten by squirrels.

This morning a green example of the walking-stick insect (*Diapheromera femorata*) was found in the Clove Lake swamp on a golden rod. Though common northward, in the Hudson River valley, it is rare with us, and this is only the fifth recorded specimen from our Island.

Mr. Davis also exhibited some exotic water plants that had been introduced by some person of an experimental turn into one of the numerous small ponds in the woods north of the Moravian Cemetery. Among them was the Chillian Mermaid-weed, the South American Pond weed (*Eichornia crassipes*), a lily and one of the sedges, all of which seem to do well among the native plants.

Boston Society of Natural History.—November 1st.—The following paper was read:

Professor George Lincoln Goodale, "On the cultivation of Tea, Coffee and Cacao. Illustrated by stereopticon views of plantations in Ceylon and Java.—SAMUEL HENSHAW, *Secretary*.

The Biological Society of Washington.—October 21. The following communications were read:

Professor Lester F. Ward, "Weismann's Concessions." Doctor C. Hart Merriam, "Notes on a Biological Reconnoisance of Wyoming." Mr. Vernon Bailey.

November 4th.—The following communications were read:

Mr. W. T. Swingle, "Some Problems of Plant Geography in Florida." Doctor C. Hart Merriam, "Fauna and Flora of Eastern Wyoming." Doctor C. W. Stiles, "Artificial Species of Cestodes." Professor Lester F. Ward, "Cycadean Trunks in the American Cretaceous."—Frederic A. Lucas, *Secretary.*

National Academy of Science.—The following papers were entered to be read at the meeting held at Albany, N. Y., November 7th, 1893.—I. American Palæozoic Cockroaches, Samuel H. Scudder. II. Additional Researches on the Motion of the Earth's Pole, Seth C. Chandler. III. Biographical Memoir of A. H. Worthen, C. A. White IV. Biographical Memoir of W. P. Towbridge, C. B. Comstock. V. The Geological Map of the State of New York, James Hall. VI. On a new form of Telescopic Objective, as applied to the twelve-inch Equatorial of the Dudley Observatory, Charles S. Hastings. VII. On the Structure and Development of Trilobites, Charles E. Beecher, (Introduced by A. Hyatt.) VIII. Double Stars, Asaph Hall. IX. Latitude Determinations at the Sayre Observatory, Charles L. Doolittle, (Introduced by Lewis Boss.) X. Insect Voices, Joseph A. Lintner, (Introduced by James Hall.) XI. Edible and Poisonous Fungi, Charles H. Peck, (Introduced by James Hall.) XII. A New Process of Printing in Color, Edward S. Morse. XIII. On Reaction—Times and the Velocity of the Nervous Impulse, J. McKeen Cattell and Charles S. Dolley, (Introduced by G. F. Barker.) XIV. The Palæontology of the State of New York; the present condition of the work, James Hall. XV. Certain Histological Relations Between the Subalpine Plants of the White Hills and of the Labrador Coast, George Lincoln Goodale.

A special stated session of the Academy took place on Wednesday, November 8th, in Albany, to consider the President's Annual Report to Congress, and other business.

The new Dudley Observatory was dedicated. Prof. Newcomb made the speech for astronomy and there were other speeches by Mr. Lansing and Bishop Doane, Gen. Rathbone was master of ceremonies.

SCIENTIFIC NEWS.

The Natural History Society of Dantzic offers a prize of 1250 francs for the best essay on the most efficacious means of destroying the poisonous insects in the forests of western Prussia. The essays must be written in German or French and be sent to the Society before the end of 1898.

Professor Loew, of Munich, has been elected to the chair of Chemical Argriculture in the University of Tokio. Professor Loew is well known from his researches on the nature of protoplasm.

Dr. H. Möller has been appointed Professor of Botany in the University of Greifswald.

An exploring and surveying expedition has been organized in Brazil to study the less known parts of the Amazon basin and to collect information as to ethnography and natural history. The expedition was intended to leave Santos in August, and cross the plateau of Matto-Grosso towards the upper waters of the Amazon, where surveys and scientific collections will be made.

The California Academy of Sciences has published a bibliography of the Paleozoic Crustacea, prepared by Mr. A. W. Vogdes. Besides the list of authors there is an index of the species described in each work. The literature ranges from 1698 to 1892.

Erratum.—Through an oversight on the part of the engraver the figures (Plates XIX–XX) accompanying the paper on "Eggs of Pityophis melanoleucus," in the October NARURALIST, were reduced one-quarter, while the accompanying legends were printed as in the original copy. The error neeessitates the substitution of the following for the table of explanations on page 885, and corresponding corrections in the legend subscribed to each figure.

EXPLANATIONS OF PLATES XIX, XX.

Pityophis melanoleucus.

Fig. 1—Cluster of seven eggs represented as they naturally cohcre. a—point at which an eighth egg was attached.; ¾ natural size.

Fig. 2—Surface cracking of the calcareous crust—from an equatorial region ; x 7½.

Fig. 3—Vertical section of a small portion of the egg shell showing a small part of five laminæ ; x 600.

Fig. 4—Several fibres of different sizes after being dried and mounted in glycerin. The lumens are filled with air ; x 600.

Ftg. 5—Surface view of a small portion of a lamina ; x 127.

Fig. 6—A few isolated fibres. x 375.

Fig. 7–8—Two views of embryos in their natural positions on the yolk ; ¾ natural size.

Fig. 9—Left side of head of an embryo showing the scutes. x 5¼ ; p. 881.

Fig. 10—Dorsal view of the same; x 5¼ ; p. 881.

Fig. 11—Anal plate and hemi penes of a male ; x 6.

Fig. 12—Same region of a female ; a—rudimentary hemi penes ; x 6.

Fig. 13—Lateral (external) view of a hemipenis ; x 5¼.

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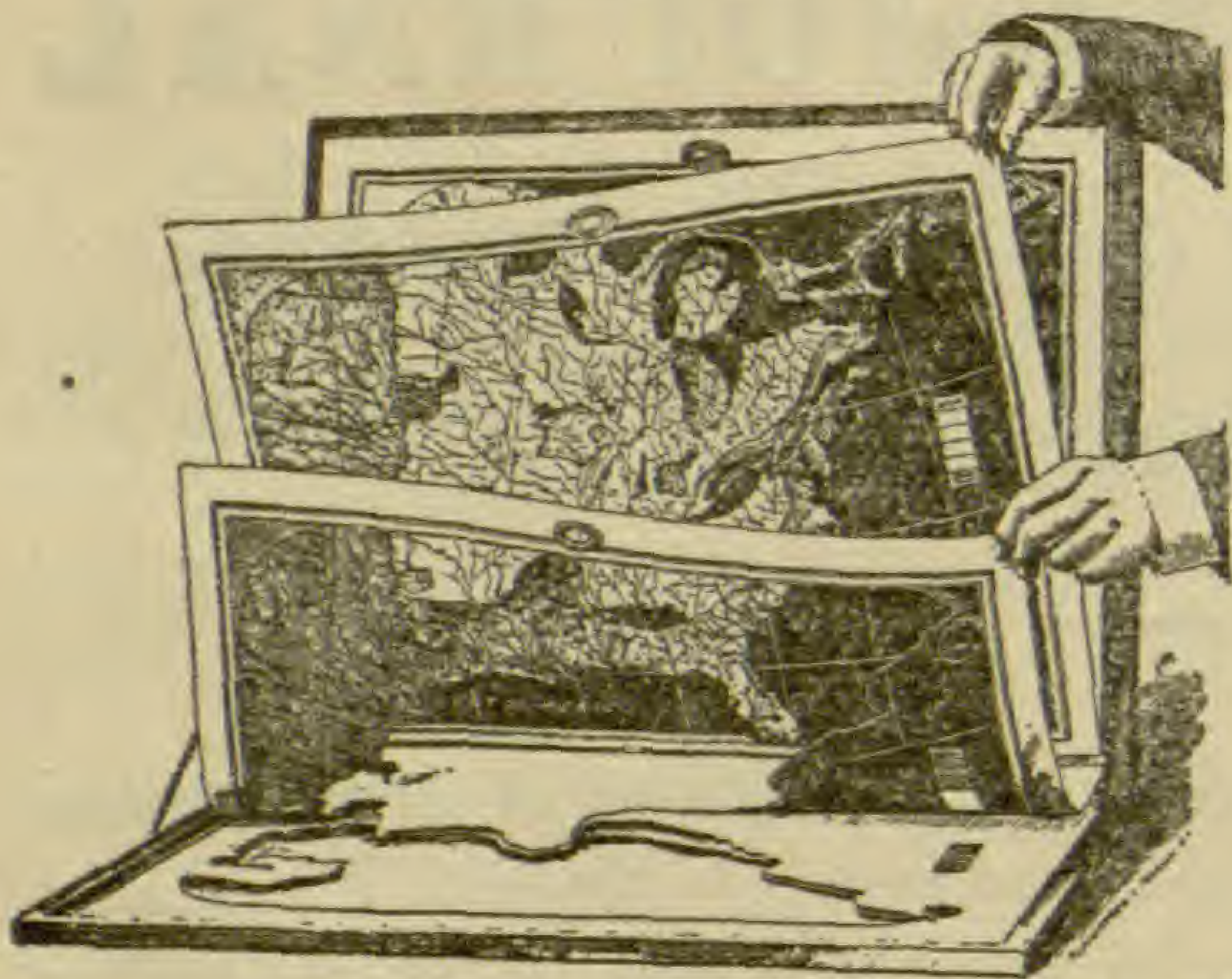

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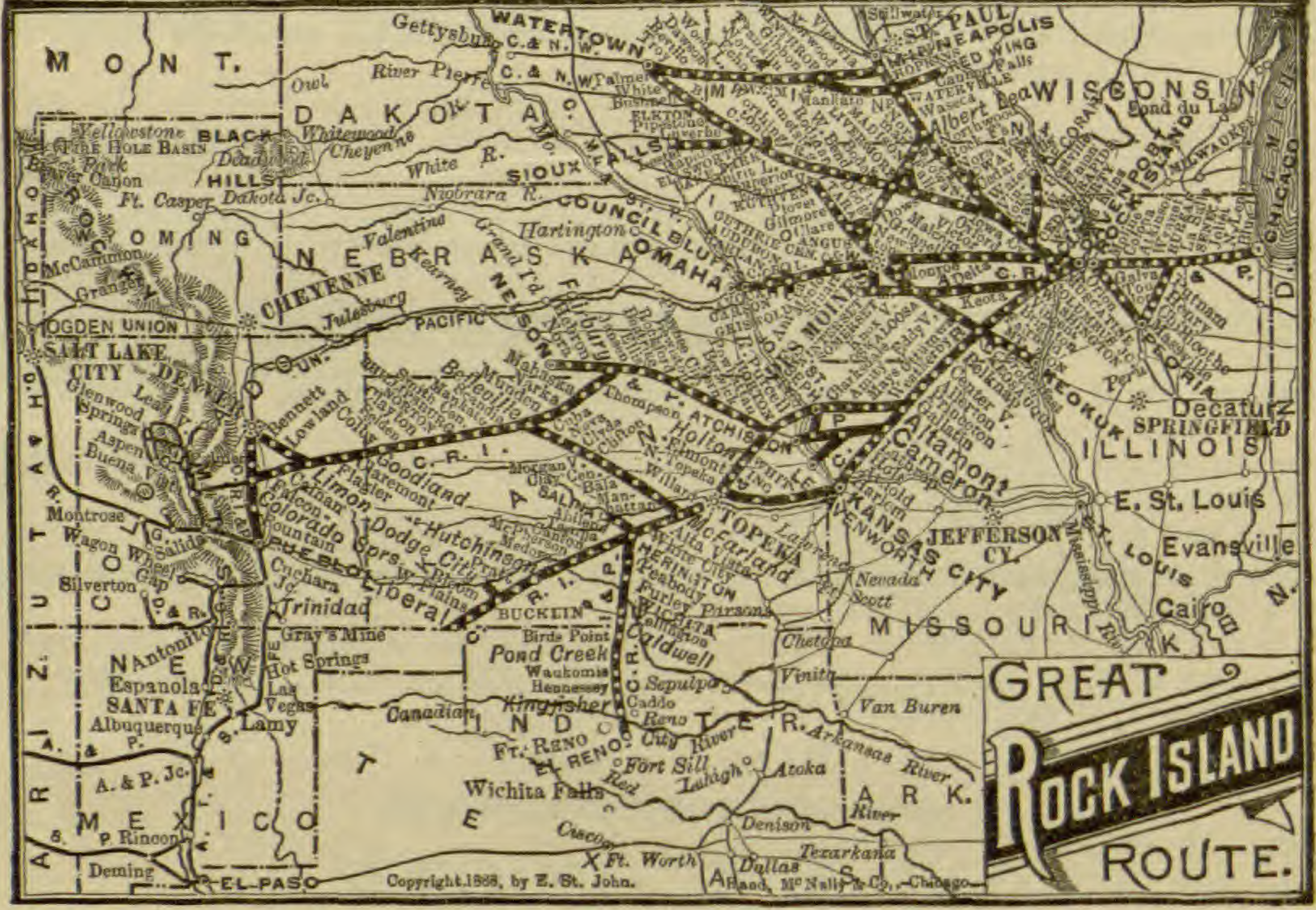

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