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EDWARD D. COPE AND J. S. KINGSLEY,

ASSISTED BY

DR. C. O. WHITMAN, DR. C. E. BESSEY, THOMAS WILSON, PROF. C. M. WEED, PROF. W. S. BAYLEY, PROF. E. A. ANDREWS.

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THE GASES IN LIVING PLANTS.[1]

BY J. C. ARTHUR.[2]

The present state of knowledge regarding the kinds, sources and movement of gases in plants does not constitute a completed volume. There is much yet to be learned, old views are to be corrected, and alleged facts are to be more firmly established. The subject is thoroughly modern, the first writer to give any connected and intelligent account of the behavior of gases in connection with living plants being De Saussure in his brilliant and epoch-making work describing his chemical researches upon vegetation, published in 1804.

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[1] Read before the Biological Section of the Amer. Assoc. Adv. Science, in Washington, August, 1891.

[2] D. Sc. Professor of Vegetable Physiology and Pathology, in Purdue University, Indiana.

set of organs to the tracheæ of insects, and therefore believed them to have the same office. His views were accepted by the Englishmen, Grew and Ray, who wrote about the same time, but found no supporters in Germany or France. The views of Malpighi, who in many respects was far in advance of the other botanists of his age, fell into obscurity, insomuch that even the existence of ducts was finally denied.

The subject was not revived until 1715, when Nieuwentyt demonstrated the presence of air in plants by placing sections of stems in water under an air pump. The demonstration was better performed by Christian Wolff, who was a philosophical naturalist of much insight. He placed leaves, wood, and other parts of plants, in water, freed from air, under the air pump, and after seeing the bubbles rise from the tissues as the air was exhausted from the receiver, he allowed the air to re-enter the receiver, and found that the tissues were at once filled with water, and that some kinds were thereby made so heavy as to sink.

In England, a few years afterward (1727), Stephen Hales, the real founder of experimental vegetable physiology, repeated and improved upon the air pump experiments, but used his knowledge to explain the life processes in a different manner from his predecessors. He combined the fact that gases are recovered from plants by dry distillation and fermentation to support a well arranged theory of the use of gases in forming the solid parts of plants. The use of gases by plants was, therefore, according to Hales, a part of the subject of the nutrition of plants.

But this small advance led to no further developments, and was again lost sight of for many years. After nearly half a century, in 1771, Priestley hit upon a discovery which, coming as it did only three years before the discovery of oxygen, and only shortly before the re-organization of chemical theories by Lavoisier and others, proved very fruitful.

Priestley's discovery was simple enough, amounting only to the fact that plants give off oxygen. He tells of his discovery in an interesting way, and I, therefore, quote a few paragraphs

from his communication to the Royal Society, announcing the matter:

"The quantity of air which even a small flame requires to keep it burning is prodigous. It is generally said that an ordinary candle consumes, as it is called, about a gallon in a minute. Considering this amazing consumption of air, by fires of all kinds, volcanoes, etc., it becomes a great object of philosophical inquiry, to ascertain what change is made in the constitution of the air by flame, and to discover what provision there is in Nature for remedying the injury which the atmosphere receives by this means.

"I flatter myself that I have accidentally hit upon a method of restoring air which has been injured by the burning of candles, and that I have discovered at least one of the restoratives which Nature employs for this purpose. It is vegetation. * * * One might have imagined that, since common air is necessary to vegetable as well as to animal life, both plants and animals had affected it in the same manner, and I own I had that expectation when I first put a sprig of mint in a glass jar standing inverted in a vessel of water; but when it had continued growing there for some months, I found that the air would neither extinguish a candle nor was it at all inconvenient to a mouse which I put into it. * * * Finding that candles burn very well in air in which plants had grown a long time, and having had some reason to think that there was something attending vegetation which restored air that had been injured by respiration, I thought it was possible that the same process might also restore the air that had been injured by the burning of candles. Accordingly, on August 17, 1771, I put a sprig of mint into a quantity of air, in which a wax candle had burned out, and found that on August 27 another candle burned perfectly well in it. This experiment I repeated, without the least variation in the event, not less than eight or ten times in the remainder of the summer."

Had Priestley had the good fortune to have set his jar containing green sprigs into direct sunlight, he would have made an additional discovery of almost equal importance. But the world did not wait long till Ingenhousz went over the ground

and discovered (1779) that light was an essential factor in restoring air, and that by the aid of sunlight he could perform in a few hours the experiments which took Priestley five or six days.

In 1800 Senebier added the discovery that plants obtain all their carbon from carbon dioxide, but fell into the error of supposing that part, at least, of this gas was taken up by the plant through its roots, an error that has proved extremely tenacious, existing in our text books to the present day, although repeatedly and fully disproven.

We have now arrived at the time of De Saussure (1804), who, with his superior chemical knowledge, placed the whole subject in excellent shape. He distinguished between carbon assimilation and true respiration. He dealt with the subject quantitatively, and showed that there was a definite relation between the carbon dioxide taken up by the plant and the oxygen evolved by the action of light. He clearly pointed out that the presence of oxygen was as essential to the growth of plants as to animals, the most active parts, such as green leaves, opening flowers, etc., requiring the most, and that this requirement had no relation to the presence of light.

De Saussure also pointed out that while plants receive their supply of carbon dioxide for assimilation, and oxygen for respiration directly from the atmosphere, yet the nitrogen, which is an essential constituent of their organization and by far the most abundant gas in the atmosphere is not utilized by plants in the gaseous form.

Having now established that plants contain gases, that these gases are the same as those of the atmosphere surrounding the plant, that oxygen and carbon dioxide are made use of in their gaseous forms in the life processes of plants, while nitrogen as a gas is not actively connected with the life of plants, and having established these facts with a wealth of accurate experiment and logical deduction that permitted no doubt of the truth, it was left to De Saussure's successors to elaborate the structure which he had so ably built, without being called upon to again readjust the foundations.

It was over thirty years before a work of importance in this line again appeared. In 1837 Dutrochet published his anatomical and physiological memoirs, in which he carefully studied the structure of vegetable organs as well as their functions. He was the first to rightly point out the relations of the cavities in plants to the movement of gases in respiration, that only cells with chlorophyll are able to decompose carbon dioxide, and to distinguish sharply between respiration and assimilation. But although he recognized the essentially different character of the two processes, respiration and assimilation, yet he used the erroneous and absurd nomenclature of the time, and called them nocturnal and diurnal respiration. The weight of his example did much to fix the terms in popular usage, where they still persist, in spite of the protests of every able investigator and writer upon the subject since; and even though the matter was set right by Garreau in 1851, who did admirable work upon plant respiration.

In 1865 appeared the handbook of experimental physiology of plants by Julius Sachs, the founder of the modern school of vegetable physiologists. The work was comprehensive, well balanced, and replete with clear ideas of the theoretical bearing and logical association of the facts.

The author's laboratory at Würzburg, where he shortly became established, has been the school from which most of the great plant physiologists of the present have received instruction and from which all have drawn inspiration. It is sad that its doors should now be darkened by the mists that have gathered over the intellect of its honored director.

In the handbook of Sachs a chapter is devoted to each of the three branches of the subject; aeration, or the movement of gases in the plant; respiration, or the action of atmospheric oxygen; and the effect of light upon vegetation, chiefly in assimilation. Each of the topics is treated in a clear and masterly manner.

Nationality of Discoverers and Writers.

Having traced the growth of knowledge regarding the vital relations of gases to plants up to the time when it was possible

to present the subject in a reasonably complete and well balanced manner, it will be more satisfactory to drop the chronological method of treatment, and to outline the salient features of the subject as they are understood at the present time. Before doing so, however, it will not be unprofitable to glance for a few moments at the parts which the several nations have played in this growth of knowledge, and at the reciprocal influence which has been exerted upon the teachers of those countries.

Science in its highest aspects has always been, as at the present time, the property of the whole world, knowing no political restraint or nationality. The barrier of language, however, has had much to do with retarding the diffusion of knowledge from the original sources of discovery into the text books, which serve as the means of enlightenment for the mass of learners.

The great discoverers and thinkers in our present subject, since the days of Malpighi, an Italian, have been either French, German or English. The Germans, before 1865, made no discoveries of commanding importance, and even their text books barely gave a true account of the subject as known at the time. Link, in 1807, ignored the all-important discoveries of Senebier and De Saussure, the more readily, doubtless, because they were Frenchmen. Twenty-five years afterward De Candolle's general treatise was translated from the French and became one of the most influential text books in Germany.

The chief activity among Englishmen occurred before 1800, and brought forward the names of Hales, Priestley and Ingenhousz. The advanced work was taken up by Frenchmen after 1800, among whom Senebier, De Saussure, Dutrochet and Boussingault are the most conspicuous investigators.

It is chiefly the French botanists, particularly De Candolle and Dutrochet, who have had the most potent and lasting influence upon the popular conceptions of the English regarding vegetable physiology. To them we can also trace a number of errors and omissions which figure in our school text books at the present time. De Candolle was the author of the

imaginary "spongioles" upon the root tips, which still have a sort of backwoods existence in the minds of some persons, although practically eradicated from the text books. He subscribed to the dual respiration of plants by which they gave off oxygen in daylight and carbon dioxide in darkness, which is still taught by certain American text books. In other American text books, which are still standard, a reaction is shown by the suppression of any suitable account of respiration proper, this important subject being referred to only incidentally in a line or two in connection with a short account of the use plants make of stored food material. Thus, in the latest revised edition of Gray's Lessons in Botany, as in the preceding edition, barely three lines are devoted to respiration, while two pages are given to assimilation. This work also teaches the incorrect doctrine[3] that carbon dioxide beside reaching the plant through the surface of the leaves, "is absorbed by the roots of plants, either as dissolved in the water they imbibe, or in the form of gas in the interstices of the soil." In Bessey's Botany, first issued in 1880, respiration is treated in essentially the same brief manner, and it is curious to note that the unusually complete index to the work does not contain the words gas, breathing, or respiration.

The modern phase of plant physiology may be said to have been introduced to English speaking students by the translation of Sach's text book in 1875, and reinforced by the appearance of Goodale's work in 1885, on this side of the Atlantic, and of Vines' work the following year in England. In these works the balance between respiration, assimilation and the physical movement of gases is fairly well maintained. Another work in English, less pretentious, but equally accurate and discriminating with the last mentioned, and antedating them, should be spoken of here, that of Johnson's How Crops Feed, published in 1870. The work was deservedly popular, and is still a source of exact information.

[3]In the discussion which followed the reading of this paper, Prof. Geo. L. Goodale gave Dr. Gray's reasons for retaining his early views. It was Dr. Gray's belief that his statement would prove, upon more extended investigations, to be essentially correct. Prof. W. H. Brewer spoke in further support of the conservative views of Dr. Gray.

(To be continued.)

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

By Clarence B. Moore.

(*Continued from November Number, 1892.*)

(*Second Paper.*)

SHELL HEAP THREE MILES NORTH OF PALATKA.[1]

This shell heap on the west bank of the St. John's has been largely washed away by the river, and in addition great quantities of its shells have been "lightered" to Palatka for use upon the streets. It was visited by Wyman and by Le Baron[2] who probably made no excavations, or at all events, did not put them on record. Implements found by them both at this point can be seen at the Peabody Museum, Cambridge.

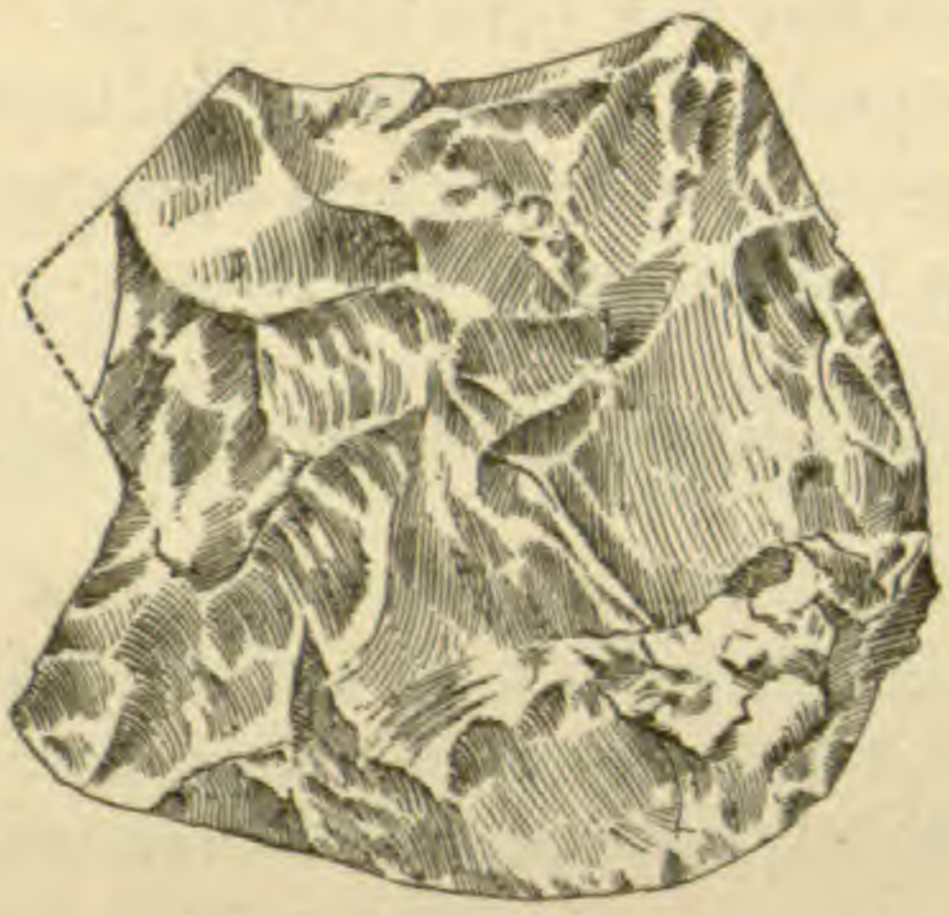
This shell heap is peculiarly rich in relics of stone and of bone, the implements and arrow-heads being rough and of the shell heap type, a much ruder form than the arrow-head or chisel usually found on the surface throughout Florida. It was twice visited by the writer, who found nothing of interest through excavation, but who, in April, 1892, was fortunate enough to be upon the ground at a period when the river was lower than upon any previous occasion on record, leaving bare a large area usually covered by water and rich in relics washed from the section of the shell heap bordering upon the river. A careful search yielded six bone awls; four other implements of bone; two articular portions of the bone of the deer, separated from the shaft by the aid of a cutting instrument; one flat fragment of bone lined along the entire length,

[1]W. W. Calkins (Proceedings of the Davenport Academy of Natural Sciences, Vol. 2, pages 226–227) explored a river mound "north of Palatka," which may be identical with the one under consideration.

[2]Smithsonian Report, 1882, p. 771 et seq.

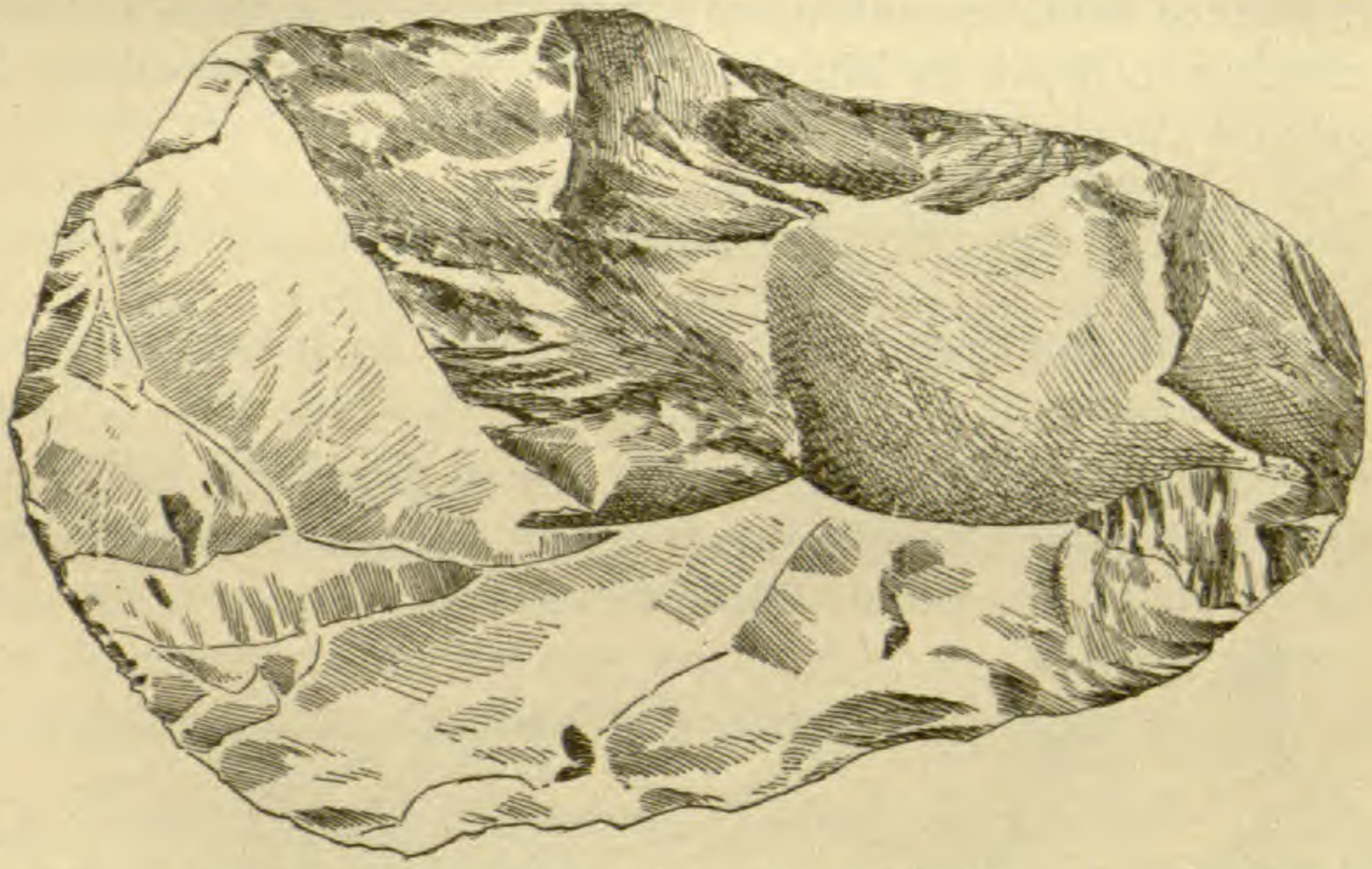
with a hole in the center extending almost through; a small piece of greenstone cut into the form of a pyramid, and six arrowheads, one of quite unusual pattern for the St. John's River, though found in some of the Western States[4] (Fig. 1).

FIG. 1. Size, $\frac{1}{1}$.



Captain Rossignol, formerly in charge of lighters carrying shell to Palatka, presented the writer with a collection of

FIG. 2. Size, $\frac{1}{1}$.



implements found *in situ*, at this place, by him, comprising a number of rude arrow-heads and an implement of chert very

[4]Charles C. Jones, Jr., in "Antiquities of the Southern Indians," describes implements of this character as being broken arrow-heads turned into scrapers. Fig. II, Plate xiv, represents a specimen from Georgia.

roughly wrought on one side, the other being left flat and smooth, recalling the implements of the Moustier Cavern, Dordogne, France (Fig. 2). This shell heap is probably one of the earlier class. A careful search along the entire section of the heap exposed to the action of the river failed to reveal any pottery, and none was met with in digging. Two pieces upon the surface were probably from later Indians. Investigations at this spot, however, were not based upon enough excavations to give a final judgment upon the subject.

TWO SHELL HEAPS ON SALT RUN.

Salt Run makes into Lake George about two miles southwest of where the St. John's leaves the lake. On the right bank, going up, at a distance of about half a mile from the mouth, is a shell deposit some two hunderd yards in length and one hundred yards in breadth, with a height of from four to five feet on the water's edge, increasing to a maximum of ten feet somewhat beyond the middle toward the land. On the same side of Salt Run, about half a mile farther up, is a deposit of shell presenting no irregularities of surface, though varying in depth at different points, owing to unevenness of ground upon which the deposit was made.

EXCAVATION I.

$5\frac{1}{2}$x5x$3\frac{1}{2}$ feet deep; after surface loam no pottery was met with. Fragment of bone awl at a depth of $3\frac{1}{2}$ feet. About three feet down was found, within half a foot of the bottom of

FIG. 3. Size, $\frac{1}{1}$.

the shell deposit, a lance-head of graceful pattern, perfect in every respect; the only lance-head, as far as the writer has been able to learn, ever found at a considerable depth from the surface in any of the shell heaps of the St. John's (Fig. 3). Other excavations yielded nothing of marked interest.

HITCHEN'S CREEK.

At the point where the St. John's River enters Lake George is Volusia Bar. About half a mile south, Hitchen's Creek joins the St. John's on the east side of the river. A short distance above, on the left hand side, going up the creek, are shell heaps and fields under cultivation; in all, about seven acres. A number of excavations yielded the usual bones of edible animals, and showed traces of numerous fire-places at varying depths. In the rear of the dwelling the shell deposit, considerably higher than elsewhere, is closely packed, the shells being crushed to a marked extent and having a large admixture of sandy loam—a "kjökkenmödding." In this deposit, below two feet, no pottery was met with, and the Paludinæ were of small size, in comparison to those of some of the shell heaps. Scattered on the surface were *Paludinæ georgianæ* of large size, mingled with a Paludina previously unknown, *Paludina georgiana*, variety *altior*, Pilsbry.[5] The portion of the shell deposit, toward the swamp, is composed of unbroken shells, mostly of the two varieties of Paludina, of unusually large size and unmixed with sand or loam. Plain pottery is found in great abundance throughout. Water is reached at a depth of two feet. This deposit was probably made by the aborigines living upon the shell ridge adjacent, after the ridge had attained considerable size, since but few of the new variety of Paludina were found in the ridge below the surface and at comparatively little depth.

SWAMP SHELL RIDGE NEAR MORRISON'S CREEK.

About three miles south of Volusia Bar, Morrison's Creek, a "cut-off," divided from the St. John's by an island, enters the

[5]The Nautilus, April, 1892, p. 142, et seq.

river. Below this point, in the swamp, entirely surrounded by water when the river is high, is a ridge of shell running north and south, 350 feet in length, with a maximum breadth of 180 feet. The southern extremity, the lowest portion of the ridge, is from 4½ to 6 feet in height; while the northern end attains a maximum elevation of 11 feet, 10 inches, above the level of the swamp when dry. Two excavations, 8x5 feet, 4 in.x9½ feet deep and 7½x4x6 feet deep, were made. Two or three bits of rude, plain pottery were met with, but none at a greater depth than two feet from the surface. Just below the surface a human humerus was found, and a human vertebra at a depth of one foot. A fire-place was at the same depth but at a distance from the vertebra, which showed no marks of fire. At a depth of four feet was found a triangular implement of shell; while 4 feet, 8 inches, down, immediately upon a fire-place, were two rude arrow-heads, one with ashes upon it. Animal bones, disconnected, mainly of the alligator, the turtle and the deer, were encountered throughout.

MT. TAYLOR.

This great swamp shell ridge,[6] the highest fresh-water shell deposit on the St. John's River, lies on the east bank, 200 yards (paced) from the water's edge. It is about one mile south of Volusia, and in dry seasons can be reached from the river by wading through the swamp; though access from dry land in the rear, about forty yards distant, is advisable. Under any circumstances, the services of a guide are a necessity. This shell heap is not referred to by Le Baron, nor is it particularly mentioned by Wyman, who could not have failed to describe so remarkable a heap, had it been accorded a visit. On page 44 of his memoir, Fresh Water Shell Mounds of the St. John's River, Florida, "two mounds, right bank, between Lake Dexter and Volusia," are included in the

[6]The thanks of the writer are due to Mr. William Edgar Bird, of Brooklyn, for much information and valuable assistance, and for most cordial permission to prosecute investigations on every portion of his 5000 acres lying between Lake Dexter and Volusia; including the great shell heaps and sand mound of Bluffton, in addition to Mt. Taylor and other shell heaps in the swamp.

list of shell heaps. This somewhat indefinite description would seem to indicate that his knowledge of the existence and location of Mt. Taylor was based upon information derived from others and not personally verified.

Mt. Taylor, standing alone in the swamp, which at high water is covered to a depth of 1½ feet. rises abruptly on every side, the ascent of one portion being at an angle of 40°. The maximum height of the ridge is 27 feet, 2 inches; its length at base 500 feet, with a maximum breadth of base of 175 feet. An almost level plateau on the summit has a length of 266 feet, with a maximum breadth of 80 feet. The mound is overgrown with palmettoes, palmetto scrub, live oaks and cedars. It lies longitudinally east and west, and is composed almost exclusively of Paludinæ of a smaller size than those of many of the later shell heaps. With the exception of a few fragments on the surface, no pottery was found in any portion of the heap, while implements of any description were of infrequent occurrence in the various excavations. As a rule, it may be said, the older the shell heap, the fewer relics are met with, though weapons of stone exist at all depths, even in mounds which contain no pottery, and in others below the level at which fragments of pottery are found.

(To be continued)

LEGENDS OF THE SUMIRO-ACCADIANS OF CHALDEA.

By Alice Bodington.

In The American Naturalist for August, 1892, Mr. Wilson puts in a strong plea for the study of prehistoric anthropology, nor can the claims of this science be overrated. But of equal interest in its own line is the study of that earliest civilization of Western Asia, which a few years ago was itself prehistoric, and which has only emerged into the light of day since the deciphering of the Cuneiform inscriptions of Assyria and Chaldea.

Some 5000 years B. C., wandering Turanian tribes[1] settled in the fertile alluvial plains at the mouths of the great rivers, Tigris and Euphrates, round the head of the Persian Gulf. Materials for building, it might be thought, did not exist, save for the giant reeds, fourteen to fifteen feet high, with which the Arabs of that marshy region still construct their huts. But the Sumiro-Accadians,[2] as these Turanian tribes were named, had the faculty possessed by their relations, the Chinese, of taking the first steps in inventions. Out of the mud and clay of their new home they made bricks, at first mere cakes of sund-dried clay; then these cakes were found to gain consistency by mixture with finely chopped straw; finally the clay was kiln-dried and gained a hardness and consistency equal to the best bricks produced now. The kiln-dried bricks were highly valued and were stamped with the name and titles of the king for whose palaces and temples they were to be used. Some bearing the name and title of Gudéa, the *patesi* or priest-king of Sirgulla, have inscriptions of

[1]Chaldea. Story of the Natives. Z. A. Ragozin.

[2]I must disclaim all responsibility for the spelling of proper names, since every authority I have consulted spells the names differently, and no fixed standard seems to have been arrived at. For instance, the spelling is sometimes Shumiro-Akkadian, sometimes Sumiro-Accadian.

a highly archæic character. A statue of unique interest was found at Sirgulla;[3] the head is strikingly Turanian in form and feature and bears a turbaned cap such as may still be seen in Mongolia. No type can be more strikingly unlike that of the Semitic Assyrians who were to be in later times the rulers of Chaldea. This statue, and the bricks with their archæic inscriptions found with it, are considered to be as old as between 4000 and 3000 B. C. A successor to this oldest of known monarchs was Ur-ea, king of Ur, whose date can be approximately arrived at,[4] and whose reign was over before the Elamite Conquest of Chaldea; when Chedorlaomer (Khadar-Lagamar), of Genesis, chapter xiv, marched an army across the desert to attack the rich and populous valleys of Jordan, and carried off Lot, the brother of Abraham, among his captives.

In the materials for holding their bricks together there was also progressive improvement; in the oldest buildings discovered, a sticky red clay or loam was used; then bitumen was substituted, which, being applied hot, adheres so strongly to the bricks that pieces of these are broken off when an attempt is made to take a fragment of the cement. Finally, in the latest Babylonian period, a beautiful white cement made of calcareous earth was used, which has never been surpassed for lightness and strength.

The whole country of Chaldea was absolutely flat; no vestige of natural hillock occurred throughout its whole extent. But the Accadians, whose very name shows their origin as mountaineers, were determined to raise their most important buildings above the inundations, and the wild beasts and noxious insects of the marshy plains. They erected artificial mounds of a size almost incredible. The great mound of Koyun-jik, which represents the palaces of Nineveh[5] itself, covers an area of one hundred acres, and reaches an elevation of ninety-five feet at its highest point. To "heap up such a

[3]Modern Tell-Loh.

[4]Chaldea, p. 214–19.

[5]Though an Assyrian city, Nineveh was built on the Chaldean plan, on a "tell" or mound.

pile of brick and earth would require the united exertions of 10,000 men for twelve years."[6] Then only could the construction of the palaces begin! The mound of Nebbi-Yuma, which has not yet been excavated covers an area of forty acres and is loftier and steeper than its neighbor. The platform of the principal mound of Mugheir (the "Ur of the Chaldees" from which Abraham went forth) is faced with a wall ten feet thick, of red, kiln-dried bricks cemented with bitumen.

The sub-structure of these mounds was made up of rough bricks and rubbish, hence the inherent weakness of the whole structure. The heavy semi-tropical rains falling for weeks at a time soaked through the casing of fine bricks, and the foundation became a mass of yielding mud. The mighty palaces and temples upon which the Assyrian and Chaldean kings lavished all the resources of wealth, all the treasures of art, sank into sand-choked, shapeless heaps. But the treacherous clay could preserve, hidden from the prowling Arabs who roam over this land of once mighty empires, priceless treasures of art and literature. Exquisite alabaster slabs, richly engraved, beautiful enamelled tiles forming colored friezes; the great human-headed bulls whose very discovery made the name of Layard famous; the life-like groups of lions and lionesses; and incomparably more precious than all, the royal libraries formed by the great kings, have been preserved for centuries beneath these unsightly mounds. For the one available substance, clay, formed the almost imperishable material of which the Chaldean and Assyrian "books" were made.

In the great mound of Koyun-jik (Nineveh) Layard found the remains of two sumptuous palaces, the residences of Sennacherib and of his grandson Asshurbanipal, who lived some 650 years B. C., two of the mightiest sovereigns and conquerors of the Eastern World. In Asshurbanipal's palace the explorer found two small chambers, containing a layer, more than a foot in height, of baked clay tablets, covered on both sides with cuneiform writings. Some were still entire, others in fragments. Layard filled many cases with the tablets, broken and unbroken; they were sent to England, and lay

[6]Five Monarchies. Rawlinson, Vol. 1, pp. 317–18.

for years in the British Museum untouched and unnoticed. George Smith, a young archeologist whose devotion to science and untiring industry and patience enabled him to undertake —and to succeed in—an apparently impossible task, determined not only to arrange and engrave the cuneiform texts on the tablets, but to *read* them, and this he succeeded in doing. The result was something astonishing. A series of twelve tablets was brought to light containing an epic poem of the highest antiquity and interest, the one alluded to further on, containing the earliest versions of the great Sun, Moon and Earth myths, of the Deluge, of Bel and the Dragon and of the Creation of the world. Fragments, of course, were missing, and to seek these George Smith was sent (by the generosity of the owners of *The London Daily Telegraph*) to search the Archive Chambers at Koyun-jik, and by inconceivable good fortune, found many of the missing pieces. On his second visit to Chaldea he fell a victim to plague. His last legible words were worthy of a martyr to science. "Not so well. If doctor present I should recover, but he has not come; if fatal, farewell to . . . *My work has been entirely for the science I study.* There is a large field for study in my collection. I intended to work it out, but desire now that my antiquities and notes may be thrown open to all students. I have done my duty thoroughly. I do not fear the change, but desire to live for my family."

Besides the tablets containing the epic poem, two hundred tablets divided into three books were found at Nineveh, fifty of which have been deciphered. The contents of these also are supremely interesting; one book, the oldest, reveals the Shamanitic stage of the Sumiro-Accadian religion; a stage in which many Turanian tribes still remain. It treats of "evil spirits" with which earth, sky and the "abyss" under the earth were conceived to be filled; of sorcerers who could employ the power of the evil spirits for the destruction of mankind, and of magicians who understood incantations and spells capable of driving away these malignant powers,[7] answering to the "black" and "white" magic of the Middle

[7]La Magie et la Divination chez les Chaldeéns. François Lenormant.

Ages. The second book treats of diseases, for which no cure was known but exorcisms, since diseases were conceived to be personal demons. Even so late as three or four hundred years B. C., Greek travelers visiting Babylon beheld sick persons brought out into the streets, where any passer by could enquire as to their malady and suggest a remedy! Even this strange plan was not resorted to till all known forms of incantation had been gone through and proved vain. The third book shows a great advance from this religion of pure terror. Beneficent spirits, gods in fact, were appealed to, especially Una, the Heaven-god; Ea, the great deity of the Earth and Waters; Im, the Storm Wind; Ud, the Sun, and Gibil, Fire. Ea, above all, was beloved by the Sumiro-Accadians for his goodness and trusted for his wisdom. His very name was a terror to evil spirits. But beneficent as he was, Ea was considered too great a deity to be lightly invoked, and in his son Meridug, they found a spirit whose sole office was to mediate between his father and suffering mankind. A whole tablet is devoted to a description of one such intercession, where the "Disease of the Head (insanity) has issued from the Abyss, from the dwelling of the Lord of the Abyss," and has attacked a human being. Then "Meridug has looked on his misery. He has entered the abode of his father, Ea, and has spoken unto him: 'My father, the Disease of the Head has issued from the Abyss. What he must do against it the man knows not. How shall he find healing?'" Ea replies, "My son, how dost thou not know? What should I teach thee? What I know, thou also knowest. But come hither, my son Meridug . . . ." Here follow directions for the cure of the sufferer that the "Disease of the Head may vanish like a phantom of the night."

The conception of conscience was also carried to a high degree among the Sumiro-Accadians. With such insistence and authority did it speak that it was believed to be the voice of an indwelling guardian spirit. Some most beautiful prayers took their origin from this belief; they have been called the Penitential Psalms, from their striking likeness to those psalms in which King David confesses his iniquities and

humbles himself before the Lord. I have space but for a few verses of the Sumiro-Accadian psalm called "The complaint of the repentant heart."

"O my God, my transgressions are very great; very great are my sins. I transgress and know it not. I wander in wrong paths and know it not. The Lord in the wrath of His heart has overwhelmed me with confusion. I lie on the ground and none reaches a hand to me. I cry out and there is none hears me. . . . My God, who knowest the unknown be merciful. . . . How long, O my God? . . . Lord Thou wilt not repulse Thy servant. In the midst of the stormy waters, come to my help, take me by the hand."

Since the key to the cuneiform inscriptions has been discovered, it has been evident that many legends of Genesis are varients of Sumiro-Accadian originals, and that from this source too was drawn the Jewish belief in magic, witchcraft, dreams, supernatural serpents, sacred trees, etc.; whilst the pure Monotheism of later times was fighting hard to establish itself in the hearts and minds of a people, who came from a cradleland of many gods. For in those palmy days of the Yellow Race, when it was at the head of human progress, the Semites are seen as nomad tribes dwelling amongst the Accadians, and in one most noted instance wandering from Ur of the Chaldees, till they finally reached Egypt and the Nile. And the legends, the superstitions, the forms of prayer of Accad are faithfully reflected in the earliest traditions of Israel.

(To be continued.)

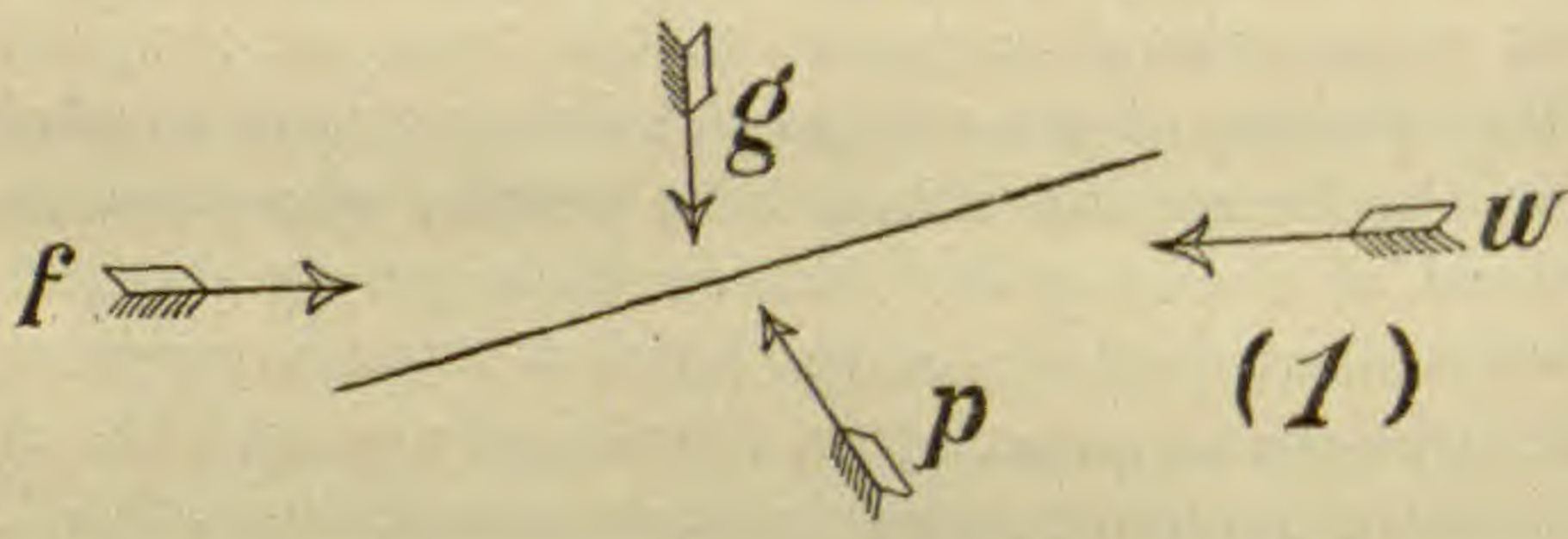
THE FLIGHT OF BIRDS.

By I. Lancaster.

I have been asked what effect the application of soaring methods has upon active wing flight. If soaring goes on so easily where gravity is the motive power, why do not all birds soar?

The soaring activity is not understood when such a question is put, obscurity arising, doubtless, from misconception.

The usual statement of soaring held by everybody, and especially by mechanical authority, is diagrammed in 1, where g represents weight, w, horizontal air resistance, and p,

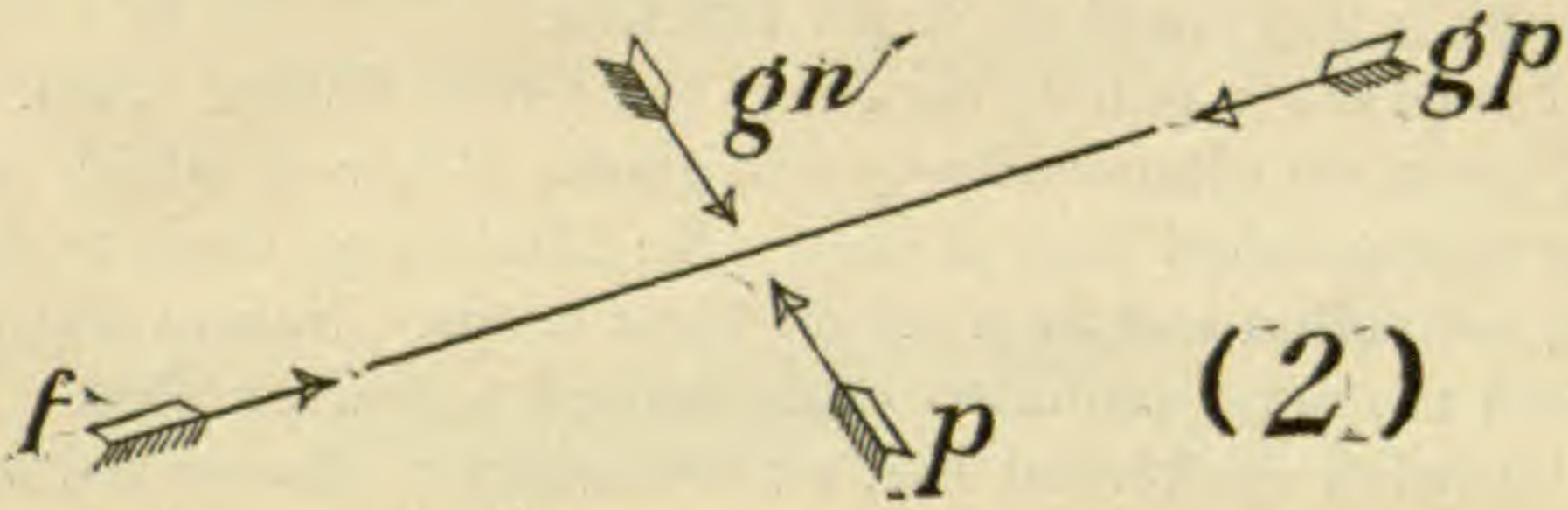


normal pressure. When a horizontal force, f, is applied, of sufficient magnitude to cause p to equal both g and w, the plane moves on the horizontal path of soaring flight. Soaring, or indeed any sort of bird flight, would be impossible thus stated, which may be called the formula method.

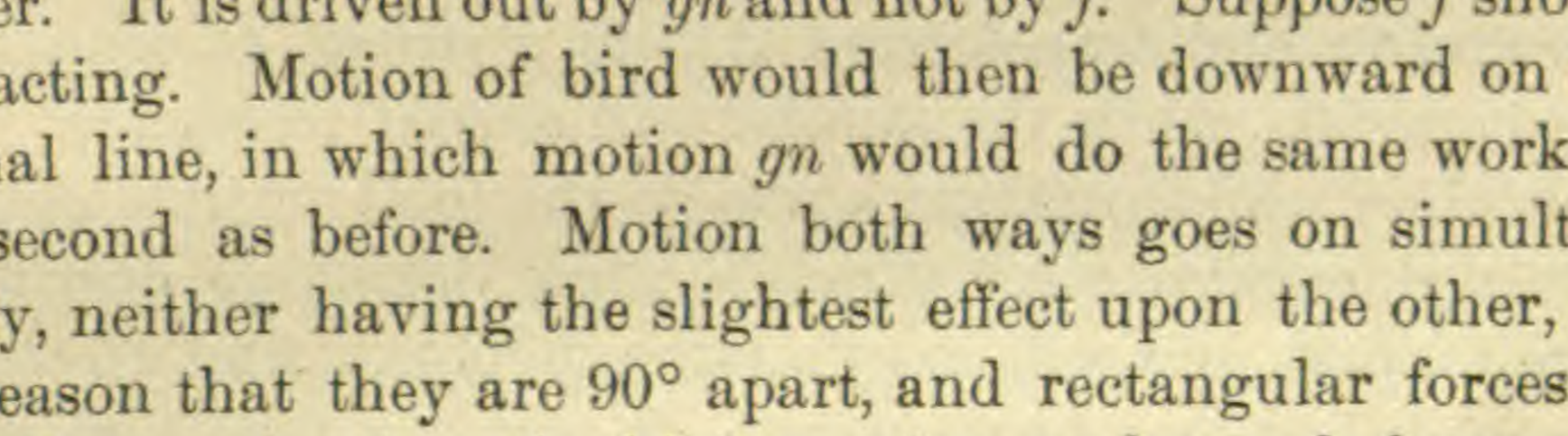
The soaring statement presented by nature, is seen in 2, where the horizontal force, f, and the horizontal resistance, w, are stricken out. Vertical g is replaced by gn and gp, while p remains the same in direction but not in magnitude. The pressure plane of air throws g out of vertical, making gn and gp out of it; p is equal to gn; f is equal to gp, and the plane soars; f pushes gp *up* as fast as gn pushes p *down*, producing a horizontal resultant.

Compare both statements with 3. In either case a prism of air as wide as the distance across the extended wings of the

bird, as thick as the perpendicular distance between the front and rear edges of the wings, and say fifty feet long, is driven



out of the way in one second of time. This is done, as above stated, in both cases, but the way of doing it is the vital matter. It is driven out by *gn* and not by *f*. Suppose *f* should stop acting. Motion of bird would then be downward on the normal line, in which motion *gn* would do the same work in one second as before. Motion both ways goes on simultaneously, neither having the slightest effect upon the other, for the reason that they are 90° apart, and rectangular forces do not affect each other, the bird moving under each force as if the other were not acting. The way in which the air is driven out is determined by *f*, but *gn* does all the work. The law of



fluid reactions throws all the air resistance to the bird's motion around, normal to the plane of its wings; *gn* then forces it down, while *f* keeps the bird level.

There is yet a very important point to be understood. In methods sanctioned by mechanical authority weight and air resistance are added in pressure. Both are assumed to be resistance to the soaring force. They should be subtracted,

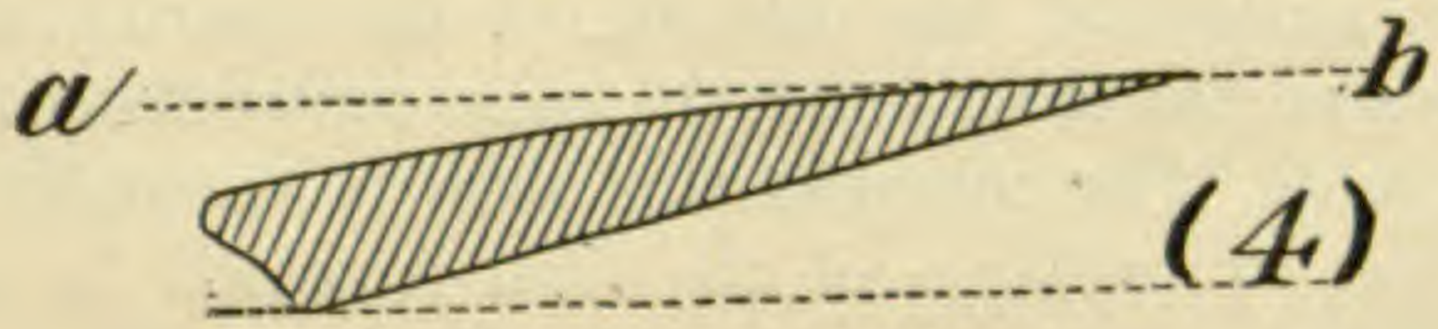
not added. p is a reaction against gn and not a force equal to gn, acting with it against the soaring force. Atmosphere resistance to the bird must be overcome, but weight overcomes it, and is itself used up in the exertion.

I once saw a parody on Jack, the Giant Killer. Jack was set upon simultaneously by two giants, either of which could have demolished him at once. He adroitly set them to fighting each other and then cut off their heads. Nature met with much the same problem. She desired a soaring bird. Two antagonists confronted her, air and weight. She so fashioned a bird as to take advantage of the law of fluid pressure, which set weight upon air resistance, in which contest they were both destroyed. She outdid Hercules in details of destruction. Pressure first cut weight into two unequal parts, then fell upon the greater and transformed it into a stream of escaping air condensation, while the smaller still offered resistance. Then from these condensations, equal to the total normal part, she obtained enough force through wing details to destroy the parallel part, and still have a large surplus. And all this was accomplished by a bird's wing. It seems a pity that such a magnificent piece of work should belong only to fishhawks, carrion crows, and the like.

Further, a single matter must be noticed. By referring to 3, it will be seen that there is a region behind and above the lower surface of the bird, and beneath the front edge, of triangular shape, that is not affected by the air. If the bird had but one motion on the upward slant, any thickness of parts, either of wing or body, would resist. But normal motion confines air collision to the under side, leaving a confused mass of eddies and reacting currents at the upper side. This region of eddies may be filled with solid materials and still not destroy the effect of a mathematical plane devoid of thickness. The front edge must be sharp but the rear edge may be overreached, as in 4, without further resistance. Such shape will move farther in the same time unit normally than a flat shape, while parallel motion is not changed in the slightest degree. The least projection above a b increases resistance.

I have called this region the "neutral zone," for want of a better name. The bodies of all birds are almost entirely confined to this zone.

The original question is now in order. Why do not all birds soar? For many reasons, among which are the following:



1. A bird may be of such shape that to throw it over to an inclination that gives a parallel factor small enough to be neutralized by the forward thrust would get part of the animal out of the neutral zone. The gray pelican of the Gulf coasts is a case in point; especially when its gullet is full of fish. It must flap to get thrust for its large parallel factor. If its wings were one foot longer on each side, it could doubtless soar continuously, even if its body did encroach on resisting air to some extent.

2. Weight may be too great for surface. In this case condensations escape too readily to be utilized. A wild turkey, prairie-chicken, or pheasant, are examples.

3. Weight may be too little for surface. Here condensation is too weak to give thrust. A species of sea-gull found on the lower Florida peninsula is a good example. In May and June, when food is scarce, they flap continually. In November and December, when food is plenty, they rarely move a wing. They will put into an empty craw their weight in food.

4. Life habits may prevent suitable feather construction. I presume this reason may apply to many small birds.

In the case of bats, the small factor may be entirely neutralized by flapping, as there seems to be at least no surface provision for utilizing the escaping condensations.

Flying squirrels do not sustain themselves.

But in no case of bird flight that I am acquainted with, can it be said that the normal factor is opposed by flapping. That is cancelled by its own work on air. Flapping goes on for the sole purpose of producing parallel motion by either increasing the energy of the condensations, or by a backward push against the air.

It must be borne in mind that the nearer the bird's wings approach horizontal, the less will be the obstructive gravity factor, but on the other hand, the more contracted will be the neutral zone. The moment this zone is encroached upon, more is lost in resistance of air, than is gained by lessening the small factor.

In experimenting, I never pay the least attention to what I have called the "soaring force," meaning thereby the force required to push the plane to the resultant, after the small factor is neutralized. I have never used scales delicate enough to measure this force. The moment the small factor is out of the way, the plane runs to the front to the limit of its freedom.

There is the narrowest possible margin between active and fixed wing flight. The only group of white pelicans I ever met with, eight in number, moved through the air in alternate flapping and gliding motion. Once only, I found them facing a southwester on fixed wings. They rested in the gale as firmly as if fastened to a rigid support. I had been observing them daily for five months and was rewarded by this very unusual exhibition. I shot one of them and found its gullet and intestines full of fish, and it could only spread one square foot of surface to each five pounds of weight, the greatest contrast of surface to weight I ever found.

The entire subject of bird flight has been persistently misconceived. It must be recast in toto to rescue it from the mass of delusion that involves it. To speak of erroneous details is labor lost. It is *all* erroneous. There is no stress in the entire activity, either in direction or magnitude, where stresses are supposed to be. When it is seen that from eleven-twelfths to seventeen-eighteenths, approximately, of total weight is employed in overcoming total air resistance to the

bird's motion, it is easily conceivable that the animal may overcome the remaining resistance without the necessity of estimating the muscular exertion of a creature weighing eight ounces in terms of horse power.

EDITORIALS.

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

—At the October meeting of the American Humane Association, held in Philadelphia, a resolution was passed of a very dangerous nature. It urged upon the Legislature of every State in the Union the enactment of laws which shall prohibit, under severe penalty, the repetition of painful experiments upon animals for the purpose of teaching or demonstrating well-known and accepted facts. The danger lies not in the intent, but in the fact that incompetent persons will feel it their duty to say that this experiment is painful, that another is unnecessary; and further, it strikes a deadly blow at all future increase of knowledge. An investigator in physiology can only be trained by the laboratory method. He cannot read the accounts of previous work and, with no further preparation, proceed at once to the solution of new problems. He must, rather, test his powers of experimentation by this very repetition which the proposed law prohibits. He must demonstrate for himself "well-known and accepted facts," and until he is able to bring his results into full accord with those facts he is incompetent to enter untrodden fields where he is without checks upon the accuracy of his results.

That the proposed legislation is not so vicious as some, which, fortunately, has been rare in the United States, is a matter for which we should be thankful; but, on the other hand, it would place a dangerous tool in the hands of such fanatics and unqualified persons as commonly occupy important positions in connection with the societies for the prevention of cruelty to animals. The writer has a somewhat extensive acquaintance with the physiological investigators of both Europe and America, and he knows them to be as a class humane persons unwilling to inflict unnecessary suffering upon any animal, and at the same time fully as competent to judge of the necessity of any experiment as the persons whom the proposed legislation would put in the position of prosecutors and judges.

—Lieutenant Peary has obtained leave of absence from the Secretary of the Navy for the purpose of further prosecution of Arctic explorations. He proposes to establish himself at a point on the northern coast of Greenland already visited by him as a base for

explorations northward. He expects to travel over the ice which covers the ocean, toward, and if circumstances permit, to the pole. It will be a fortunate circumstance, and one conducive to the success of the expedition, if land shall be found to the north of Greenland. This, Lieutenant Peary suspects, may be the fact. Transportation will be thus more easy and less dangerous, and much of interest to science may be expected to result. The determination of the geologic and paleontologic features of the region is of first-class importance to world-history, and much important evidence will be contributed toward the solution of some at present obscure problems.

—THE numbers of THE AMERICAN NATURALIST for 1892 were issued at the following dates: January, March 26; February, March 31; March, April 25; April, April 29; May, May 1; and all subsequent numbers on the first of the month named on the cover and pages.

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RECENT LITERATURE.

The Apodidæ.[1]—This, one of the latest of the "Nature Series," is not up to its predecessors either in accuracy of statement or suggestiveness of matter. The author, starting off with the intention of working up the comparative anatomy of this family of phyllopod crustacea, has been led to regard them as all-important in phylogenetic speculations, but, unfortunately, the good points of his volume are not original, while the original portions cannot be praised. Thus the central position of the Phyllopods in the Crustacean branch was recognized long ago, while the comparison of the foot of the Apus with the parapodum of a Polychæte worm was made long before Bernard entered the field of zoology. On the other hand the special studies of Mr. Bernard have led him to regard the differences between the annelids and Apus as of extremely minor importance. All you have to do, says he in effect, is to bend the anterior end of a carnivorous annelid back upon itself to produce this portion of Apus, and the thing is done. Resemblances are magnified and differences are minimized or ignored, and presto! Apus is the all-important arthropod. The name of Macmillan & Co. is so uniformly associated with only first-class works that we were surprised to see it on the present volume.

Darwin, and After Darwin; I, The Darwinian Theory, by George John Romanes.[2]—Romanes has devoted the best years of his life to the defence of the evolutionary faith and to making himself acquainted with, advocating, and extending Darwin's ideas. The present work consists of two volumes, viz., "The Darwinian Theory," and "Post-Darwinian Questions." The latter, soon to be issued, is to treat of heredity, utility, isolation, etc., which have become prominent since the death of Darwin. The former is a systematic exposition of the Darwinism of Darwin. It gives a résumé of the evidence, as it is known at present from classification, Morphology, Embryology, Paleontology, and Geographical Distribution, and includes a full discussion of the Theories of Natural and of Sexual Selection. It is a neat volume of 460 pages, fully

[1]The Apodidæ. A morphological study, by Henry Meyners Bernard. London and New York. Macmillan & Co., 1892.

[2]Chicago. The Open Court Publishing Company, 1892.

illustrated with new figures that largely increase its value. It is the best single volume on the general subject that has appeared since Darwin's time, and it is doubtless destined to be for years to come the one book to which general readers will turn for a concise statement of his ideas.

The principle of continuity makes antecedently probable the theory of organic evolution. The probability is strengthened by the fact that a natural classification of organic beings seems with the advance of knowledge more and more evident. The evidence from Morphology in the present volume is confined largely to a discussion of rudimentary structures, and especially such as are found in the human body. Muscles of the external ear, panniculus carnosus, feet, hands, tail, vermiform appendix of the cæcum, ear, hair, teeth, perforation of the humerus and flattening of the tibia are all treated. In this connection Dr. Louis Robinson's recent interesting observations on the grasping power of the infant's hand are reported. In discussing Embryology, considerable space is devoted to the phenomena of fertilization and karyokinesis, since the author believes the great similarity in these highly complex and specialized processes, shown throughout the animal and vegetable kingdoms, to be indicative of organic continuity, and hence evidence of the highest importance. The testimony afforded by connecting links, which has accumulated mainly since Darwin first published, forms an interesting section, made more interesting by good figures. Geographical Distribution is mainly a summary of Wallace's observations.

The evidence for and against the theory of Natural Selection is fully and fairly given. Romanes believes this principle to be not the sole, but the most important, factor of organic evolution. The main general arguments in favor of the theory are three, viz., its inherent necessity, the facts of heredity, variation, and struggle for existence being excepted; the fact that among all the millions of structures and instincts, each is developed for the benefit of its own species, and in not a single case for the exclusive benefit of another species; also the facts of domestication. Protective coloring, warning coloring and mimicry afford strong evidence. The theory of Natural Selection is often misunderstood, even by its advocates, notably by Wallace. Certain apparently strong objections to it are capable of being answered, and this Romanes proceeds to do, discussing the presence of similar organs in widely different groups (Mivart's instance of the eyes of the cuttlefish and of vertebrates), and the preservation of the first beginnings of structures (the Duke of Argyll's "Prophetic Germs"),

where the principle of correlation must play so important a part. The electric organ in the tail of the skate is a formidable case, which our present knowledge is not able satisfactorily to dispose of. In the last chapter Mr. Wallace's objections to Darwin's theory of Sexual Selection are replied to. The relations of the Darwinian doctrine to adaptation and beauty in organic nature are discussed in brief, and finally its relations to the fundamentals of religion.—F. S. LEE.

The Diseases of Personality, by TH. RIBOT.[3]—The new Psychology is under a great debt to Ribot for his studies of nervous diseases. In this last volume he bases personality as the highest form of psychic individuality upon the organic sense. All the bodily organs are constantly sending into the central nervous system impulses that give rise to sensations. These organic sensations are relatively more prominent in the lower animals, because there they are not, as they are higher in the scale, covered up by desires, passions, perceptions and ideas. Everywhere, however, they form the physical basis of personality. The author analyzes the organic, emotional and intellectual conditions and disorders of personality. The discussions include the meaning of "individual" in various forms of animal life; the personality of twins and double monsters; the rôle of memory; transformations brought about by hallucinations and by ideas; the phenomena of the dissolution of personality in cases of progressive dementia. A convenient, if not entirely comprehensive, classification of the diseases mentioned is that its three categories, viz., *alienation* (where the changed person is either entirely ignorant of his former self or regards it objectively), *alternation* (ordinary cases of double consciousness), and *substitution* (where the individual takes on a new character, yet is conscious of his former one, as where he now believes himself a king, although he remembers that he was formerly a poor man).

It is to be hoped that the same publishers will issue in the same neat form the author's works on the diseases of memory and of the will.

F. S. LEE.

[3]Authorized translation, Chicago. The Open Court Publishing Co. pp. 157.

General Notes.

GEOLOGY AND PALEONTOLOGY.

On the Formation of Oolite.—Dr. A. Rothpletz has proposed a theory of the formation of oölite, which is as interesting as it is novel. He noticed on the shores of Great Salt Lake, Utah, snow-white and silver-gray calcareous corpuscles in great numbers. They form a large part of the beach sand, and where they lie in the water they are partly covered with a bluish-green alga-mass. On examination the algoid bodies proved to be colonies of cells of the lime secreting algæ, Glœocapsa and Glœothece. By a series of experiments Dr. Rothpletz satisfied himself that the calcareous bodies secreted by the plants and the calcareous bodies which compose the beach sand are identical. Pursuing his researches, the author investigated the oölites from the strand of the Red Sea, and found that although slightly differing in structure, these oölites originate similarly to those of Salt Lake; that is, from lime secreting algæ.

In studying fossil forms Dr. Rothpletz has found in a gray limestone from the Lias of the Vilser Alps, and in the great oölite structure of the Wettersteinkalk structures analogous to the calcareous bodies from Salt Lake. Also the structure of certain calcareous oölites investigated by Wethered, and more recently by Bleicher (May, 1892), closely resembles that of the Red Sea oölite. In view of these facts, Dr. Rothpletz is inclined to believe that at least the majority of the marine calcareous oölites with regular zonal and radial structures are of plant origin; the product of microscopically small algæ of very low rank, capable of secreting lime.—From *Botanisches Centralblatt.* Translated by F. W. Cragin for the *American Geologist,* Nov., 1892.

Geology of Northeastern Alabama.[4]—Mr. Hayes' report covers the topography, drainage, stratigraphy and structure of Northeastern Alabama and adjacent portions of Georgia and Tennessee. It is intended as a basis for the economic geology of that region, and is, therefore, general rather than special and detailed. The rocks of the

[4]Report on Geology of Northeastern Alabama and adjacent portions of Georgia and Tennessee. Bulletin No. 4, Geological Survey of Alabama. By C. Willard Hayes, Assistant Geologist U. S. Geol. Surv., 1892.

area under consideration are all Paleozoic, and include representatives of all the larger subdivisions of that system. A columnar section of the strata exposed east of Browntown Valley gives the Cambrian rocks an average thickness of 7550 feet; the Silurian, 5935 feet; the Devonian, 180 feet; and the Carboniferous, 2175 feet. The formation names are all new, being purely geographic and local. It is questionable if the making of new names is necessary in regions contiguous to those with similar formations whose names have been generally adopted. The reason advanced, "to avoid all remote correlations," does not seem sufficient to warrant such innovations.

The report is accompanied by an excellent Geological map which shows a structure section through Northeastern Alabama.

The Mesosauria of South Africa.—Paleontologists are indebted to Prof. H. G. Seeley for a detailed description of the Mesosauria of South Africa, and an exact statement of the relations of Mesosaurus with Stereosternum.

For many years the genus Mesosaurus has been evidenced by a single fossil from Griqualand, South Africa, described by Gervais in 1865 under the name *Mesosaurus tenuidens*. In 1878 four specimens from the shale at the margin of the Kimberley Diamond field were obtained by Mr. G. H. Lee, and deposited in the British Museum. They show that Mesosaurus was a long-tailed reptile, with hind limbs well developed. Mr. Seeley found it impossible to refer the Kimberley specimens to *M. tenuidens*, and described them under the name *M. pleurogaster*. The well-developed abdominal ribs, formed of flattened plates, give this species its most distinctive feature.

A second specimen of *M. tenuidens* found in the district of Albania by David Arnold, preserved in the Cape Town Museum, shows the ventral aspect of the anterior part of the skeleton. There are some differences between this specimen and the type, but Mr. Seeley does not consider them important enough to prove specific distinction.

Another specimen of the same genus, from near Burghersdorf, is in the Albany Museum at Grahamstown. It shows the dorsal aspect of dorsal vertebræ and ribs. It indicates a new species, but there is no character available for its definition except that of relatively stout ribs.

In discussing the relations of Mesosaurus with Stereosternum, Mr. Seeley refers to *Stereosternum tumidum* from Brazil, described by Cope in 1886, and figures the shoulder girdle of that species to show a pair of wide, thin, crescentic bones in advance of the

shoulder girdle. In regard to these bones Mr. Seeley says: "If the transverse expansion seen in the Paris type of *Mesosaurus* is the same bone, its form is imperfect, but it is in the same position as the lateral crescentic bone of *Stereosternum*. There is nothing in the Cape Town *Mesosaurus* which corresponds in form with these bones in *Stereosternum*, and the shoulder girdle in the two types seems to be unlike, because the coracoids in the Brazilian genus met (as shown by the thickened margin) in the median line, while in *Mesosaurus* there seems to have been a squamous overlap as in Monotreme mammals, and as the coracoid cartilages overlap in *Triton* and *Salamandra*. This condition, so far as I am aware, is not otherwise suggested by remains of fossil reptiles. There is also a possible resemblance to Salamanders in the fact that the scapula and coracoid are not separable, though the Cape Town *Mesosaurus* appears to indicate a suture.

These African Sauromorpha closely resemble some genera from the Trias of Europe in general form and characters of the humerus. This leads Mr. Seeley to present, for the present, the following classification of a small group to which he gives the name "Mesosauria:"

Mesosauria.

General Characters.—Palate closed in the median line, teeth slender, prehensile; cervical ribs with a single articulation, dorsal ribs articulated to the anterior face of the neural arch. The shoulder-girdle formed of scapular and clavicular arches. Humerus expanded distally with an ent-epicondylar foramen. Digits terminating in claws.

Division I. Proganosauria.

Articular faces of centrum conically cupped, coracoid and scapula anchylosed, a larg· clavicle (or separate episcapulæ), a sacrum of four vertebræ, a foramen in the pubis, five bones in the distal row of the tarsus, neck short, tail long. South Africa, South America.

Division II. Neusticosauria.

Articular faces of centrum flat, coracoid and scapula separate, clavicles relatively small (no separate episcapula), sacrum unknown, a notch instead of a foramen in the pubis, neck long, tail short. Europe.

This order is an important diagnostic type of its horizon, and all additional knowledge respecting it is welcome.

Quarterly Jour. Geol. Soc., Nov., 1892.

Kansas Pterodactyls.—The wealth of material in the museum of the Kansas University affords Prof. Williston the opportunity to compare the genera Nyctodactylus, Pterodactylus and Pteranodon, with the following result:

"It seems very probable that the genus Nyctodactylus has no teeth in its jaws; it agrees in *every other respect* with the genus Pterodactylus, so far as known. Now, in not a few species of Pterodactylus the teeth are confined to the anterior end of the jaws, and their entire absence, unaccompanied by other structural differences, will hardly constitute an order, or even a family.

"Pteranodon differs from Pterodactylus, so far as that genus is known, in the united coracoscapulæ and pubes, both of which characters are found in Rhamphorhynchus.

"The sole family characters remaining then, for Pteranodon, are absence of teeth, a supra-occipital crest, and the articulation of the upper end of the scapula."

Prof. Williston, therefore, proposes the following classification:

Order Pterosauria.

Family Pterodactylidæ; sub-families, Pteranodontinæ, Pterodactylinæ.

Family Rhamphorhynchidæ.

Family Ornithocheiridæ.—Kansas University Quarterly, July, 1892.

Geological News, General.—Prof. S. W. Williston considers the practice of American text-books in Geology in introducing generic names of characteristic fossils as the names of the geological horizons whence they come as very reprehensible. Leconte's Elements contains a long list of such names that have long been out of use by paleontologists.—Kansas Univ. Quart., July, 1892.——According to T. Mellard Reade, marine sands are rounded and highly polished, while non-marine but purely glacial sands are invariably angular.—*Geological Magazine*, Oct., 1892.——M. Boule calls attention to some well-preserved remains of *Elephas meridionalis* found in the volcanic terranes of Senèze (Haute-Loire). They resemble *E. meridionalis* of the English Crag. This fossil confirms M. Boule's previous statement that while some of the volcanoes of the valley of the Allier (Coupet and Chilhas) were active during the middle Pliocene, others, like Senèze, are contemporary with *E. meridionalis*, and are therefore more recent.—*Revue Scientifique*, Nov., 1892.

Paleozoic.—A new form of the rare group Agelacrinitidæ has been found in the lower carboniferous limestone of Cumberland,

England. The fossil is described and figured in the Quart. Jour. Geol. Soc. May, 1892, under the name *Lepidodiscus milleri*, by G. Sharman and E. T. Newton.——Mr. H. G. Seeley describes a new reptile from Welte Vreden, Cape Colony, *Eunotosaurus africanus*. The dorsal vertebræ in form and number suggest the Chelonian type, but the specimen affords no proof that the whole of the dorsal vertebræ are preserved. Every character preserved differs from those of South African fossils hitherto known, with the exception of the pubis, which suggests that the specimen is referable to the Mesosauria in a division distinct from the Proganosauria.—Quart. Jour. Geol. Soc., Nov., 1892.——Eleven new species of Lower Silurian Ostracoda referable to the two genera Leperditia and Schmidtella are described and figured by E. O. Ulrich in the Amer. Geol., Nov., 1892.

Mesozoic.—Mr. Arthur Hollick calls attention to some fossil molluscs found at Tottenville and Arrochar, Long Island. Prof. Whitman has determined them to be marine cretaceous species. These, in connection with cretaceous plants found in the same locality, establishes the cretaceous strata which have hitherto been assumed to extend along the southern and western shores of Long Island.—Trans. New York Acad. Sci., 1892, p. 96.——A new Mosasaur, *Clidastes westii*, is described by Mr. Williston. The fossil was found in the uppermost of the Niobrara beds, and consists of a complete lower jaw, quadrate, portions of the skull, the larger part of the vertebral column, and the incomplete hind and fore paddle. It is estimated that the animal in life measured seventeen and one-half feet.—Kansas Univ. Quart., July, 1892.——Mr. Uhler's observations show three structural units in the Tuscaloosa formation instead of the one insisted upon by McGee and Darton. His division is as follows: 1 The Potomac formation proper laid down on the broken border of the crystalline rocks and capped by the variegated clay. 2 The Albirupean formation, which includes the series of clays, sands and cobble-stone deposits resting between the variegated clay and the base of the Severn formation. 3 Alternate clay sands resting upon the irregular and eroded surface of the white clay or sand of the preceding group.—Trans. Maryland Acad. Sci., 1892.

Cenozoic.—The collection of fossil marsupials at Queensland includes a fine series of mandibles of *Phascolomys mitchellii*, which support Mr. De Vis in making this a distinct species from *P. platyrhinus*. —Proceeds. Linn. Soc. N. S. W., 1891.——Two species, *Laganum*

decagonale and *Cassidulus florescens*, have been added by Mr. Gregory to the Australian fossil Echinoidea. The papers recently published by Cotteau, Tate, Bittner, and Gregory on Australian Cenozoic Echinoids, show that the fauna in question is Eocene and Oligocene instead of Miocene, and that it is remarkably rich and varied in genera.—*Geol. Mag.*, Oct., 1892.——A collection of mammalian bones from Mongolia reported on by Lydekker are of interest since they carry the Chinese mammalian fauna to a more northern district than has hitherto been known, and they indicate two Indian Siwalik species not previously recorded from Chinese territory, viz., *Hyæna macrostoma* and *Equus sivalensis*.—Records Geol. Surv. India, Vol. xxiv.

MINERALOGY AND PETROGRAPHY.[1]

The Origin and Classification of Igneous Rocks.—Mr. Iddings[2] has recently published at length the data upon which are based his conclusions concerning the causes of the different structures exhibited by the igneous rocks of Electric Peak and Sepulchre Mountain and of their varied mineral composition. The main results reached by this study have already been noticed in these pages.[3] It may be well again to call attention to the fact that in this region the different conditions attending the final consolidation of the ejected and of the intruded magmas affected not only their crystalline structure, but also their essential mineral composition; consequently, the molecules in a chemically homogenous fluid magma combine in various ways and form quite different associations of silicate minerals, producing mineralogically different rocks. For instance, biotite is an essential constituent of even the most basic of the intrusive rocks, while in the effusive phases it is rarely found in rocks containing less than 61% of SiO_2. Again, quartz is common in the coarser grained varieties of the former and is absent from those of the latter. Therefore, it is more proper to consider intrusive and effusive rocks that have a like chemical composition as *corresponding* or *equivalent* rocks, than those forms of the two series that have similar mineral compositions. The classification of igneous rocks should recognize the close dependence of structure and mineralogical composition upon geological relations. But, since the structure is the best exponent of these relations, structure should form the basis of this classification. Though giving most of his attention to the general subject of the relation existing between the structure and the geological position of the rocks of the area described, the author devotes a portion of his article to illustrating the intergrowths of hypersthene, pyroxene and hornblende that occur so plentifully developed in the rocks of the region.——In a second paper the same author[4] attacks the great problem of the origin of igneous rocks. He introduces the subject by outlining the growth of the theory first enunciated by Scrope, that the varieties of igneous rocks are the result

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2]Twelfth Ann. Rep. Director U. S. Geol. Survey, Washington, 1892, p. 569.
[3]Cf. AMERICAN NATURALIST, April, 1890, p. 360.
[4]The Origin of Igneous Rocks. Bull. Philos. Soc. Wash., xii, 1892, p. 89.

of the differentiation of a homogeneous magma. Scrope's notion was a crude one, but it has been built upon little by little until it has, in the hands of Mr. Iddings, been placed upon a footing secure enough to warrant its being thoroughly tested by observation and experimentation. The author points out the evidences of the close relationships exhibited by the rocks emanating from a volcanic center and their differences from similar groups from other centers, and then takes up the question of the differentiation of molten magmas. He brings forward geological and chemical evidences of the fact of differentiation, and explains the act upon Soret's principle that in a solution whose parts are at different temperatures there will be a concentration of the salt in the colder parts. Lagorio has shown that rock magmas are solutions, and Iddings believes they are solutions of the chemical elements or of their oxides. Consequently, after differentiation has taken place and cooling sets in, different minerals are formed according to laws that depend upon the proportions of the oxides occurring in the differentiated portions. This is apparently contradictory to the view of Rosenbusch,[5] who regards rocks as having originated in the differentiation of a magma, but of a magma which is a solution of *silicate salts* in a *silicate solvent.* As a result of the condition of affairs suggested by Iddings the first eruption from a volcanic center would naturally possess a composition intermediate between those of succeeding eruptions. As a fact the author states that the sequence is usually a rock of intermediate composition, followed by less siliceous and more silic-eous ones, to those very basic and very acid. The last eruptions are of very exceptional character. These will occur in small quantity only, and will be first eroded from the surface. Consequently these forms will be found principally in dykes. They are the forms to which Rosenbusch has given the group name "Ganggesteine." These rocks, according to Iddings, have their equivalents among volcanic flows, but the association of minerals in them is different. It is simply their structure, therefore, that characterizes the dyke rocks. They have originated in the same manner as have other eruptives, and consequently are not essentially different from them. The author's views are developed carefully and at considerable length. They will undoubtedly serve to turn the attention of petrographers to a subject that has lain neglected long enough—the comparative study of rocks of single geological provinces. The paper will well repay very careful reading by all petrographers and theoretical geologists, who should be

[5]American Naturalist, Nov., 1890, p. 1071.

glad to know that it is on sale by the Philosophical Society of Washington, from whose secretary it may be purchased for $1.

The Novaculites of Arkansas.—In his excellent discussion of the novaculites of Arkansas, Griswold[6] describes most of these rocks as consisting of very tiny irregular grains of quartz with occasional specks of carbonaceous matter. Originally the rock contained also well crystallized rhombohedra of calcite, traces of which are sometimes seen in the sections. Generally, however, the calcite has entirely disappeared, and its place is now occupied by a rhombic cavity, around which the quartz grains are packed as though they had been shoved about by the crystallizing carbonate. The good cutting qualities of Arkansas whetstones are thought to be due to the presence of these cavities. The purity of the Hot Springs novaculite is shown by an analysis that yielded:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
99.45	.26		.12	tr.	.19	.54	.06	=100.62

According to the author the rocks were first deposited as a mud or ooze, in which calcite crystallized. They were then consolidated by simple pressure, and finally, after upturning and erosion, they were supplied with a small quantity of secondary silica.

Petrographical News.—Osann[7] has discovered that the mineral heretofore regarded as sodalite in the Montreal eleolite-syenite is nosean, as it contains 5-6% of SO_4, and very little calcium. It is quite abundant in the rock, and is included as idiomorphic grains in its garnets. A microscopical test proposed by the author for distinguishing between nosean and sodalite is as follows: Moisten slide with dilute acetic acid to which a little barium-chloride has been added, and allow to stand in an atmosphere of the acid. Sodalite remains transparent, while nosean is covered with an opaque coating of barium sulphate.

The coloring matter of the black limestone of the Pyrenees is shown by Jannetaz[8] to be carbon, probably in the form of anthracite.

The new catalogue of geology and petrography issued by Ward's Natural Science Establishment, of Rochester, N. Y., deserves mention

[6]Ann. Rep. Geol. Survey of Ark. for 1890, Vol. iii, pp. 122–168.

[7]Neues Jahrb. f. Min., etc., 1892, i, p. 222.

[8]Bull. Soc. Franç d. Min., xv, 1892, p. 101.

in these notes because of the full list of rock names contained in it. The principal rock types are defined, and under each are given the technical names of all its varieties. It is further interesting as an indication of the growing importance of lithology in this country, since it is quite evident that Prof. Ward would not find it advisable to keep in stock such a large quantity of rock material were the demands for it rare. The catalogue may well serve the geologist as a table of petrographical synonyms.

A New Occurrence of Ptilolite.—A new occurrence of *ptilolite* has been discovered by Cross and Eakins[9] in Custer County, Col., about three miles southeast of Silver Creek, in the vesicles of a dull green devitrified pitchstone. The mineral is in very slender needles that are optically negative. An analysis made on very carefully selected material gave:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O	Total
67.83	11.44	3.30	.64	2.63	13.44	=99.28,

which is equivalent to $R_7\,Al_2\,Si_{10}\,O_{24}+6\frac{2}{3}\,H_2O$, a formula identical with that determined for mordenite by Pirsson.[10] Clarke[11] regards a part of the water in each mineral as basic, and believes that mordenite, the ptilolite from Silver Creek and the original ptilolite (which is poor in Na_2O) are mixtures of the salts. $Al_2\,(Si_2O_5)_5\,Ca\,H_2.\,3Aq$, $Al_2\,(Si_2O_5)_5\,Ca\,H_2.\,6Aq$, $Al_2\,(Si_2O_5)_5\,Na_2\,H_2.\,6Aq$ and $Al_2\,(Si_2O_5)_5\,K_2\,H_2.\,6Aq$.

Mineralogical News.—*Polybasite* and *tennantite* are reported by Penfield and Pearce[12] from the Mollie Gibson Mine in Aspen, Col. The former is the ore of the mine. It occurs massive, often associated with barite and siderite. It is of a grayish-black color, and has disseminated through it patches of the lighter tennantite. Analyses, corrected for impurities, follow:

	S	As	Sb	Aq	Pb	Cu	Zn	Fe
Polybasite.....	18.13	7.01	.30	56.90		14.85	2.81	
Tennantite...	25.04	17.18	.13	13.65	.86	35.72	6.90	.42

Crystals of both minerals are known to occur in several of the Colorado mines, though they have not yet been described.

[9]Amer. Jour. Sci., August, 1892, p. 96.
[10]Cf. American Naturalist, 1891, p. 372.
[11]Amer. Jour. Sci., August, 1892, p. 101.
[12]Amer. Jour. Sci., July, 1892, p. 15.

The *cerussite* from Pacaudière, near Roanne, Loire, France, is stated by Gonnard[13] to be associated with copper, silver and lead compounds, pyrite, limonite, quartz and calcite. Its simple crystals present a large variety of planes. Twinned crystals are common, and trillings are known. A description of the several types is given by the author. For sixty years past the same mineral has been known to occur at the argentiferous galena mines of Pontgibaud Puy-de-Dôme, but the fact has not been noted in the treatises on Systematic Mineralogy. All the crystals seem to have been formed at the expense of galena and bournonite by the action of CO_2 from the neighboring volcanic vents. The habit of its crystals is well described by Gonnard[14].

Morenosite [(Ni Mg) SO_4+7H_2O] in green stalactites from the foot of the Breithorn in Zermatt, yielded the same mineralogist[15] the figures $SO_3 = 28.7$; $NiO = 18.5$; $MgO = 6.5$; $H_2O = 46.5$. A single fragment of an ochre-yellow mineral from New Caledonia is a silicate of nickel, magnesium and iron:

SiO_2	Fe_2O_3	Al_2O_3	NiO	MgO	H_2O	Total
33.0	18.5	1.5	26.3	8.0	14.0	= 101.3

Frossard[16] substantiates the statement of Mallard that the black garnet *pyreneite* is a grossularite and not a melanite as reported by Raymond. Its density varies between 3.375 and 3.53.

Vesuvianite is reported by Pisani[17] from Settino in the Rhetian Alps. Its analysis gave:

SiO_2	Al_2O_3	FeO	CaO	MgO	MnO	Loss	Total
39.0	14.3	1.8	37.4	6.7	tr.	.9	= 100.1

The supposed *martite* crystals in the rock of Cuzeau, Mont Doré, are tabular hematites cemented into octahedra by magnesio-ferrite, as determined by Lacroix.[18]

In the basic clays of Condorcet near Nyons, Drôme, France, are boulders of siliceous limestone, with cavities whose walls are lined with bi-pyramidal *quartz* crystals, transparent *celestite*, *dolomite* and *calcite*. The quartz and celestite both contain rare planes beautifully developed.[19]

[13]Bull. Soc. Franç d. Min., xv, 1892, p. 35.
[14]Ib., xv, p. 41.
[15]Ib., xv, p. —.
[16]Ib., xv, p. 58.
[17]Ib., xv, p. 47.
[18]Ib., xv, p. 11.
[19]Ib., xv, p. 27.

Mineral Syntheses.—Bourgeois and Traube[20] having failed to produce *carbonates of the magnesium* group of elements by the reaction of urea, water and metallic chlorides on each other at 130° in sealed tubes, have made another attempt at their synthesis by substituting potassium cyanate for the urea. The attempt proved successful, needles of *aragonite* and rhombohedra of *dolomite* and *magnesite* having been produced under the conditions mentioned, when the chloride used was a mixture of the magnesium and calcium salts in molecular proportions.

By the slow action of dilute solutions of copper chloride upon freshly precipitated lead hydroxide at ordinary temperatures there is produced a blue powder consisting of octahedra and cubes of *percylite*, with which are associated quadruple twins of a colorless mineral supposed by C. Friedel[21] to be *phosgenite.*

Crocoite has been obtained by Ludeking[22] upon allowing a strong solution of caustic potash to stand for some time in contact with lead chromate in the presence of a little potassium chromate. By using a large excess of very strong caustic potash *phœnicochroite forms.* The crystallization of the latter substance is due to the abstraction of the solvent by the carbon-dioxide of the air, and of the former by a further reaction between the caustic potash and chromic acid.

New Minerals.—*Penfieldite.*—This mineral, discovered by Prof. Genth[23] on the slags from Laurion, Greece, is evidently produced by the action of sea water upon the materials of the slag. It is usually in the form of hexagonal prisms with basal planes, or in prisms tapered by pyramids. The color is white and the lustre vitreous to greasy. An analysis of the tapering crystals gave: Cl = 18.55, Pb = 78.25, O = ——, indicating the formula Pb O. 2Pb Cl_2.

Brazilite is a new tantalo-niobate from the iron mine Jacupiranga, in S. São Paulo, Brazil. Hussak[24] describes it as occurring in the magnetite-pyroxene rock called by Derby jacupirangite. It was separated by washing the decomposed residue of this rock in a miner's pan, and has heretofore been taken for orthite. Its crystallization is monoclinic with $a : b : c = .9859 : 1 : .5109$. $\beta = 98° 45\frac{1}{2}'$. The forms observed in its crystals are $\infty P\overline{\infty}$, ∞P, $\infty P2'$, $-P\overline{\infty}$, oP, $P\overline{\infty}$,

[20]Ib., xv, 1892, p. 13.
[21]Ib., xv, 1892, p. 96.
[22]Amer. Jour. Sci., July, 1892, p. 57.
[23]Amer. Jour. Sci., 1892, p.
[24]Neues. Jahrb. f. Min., etc., 1892, ii, p. 141.

$2P\infty'$, P and —P. The crystals are tabular parallel to the orthopinacoid and are nearly always twinned, frequently yielding very complicated groupings. The color of the larger crystals varies from sulphur-yellow to black. Their hardness is 6.5 and density 5.006. The plane of their optical axes is parallel to the clinopinacoid, and the double refraction is negative. The extinction is 8°–15° in obtuse β, and the pleochroism varies between dark-brown and oil-green. The minerals associated with brazilite are apatite, magnetite, perofskite, ilmenite, and a spinel. An analysis of the new minerals is promised shortly.

Landauer's Blowpipe Analysis.—This little book[25] will be cordially welcomed by English and American teachers in colleges in which the use of a large manual of blowpipe analysis is undesirable. It is as suitable for classes in mineralogy as in chemistry, since it will enable the student to determine the composition of a mineral as rapidly as will the use of the great majority of Determinative Mineralogies upon the market. Moreover, it possesses one desirable advantage over those schemes in which the hardness, color and streak of chemical compounds are made to serve as distinctive tests for them, in that it compels the experimenter to study the chemical nature of the substance with which he is working. A mineral is a definite chemical substance. A student of mineralogy who is unfamiliar with the composition of bodies with which he is working, though he may know considerable about their physical properties, is neglecting the foundation upon which his knowledge of minerals must rest. The little book before us is an excellent introduction to the larger works like those of Brush and Plattner. It is, besides, complete enough for most of the purposes to which such a book is usually put. Beginning with a good description of the apparatus and reagents necessary to blowpipe manipulation, it follows with an account of the operations employed, describes Bunsens flame reactions, mentions the distinctive tests for the various chemical elements, gives Landauer's and Egleston's schemes for the systematic examination of inorganic substances, and closes with tables exhibiting the reactions of the various metallic oxides, and in a condensed form the results of the different operations described in the text. The book must find a place in many laboratories.

[25]Blowpipe Analysis, by J. Landauer. Authorized English Edition by James Taylor. Second Edition. Macmillan & Co., 1892, pp. 14 and 173.

BOTANY.

A New Edition of Wolle's Desmids.—Botanists who failed to secure a copy of the first edition of Wolle's "Desmids of the United States," and who were meditating whether or not to pay the extortionate prices charged by the antiquarian booksellers, will be glad to know that the author has brought out a new edition with considerable additions, which he is offering at $6.50. The book was well worthy of this new edition, which will doubtless find a ready sale.

Botanical Definitions.—It is the misfortune of every science that it has a mass of technical words or of words with technical meanings, which must be defined before they can be understood by the general reader. Indeed the number of these terms is so great in some sciences, notably Botany, that even the professional botanist is obliged to turn to some handy volume for the meaning of a strange word. So we must have glossaries and dictionaries of scientific terms. The latest one to appear is Crozier's "Dictionary of Botanical Terms," a pretty volume of about 200 pages, upon which the publishers (Holt & Co.) have done well their share of the work. Turning to the substance of the volume we find it disappointing. While it catalogues about 6000 words and omits few words of importance, and while its definitions are generally not false, they are in very many cases so meagre as to leave the user of the book little wiser after than before consultation. The author has failed to distinguish between a true statement regarding a word, and a *definition* of the word. Many of the definitions in this book do not define. As examples, see Accessory Gonidia ("gonidial formations in some species of Mucorini in addition to the typical kind"), Apical Cell ("the generating cell of a growing point"), Archegonium ("the female organ in the higher cryptogams"), Basidiospore ("a spore borne on a basidium, as those of mushrooms"), Linnæan System ("the system of classification devised by Linnæus, founded upon the number and arrangement of the stamens and pistils; sexual system"), Sexual System ("see Linnæan system"). On the other hand, some of the definitions of the new terms are well drawn. The older terms fare pretty well, and are as well defined as they usually are. It is the new terms which often fare badly. Yet such a book is not wholly useless. When one needs to confirm his impression as to the meaning of a word it will be helpful, for, as indicated

above, the statements are generally true. The general reader, however, and the beginner in botany who meets a word for the first time and who seeks a definition which will give him a clear notion of its meaning, will often turn away disappointed.—CHARLES E. BESSEY.

Timely Words as to the Nomenclature Question.—At this time, when there is not a little of ferment and effervescence over the rules which should govern in the nomenclature of plants, it will be well for us all to read the following remarks made by Alph. De Candolle in the introduction to the "Paris Code" of 1867. They convey very well the ideas of the "moderns" of to-day.

"The system of nomenclature of organized beings, founded by Linnæus, was looked upon until the middle of this century as extremely ingenious, and has been thought, by some authors, a most admirable one. It was quoted in philosophical lectures and found superior to that of chemical nomenclature, on account of its adapting itself more readily to changes necessitated by the progress of discovery. Botanists professed for it the greatest veneration. They boasted of having developed a better nomenclature than zoologists, which is not surprising, as the most illustrious botanists, thirty or forty years ago, gave infinitely more attention to this subject than zoologists.

Nevertheless, of late years, a change has been perceptible; opinion is wavering, enthusiasm abated. Here and there, in different countries, doubts have arisen and complaints have been made regarding the system of botanical nomenclature." * * *

"It follows that it is useful—every twenty years, for instance—to revise the *ensemble* of received rules." * * *

"Without going far back it is easy to see that since the end of the eighteenth century botanists have endeavored to free themselves from many useless shackles put on by Linnæus and tightened by his disciples, above all with relation to the choice of generic names. De Candolle [the elder, in *Théorie Elémentaire*] was ruled by the idea of having the law of priority properly respected, a law which, fifty years ago, was often unscrupulously infringed." * * *

"The time must however come, when actually existing vegetable forms having all been described, herbaria containing undoubted types of them, botanists having made, unmade, or oftentimes remade, elevated or lowered, and above all modified, some hundred thousand groups, from orders downward to simple varieties of species, the number of synonyms having become infinitely greater than that of admitted groups—it will become necessary to effect some great revolution in the

formation of science. This nomenclature that we are striving to improve will have the appearance of an old scaffolding, made up of parts laboriously renewed one by one, and surrounded by a heap of more or less embarrassing rubbish, arising from the accumulation of pieces successively rejected. The edifice of Science will have been constructed, but it will not be sufficiently clear of all that has served to raise it. Perhaps there will then come to light something very different from the Linnæan nomenclature—something will have been devised for giving definite names to definite groups." * * *

"In the meanwhile, let us improve the system of binomial nomenclature introduced by Linnæus. Let us endeavor to accommodate it to the continued and necessary alterations that take place in science, and for this purpose let us diffuse as well as we can the principles of the method; let us attack slight abuses, slight negligence, and let us come, if possible, to an understanding on debated points. We shall thus have prepared, for some years to come, the way for better carrying out works on systematic botany."

Engler and Prantl's "Naturlichen Pflanzenfamilien."—This great work is making such headway that another year will nearly complete it. During 1893 we are promised the Fungi, Hepaticæ, Musci and the Pteridophytes. The Gymnosperms and Monocotylodons, are already completed, while but few families of the Dicotylodons remain to be worked. Recent numbers treat of the Compositæ (74), Oleaceæ, Salvadoraceæ and Loganiaceæ (75), and Myxogasters and Fungi (76), the last by the well-known Mycologist Schröter. His tabular view of the system of classification of the Fungi which he adopts is instructive. See page 50.

Mo. Bot. Garden,
1895.

- Phycomyctes.
  - Oömycetes.
    - Sporangieæ
      - Hemisporangieæ
        - *Chytridineæ.*
        - *Ancylistineæ.*
      - Eusporangieæ
        - *Monoblepharidineæ.*
        - *Saprolegnineæ.*
    - Conidieæ
      - *Cystopodineæ.*
      - *Peronosporineæ.*
  - Zygomycetes.
    - Sporangieæ
      - *Mucorineæ.*
    - Conidieæ
      - *Entomophthorineæ.*
- Eumycetes.
  - Ascomycetes.
    - Euasceæ.
      - Hemiasceæ
        - *Protomycetineæ.*
        - *Ascoidineæ.*
      - Protoasceæ
        - *Saccharomycetineæ.*
        - *Endomycetineæ.*
      - Holoasceæ.
        - Hymenioasceæ.
          - Gymnocarpeæ
            - *Taphrineæ.*
            - *Helvellineæ.*
          - Hemikleistocarpeæ
            - *Pezizineæ.*
            - *Phacidiineæ.*
          - Kleistocarpeæ
            - *Tuberineæ.*
        - Plectasceæ
          - *Gymnoascineæ.*
          - *Elaphomycetineæ.*
        - Pyrenoasceæ
          - *Perisporiineæ.*
          - *Sphaeriineæ.*
          - *Hysteriineæ.*
  - Basidiomycetes.
    - Hemibasidieæ
      - *Ustilagineæ.*
      - *Tilletiineæ.*
    - Eubasidieæ.
      - Protobasidieæ.
        - Phragmobasidieæ
          - *Uredineæ.*
          - *Auricularineæ.*
        - Schizobasidieæ
          - *Tremellineæ.*
          - *Dacryomycetineæ.*
      - Holobasidieæ.
        - Hymeniobasidieæ.
          - Gymnocarpeæ
            - *Exobosidiineæ.*
            - *Thelephorineæ.*
            - *Clavariineæ.*
            - *Hydneineæ.*
            - *Polyporineæ.*
          - Hemiangiocarpeæ
            - *Boletineæ.*
            - *Agaricineæ.*
            - *Phallineæ.*
          - Angiocarpeæ
            - *Hymenogastrineæ.*
            - *Lycoperdineæ.*
            - *Nidulariineæ.*
        - Plectobasidieæ
          - *Sclerodermineæ.*

ZOOLOGY.

Locomotion of Limpets.—Herdman records[1] several facts which seem to militate against the view that limpets do leave their resting place and return to it again. It has been shown that they can leave and travel some distance, but he found a specimen of *Patella vulgata* which was sticking to a cylindrical bar of iron and which had the shell molded to fit the surface. Now as the bar was short and free to move about, the probabilities are that if it once left the support it would never be able to return to it. In other cases he found limpets at the bottom of deep pits, from which it would be very difficult, if possible at all, for them to extricate themselves.

Tunicate Studies.—Herdman publishes[2] some notes on the structure of the Appendicularian, Œkopleura. This form was studied by serial sections, and the results, most interesting, are: The condition of the endostyle as a diverticulum to a great extent shut off from the branchial sac; the presence of a genital duct; the distribution of the enlarged ectoderm cells and the cuticular test; the exact course of the nerve cord through the posterior part of the body; and the shapes and positions of the alimentary and reproductive viscera.

In the same publication[3] Garstang points out that *Appendicularia mossii* (*Mossia dolioides*) is to be regarded as a member of the genus Kowalevskia of Fol, and that it in reality has not that importance from the phylogenetic standpoint which was attributed to it by Herdman in his "Challenger" report.

The Skeleton and Teeth of the Australian Dugong.—Zoologists are indebted to Prof. G. B. Howes and Mr. J. Harrison for a valuable paper on the skeleton and teeth of the Australian Dugong, of which the following is an abstract:

"The authors showed that the vertebral epiphyses are more fully developed than Albrecht has suspected, and that they appear late and rapidly ankylose with the centra, a feature of especial interest, in view of Lefévre's alleged discovery of fully developed epiphyses in *Halitherium schinzii* and *Metaxytherium*. On comparison with the Cetacea

[1]Trans. Liverpool Biol. Soc., vi, 22, 1892.

[2]Trans. Liverpool Biol. Soc., vi, 40, 1892.

[3]L. C., p. 57, 1892.

they sought to associate the reduction of the epiphyses with adaptation to an aquatic existence.

"In dealing with the limb-skeleton they described a longitudinal cleavage of the phalanges, akin to that recorded by Kükenthal for the Cetacea. The only structures observed which were at all comparable to supernumerary phalanges were derivations of the terminal (ungual) ones, arising proximally; and the observations lend no support to Kükenthal's view that supernumerary phalanges are epiphysial in origin.

"The first upper incisor and the four lower ones of either side were shown to have milk predecessors, which are early absorbed. Five teeth were shown to be present on either side of the symphysial region of each mandibular ramus of *Manatus*, the fifth one being claimed as a canine; and in this animal the authors described milk predecessors to the two anterior pairs of mandibular cheek teeth."

On the Cephalo-humeral Muscle and the So-Called Clavicle of Carnivora.—At a meeting of the Philadelphia Academy, Dr. Harrison Allen spoke of the peculiarities of the cephalo-humeral muscle in mammals and invited especial attention to the presence of a small fibro-cartilaginous disc in the junction of the cephalo-humeral with the muscles which are inserted in the bones at the region of the shoulder. This is well defined in *Felis* and is identified as a rudimental clavicle. Dr. Allen has detected this structure in *Herpestes*, *Taxidea*, *Cercoleptes*, *Bassaris*, and *Procyon*.

The cartilage is either in the form of a flat disc or a minute scythe-shaped rod, and is constant in lying directly over the greatest convexity formed by the round of the shoulder. It seems to give strength to the center of a muscle system of which the cephalic, cervical, pectoral and latissimal sheets are parts. The identification of such a plate or rod with a true clavicle is doubtful, since in *Balantiopteryx* (a genus of bats) the structure above described is remarkably developed, while the clavicle is as well formed as in any other animal. The long rod-like body is continuous with a fascicle of fibres arising from the pectoralis and receives the insertion of the occipito-pollicalis. The anterior end of the rod lies in the upper border of the wing membrane and is continuous with the fibrous thread which represents the tendon of the occipito-pollicalis as this muscle is defined in the bats generally. From both the proximal and distal divisions of this muscle delicate fascicles pass toward the elbow and the entire plan appears to be associated with the rudiment of the characteristic skin sac. Slight modification of this arrangement is met with in the allied genus *Rhynchonycteris*.

Comparison of this arrangement with that seen in the common brown bat (*Adelonycteris fiuscus*), the noctula bat (*Noctulinia noctula*), and the false vampire (*Vampyrus spectrum*) showed by the part taken by the rod in *Balantiopteryx* is the tendon of a pectoral muscle-fascicle which is inserted into the occipito-pollical muscle as it crosses the shoulder, while in the group of the Molossi the muscle-fascicle is fleshy throughout its entire extent, but on the whole preserving the same relations. Thus the fibro-cartilage of *Balantiopteryx* is represented by fibrous tissue in *Adelonycteris* and both these in turn by muscle in the Molossi. Dr. Allen believed that it was inexact to speak of a clavicle and of this rod as things which were equal. The clavicle acts with the scapula in supporting the head of the humerus but in no wise limiting or determining its movements, while the rod is always over the outer aspect of the shaft of the humerus below its head and acts as a check to abduction of this bone.—Proceeds. Phila. Acad., Pt. 2, 1892.

A New Synaptomys from New Jersey.—While trapping for a type series of the new race of *Evotomys* described by Mr. Stone in the present number of THE NATURALIST, I had the fortune to secure a specimen of this long-looked-for genus, which is, I believe, the first taken in flesh east of the Alleghany Mountains.

It had previously been detected by the U. S. Department of Agriculture in the rejects of a barn-owl living in the tower of the Smithsonian Institution.

A comparison of the New Jersey specimen with two *Synaptomys cooperii* from Ohio, courteously loaned by Mr. J. A. Allen, of the American Museum of Natural History, N. Y., shows such marked specific differences that it will be unnecessary to more than briefly allude to them.

SYNAPTOMYS STONEI.—Sp. nov. Type No. 567. ad. ♀. coll. S. N. Rhoads, May's Landing, N. J. Dec. 2, 1892.

Special Characters.—Outward appearance and proportions as in *S. cooperii*. Above blackish-brown, with black hairs more predominant over the shorter brown hairs than in *cooperii*. The same color reaching around sides of belly instead of being confined to dorsal area as in *cooperii*. Hoary gray belly and neck of *cooperii* replaced by dark plumbeous gray. Feet, including soles, plumbeous, without brown shade. Two middle toes of fore-feet and four inner toes of hind feet, including nails, white. Tail unicolor plumbeous gray. Lips encircled with narrow white edgings.

Skull narrower, shallower, and, viewed from above, less angular than that of *cooperii*, but of same length. Lower jaws viewed from below, ditto. Incisors shorter, broader, and less cylindrical, with sulcation of upper pair much more distinct. Zygomatic foramen longer and narrower. Sagittal suture and parietals relatively much longer; interparietal transversely narrower, longitudinally longer. Supra-occipital in *cooperii* twice as wide as deep, in *stonei* thrice as wide as deep.

Molars one-third wider and one-eighth longer in *stonei*. In *cooperii* the length of the symphysis mandibuli just equals the distance from its posterior end to the angle formed by the antero-inferior border of the masseteric fossa; in *stonei* the symphysis is one-third longer.

Posterior face of angle of lower jaw in *stonei* very stout, abruptly rounded, and recurved outward; in *cooperii* it is slender, spatulate, elongated posteriorly in a nearly vertical plane, and the margin below the condyle not thickened as in the former species.

Measurements in millimeters of the New Jersey specimen in the flesh, with averages of six alcoholic specimens of *cooperii*, made by Dr. Coues, are given:

	Full length.	Tail.	Foot.	Ear.
Synaptomys cooperii.....	105	18	18	8
Synaptomys stonei.....	117	18	18	9

The age of specimens on which the above cranial and color characters are based is evidently about the same. In other respects they may be safely considered normal adult representatives of the species in the different localities where they were taken. The new species may fittingly bear the name of my friend and colaborer, Mr. Witmer Stone, Curator of Birds in the Philadelphia Academy of Natural Sciences.

SAMUEL N. RHOADS.

A New Evotomys from Southern New Jersey.—On October 25, 1892, while collecting small mammals near May's Landing, New Jersey, in company with Mr. S. N. Rhoads, I captured a specimen of *Evotomys*, a genus which has not previously been reported from south of Massachusetts and the Adirondacks, except in the higher mountains of North Carolina. The next day three more specimens were secured, and subsequently (December 2) Mr. Rhoads collected four others in the same locality. A comparison of these specimens with a series of *Evotomys gapperii* from Northern New York, which is apparently the most closely related form, shows them to be subspecifically distinct,

and I therefore propose for the New Jersey animal the name *Evotomys gapperi rhoadsii* in honor of my friend, Mr. Samuel N. Rhoads.

The comparison of a series of skulls of *E. gapperii* and *E. g. rhoadsii* fails to show any constant differential characters, though the immature specimens of the new race are peculiar in the structure of the last upper molars. In these teeth the first reentrant angle on the inside is opposite the second salient angle on the outside instead of the first reentrant angle as is the case in the adults of both forms. One young specimen of *E. gapperii* shows a tendency to this structure, but in all the other specimens that I have examined the reentrant angles meet, and the outer one is deflected posteriorly.

In proportions the New Jersey race seems to average rather smaller than *E. gapperii* from the Adirondacks, while the tail is shorter and the feet slightly longer than in that species.

As regards coloration *E. g. rhoadsii* is everywhere darker than *E. gapperii*, and has a plumbeous cast on the sides and flanks, while it lacks almost entirely the buff suffusion generally seen on the sides and under surface of the latter species.

Above the color is decidedly darker than in *E. gapperii*, and there are a great many more black hairs scattered over the back. The reddish area is not so well defined and the color is darker—more of a mahogany shade. The tail is distinctly bicolor, but the upper surface is darker than in *E. gapperii*, and the feet have a decidedly gray suffusion, contrasting strongly with the pure white of the latter species.

Some immature specimens of *E. gapperii* approach adult *E. g. rhoadsii* in general coloration, but the young of the latter race with which they should properly be compared have scarcely a trace of the reddish dorsal area, the middle of the back being brownish and the sides gray. The table on next page, will show the comparative measurements of the two forms, the specimens of *E. gapperii* being selected from a series kindly loaned me by Mr. G. S. Miller.

Dr. C. Hart Merriam, of the Department of Agriculture, Washington, D. C., has kindly examined my New Jersey material and compared it with *Evotomys carolinensis* and other species to which I had not access, but its closest relationship appears to be with *E. gapperii*. All the specimens of this new mouse so far secured were taken in a cranberry bog on the Egg Harbor River, about a mile above the town of May's Landing, N. J. The unexpected occurrence of this boreal genus well within the Carolinian Fauna may probably be accounted for by the theory already advanced by Dr. Merriam that in these damp bogs, where the temperature is much lower than in the surrounding dry

Evotomys gapperii.

No.	Sex.	Locality.	Date.	Length.	Tail Vertebræ.	Hind Foot.
1570/1367	♂	Peterboro, N. Y.	July 17, 1892	151 mm.	41 mm.	17 mm.
1577/1374	♀	" "	July 19, 1892	165	51	18.4
1637/1434	♀	" "	Aug. 1, 1892	160	46	19.6
1340/1158	♂	Keene Valley, N. Y.	Mar. 17, 1892	155	45	20
		Average.....		158	46	19

Evotomys gapperii rhoadsii.

No.	Sex.	Locality.	Date.	Length.	Tail Vertebræ.	Hind Foot.
160	♂	Type, Coll. of W. Stone.	Dec. 2, 1892.	142	40	20
161	♀	" "	" "	130	37	20
570	♀	Coll. of S. N. Rhoads.	" "	123	34	21
571	♂	" "	" "	130	36	20
		Average.....		131	37	20

areas, the conditions of life are quite suited to more boreal species, especially animals of nocturnal habits. The presence of various Ericaceous and other boreal types of plant life in these locations also supports this hypothesis.—WITMER STONE, Academy of Natural Sciences, Philadelphia.

Zoological News.—VERTEBRATA.—Some new reptiles and fishes from Australia are described by J. Douglas Ogilby. The list comprises *Typhlops curtus* from the Gulf of Carpentaria, *Hoplocepalus suboccipitalis* from Morel, and *Clupea sprattelloides* from rivers flowing into Port Jackson and Botany Bay. The latter species has until now been supposed to be the young of *C. novæ-hollandiæ*.—Records Austr. Mus., Vol. ii, No. 2.——F. W. True reports that the collection of African mammals presented to the National Museum by Dr. Abbott contains several species apparently new: *Dendrohyrax validus, Mus aquilus, Dendromys nigrifrons, Sciurus undulatus, Cephalophus spadix.* The known range of several species is considerably extended by Dr. Abbott's labors. The mammalian fauna of the Kilima-Njaro region as indicated by this collection includes seventy-one to seventy-three species.—Proceeds. U. S. Natl. Mus., Vol. xv, pp. 445–480.

EMBRYOLOGY.[1]

Gastrulation of Aurelia.[2]—Frank Smith has entered into the controversy between Claus and Goette concerning the origin of the entoblast of Aurelia. The results obtained from his first sections led him to think that the conclusions reached by Goette for *Aurelia aurita* would be confirmed in the case of *A. flavidula.* Better staining, thinner sections and more accurate orientation have, however, made it certain that the gastrulation in this species is much more in accord with the description given by Claus and that the process really is one of invagination. The result of cleavage is a one-layered blastosphere as in *A. aurita.* The cells of the blastosphere are usually somewhat shorter at one pole than elsewhere, and it is from this region that the entoblast is formed. It develops as a single continuous layer of cells surrounding a small cavity, the coelenteron. From the beginning there is a narrow blastopore. Only a small portion of the wall of the blastosphere is concerned in the invagination, and to that extent it is not typical. The cœlenteron is, however, at all stages, an open sac-like cavity, and therefore noticeably different from that of *A. aurita* as described by Claus. The cœlenteron enlarges until the cleavage cavity is entirely obliterated and the entoblast everywhere comes into contact with the ectoblast. The entoblast, at first thin, thickens after the completion of gastrulation.

While the entoblast is formed by invagination, ingression of cells from the wall of the blastosphere into the cleavage cavity does occur, although only in a minority of cases. It may happen any time after the blastosphere contains about 100 cells, sometimes before invagination. When this phenomenon takes place it is similar to that represented by Goette (Figs. 1–5) for the earlier stages of the blastula in *A. aurita,* and consists of the migration into the cleavage cavity of one or two, rarely more than three, of the cells of the blastospheric wall. Soon after invagination the nucleus of the cell disappears and the cell breaks down, or, less frequently, persists until gastrulation is complete. In the latter case it becomes forced through the entoblastic wall into the cavity of the cœlenteron. The cause or purpose of this immigration does not appear.

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]Bull. Mus. Comp. Zool., Harvard, xxii.

The author thinks that the difference in opinion between Claus and Goette is partially due to there being two kinds of cells that find their way into the cleavage cavity. Besides the large cells just described he found in a much smaller number of cases one or two very small cells that look precisely like the small cells that appear in the deeper part of the ectoblast at about the time gastrulation begins.

There is no evidence that the immigrating cells have anything to do with the formation of the entoblast, and Goette's case is further weakened by the fact that all the conditions shown in his figures (6–9) can easily be reproduced from sections of invaginating gastrulæ of a single stage of development.

Cleavage in Aequoria Forskalea.—Dr. V. Hæcker[3] contributes an interesting series of observations on this subject. He finds that when the specimens are in good condition the time relations between the successive periods of activity are remarkably precise.

If ripe, the eggs are laid between 7 and 7.30 A. M. The first polar body is extruded at 9 A. M. The entrance of the spermatozoan and the division to form the second polar nucleus takes place at 9.30. At 10 A. M. the dyaster stage of the first cleavage nucleus occurs, and with it the first indication of the division of the cell body. The daughter nuclei are undergoing metakinesis at 11, and at 12 the four nuclei of the next set are in the dyaster stage. The nuclear divisions continue to take place an hour apart at least as far as the sixty-four cell stage, and this seems to show that the nucleus is not affected at this period by the amount of cell protoplasm that it controls. Normally nuclear division takes place at the same time throughout the egg, and the blastomeres are of equal size up to the sixty-four-cell stage.

When eggs are laid after the specimen has been kept in an aquarium several days, irregularities generally occur in the time of nuclear division and in the size of the blastomeres. At the same time a pathological form of nuclear division, the triaster, appears, and the mass of cells loses its spherical shape.

A remarkable feature of the cleavage of the egg of Aequoria is the presence of a body for which the author proposes the name *Metanucleolus*. In the older ovarian eggs and in eggs just laid there is a large nucleus containing a very fine network of chromatin and a large spherical or reniform nucleolus. About half an hour after the egg is laid this nucleolus appears to have been extruded, for the nucleus is now much smaller than it was and has no nucleolus, while in the egg

[3]Archiv. fur Mikro. Anat., 40 Bd., 2 Heft.

outside of the nucleus but close to it there is a body resembling the former nucleolus in every particular, except position. This body, the metanucleolus, never divides, there is never any radial arrangement of the protoplasm about it, and it may be found in one of the blastomeres until a later stage in the cleavage. From a review of the work of Metschnikoff, Boveri, and others, the author thinks that homologous structures have been seen, although wrongly interpreted, in the Lepto-medusæ, Anthomedusæ, Siphonophores and apparently also in Mytilus and Sagitta. He has also examined Weismann and Ischikawa's preparations of the winter eggs of Daphnids, with the result that he regards the paracopulation cells as not cells at all, but as in all probability structures homologous with the metanucleoli of the medusæ.

Another point of interest in this paper is the numerical relation between the chromosomes of the second polar spindle and of the first cleavage spindle, there being six in the former and twelve in the latter. Boveri had pointed out that in the forms in which this point had been studied, while the number varied in different species, the number of chromosomes in the cleavage spindle was always just double the number in the last polar spindle, and he had also noticed that the number of the latter in certain species could be arranged in a geometrical series in which the numbers are forms of two (2, 4, 8, 16, 32). Hæcker reviews the literature of the subject and shows that there may be two other series besides this one. There is a series of the forms of three (3, 9, 27, etc.), of which, however, there is but one example, Echinus with nine chromosomes, and then there is a mixed double and triple system (6, 12, 18, 24, 36, 48, etc.), to which Aequoria belongs, as well as the greater part of the insects and the vertebrates. He concludes that all cases so far known may be arranged in three systems in such a way that in general nearly related forms belong to the same system.

R. P. Bigelow.

(1) Zeit. f. Wiss. Zool., 49, 1890, pp. 503–580, plates 24–26.
(2) Zeit. f. Wiss. Zool., 51, 1891, pp. 685–730, plates 35–37.
(3) Zeit. f. Wiss. Zool., 54, 1892, pp. 1–249, plates 1–12.

ENTOMOLOGY.[1]

The Pupa of Argyramœba œdipus Fab.—The description given below is drawn from a pupal skin sent to me with the fly by Prof. C. P. Gillette, who bred the latter from a nest of *Odynerus* sp., at Fort Collins, Colo. In a paper which will be published in *Psyche*, I have described the pupa of *Toxophora virgata* O. S., and also made some mention of the pupæ of Bombyliidæ which have so far been described. The pupa of the present species differs quite markedly in detail from that of the Toxophora above mentioned.

Pupa of *Argyramœba œdipus*: General color of empty pupal skin very pale straw colored; the cephalic horns black, reddish-brown basally, anal horns black, slightly reddish-brown at base; dorsal rows of ridges reddish-brown, the terminal spinous processes blackish; prothoracic spiracles reddish-brown, other spiracles but little darker than rest of integument, slightly brownish. Head conforming to shape of head of adult fly, more or less sub-spherical in form. Eight cephalic horns or teeth arranged in four pairs, the three anterior pairs joined in a common base, the posterior pair removed from others; anterior pair longest, their rufous brown joined basal portion distinctly shorter than their black free terminal portion, moderately slender, nearly straight, directed forward, gradually tapering to tips; second and third pairs more closely approximated one pair to the other than are the first and second pairs, but the two horns of each pair widely removed from each other, both pairs directed nearly forward but at a slightly more downward angle than first pair; third pair much shorter than second, more curved or claw-like; posterior pair closely approximated at base, nearly as large as third pair, but straight and directed inferiorly, situated nearly in middle of ventral surface of head segment; a pair of quite widely separated divergent bristles on outer dorsal surface of anterior cephalic horns; a more approximated nearly parallel pair just posterior to these but arising from integument of head near anterior dorsal edge, being situated just behind the suture at base of cephalic horns; a divergent pair situated just anterior to base of the posterior of fourth pair of cephalic horns; a small bristle on each side at hind margin of ventral surface of cephalic segment. Thorax a little wider than head, the neck being somewhat constricted; a pair of

[1]This department is edited by Clarence M. Weed, Hanover, N. H.

closely approximated short bristles arising from the same papilla on lateral dorsal surface of thorax a little anterior to middle; a bristle below these on pleural surface, another still below and a little anterior to this one. Wing cases reaching about to base of third abdominal segment, leg cases a little longer. Scutellar segment about as wide as thorax, with a transverse row of ten or eleven long, more or less curled hairs on each side of dorsum approximated to anterior margin, there being a bare space on median portion of segment between the inner ends of the rows; about ten somewhat longer similar hairs on extreme lateral portion of segment on each side, arranged in a more or less complete semicircle, the open portion of the semicircle being toward the posterior end of body; the lateral hairs are longer and slightly stouter than those of dorsum, being nearly as long as transverse width of segment. Abdominal segments one to four, about same width as scutellar segment, each armed on dorsum with a transverse row of short longitudinal parallel chitinous ridges or very narrow plates, there being thirteen in a row on first and second segments, twelve on third segment, and nine on fourth, the rows a little approximated to posterior margin of segment, especially in middle; these ridges are about two-sevenths as long as length of segment, those in middle of rows being the largest and heaviest, the outer ones shorter and diminishing in size, those on fourth segment less heavy than those of first to third segments, and each ridge is produced at its ends into a spinous or hook-like process, the ridges in profile presenting a crescentic appearance with the concavity uppermost. The other abdominal segments without these rows of ridges, fifth segment nearly as wide as preceding, sixth segment hardly narrower than fifth, the fifth and sixth segments each with a transverse continuous row of hairs on dorsum arising from a transverse ridge, extending down to lateral ventral edge of segment and continued on sides of venter, these rows somewhat approximated to posterior margin of segment. Segments (abdominal) one to four with a thin transverse row of shorter weak hairs on each side of dorsum, arising in posterior edge of rows of ridges, extending down on each side to lateral margin, no hairs on median dorsal portion; same segments with a more or less complete lateral semicircle of longer hairs as on scutellar segment, but somewhat weaker and shorter than those on that segment, the hairs on fourth segment extending beneath on sides of venter. Seventh abdominal segment much narrowed, rapidly and evenly narrowing from base to posterior margin, its width on posterior margin hardly more than one-third its width anteriorly, its mean width about one-half that of sixth

segment, with a transverse row of several hairs on each side of dorsum extending below on edge of venter, discontinued in middle on dorsum, slightly approximated to posterior margin of segment. Eighth or anal segment narrow, same width as posterior margin of seventh, nearly as long (to base of horns) as wide, terminated by three pairs of anal horns; anterior or upper pair short, small, situated at base dorsally of middle pair; middle or second pair long, curved slightly upward terminally, nearly as long as length of segment, widened inwardly on basal half so that the bases are closely approximated, inner outline hollowed out on apical portion, longitudinally corrugated at base above, with a dorsal longitudinal groove widening to hollowed portion and then extending narrowly to tip, moderately sharp at tips; third or inferior pair short, small, hardly as large as anterior pair and not so stout at base, directed more downward than middle pair, situated on outer base ventrally of middle pair; just anterior to first pair on dorsum there is a median very small spinous tubercle, apparently a rudiment (or herald) of a fourth pair of anal horns. Prothoracic spiracle situated on lateral front border of thorax (prothorax) just anterior to wing bases, mesothoracic spiracle not apparent, metathoracic spiracle situated anteriorly on lateral edge of dorsum of scutellar segment; first to sixth abdominal pairs of spiracles situated on anterior edge laterally of dorsum of first to sixth abdominal segments; seventh pair situated one on each side of dorsum of seventh segment immediately behind the transverse row of hairs. It is interesting to note that a quite long section of the tracheæ is left attached in most cases to the spiracles on inside of the pupal skin, especially to the thoracic pairs. The fly escaped by the pupal skin splitting along the dorsal median line of the head and thorax, the slit extending slightly into the scutellar segment; also splitting laterally backward on each side of head from a little above the base of anterior cephalic horns along what would nearly correspond to the frontal fissure in Muscidæ, the break curving shortly and obliquely upward to thoracic suture, and allowing the nearly triangular posterior dorsal or upper section of the integument of the head to become loosened laterally below from its junction with the thorax, and hanging like a flap by its median dorsal junction.

Length, 9½ mm.; width of basal abdominal segments, 2½ mm.

The anal extremity of this pupal skin is distended with a dirty colored hardened fluid ventrally, just below and anterior to anal horns, into a large round tubercle with a subcentral deep pit or orifice-like depression which is approximated to posterior margin, the anterior portion of the tubercle being greatly bulged and distended. The

diameter of this false tubercle is as great as the posterior width of the sixth abdominal segment. The fluid which distended it is perhaps homologous with the meconium of butterflies.

The description of the manner in which the pupal skin splits to allow the escape of the fly was omitted in the description of the pupa of *Toxophora virgata* in the article above referred to. It is accomplished in the same way as just described for the present species, except that the dorsal median split does not reach posterior margin of thorax, and the dorsal pieces of head are not so much detached from their lateral thoracic fastenings, and are left more quadrangular in shape by the oblique lateral breaks of head. It may also be mentioned that a section of the tracheæ is left attached to inside of prothoracic spiracles.

My reasons for calling the first abdominal segment of other authors the scutellar segment, are stated in the article on Toxophora.

C. H. Tyler Townsend.

The Horn-Fly in Canada and Texas.—Mr. James Fletcher, Entomologist to the Canadian Department of Agriculture, announces[2] that the Horn-fly (*Hæmatobia serrata*) has appeared in enormous numbers in the Provinces of Ontario and Quebec, causing considerable anxiety to stock-owners. It was first definitely heard from at Oshawa, Ont., July 30, 1892. An excellent résumé of the life-history of the pest and of the means of preventing its injuries is given.

That this insect is also spreading rapidly in the southwest is shown by the following note from Dr. Mark Francis, of the Texas Agricultural College, who wrote me under date of Oct. 18, 1892, from College Station: "The horn-fly seems to be spreading westward. I saw it at Stillwater, Oklahoma, two weeks ago. It has not reached here yet, but I saw great numbers of them at Hempstead, Texas (forty miles southeast of here) last Friday. I think there can be no doubt as to its identity, as I have compared them with type specimens from Prof. H. Garman, of Kentucky."

Two days later Dr. Francis again wrote that the horn-fly was observed at College Station, Oct. 19, for the first time.

In Southern New Hampshire this insect has been very numerous the past season, and it has been gradually spreading northward through New England. But a hopeful report comes from New Jersey, where the insect was first observed. Prof. J. B. Smith states that it now causes little trouble there, and is seldom noticed as specially abundant.

[2]Central Exper. Farm, Ottawa, Bull. No. 14.

The Wheat Frit-Fly.—Dr. Otto Lugger reports[3] extensive damage to wheat in the northwest by a larva supposed to belong to one of the frit flies. The stem is injured about three inches above the ground, the larvæ occurring immediately above a node. The insect so weakens the plant at this point that the stalk falls over some time before harvest, the grains do not fill out, and reaper passes over the fallen stem. The puparia resemble the "flaxseed" state of the Hessian fly, and are found within the culm. It is supposed that the insect hibernates with the puparia. Burning and plowing under the stubble are the remedial measures recommended. This is apparently the worst frit-fly attack on wheat yet recorded in America. Dr. Lugger says that in many places fully one-fourth of the entire crop of wheat has been destroyed and in a great many more the losses amount to at least one-tenth.

Entomological Notes.—That excellent periodical, *Entomological News*, has instituted a department of economic entomology, with Prof. J. B. Smith in charge. This magazine will prove very useful to amateur as well as professional entomologists, and deserves cordial support. There has lately been a tendency to insert only very short articles, or to continue a single article through several issues (somewhat after the fashion of *Entomologica Americana*), which is unsatisfactory to all concerned.

Mr. M. H. Beckwith discusses[4] the injuries of the strawberry weevil (*Anthonomus musculus*) in Delaware, and reports finding the larvæ feeding upon the ovaries of strawberry blossoms. He surmises that there may be two or possibly three broods each year, but has been unable to trace the life-history of the insect during the latter summer months.

Concerning the recent bestowal by the University of Heidelberg of the honorary degree of Doctor of Natural Science upon Baron C. R. von Osten Sacken, Prof. S. W. Williston writes:[5] "Baron Osten Sacken's work has been chiefly related to American Dipterology, but the ripe fruits of his wide experience and broad grasp of principles have enriched all dipterology, and, I believe, all entomology. Others there are and have been who have won enviable honors in systematic dipterology; others who have written more extensively than he, but no one has written more that will be appreciated in the future than has Baron Osten Sacken.

[3]Minn. Exp. Station, Bull. No. 23.

[4]Delaware College Exp. Station, Bull. No. xviii.

[5]*Psyche*, Vol. 6, p. 346.

Dr. J. C. Neal discusses[6] a number of injurious insects that have appeared in Oklahoma. He includes *Pieris rapæ*, *Plusia brassicæ*, *Heliothis armigera*, *Diabrotica vittata*, *Lytta cinerea*, *Oncideres cingulata*, and *Blissus leucopterus*.

The recent biennial report of Prof. S. A. Forbes as Director of the Illinois State Laboratory of Natural History, shows that entomological studies are being vigorously prosecuted in that favored State. Fully 20,000 specimens have been added to the pinned collections, and 2700 bottles and vials to the biological series. We are glad to note the announcement to two important papers soon to appear in the Bulletin of the laboratory, the first by Mr. John Marten, containing descriptions of new species of Illinois gall gnats, and the second by Mr. C. A. Hart, a descriptive list of the aculeate Hymenoptera of Illinois.

PSYCHOLOGY.

Notes on Habits of Certain European Birds.—M. Ch. von Kempen has recently published some observations on birds from which the following extract is quoted to show the voracity of the ordinary sparrow-hawk (*Accipiter nisus*):

"For several years I lived in the country, and was accustomed to write during the summer near an open window. The apartment had from one side a view of the garden; from the other one looked out over the fields. Suddenly I saw a sparrow-hawk dart through the room; he flew with such violence that he broke the glass of the window, against which he dashed in his impetuous flight. I soon had an explanation of the circumstance. A linnet (*Sylvia hortensis*) perched near me was evidently the attraction. The warbler had flown into the room to escape the hawk, which in headlong pursuit, had gone through the room like an arrow from a bow.

"In February, 1889, I had in my town garden a certain number of lapwings (*Vanellus cristatus*); each evening, when I would go to shut them up in a cage, I would find one less than I had counted in the morning; I attributed this loss to a cat belonging in the neighborhood. The third day on missing another of my pets, I resolved to discover the thief, and concealed myself for that purpose. In the morning I saw a sparrow-hawk coming straight to my garden from the old tower

[6]Oklahoma Agri. Exp. Station, Bull. No. 3.

of Saint Bertin. In spite of my presence he tried to carry off his daily meal, but I struck him with my hands and made him drop his prey. I then put my lapwings in their cage, as I was expecting to go out after dinner. What was my astonishment on going to see my birds in the evening to find the sparrow-hawk keeping them company in the cage. He had forced himself in through the bars but could not get out in the same way, and so was a prisoner with the lapwings, which he had not, as yet, dared to touch. The hawk was a young male, and now forms a part of my natural history collection."

Two other citations show that birds can familiarize themselves with objects which ordinarily terrify them.

"The jackdaws (*Corvus monedula*) and barn-owls (*Strix flammea*) are very numerous in all the towers of Saint-Omer; they are so accustomed to the noise of the clocks that they build their nests against the clappers.

"Last year I saw a nest of a titmouse (*Parus major*) built in a little mill that children played with in a garden. This noisy scarecrow, turning with every wind, did not frighten the saucy birds, and they reared their young with comfort.

"I now give two observations of another sort that prove beyond a doubt that birds possess a memory:

"I had in the country two domestic peafowls (*Pavo domesticus*); they were accustomed to come every evening to get their slice of bread cut in small bits before perching themselves on the roof; and if they were forgotten they would wait nearly all night before abandoning all hope of the treat. They were so tame that the male, as well as the female, would eat from our hands. After I had gone to the city, in order to keep the peafowls out of the garden, where, it is well known, they cause great havoc among the vegetables, the berries, and the currants, they were given corn in abundance in a place quite remote, but they declined these overtures and returned constantly to the place where I had fed them; I found them there on my return the following year. During the summer the female laid ten eggs, a less number than usual; nine young chicks were born, which, following the example of their parents, came every evening to look for their repast.

"During the winter a storm, accompanied by a fall of snow, burst upon us during the night, and the unfortunate peafowls were thrown from their perch on the roof; some wandering dogs strangled them, and we found their remains scattered over the field.

"I have at this time two laughing gulls (*Larus ridibundus*) living. I give them twice a day, at regular hours, bits of meat. Some jack-

daws (*Corvus monedula*) come every day, at the exact hour, never too soon, never too late, from the towers of the Chapel of the Lyceum, an old church of the Jesuits, to snatch from me, or from any one who takes my place, the bits of meat that we give to the gulls.

"Last year a dwarf hen which belonged to me chased from its nest a female pigeon which had been setting for two days, broke up the eggs, and laid one of its own in the nest. The pair of pigeons continued to care for the egg of the hen, and, at the end of twenty-one days (which was really twenty-three for the pigeons) the chick came out of the shell. To see the efforts of the parents to feed it was curious. The second day, seeing that their efforts were in vain, I gave it some moistened bread, then I put it under the pigeon; so matters went on for three days, but the chicken wished to run about and I was obliged to take it from its adopted parents."—Bull. Soc. Zool., No. 4, 1892.

A Nest Building Frog.—In your issue for May, 1889, page 383, you published a paper in reference to certain batrachian nests discovered by me at Nikko in Japan. This summer I was shown by Dr. Guenther, at the British Museum, a couple of similar structures, though very much smaller in size, preserved in alcohol, and which had been received by the Museum from Japan. One of them had been taken from a shrub growing in the mouth of a well. Dr. Guenther told me that this nest is referable to a species of Polypedates. Day before yesterday I received a letter from my friend, Dr. A. C. Good, who is at present conducting a series of explorations in German West Africa. I take the liberty of transcribing a portion of the letter as follows:

"I desire to write you of something I saw on my last trip. As we brushed against the bush, that frequently overhung our path, I several times noticed, now on my shoe, now on my knee, a white froth. I thought it belonged to some insect, but for a long time I only noticed the white foam-like substance when I had gotten past the bush from which I had brushed it.

"At length, however, I brushed off a large bunch of substance, and when I tried to brush it from my clothes I uncovered some small creatures which wiggled about in it and evidently made this froth-like matter their home. On closer examination I discovered, very much to my surprise, that they were tadpoles.

"Later on I found on the underside of a leaf, a mass of this white substance that had not been disturbed since it had been placed there by the mother frog. I take it for granted that these tadpoles produce

tree-frogs. The nest was about three inches long, by two or two and one-half inches wide, and nearly an inch in depth. In the inside and at the edges the frothy mass was quite white, and in consistency resembled the white of an egg after being thoroughly beaten. The lower face of the nest had taken on a yellowish tinge from long exposure. In this I found eggs, or semi-transparent jelly-like bodies as large as a small pea, which had already some power of motion, and on a few of which the tail was just beginning to take form. In another nest I found similar eggs just developing and also well-developed tadpoles. These last were about one-eighth of an inch in length and had tails one-half of an inch long. They seemed to move with difficulty through the mass.

"I wonder whether this froth is at once home and food to them, but am unable to say. These nests are frequent everywhere except near the coast. I saw none nearer than ten miles from the beach.

"I remember your saying something about finding tadpoles in trees in Japan, and I have the impression that you published something on the subject. If so this will be of interest to you."

Whether the creatures, the young of which Dr. Good found in this frothy mass were the tadpoles of *Chiromantis guineënsis*, to which a similar habit is ascribed by Bucholtz, of course I cannot say.—W. J. Holland, Chancellor Western University of Pennsylvania.

Horse "Human Nature."—My son writes from a Wyoming ranch that a blind bay mare is ostentatiously protected by a black mare, the two having been raised together.

The blind horse would suffer greatly for feed, water, and from herd interference if the black were not constantly on guard. The latter watches the bay and grazes in a circle about her, keeping other horses at a distance by kicks and bites if necessary, selecting good grazing spots and watering places.

The guardian is rewarded with occasional kicks and other human-like evidences of gratitude.—S. V. Clevenger.

ARCHÆOLOGY AND ETHNOLOGY.

Legendary Evolution of the Navajo Indians.[1]—The Navajos once lived in a world below this earth. The tribe had twelve chiefs, and the chief had four wives. This head chief arose early in the morning and commanded his people to go to work. One morning he failed to arise. The third morning he failed to arise. The fourth morning he made no appearance. On the fifth morning the Navajos became uneasy, and went to find their chief. The other eleven chiefs wondered what became of him, and when they found him they learned that his oldest squaw had left him, and had married another man. The old chief grieved very much and refused to be comforted.

In a short time the squaw came in and said, "I have left you because I have ceased to love you. I can make my own living, and you can make yours." So they had a row.

This woman was chief of the women of the tribe.

Then the squaw called all of the women to council and said, "Let us part from the men!" So the women said, "Take all the men, boys, and male babies and cross the large river.[2] Burn logs out to make the canoes, and stay over there four years."

They gave the male children into the hands of some hermaphrodites, who raised them on the brains of wild sheep and deer.

The men sailed across the large river, planted large fields of corn, and raised immense crops. The first year the women raised a fair crop; the second year they raised less; the third year they had hardly enough to eat; and the fourth year was a complete failure.

The women became discontented, and were in a starving condition. Some of them ran into the river and were drowned.

[1]These legends were collected by the writer while employed in the Indian service at the Navajo Indian agency. They were related by Tsĕ-dĭ-ăhl-hă'-ŭn-bĕ-gĕh, or Rocking Sun, the great Lightning Medicine-Man of the Navajos. These legends were carefully interpreted, and are given word for word as they were related.

[2]The "Happy Hunting-grounds" of the Navajo Indians are represented as a land full of forests and lakes which abound in various kinds of game and fish. Flowing through the center of this land is a huge river which separates the braves and pretty maidens from the inferior members of the tribe and the old women.

So the women begged the men to come back to them. The woman-chief admitted that she had done wrong, that the women could not make their living, and that the men could not make their living.

Then the young chiefs held a council and said, "Let us go back to the women in four days, or they will die." So in four days they went back to the women, and had a feast of deer meat and love-making.

While they were having a good time the Coyote picked a young whale out of the water and hid it under his blanket. On the fourth morning after this, when they awoke, they saw a large blue wave of something coming from the east. The old chief sent an Indian to see what it was. The Indian returned and said that it was water. They looked to the north and saw a big white wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." They looked to the west and saw a black wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." Then they looked to the south and saw a green wave coming. The chief sent an Indian to see what it was. The Indian returned and said, "It is water." Then the chief called the tribe to council and said, "Something is wrong, we all will be drowned."

At that time the Navajos were animals and had squirrel blood in them. So the White Squirrel planted a pine tree; the Gray Squirrel planted a rattoon tree; and the Turkey planted a pipe-stem reed. The Navajos all ran into this reed and began climbing up on the inside. The reed grew very fast, even faster than they climbed. The water began rising higher and higher, and followed close to their heels. The Coyote was among them. The Badger went up first, making way for the rest with his paws. The Badger consoled the rest by saying, "I am very near the top of the earth." In getting his feet muddy his legs and feet have remained black from that time. The Turkey came up last, and the foam of the water touching its tail caused its tail-feathers to be tipped with white from that time.

Finally they came up through a lake, and they knew they had reached the top of the earth.

The Badger looked out and said, "I see a big Water Animal and some Big Men who are very mean." Then they sent the Locust out to see what kind of an earth this was. A big White Bird came from the north, met the Locust and said, "Things like you are not to be seen here!" Then the Locust replied, "We will see about this." A Yellow Bird came from the west, a Black Bird came from the south, and a Blue Bird came from the east, and they all said, "Things like you are not

to be seen here." But the Locust said, "We will see about that. If you will do as I do you may have this land; but if you do not do as I do I will beat you." The Locust had two arrows. He stuck one of them up through his body and the other one down his mouth. Then he took the two arrows and crossed them through his heart. He next threw the arrows at the White Bird and said, "If you do not do as I have done I will beat you." The White Bird took the arrows and pretended to do these things, but he only ran the arrows through his feathers.

There was so much water that the Locust could not bring his companions up out of the reed. So he took a mountain-sheep's horn and broke the land to the north and to the south and to the west and to the east, and the water all ran off. The Locust then went back and brought his companions out of the hole which the Badger had made. But the water still followed them up through this hole.

Then the chief said, "Some one has been playing a trick." He said to the Coyote, "You are always up to some meanness! What have you under your blanket?" The Coyote opened his blanket, showed the young whale to the chief, and then dropped it down this hole. The water immediately went back down the reed into the river. They all came out, but could not walk because of so much mud. Then the chief prayed to the wind, and the wind dried the mud.

The Navajos were now changed to people, but they did not know what to plant. The Turkey flew up, and the first time he dropped some yellow corn; the second time he dropped some red corn; the third time he dropped blue corn; and the fourth time he dropped all kinds of corn.

The Navajos then made hṓ-gäns (houses), and the women and children played in them while the men worked. Some of them made houses in the rocks.

The chief then said, "We will see if there will be any deaths up in this world. I will throw a big log into the water, and if it sinks, we will each one have to die; but if the log floats, we will never die."

Then the Coyote tied a string to a rock and said, "I will throw this into the water, and if it sinks we will each have to die, but if it comes up and floats, we will never die."

The chief then said to the Coyote, "You are always doing some mean trick!"

But the Coyote said, "I cannot help it. If the Navajos never die, we will always be the same; but if the Navajos die, we will all be

different. We all have children, and if none ever die, this earth will not hold us."

On the fourth morning, one of their number died. They all looked for this one, but they could not find him. Then they looked down this hole which they came out of a few days before, and they saw this man down there combing his hair. This man looked up and said:

"I am happy down here. In time, you all will be down here where I am." Then there was a famine, and about half of them died.

The Mysterious Maiden.

There was a little girl found at daylight one morning. The woman who found her claimed that she was the "Mysterious Maiden," and so another woman took her and raised her. This child soon grew to womanhood.

This maiden conceived from a piece of petrified wood and bore a Giant. She conceived from a feather and bore a Large Bird. Then she conceived from a horn and bore a Large Animal (something like a buffalo), which ate the Navajos. She next conceived from a berry and bore a Bear. She then rubbed herself against a rock. Behind this rock was a patch of berries. When the Navajos went to gather the berries, the rocks would crash together and kill them. The sides of the rocks were covered with blood. The maiden then conceived from a reed and bore a patch of reeds. If a Navajo went into these reeds, he never was seen again. She next conceived from a battle-axe, and bore an Old Hag who lived among the rocks. This Old Hag would moan and cry for some one to come and kill her. When a Navajo went to kill her, she would blow on the battle-axe and the axe would kill the Navajo. She then conceived from a hair, and bore an Animal Whose Hair Grew Fast to the Rocks. This Animal stood on the brow of a precipice. Over in a corner of his den were some beautiful arrows. This Animal would tell the Navajos to come and get those arrows, but when they went there he would kick them over this precipice, and his children, who lived down below him, would devour them. Next, this maiden conceived from the sand and bore a pair of Big Eyes. At night, those Eyes shone like a big fire, and they would hollow for people to come over there. Then the Eyes would pierce their hearts and kill them. She next conceived from an antelope-hoof and bore Twelve Antelopes, who used to destroy Navajos. Lastly, she conceived and bore two sons. The oldest boy was conceived from the sun, and the younger one from the water. These boys were going to kill all of

these animals which destroyed the Navajos, but the Navajos were nearly all killed before this time. These boys grew up to be very large, had bows and arrows, and they used to run off. One day these boys asked their mother who their father was. She replied, "The cactus and the water." But the oldest boy said, "I do not believe this." Then the mother said, "The sun is your father, but he lives a long way off."

Origin of the Yāy'-Bĭ-Chĭs.[3]

The father of the Red Yaybichy was the sun. The father of the White Yaybichy was the water. The Mysterious Maiden[4] conceived from the sun and bore the Red Yaybichy. She conceived from the water and bore the White Yaybichy.

This Mysterious Maiden was out picking up wood, and was going to put it on her back, when the sun came up to her, dressed in turquois, beads, feathers, and fine skins. He told this maiden to be by herself that night, and he would come to her.

The Mysterious Maiden went home and told her father what the sun had said. The sun came and talked with her, but she did not know it; but she heard a noise going out from the hogan (house) where she stayed. She saw this man (the sun) four days afterward, and told her father that this was the same man she saw while picking up the wood.

She saw the sun abusing himself at daylight, and this made fleas and mosquitos.

In four days, these two sons were born to the Mysterious Maiden, and in four days more, these sons went up to visit their father.

The younger son had a cedar bow, and the older son had a piñon bow. They started toward the east to see their father.

The Black Yaybichy met them there and told them to go back. He told them that there were oceans and cañons and deserts and cactus fields and great fires and great wolves and great snakes and great bears that would destroy them, and said, "Your father lives a long way off."

[3]For a description of the Yaybichy Dance of the Navajo Indians see pages 435–436 of the Annual Report of the Bureau of Ethnology for 1883–'84, by Dr. Washington Mathews, U. S. A., under the direction of Major J. W. Powell, director of U. S. Geological Survey.

The Yaybichy medicine-men are the leading medicine-men of the Navajo tribe, and play an important part in all their religious ceremonies and fetichistic mysteries.

[4]The same maiden referred to in the Legend of the Mysterious Maiden.

These boys[5] (the Red and White Yaybichys) went by a large ocean, and looked down into the valley, and saw the smoke coming out of the ground. Here lived an old Woman-spider. When the boys came up the Spider said, "Hallo, grand-children, where did you come from? People of your class never come here! This place is not for you!"

"Our mother told us to go to see our father, the sun," said the boys.

"But your father lives a long way off, and he is not a good man. He will kill you with sweat-houses and red-hot irons."

Then this old Woman-spider gave them each a white feather, and told them it would be a Spirit to guide and defend them. Then she said, "Stop here to-night with me."

The boys said, "We can not get through that hole in the ground."

Then the old Woman-spider blew into the hole and it became larger. She then vomited, and gave them (the boys) their suppers.

The sun was now straight over their heads. The boys told the old Woman-spider that they wanted to get as far as they could before sundown.

The old Woman-spider was a spirit; so she pulled the sun down with a net and then told the boys that it was now sundown. The boys stayed all night, and they grew to manhood during that night.

The Black Yaybichy met them again, and told them that they would reach their destination about noon that day, and that their father would come to them at that place at night.

At noon that day they saw a big house and started to go in. Two big bears met them and snarled, but the boys said, "We are going to to see our father." Then the bears lay down and the boys passed over them. They next met two large, vicious snakes. The snakes rattled and hissed, but the boys said, "We are going to see our father." Then the snakes lay down and the boys passed over them. They next met two big lightnings and thunders. These stopped the boys, but the boys said, "We are going to see our father." Then the lightning lay down and the boys passed over it. They next met a number of little snakes of various kinds. The boys said, "We are going to see our father." Then the snakes lay down and the boys passed over them. They next met the sun's young wife. The boys said to her, "We are going to see our father." The young wife replied, "What are you doing here? Boys like you and people of your class are not allowed here." But the boys replied, "The sun is our father." Then the young wife wrapped them up in a white cloud that pointed toward the north. She also made a black cloud that pointed toward the east; a yellow

[5]The boys referred to in the Legend of the Mysterious Maiden.

cloud that pointed toward the south, and a red cloud that pointed toward the west. It was now pretty near night (sundown).

The sun had two children by this young wife, a girl and a boy.

The boy spoke and said, "I hear my father coming home, for I hear the white gourd rattle."

The girl spoke and said, "My father is coming, for I hear the blue gourd rattle." Then the boy said, "My father is coming home, for I hear the ivory gourd rattle." The girl spoke and said, "My father is coming close, for I hear the turquois gourd rattle."

At that moment the father came, making a fearful noise rattling the irons on his body.

The sun demanded of his young wife who those two young men were that he saw come into the house, but did not see go out again.

The wife replied, "You think you are pretty cunning. You told me that you had no wife but me. These young men claim to be your sons."

At this the sun became angry and rattled his gourds, and the earth began to tremble, the lightning flashed, the bears roared, and the snakes rattled and hissed. The sun then demanded where the two young men were, but the wife made no answer. He demanded this again, but no answer. He then demanded the fourth time, but still the wife refused to answer. Then the sun went to the cloud in the east, and knocked that down; but no one fell out of it. He went to the cloud in the west, and knocked that down; but no one fell out of it. He went to the cloud in the south, and knocked that down; but no one fell out of it. He went to the cloud in the north and knocked that down, and the boys fell out of it and stood before him.

All at once four sharp irons, corresponding to the four clouds, pointed toward the boys. There was a white iron from the north, a black iron from the east, a yellow iron from the south, and a red one from the west. The sun threw the boys violently against these irons, the north one first, then the east one, then the south one, and then the west one, but this white feather which the old Woman-spider gave them would let them down easy; so they remained unhurt.

The sun became angry and said, "I will find out if you are my children. If you withstand my test you are my children." Then a spirit descended and stood on each of their ears, and told the boys how to answer the sun's questions. It said, "Tell him he is your father." Then the sun took a huge turquois hammer and tried to mash the boys, but the feathers made the turquois hammer come down easy. The sun

then made the boys smoke some poison in first, a turquois pipe, and second, in an ivory pipe. He did this the second time, and still the boys were unhurt.

The sun said to his servants "Make a sweat-house and put four irons in it, one of the irons shall be white, one blue, one yellow, and one black, and make the house boiling hot."

Just as the boys started to go into the sweat-house a Gopher came up through the ground and told the boys to crawl into his hole. The hole was inside of the sweat-house.[6]

The Gopher said "If you stay in there the sun will throw water on the irons and the irons will break and kill you." So the boys went into the Gopher's hole. The Gopher then said, "If your father asks you if you are warm you go out of the hole and say, yes. You can thus fool him. He will throw the water, but you will be safe in this hole. He will then be through with you."

The sun placed a blanket over the mouth of the sweat-house and did as the Gopher had said. When the sun looked in he saw the boys sitting there unhurt. Then he kissed the boys and told them that they were his sons, and that they had gone through with all of the forms that could kill them. The sun then took the boys home with him and made his other son and daughter shake hands with them.

The young wife was then in a good humor, and dressed up her step-sons. One of them she painted red, with white streaks down his back, representing the lightning; the other one she painted white.

The sun then asked the boys what they wanted as a gift. The Spirits on their ears said, "do not answer him until he asks you another question." The father took them through a large iron gate to the east and showed them fine horses of all colors. The father said, "Boys, do you want these?" The Spirit said, "Tell him no." Then he opened a large iron gate to the north and showed them some fine sheep, and said, "Do you want these?" The Spirit said, "Tell him no." He next opened a large iron gate to the west and showed them some fine goats, and said, "Do you want these?" The Spirit said, "Tell him no." He then opened a large iron gate to the south and

[6]The Navajo Indians have sweat-houses at the present day. The house is made in a hemispherical form. Its first roof consists of poles, the second one is stones, and the third one is dirt. A hole is left in one side for ingress and egress. The house is usually located in close proximity to some stream or pond, and is used for medical purposes. Rocks are heated and thrown into the sweat-house and water is thrown on the heated rocks, causing steam to fill the apartment. The patient now goes into the sweat-house and covers the door with a blanket. After a time he comes out and plunges into the adjoining lake or river. This process is often repeated in winter.

showed them deer, buffalo, antelope and all kinds of game, and said, "Do you want these?" The Spirit said, "Tell him no." The father then brought the boys home, and said, "My children, what can I do for you?"

The boys looked and saw four lightning arrows and a huge bow hanging on the wall. The spirit said, "Tell him that you want these; that some animals, a Huge Giant, Twelve Antelope, a Huge Bird, an Animal Whose Hair Grew Fast to the Rock, are eating all the Navajos. Those arrows will kill them."

The sun replied, "The Giant[7] is my son and your brother, but if he is eating the Navajos you have my permission to kill him. He has no right to live. I will take you and go to-morrow morning."

On the following morning they started, and came to Sanmateo Mountain[8] about noon. The sun said, "Boys, where did you start from?" The Spirit said, "Tell him that it was from here; that here is where the Big Giant was." Then the sun let the lightning down, and the boys climbed down the lightning to a big spring at the foot of the mountains.

The Giant drank the water from the spring, and then lay down on a rock to rest. He did this the second time and the third time and the fourth time. As he turned his face toward the north the boys saw him lying on the rock. The Giant turned his face toward the east, and they could see his shoulders. He turned his face to the south, and they could see his waist. He turned his face to the west, and they could see his whole body.

The Giant now saw the boys and said, "Will not they make fine eating?" The Spirit said, "Tell him that he will make fine eating." The giant then flew in a rage and threw an iron boomerang at the head of the older boy. The Spirit said, "Stoop low, for he is throwing at your head." The Giant then threw one at his middle; the Spirit said, "Jump to the right or he will hit you." He next threw one very low, and the Spirit said, "Jump high, for he is going to throw it low."

The sun then appeared and said, "He is my son and I will have the first chance at him." Then the sun struck him with the lightning. The Giant fell to the earth and grew weak because he lost his blood.

[7]The same giant referred to in the Legend of the Mysterious Maiden.

[8]Sanmateo Mountain, or Mt. Taylor, is about forty miles from Fort Wingate, New Mexico. It seems to be the seat of nearly all the gods and demons of which the Navajo mythology is so replete. Dr. Mathews refers to it several times in his "Mountain Chant," found in the annual report of the Bureau of Ethnology, 1883–'84, J. W. Powell, Director.

The black rocks (igneous rocks) are his blood, and the petrified wood is his bones. The Spirit then said, "Do not let his blood run together, or he will get up again." His blood ran down the hill.

The boys then shot him with the four arrows which their father had given them, and killed him. The younger boy picked up the iron boomerangs and kept them. The younger boy was given the turquois gourd from his father.

They then saw these animals—the Buffalo, the Twelve Antelope, the Large Bird, and the Animal Whose Hair Grew Fast to the Rocks over in a little valley. They shook this turquois gourd at these animals and the animals all died.

The boys then went to the Cañon de Shelley[9] and went into one of the cliff-dwellings, known as the "White House," and disappeared, forever to remain as Yaybichys.

The Mission of the Yaybichys.

A man was once struck by lightning and knocked all to pieces. The Yaybichys came and sang over him and brought him to life again. The White Yaybichy was the first one who came. This one went over his body from east to west, from west to east, from north to south, and from south to north, and had four songs. This one picked up his meat.

The Black Yaybichy did the same as the white one.

The Red Yaybichy came, and when the man came partly to life he came from the east, and had a gourd in his hand, and made a noise like lightning. He came from the south and made another queer noise. Then he came from the west, and then from the north, and shook the gourd[10] over the dead man's head.

The gourd represents the noise of the lightning when it strikes a person.

The White Yabichy took the man home, after he got alive, and showed him all these medicine things, and how he worshiped them.

[9]Pronounced de Shay. It is a beautiful little cañon situated about fifty miles from Fort Defiance, Arizona Territory. It contains many cliff dwellings, among which is the one known as the "White House," (because of its whitened walls) which is visited by numerous adventurers every summer. Most of the walls remain at the present day. There are now twenty-six Yaybichys in the Navajo tribe, including the sun and these two boys.

[10]The turquois gourd referred to in the Origin of the Yaybichys. The medicine-men of to-day seem to have unlimited faith in the turquois gourd.

This Yaybichy took him to Sanmateo Mountain and told him these things. He told him that a thousand years from this time the people would follow the teachings of the Yaybichys, that his son and his son's son through a period of a thousand years would be able to bring people back to life.

Then the Red Yaybichy took this man to Sanmateo Mountain and shook the gourd over him and told him how to wave the gourd over the dead man, from east to west (from sunrise to sunset), and from north to south. Then this man came back into the Navajo tribe and showed them how to use the medicine things,[11] and he was a great medicine-man.

But when this man came back and the Navajos broke their arms and legs, then they used these same medicine things, and they got well. So that made the Navajos have confidence in the medicine-man and the medicine things.

When any one gets sick we rattle the gourd over him and he gets well.

These two Yaybichys, the red one, called Yä-nä́ Yä-zän, and the white one called Tō-wäzh-zhŭs-chĭ́-nĭ, were made on the top of Sanmateo Mountain.

There were some animals that ate the Navajos at that time, viz., a Bear, a Large Bird, a Huge Giant, and a Fierce Animal Whose Hair grew Fast to the Rocks, and which coaxed the people to pass that way, when he would kick them down over the rocks and then go down and eat them up.

There was another fierce animal which chased the Navajos, killed them, and devoured them.

The Red Yaybichy killed all these animals[12] off.

There was a sister who had twelve brothers. This sister became a bear and killed the twelve brothers. Then the White Yaybichy killed this sister.

The father of the Red Yaybichy was the sun. The father of the White Yaybichy was the water.—T. Stanton Van Vleet.

[11]The "medicine things" referred to are the things which are used by the Yaybichy medicine-men at the present day. They consist of five pieces, each one of which performs a specific duty in restoring the health of the patient. The medicine-men claim that these "medicine things" have been handed down from generation to generation since the origin of the Yaybichys.

[12]These are the animals to which the "Mysterious Maiden" gave birth. They seem to have a significant place in Navajo mythology, and find their way into a large number of their legends.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—At the meeting of the Biological Section, Nov. 14, Prof. H. F. Osborn was elected chairman, and Bashford Dean secretary. The papers of the evening were:

Arthur Hollick, On Additions to the Palæobotany of the Cretaceous of Staten Island. These include about forty species not previously recorded from eastern North America, although in part described as occurring in the cretaceous of Greenland and in the Laramie. About fifteen new species were recorded, representing *Populus, Platanus, Myrica, Kalmia, Acer* and *Williamsonia.* The fossils were in the main taken from fire-brick clay. H. F. Osborn, Report Upon a Collection of Mammals from the Cretaceous (Laramie). The multituberculates *Meniscoëssus* and *Ptilodus* were assigned to the Plagiaulacidæ, the former a probable ancestor of *Polymastodon.* The relations of these mammals were shown to be closer to Puerco than to upper Jurassic forms. Arthur Willey, On the Significance of the Pituitary Body, suggesting from studies on Ascidians and Amphioxus a primitive monorhinic condition in vertebrates. The nasal sac of Petromyzon is of secondary nature, as shown by development (Dohrn) and nerve supply, but the nose in the monorhinic ancestor of vertebrates was the pituitary body of existing forms, this being represented in Ascidia, as shown by Julin, by the sub-neural gland and its duct, and in Amphioxus by the so-called olfactory pit. The pituitary body is to the lateral nares what the pineal body is to lateral eyes.

Bashford Dean exhibited an entire *Ctadodus*, a unique specimen recently collected in the Cleveland shales. The tail is for the first time shown, and indicates historically the origin of the ray parts of this organ in modern elasmobranchs.

Nebraska Academy of Sciences.—The annual meeting was held December 26 and 27, at Lincoln. Prof. Bessey was Chairman and Prof. A. H. Van Vleet, of Peru, Secretary and Treasurer. The following papers were read:

Psychology a Science, Dr. D. R. Dungan; Evidences of two Premorainic Glacial Movements, Prof. G. D. Sweezey; Evolution of the Loup Rivers, Dr. L. E. Hicks; Some Notes on the Fringillidæ of Nebraska, D. A. Haggard; The Myriapoda of Nebraska, F. C. Kenyon; The Canyon Flora of Northwest Nebraska, A. F. Woods; Notes

on the Flora of the Black Hills of South Dakota, P. A. Rydberg; Notes on Nebraska Phosphates, H. E. Fulmer; Some Notes on Mineral Water from Odell, Nebraska, Rosa Bouton; Systems of Notation in Numbers, Dr. H. E. Hitchcock; The Flora of Long Pine Canyon, Julius Conklin; The Flora of the Sand Hills, Roscoe Pound; A New Miocene Rodent, Prof. E. H. Barbour; The Fishes of Nebraska, M. E. O'Brien; Descriptions of Some New Nebraska Orthoptera, L. Bruner; Catalogue of the Orthoptera of Nebraska, L. Bruner; Notes on the Composition of the Lincoln City Gas Supply, Prof. H. H. Nicholson; The Relationship of the Nebraska Flora to That of the Regions Further West, H. S. Clason; The Erysipheæ of Crete, W. H. Skinner; The Fresh-Water Algæ of Kearney County, Nebraska, Dr. H. Hapeman; Some Mexican Lichens, Prof. T. A. Williams.

Boston Society of Natural History.—November 16.—The following paper was read: The Origin of Drumlins, Mr. Warren Upham; Profs. Shaler and Davis also spoke on the Origin of Drumlins.

December 7.—The following papers were read: Some Indian Quarries in Arkansas, Mr. Leon S. Griswold; Notes on a New Order of Schizomycetes (Bacteria). Specimens were shown with both papers.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—November 19.—The following communications were read: On Certain Minute (parasitic?) Bodies Within the Red Blood Corpuscles, Dr. Theobald Smith; The Topographical Relations of the Excretory Canals of Cestodes, Dr. C. W. Stiles; A Walchia from New Mexico, Mr. David White; Some Entomological Factors in the Problem of Country Fences, Mr. F. M. Webster; Comparative Value of Plants in Determining Floral Zones, Mr. F. V. Coville.

December 3.—The following communications were read: The Cruise of the U. S. Fish Commission Steamer Albatross in Alaskan Waters in 1892, Prof. B. W. Evermann; Some New Grasses, Dr. George Vasey; On the Rediscovery of Certain Rare Plants, Mr. J. N. Rose; Exhibition of a Complete Series of the Large American Ground Squirrels of the Subgenus Otospermophilus, Dr. C. Hart Merriam; The Mathematics of Forest Growth, Dr. B. E. Fernow.

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—November 15.—The following papers were read: Singular Copper Objects from

Ancient Mounds in Ohio, Mr. Warren K. Moorhead; Geographic Nomenclature of the District and Vicinity, a Symposium, Mr. James Mooney, Prof. Lester F. Ward, Mr. W. H. Holmes, Mr. W. Hallet Phillips, Mr. W. H. Babcock, and Dr. Frank Baker.

WESTON FLINT, *Secretary.*

SCIENTIFIC NEWS.

Prof. John S. Newberry, Professor of Geology in Columbia College, New York, died at New Haven, December 7. He was born at Windsor, Conn., in 1822, and was the descendant of an old and distinguished Puritan family. He was graduated from Western Reserve College in 1846, and from Cleveland Medical College in 1848. After two years' travel and study in Europe he established himself as a physician in Cleveland. He returned to his scientific studies, which had long been in abeyance, in 1855, when he accepted an appointment as acting assistant surgeon in the army, and accompanied, as surgeon and geologist, the expedition under Lieutenant R. S. Williamson, U. S. A., which explored the territory lying between San Francisco and the Columbia River. In 1857–'58 he was attached, in the same capacity, to the expedition under Lieutenant J. C. Ives, U. S. A., which made the first exploration of the Colorado River, one of the most important of the western territory surveys. Dr. Newberry, in 1859, participated in the exploration of the country bordering the upper Colorado and San Juan Rivers. During the war of the rebellion Dr. Newberry was a member of the United States Sanitary Commission, and directed its operations in the Valley of the Mississippi. In 1866 he was appointed professor of geology in the School of Mines, Columbia College. In 1869 he was appointed head of the reorganized Ohio Geological Survey, and under his direction the work was vigorously pushed to completion.

Prof. Newberry had probably seen more of the United States from a professional point of view than any other of our geologists. He will be best known from his work on fossil plants and fossil fishes. He was especially conscientious in his comparisons of American with European forms of extinct life that came under his observation. Personally he was of a rather impetuous temperament, whose strong friendships were offset by a spice of irascibility without malice. He will be greatly missed from his place in the scientific life of America.

Sir Richard Owen died December 18. He was born at Lancaster on July 20, 1804. He received his early education in his native town, and at the age of 20 he began a medical course in the University of Edinburgh. He completed his studies in London and Paris medical schools.

When 30 years old he was appointed to the chair of comparative anatomy at St. Bartholomew's Hospital, and two years later he succeeded Sir Charles Bell as Professor of Anatomy and Physiology in the College of Surgeons. He held the latter place for twenty years, leaving it only to take charge of the Department of Natural History in the British Museum.

He had the Cross of the Legion of Honor, was a Chevalier of the Prussian Order of Merit, and was one of the eight foreign associates of the French Institute. He was created a commander of the Bath in 1873, and subsequently was made K. C. B. Sir Richard Owen was the successor of Cuvier as the leader in the progressive advance of the science of comparative anatomy. He filled up many of the gaps unavoidably left by the great Frenchman, which he was enabled to do by the opening up of many parts of the world by British commercial and colonial enterprise. His contributions to paleontology are even more important, his researches having covered regions that Cuvier could not in his day reach. Antarctic paleontology was founded by him, for South America, South Africa and Australia yielded their treasures to him first of all. Besides being an accurate observer and describer he was a good systematist, many of the current terms of zoology having originated with him. In generalizations of a higher grade he was not active; the doctrine of evolution having arrived rather late to get that attention from him which its earlier advent would have secured.

Owen was a tall and stalwart man of spare habit. He was characterized by a mental and physical tenacity, which was exhibited in his psychic structure in the great difficulty he experienced in changing an opinion he had once formed. He was fond of diplomacy, and could dissect an adversary crosswise of the grain in the most bland and sympathetic manner imaginable.

Prof. J. T. Rothrock has resigned from the faculty of the University of Pennsylvania, and will occupy the position of Secretary of the Forestry Commission of Pennsylvania.

What is an Acquired Character?—A Correction.—In the December number of THE NATURALIST, page 1010, occurs about as

unfortunate an error in proof-reading as could have been made. The sentence "*I must confess my inability to see why this variation is not qualitative as well,*" is put in quotation marks, as if it were credited to *Weismann.* The sentence is my own, and would doubtless be indignantly repudiated by the great apostle of Neo-Darwinism, as it is flatly Neo-Lamarckian in fact.

In explanation I will simply add that I did not read the proof. The original manuscript in my possession is correct, although I am not positive that the typewritten copy forwarded to THE NATURALIST is not at fault.—C. C. NUTTING.

RECORD OF NORTH AMERICAN ZOOLOGY.

(*Continued from Vol. XXVI, p.* 798.)

GROTE, A. R.—[Validity of] *Halisidota trigona.* Can. Ent., xxiii, 109, 1891.

GROTE, A. R.—Note on Graphiphora Hubn. Can. Ent., xxiii, 101, 1891.

GROTE, A. R.—The male genitalia and the subdivisions of Agrotis. Can. Ent., xxiii, 147, 1891.

GROTE, A. R.—*Halisidota trigona.* Can. Ent., xxiii, 201, 1891.—Validity of.

GROTE, A. R.—On *Catocala flebilis* and *C. fratercula.* Can. Ent. xxiii, 281, 1891.

GROTE, A. R.—*Agrotis subgothica.* Can. Ent., xxiii, 202, 1891.—Reply to Tutt.

GROTE, A. R.—An explanation. Can. Ent., xxiv, 17, 1892.—Reply to certain criticisms of J. B. Smith, as to arrangement of Heterocera.

GROTE, A. R.—Remarks on Prof. John B. Smith's revision of the genus Agrotis. Can. Ent., xxiii 45, 1891.

HOWARD, L. O.—The larger corn stalk borer. Insect Life, iv, 95, 1891.—*Diatræa saccharalis.*

HUDSON, G. H.—A new species of Cerura. Can. Ent., xxiii, 197, 1891.

HULST, G. D.—Prof. J. B. Smith's List of Lepidoptera. Can. Ent., xxiv, 74, 1892.

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KELLICOTT, D. S.—Notes on two borers injurious to the Mountain Ash.—*Podoseiia syringæ, Zeuzophora semifuneralis.*

KELLICOTT, D. S.—Notes on the Ægeridæ of Central Ohio. Can. Ent., xxiv, 42, 1892.

KELLICOTT, D. S.—[Tortricid feeding on *Silphium perfoliatum*]. Can. Ent., xxiii, 218, 1891.

LINTNER, J. A.—[An onion pest, *Agrotis ypsilon*]. Can. Ent., xxiii, 220, 1891.

LINTNER, J. A.—On the eye-spotted bud-moth (*Tmetocera ocellaria*), in Western New York. Can. Ent., xxiii, 231, 1891.

LINTNER, J. A.—On some of our Orgyias. Can. Ent., xxiii, 232 1891.

LYMAN, H. H.—*Pamphila manitoba* (Scud.) and its varieties. 22 Rep. Ent. Socy. Ontario, 1891, 27. Can. Ent. xxiv, 57, 1892.

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MOFFATT, J. A.—*Melitta phaeton* [in Ontario]. Can. Ent., xxiv, 18, 1892.

MOFFATT, J. H.—*Petrophora silaciata.* Can. Ent., xxiv, 18, 1892. —Distribution and varieties.

NEUMÖGEN, B.—About Pseudohazis and its variations. Can. Ent., xxiii, 145, 1891.

OSBORN, H. and GOSSARD, H. A.—The clover-seed caterpillar (*Grapholitha interstinctana* Clem.). 22 Rep. Ent. Soc. Ontario, 74, 1891. Insect Life, iv, 56, 1891.

OSBORN, H.—*Asopia farinalis* as a clover pest. Can. Ent., xxiii, 283, 1891.

PACKARD, A. S.—Notes on some points in the external structure and phylogemy of Lepidopterous larvæ. Proc. B. S. N. H., xxv, 82, 1891.

PATTON, W. H.—Aphidivorous habits of *Teniseca tarquinius* (Fabr.) Grote. Can. Ent., xxviii, 66, 1892.

RILEY, C. V.—A new herbarium pest. Insect Life, iv, 108, 1891.—*Carphoxera ptelearia* n. g. and sp. Geometridæ.

SMITH, J. B.—Contributions toward a monograph of the Noctuidæ of Temperate North America.—Revision of Homohadena, Grote. Proc. U. S. Nat. Mus., xiii, 397, 1891.—*H. deserta* nov.

SMITH, J. B.—Contributions, etc., Revision of the species of Hadena referable to Xylophasia and Luperina, l. c., p. 407, 1891.—*X. cogitata, alticola, nigrior, antennata, centralis,* are new.

SMITH, J. B.—Remarks on the classification of the Lepidoptera. Can. Ent., xxiii, 245, 1891.

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SMITH, J. B.—*Limenitis arthemis,* etc. Can. Ent., xxiii, 104, 1891.

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Townsend, C. H. T.—*Chilo saccharalis* in New Mexico. Insect Life, iv, 24, 1891. 22 Rep. Ent. Soc. Ontario, 50, 1891.

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Smith, J. B.—Notes on blackberry borers and gall makers. Insect Life, iv, 27, 1891.—Cecidomyid.

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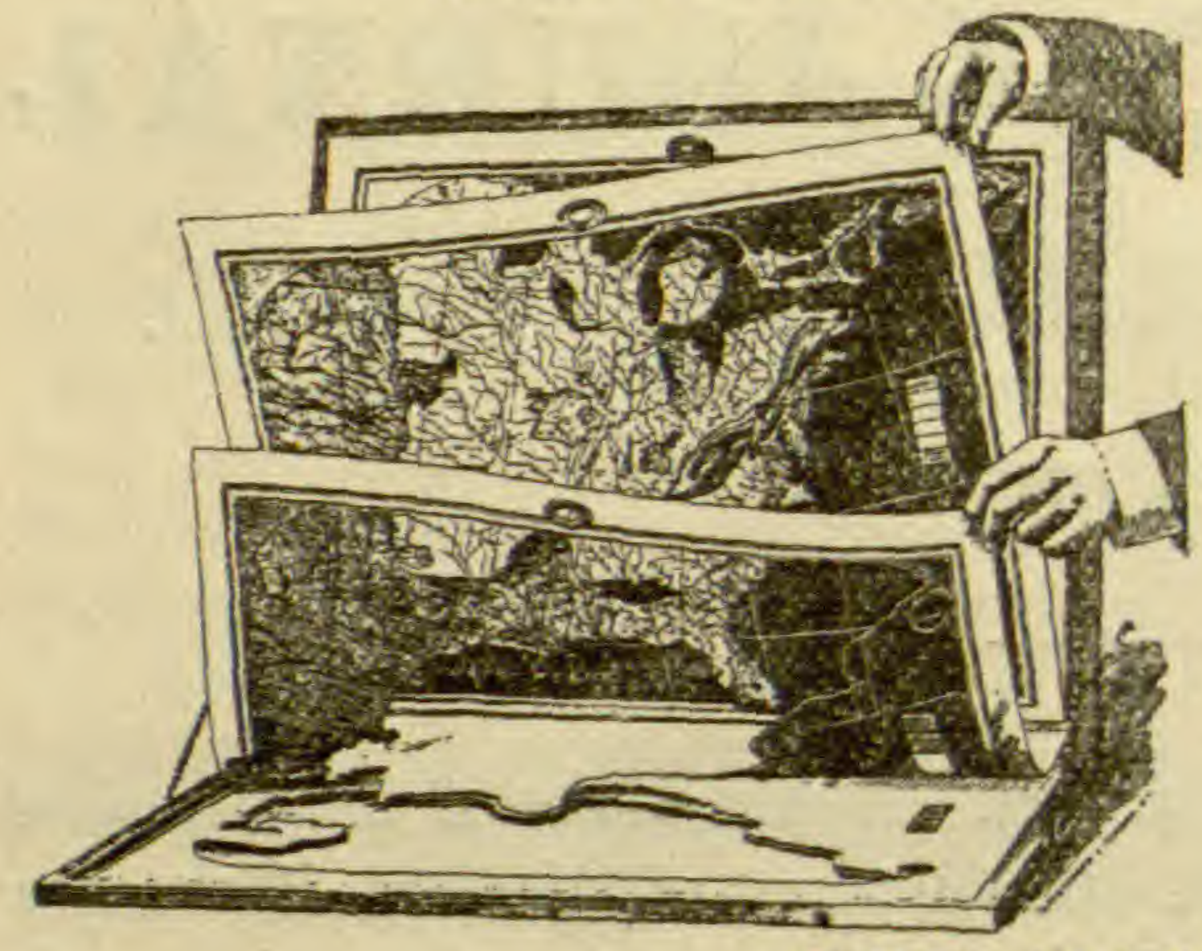

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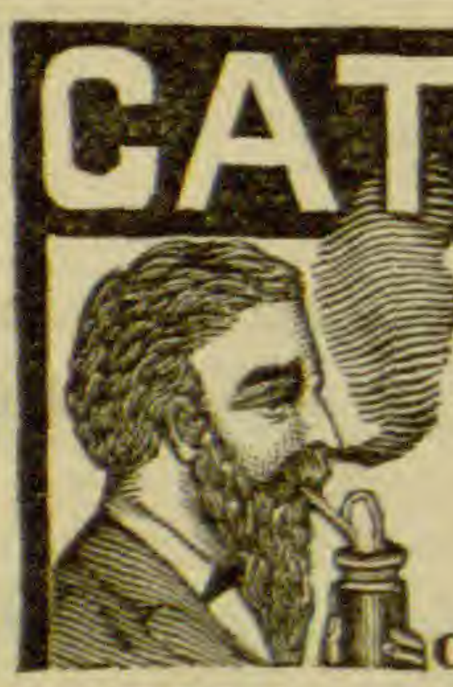

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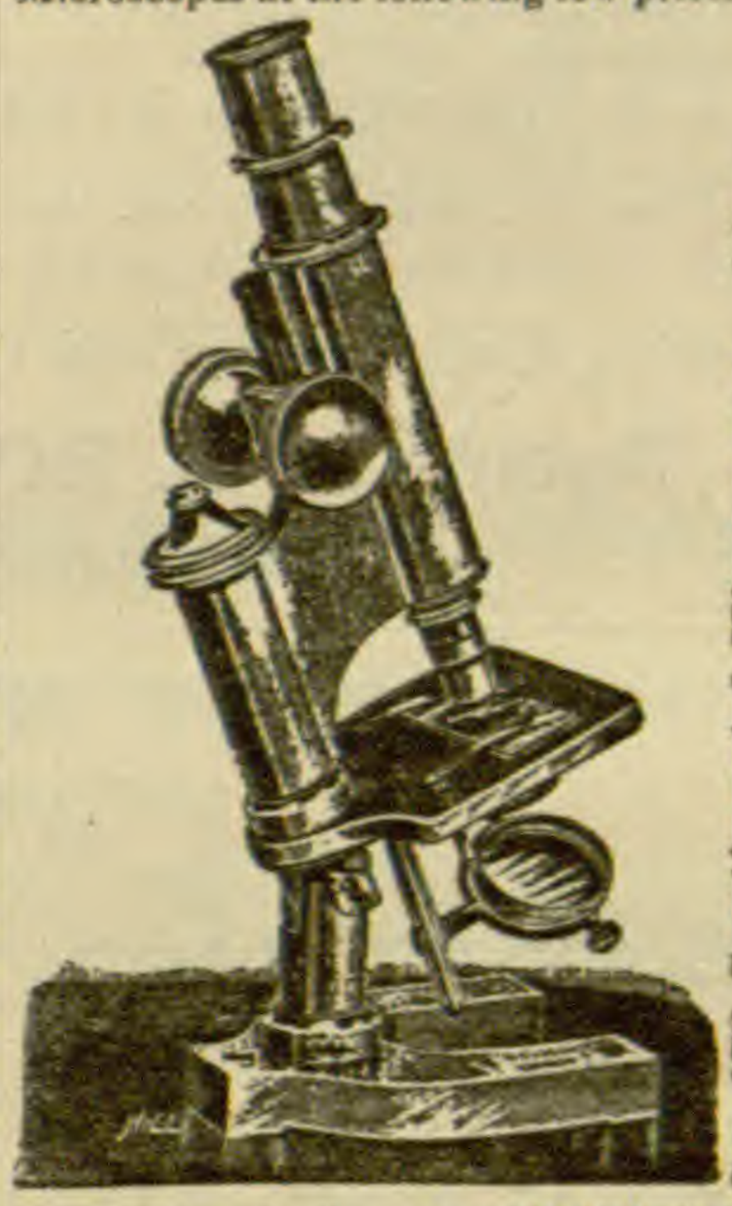

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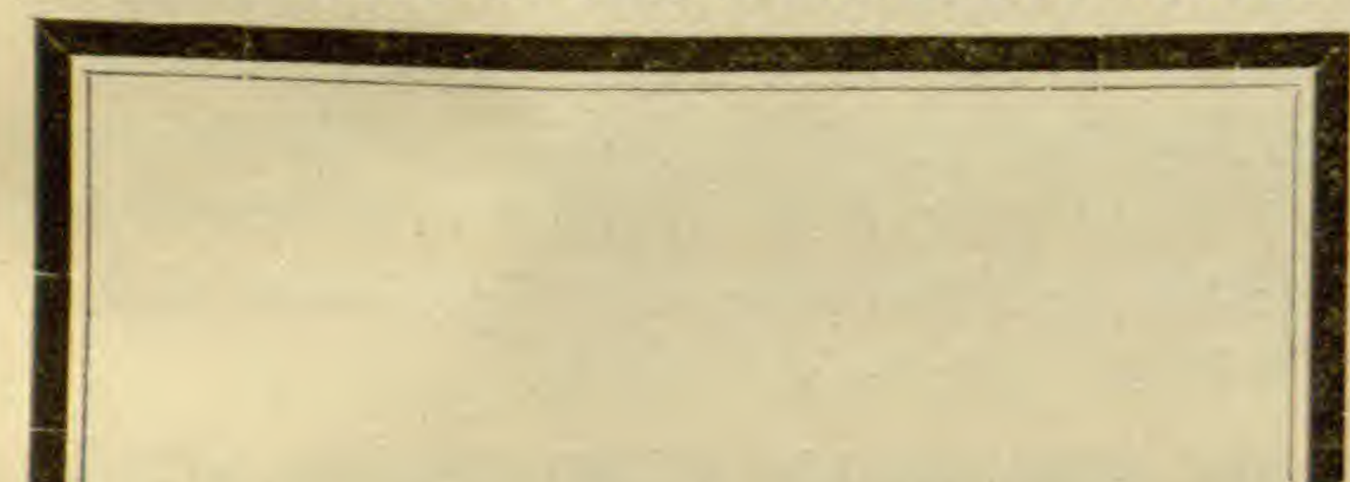

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JOINT FORMATION AMONG THE INVERTEBRATA.

By Benjamin Sharp.

The following observations were prompted by a discussion on the subject of joints, at a meeting of the Academy of Natural Sciences of Philadelphia held on November 22nd, 1892, when Prof. Cope considered some facts relating to his theory of joint formation as seen among the vertebrata.

As his theory has been known for some time, and an extended consideration of it has recently been published[1] I merely quote as a thesis, a sentence published in 1878[2]; "change of structure is seen to take place in accordance with the mechanical effect of three forms of motion, viz, by *friction*, *pressure* and *strain*."

It occurred to me that if his theory had a general application, some additional proofs could be shown to exist among the invertebrates, where we have the action of muscular force upon hard and resisting parts of the skeleton. Those which present the best study for this purpose, appear to be the crustaceans, where we find an immense variety of articulations in the body and in the limbs; highly complicated locked joints, others allowing motion in but one plane, as well as

[1]The Mechanical Causes of the development of the Hard Parts of the Mammalia, by E. D. Cope. Jour. of Morph. Vol. III, 1889, p. 137-290.

[2]The relation of animal motion to animal evolution, by E. D. Cope, American Naturalist, Vol. XII. 1878, p. 44.

loose joints, where the hard parts scarcely come in contact with one another, and cases of degeneration of the hard parts, leading to total disappearance of a previously existing joint.

In the annelides, from which, there is no doubt, the arthropod branch sprang, we find no deposit of inorganic salts in the epidermis. (I do not regard the hard, calcareous, and other secretions of tubicolous annelides as entering into this question, as they are merely protective coverings, not acted upon by the muscles of the body, nor is there even any muscular connection with it.) The outer layer of the body is generally of a horn-like character, adhering closely to the secretive cells of the epidermis, very flexible and thrown into folds by the vermicular motion of its possessor. In the leeches, the body consists of a flexible cylinder, made up of two sets of muscles, an outer longitudinal cylinder and an inner cylinder of circular fibers, the contraction of which, causes the animal to increase in length, while shortening is effected by the contraction of the longitudinal layer. The external surface of the medicinal leech, for example (see fig. 1) is thrown into a regular series of very fine folds, extending across the longitudinal axis of the body. These folds do not correspond in numbers, to the somites of the body, which are not indicated externally, five, six or more of them belonging to one somite. When the animal shortens its length, these folds are deepened and the segments thrown closely together; when extension takes place, the folds are flattened, spread open, although not wholly disappearing, as they are a fixed quantity so to speak. I believe these folds are due to mechanical action: by the disposition of the different fibers of the longitudinal series, in being inserted in a series of planes bounded by the

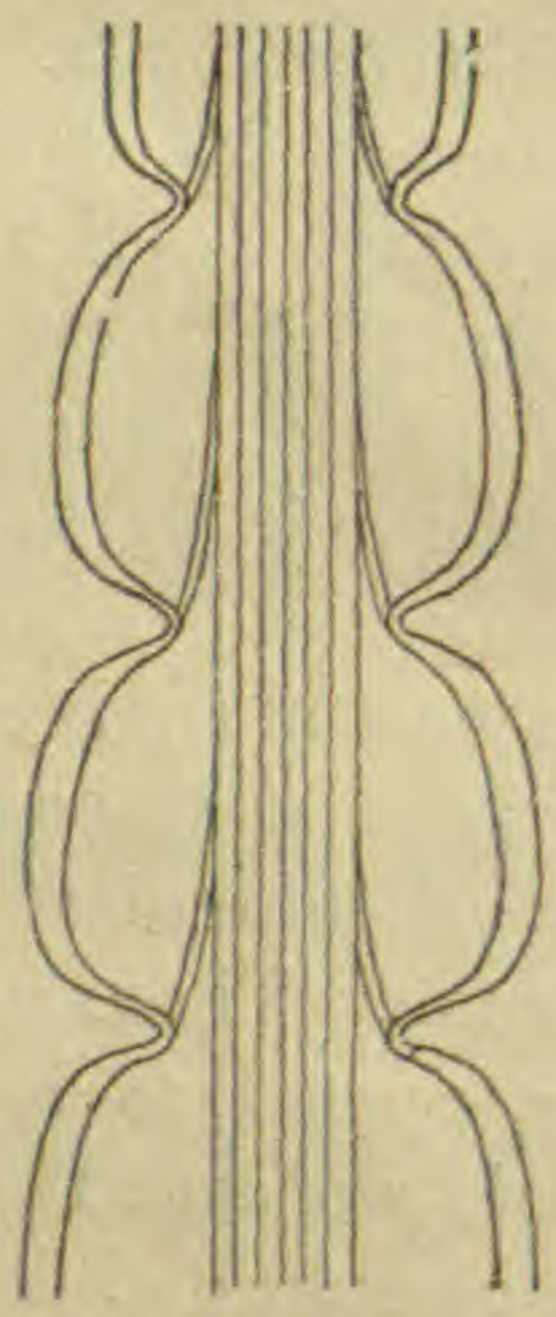


Fig 1

Diagrammatic representation of the segments of the leech showing the folds, valleys and muscular fibers.

valleys between the folds, this being aided by some of the circular fibers which pass through the longitudinal sheath, and find their attachment to the bases of the valleys.

Starting from this point, and supposing the regularity of the folds to have become established from pre-existing irregular folds by the regularity and stress of muscular action, we can conceive that when deposits of calcareous matter took place, rings similarly formed by a folding of a soft skin would receive that deposit at the most prominent portion of this fold, the convex face and not in the protected valleys, as there would be more friction or pressure from external causes, and no deposits would take place in the valleys themselves because they would not be subject to external friction, and their continual flexion would prevent any such deposits. Should such a deposit take place in the valleys, there would be a stiffening of the whole surface which would defeat motion. In fact, in the leech, the cuticle is already much thicker on the crests of the folds than in the valleys.

In the more primitive crustacea, we find the animal made up of rings extending over the whole length of the body, similar to the rings of the leech, save (fig. 2) that there is but one ring to one somite, and instead of a perpendicular valley between the folds, this valley has an inward and a forward direction, allowing the anterior edge of a caudad ring to fit into the posterior edge of a cephalad ring.

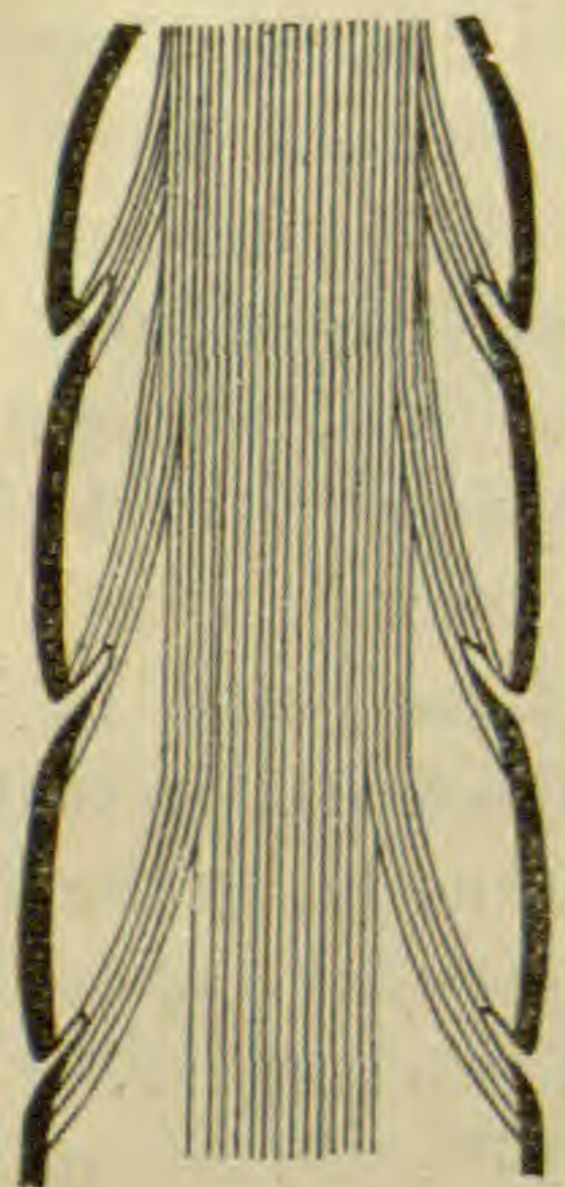


Fig. 2

Diagrammatic representation of the rings of a primitive crustacea showing the action of the muscles.

In the higher crustacea, several of the anterior rings have coalesced, and form a solid shield which is known as the carapace. This has no doubt arisen by the lessening of the action between the anterior rings when the posterior portion of the body became the more active propelling organ. As the action ceased forward the valleys came to rest, and became exposed to friction and pressure, and

consequently a deposit of calcareous matter took place producing the stiffening above hinted at.

The formation of jointed appendages from parapodic paddles of the annelides can be followed out in the same manner, since the manner of mutual relation of the segments is the same as in the case of the body segments.

It has been stated that in the leech the folds do not correspond in number to the somites of the body, while they do in the crustacea. All annelides do not move by means of a muscular system built upon the plan found in the leech. In many the circular layer has to a large extent disappeared, for the longitudino-circular plan is undoubtedly ante-annelidan. The movement of the free medusoid forms, and of the Ctenophora, is the result of a modified arrangement of this plan.

With the disappearance of the circular layer, we find a peculiar modification of the longitudinal layer. This layer becomes broken up and the fibers act in moving the setæ, which answer to limbs. In a segment of a setiferous annelid, we may observe that the longitudinal muscles of the somite in section at the position of the seta are arranged like the letter "V," in the fork of which the seta lies, the fibers to the left (anterior) pull the seta externally backward, those on the right (posterior) pull the seta forward. The introduction of the setæ, the origin of which I do not here attempt to explain has no doubt been, together with the establishment of external segmentation, a strong factor in causing the breaking up of the muscular tube into sections (myotomes), which by use and consequent increase have extended each arm of the "V" into the segment on each side, while the insertion of the end of the seta has caused a break in the muscle by the formation of an aponurosis. This gives us the peculiar disposition of a myotome to extend arcoss the union of two somites.

If we examine the segments of the so-called abdomen of the macrurous crustacea, as the lobster, we will find that the anterior face of one abdominal ring is pulled into the posterior orifice of the ring lying anterior to it, forming a kind of tubular ball and socket joint, but with a flexible part of the integument with no calcareous deposit, folded upon itself,

and acting physiologically as a tubular *ligamentum teres*. On examining the different joints, we will find that commencing at a fixed point, as at the base of the thorax, the movable ring of the first abdominal somite is *pulled into* the fixed part. Then the first abdominal somite becomes the fixed point for the movable ring posterior to it, and so on, so that we find that the rings proceed away from the thorax, each is pulled into the opening of the one in advance. This is true of all those forms where the abdomen is well formed, strong and an active organ in the economy of the animal; when this organ, the abdomen, ceases to be an active organ of motion as in the burrowing forms, as *Callianassa*, *Gebia*, some of the *Squillidæ*, etc., or where it is folded upon the sternum of the thoracic region, the muscles becoming weaker through disuse, the rings are not subject to the powerful muscular strain, and they as a rule overlap but little if at all, but lie so that the edge of one ring rests upon the edge of another. In those forms where degeneration of the abdomen has proceeded so far as not to have even the usual deposit of calcareous matter, as in the hermit crabs, there are simply indications of rings on the abdomen, and this organ is but little more than a fleshy sac containing some of the viscera, and supplied with a few muscles which act together, with the form of the organ, to keep the abdomen curled so that it may hold as a hook, the animal within the molluscan shell which it habitually occupies.

In forms as highly developed as the cray-fish and the lobster where the calcareous deposits are great, there have crept in many modifications. One of the main features in the articulations of the rings of the abdomen is the "lock" or hinge which allows no lateral movement in the tail whatever; the lateral movement is also prevented by the overlap of the pleura. This lock consists of a rounded prominence on each of the rings projecting *forward* from a posterior segment into a socket in the anterior one. The movement in any two segments so formed takes place in the plane, the axis of which passes through these two points so that the arc described by the movement is only in a vertical plane. The terga of the segment is much arched in the lobster, and the upward motion is limited after a certain point is reached by the dome

of the segment itself. In some of the *Scyllaridæ*, there is a transverse groove on the terga of the somites merely indicated in the lobster, into which the posterior face of the terga ahead of it fits when the abdomen is fully extended, and which prevents any further upward movement. It will be noticed further, in those forms that the sternum of each abdominal segment is very narrow, and that they are connected by a broad uncalcified membranous area which allows plenty of room for flexion downward.

The first abdominal segment is narrow, and in the vast majority of cases it is *considerably* narrower than the one which follows it so that it may be covered by the posterior edge of the carapace and the anterior edge of the second abdominal ring. In the *Homaridea* and *Loricata* there is an interesting provision to prevent the strain of the powerful abdominal muscles from drawing the smaller segment too far into the thorax. On each of the lateral faces of the ring there is a broad tooth or calcified lobe, which overlaps the posterior edge of the carapace allowing the latter to play between it and the surface of the ring.

When the limbs are examined, the same rule will be found to hold good viz.: that the movable part is pulled into the fixed part. A modification of this is well illustrated in the evolution of the large chelæ. In some forms, take for example *Ibacus*, the first pair, and in fact all of the thoracic limbs end in a sharp pointed segment, there being not the slightest suggestion of a chela. In *Crangon*, (fig. 3) on the other hand, the ternimal segment is pulled against the broad face of the penultimate one thus making a shift for a chela. In the Stomatopoda this step has been developed, for the last segment can be drawn against the whole length of the penultimate one (which is sometimes grooved to protect the points of the spines of the latter,) and forms with it a very effective grasping organ. The continual use of the terminal segment, the increase of the muscular power

Fig 3

a. "hand" of a form of Crangon.
b. "hand" of a form of Astacus.

will tend to draw this terminal segment backward (into) on the penultimate which enlarges with the increase of bulk of muscle, so that a well developed chelæ, as in the lobster, is found where the ultimate segment is pulled backward to about the middle of the penultimate segment.

A true ball and socket joint rarely if ever obtains in the crustacea, and for very obvious reasons. The nature of the impassive connection of the joints would not allow of the motion and the active element, the muscle acts upon the *inside* of the joint or through its center, thus making it almost impossible for muscles to act so as to give the free movement of a ball and socket joint. The same end is obtained by a series of ginglymoid joints working in different planes so that in a series of three or four joints the end of the limb, for example, can be made to describe a circle, and I am inclined to believe that in order to obtain this free motion, the first two or three joints of crustacean limbs are as a rule very short and work in different planes.

Several objections may be easily found to the statement that posterior segments are always drawn into the anterior ones. Take for example, the shrimps, where the *second* abdominal ring *overlaps* the first so that the ring ahead of it as well as the others behind it is drawn within its anterior opening. I am inclined to regard this exception as more or less proving the rule, and to consider the second segment the fixed point into which the other two rings are drawn. We see a foreshadowing of this plan in the lobster group, where, as in *Astacus*, to use the words of Huxley, "the pluræ of the second somite are much larger than any of the others, and their front edges overlap the small pleuræ of the first abdominal somite, and when the abdomen is much flexed these pluræ even ride over the posterior edges of the branchiostegites."[3]

An exception much more difficult to explain is that found in some of the anomurous forms as *Galathea*, where the fourth, fifth, sixth and seventh segments follow the rule, and the first

[3]The Crayfish, an introduction to the study of zoology, by T. H. Huxley, New York and London, 1880, p. 98 and 99.

in regard to its anterior face, but the second overlaps the first, the third, the second, and the fourth. In other words, the fourth has pulled both ways as the second has in the shrimps, but in the latter the second segment is obviously the largest of the series, while the abdominal segments of *Galathea* are all of about the same size and strength.

We may, however, provisionally accept as a natural consequence and general rule, that the motion of a movable part naturally hollows out for itself a cavity in which to move within the solid and fixed basis. This may be further illustrated in the hard parts of the vertebrata.

It is a well known fact that even when the muscles are said to be at rest, there is more or less of a strain, or pull exerted. When the human hand hangs loosely down, it rests half way between extreme flexion and extreme extension; the same may be said of the fingers, although in some persons, as in sailors, where the flexor muscles are very strong the fingers hang as so many "hooks," owing to the pull of the more powerful flexor muscles. This is well shown in cases of the paralysis of one set of muscles; the parts are drawn to the side of the healthy muscles even when no voluntary action is exerted by the normal muscles. This is too well known to medical men to require further comment, and is especially illustrated in cases of facial paralysis where the face is drawn strongly to one side by the normal muscles.

Taking the action of the normal muscles when at so-called rest, it is not surprising to find that in the joints the lighter or more mobile part, being continually pulled against the fixed part and moved upon it, that a cavity should be formed in the fixed parts by the continual action and pressure of the mobile part. Take for example, the humerus in man, the head is hemispherical and fits into a concave portion of the scapula, a true ball and socket joint, and it is formed, if there be any truth in the idea, by the humerus being pulled into the scapula by the powerful muscles of the shoulder. And as this is probably the first joint which was formed in the evolution of the limb which then acted as a fin, the rotatory motion aided and finally established the ball and socket form

of joint. Other cases might be mentioned as that of the lower jaw and the tarso-tibial joint.

In the above remarks, I have simply made an attempt to apply the theory of mechanical genesis to a much neglected group of the invertebrata, and if I, in this, have only been able to direct attention to the field of carcinology, I will feel that this short paper will have served its purpose.

THE GASES IN LIVING PLANTS.

(*Continued from Vol. XXVII, page 7.*)

By J. C. Arthur.

Kinds of Gases and Relative Amounts.

It is now our duty to give a brief statement of the kinds, the source and the movements of gases in plants.

Plants are permeated by the same gases that make up the atmosphere surrounding them: oxygen, carbon dioxide and nitrogen. Nitrogen in the form of a gas is neither used nor generated by any part of plants, unless we except the tubercles of certain roots, and so it occurs in about the same percentage inside the plant as outside of it. On the other hand, both oxygen and carbon dioxide enter into combination with, and are liberated from, the plant tissues in varying amounts at different times. The percentage of these two gases in the cavities of the plant vary through a considerable range. In a series of determinations made by Lawes, Gilbert and Pugh, in England, the oxygen ranged from 3 to 10 per cent., and the carbon dioxide from 14 to 21 per cent in plants which had been for some time in the dark, while plants which had been standing in sunlight reversed these figures, and gave 24 to 27 per cent. of oxygen and 3 to 6 per cent. of carbon dioxide. The two gases, therefore, bear a somewhat reciprocal relation, their sum usually being about 25 to 30 per cent. of the total gas in the plant.

Variation in Amount due to Assimilation.

The variations in the relative amount of oxygen and carbon dioxide are due to two independent processes incident to the life of plants. One of these processes is assimilation, by which all green cells of plants in the presence of sunlight, or its equivalent, such as a strong electric light, absorb carbon dioxide and liberate oxygen. This process goes on with great

rapidity in healthy cells, but is entirely checked upon the withdrawal of light, or when it reaches a certain low intensity. Of course it never takes place in roots, flowers, the central portion of large stems, or other parts which are not green, nor in any fungi or other plants not possessed of green coloring matter.

Variation in Amount due to Respiration.

The other great cause of disturbance in the relation of oxygen and carbon dioxide in the plant, is the process of respiration.

Respiration in plants is essentially the same as in animals, and consists in the fixation of oxygen and the liberation of carbon dioxide. It takes place in every living cell, whatever the kind of plant, whatever the part of the plant, and whatever the conditions of active existence. The rate of respiration varies with the temperature, the age of the cell, and the nature of the chemical transformations. In normal respiration the amount of oxygen absorbed is approximately the same as the amount of carbon dioxide evolved. There are, however, certain modified forms of respiration in which this does not hold true.

If living plants be placed in a vacuum, or in an atmosphere deprived of oxygen, it is found that they can still carry on life processes for some time, accompanied with an evolution of carbon dioxide. The oxygen necessary for this process is obtained from the breaking up of compounds in the cells, and it is therefore called intramolecular breathing.

The germination of seeds, which contain a large amount of oil, is somewhat the opposite of this last process. In order to convert the fat into a more directly servicable food material for the plant, a large amount of oxygen enters into the new combination, for which there is no equivalent amount of gas liberated. It consequently comes about that oily seeds in germinating absorb a far larger amount of oxygen than they liberate of carbon dioxide. This is known as vincular breathing.

Another variation from normal respiration is known as insolar breathing, and which, with still some other modifications, I need not stop to explain. To this brief statement of plant respiration must be added that much yet remains to be discovered regarding the details of the processes.

Assimilation and respiration are the two great causes which disturb the relative volume of the two variable gases in plants.

Movement of the Same two Gases.

We shall now turn to the movement of the same two gases, oxygen and carbon dioxide. There has never been a disposition, as in the case of many other plant phenomena, to explain the movement of gases upon any other than purely physical principles. We have therefore to do simply with the question of the aids and hindrances to the establishment of an equilibrium between the gases inside and outside the plant, irrespective of whether the cells are alive or dead.

Outer and Inner Pressure of Gases.

It has already been stated that the relative amounts of oxygen and carbon dioxide inside the plant are usually very different, and that within a few hours the relation of the two may be completely reversed. To this may be added that the pressure of the gases inside the plant is sometimes more, sometimes less than that of the atmosphere outside the plant, almost never the same. Hales observed in his early work that a mercury guage connected with the inside of the trunk of a tree showed an internal pressure when the hot rays of the sun warmed the trunk. This was largely due, undoubtedly, to the expansion of the gases in the trunk, by the heat. Such an excess of pressure in water plants is very common, although due to other causes. It may readily be shown by breaking stems under water, when bubbles of gas will be liberated, as undoubtedly many have noticed in gathering water lilies, or other water plants.

On the other hand, the pressure of the gas inside the plant may be less than on the outside. This has long been recog-

nized, but was best demonstrated by von Höhnel in 1879, to whom it occurred to cut off stems under mercury. In doing so the mercury rose to a considerable height in the vessels of the stem, and as mercury is without capillarity, this can only be ascribed to the greater pressure of the outside air, or in other words, to a partial vacuum in the plant.

An observation was made by Hales, whom I have mentioned so often, which we may use to illustrate how such a negative pressure, as it has been called, can be brought about. He cut off a branch, fastened an empty tube to the cut end, and plunged the other end of the tube into a liquid. He found that as evaporation of moisture from the leaves took place, the liquid was drawn up into the empty tube. This phenomenon can now be explained more satisfactorily than could be done at that early day. By evaporation the liquid water inside the plant escapes in the form of vapor, and the space it occupied is filled by the gases, thus rarifying them. This rarifaction may go on in uninjured plants until the internal pressure is greatly reduced. But in the experiment, the pressure is equalized by the rise of the liquid in the tube. A later modification of Hales' experiment is to use a forked branch, place the cut end in water to give a continuous supply of moisture for transpiration, and attach the empty tube to one of the side forks of the stem, cut away for that purpose.

Permeability of Tissues.

It is self-evident that such condensation and rarifaction of the gases in the plant could not take place if the cell walls were readily permeable to gases. Thus it comes about that one of the most important topics in connection with the movement of gases in the plant, is the permeability of tissue walls of various kinds, and especially those constituting the surface covering of plants.

I shall not attempt to conduct you through the tangle of supposition and fact, errors in experiments, correct and incorrect conclusions, and the general confusion which has come from the labors of physicists, chemists and botanists for the last twenty-five years, during which the subject has received

coefficient of absorption and the density of the gas. Cuticular and corky formations also permit the passage of gases when dry. Thus we see, that gases may be forced through the stomata, or breathing pores, by varying pressure, but can only pass through the epidermis and bark of plants by diffusion. We therefore arrive at the conclusion that the gases inside and outside of the plant are brought to an equilibrium by direct interchange through the stomata and intercellular spaces, aided by the comparatively slow process of diffusion through the whole surface of the plant, both above and below ground.

In Conclusion.

After so long a discussion of the subject of the origin, kinds and movement of gases in plants, I trust I have not only brought out the main facts regarding our present knowledge, but also made evident some of the numerous directions in which further experiment and research is needed. It would be most appropriate to transfer the activity in this subject to the laboratories of this country, and let the Americans take up the line of discoveries carried on so far by the English, French, and lastly, the German scientists.

LEGENDS OF THE SUMIRO-ACCADIANS OF CHALDEA.

By Alice Bodington.

(*Continued from Vol. XXVII, p.* 19.)

In Genesis, as is well known, two distinct accounts exist of the creation of the world and of Man, of which variants are found in the cuneiform inscriptions. One of these variants, lately found on a tablet of baked clay, with a parallel Semitic translation, is of great interest. It begins at an earlier period of cosmic history than either the Biblical or the hitherto known Chaldean account.[1] Whilst the version of the first chapter of Genesis[2] begins with a description of chaos and the old Semitic Babylonian version with the time "when the heavens were not proclaimed and the earth recorded not a name," the Sumiro-Accadian account begins with a description of the time when the "glorious house of the gods (apparently the sky,) had not been made, a plant had not been brought forth nor a tree created; when a brick had not been laid, a beam not shaped, a house not built, a city not constructed and a glorious foundation or dwelling of men had not been made." But when "within the sea there was a stream," then "the glorious city of the gods, the divine Eridhu," was built, of which Babylon, the earthly Eridhu, was a faint copy. Then the tablet mentions the creation of living beings, not men as yet, but gods and the spirits "Anunnaki"; and the supreme deity proclaims the existence of the "glorious city, the seat of the joy of their hearts." Meridug, son of Ea, now "made a foundation before the waters"; made dust and poured it out with the blood, and in one single line "he made mankind." The female principle, the goddess Araru, (the Bohu of Chaldean legend the Bohu of Genesis 1.2) "made the seed of mankind with him."

[1]That deciphered by George Smith.

[2]New Version of the Creation Story. Paper read by Mr. T. G. Pinches, of the British Museum, at the International Oriental Congress.

Then he made the beasts of the field and the living creatures of the desert; the Tigris and the Euphrates, and "proclaimed their name well," in fact said that creation was good, as in Genesis. Then Herodach created grass, the plants of the marshes and the forests; and with the plains and forests in which they were to dwell, he made oxen and other large cattle and sheep. This deeply interesting account has been necessarily much abbreviated.

The Accadian idea of the structure of the world must be understood before the various legends as to the creation and the early history of mankind become "thinkable" to the modern mind. In our mind's eye we see the world as a comparatively insignificant planet whirling at headlong speed round a central sun; we know the blue sky to be only the effect of distant air; it is not "thinkable" to us that the sun should stand still at the bidding of the leader of a small tribe of half savage Nomads, nor that a tower should be built to attain a solid sky, above which lived gods, alarmed and jealous at so daring a proceeding. Nor can we picture to ourselves a great reservoir or "Heavenly Ocean" above a solid sky, which could be "opened" to let the waters submerge a sinful world. But all these stories are in harmony with Accadian cosmogony. The Chaldeans imagined the earth as an inverted boat or bowl, the thickness of which would represent what we call the crust of the earth; while in the hollow beneath this crust lay the "abyss," the abode of many powers, and answering to the Elysium and Tartarus of classic mythology. Here dwelt Allat, the remorseless Queen of the Dead; from the Abyss issued the terrible Maskim, the seven evil spirits, who knew neither mercy nor pity.[3] Here too was Eridhu, the "glorious abode," within which was the tower which reached the skies.

Above the convex surface of the earth spread the sky, (*ana*) divided into two regions, the highest heaven or firmament, which with the fixed stars immovably attached to it, revolved as upon an axis, round an immensely high mountain, which joined it to the earth as a pillar. In the lower heaven the planets conceived of as resplendent animals of beneficent

[3]Chaldea, pp. 153–157.

nature, wandered forever on their appointed paths. The earthly ocean, a counterpart of the heavenly ocean, was imagined as a broad river, or watery rim, flowing all round the edge of the inverted bowl, precisely as Herodotus described it. And so late as the Middle Ages, we find Dante's conception of the structure of the world to be substantially that of the Accadians; the "purgatorio" is an immensely high mountain joining earth and sky, through whose circles pass the souls in a state of probation, till at the top they step into the lower heaven.

In the fine Accadian epic of which the account of the Deluge furnishes the eleventh book, the ark is represented as resting on this mountain. It relates[4] that Tzdubar, the national hero, was beloved by the goddess Tshtar. She promised him a "chariot of gold and precious stones; that kings and princes should bow before him, and kiss his feet; that his flocks and herds should multiply two fold, and his mules and oxen be peerless of their kind." But Tzdubar laughed her love to scorn, and the enraged goddess implored her father, Anu, to take vengeance on him. A monstrous bull was sent against his city of Erech, but it was slain by Tzdubar's friend, Eâbani, and laid before the altar of the god Shamash, whilst the people spent the night in feasting and rejoicing. But the vengeance of Tshtar was not to be so easily foiled. With the help of her mother she smote Eâbani with sudden death and Tzdubar with a dire disease, which made life a burden. He determined in his anguish to seek relief from his great ancestor, Hâsisadra, who dwelt, immortal, in the Blessed Land, at the "mouth of the rivers" beyond the Waters of Death. Long and weary was the journey, and on his way Tzdubar passed the giant warders of the sun—half men and half scorpions—who kept watch over his rising and his setting. On the shore of the Waters of Death the hero met the ferryman Urubél, and for a month and fifteen days they journeyed together over that dreary sea, till they reached the Chaldean "Valley of Avilon," and Tzdubar met his ancestor face to face. Here Hâsisadra related to his descendant the story of the Deluge, and his own

[4]Chaldea, pp. 301–17.

share in that great event. Tzdubar was purified and healed by laving in the Waters of Death; he returned safely to Erech, and there offered up a touching prayer to the beneficent god, Ea, that his lost friend, Eâbani, might be restored to life. Ea, through his son, Meridug, brings Eâbani from the world of Shades to the Land of the Blessed, there to live forever among the heroes of old, and so all ends happily as a fairy tale.

The Chaldean legend of the Deluge is, as is well known, an extremely close variant of the account found in Genesis, even to the rainbow as a sign of the repentance of the God Anu, for the havoc he had wrought. Only it is Tshtar who "spreads out the great bows of her father Anu," and who says "I shall be mindful of these days; never shall I lose the memory of them," and the assurance is given that though pestilence and wild beasts may be sent as a punishment for the wickedness of man, never shall a universal flood again overwhelm the earth. In the Chaldean account it is the ever beneficent Ea who warns Hâsisadra of the coming flood, and bids him prepare the ark for himself and his family, and who himself sends the cattle and the wild beasts of the field to their haven of safety; he who reproaches the other gods with the wanton destruction they have wrought, and brought Bel, hasty but quickly repentant to his senses. Bel himself took Hâsiṣadra by the hand and led him out of the ark, after the sacrifice had been offered up, "when the gods smelled a sweet savour." See Genesis viii, 21.

The great solar and catholic myths are found in their earliest forms amongst the Sumiro-Accadians, and from them they passed through the Phœnicians to the Greeks and Romans. Tshtar, the great goddess of Nature, personifying the life-producing earth, loves the young Sun-God, Dumuzi. The tablet of the national Epic, which describes the manner of his death, has unfortunately but one fragment left, which speaks of the "black pine of Eridhu, marking the centre of the earth, in the dark forest, into the heart whereof man has not penetrated; within it Dumuzi. . . ." A month was set apart, (June–July), both in Chaldea and Assyria, as

mourning for the death of Dumuzi, however it occurred; the mourners wept and wailed, and tore their hair for the first six days, and at the close of the sixth day the wildest and most extravagant rejoicing marked his resurrection and restoration to Tshtar. Six hundred years B. C., Ezekiel, in captivity at Babylon, speaks of the "women weeping for Tammuz," (Dumuzi). We have, fortunately, the tablet, nearly complete, which relates Tshtar's descent to "the land whence there is no return, towards the dwelling that has an entrance but no exit, towards the hall from which the light of day is shut out, where the shades of the dead dwell in the dark." Tshtar haughtily orders the warder to open the gate, "If thou openest not, I will demolish the threshold. . . . I will let loose the dead to return to earth. . . . I will make the risen dead more monstrous than the living." The gatekeeper humbly answers the angry goddess: "Be appeased, O Lady, let me go and report thy name to Allat, the Queen." And Tshtar declares that she comes only to "weep over the heroes who have lost their wives; over the wives who have been taken from their husbands' arms. I wish to weep over the Only Son, (a name of Dumuzi,) who has been taken away before his time." Allat, full of evil delight that a hated rival has come within her power, orders the keeper to open the seven-fold gates for Tshtar, with the stipulation that at every gate she should strip off some of her attire. The warder of Arallu takes from the goddess her earrings, her necklace, her jewelled girdle, the bracelets on her arms, and the bangles at her ankles, and lastly her long flowing garment, and with these her divine power departed, and she stood powerless before the spiteful Queen of the Dead. Allat orders her chief minister, Namtar, the Pestilence, to lead Tshtar away, and to afflict her with sixty dire diseases, in the deepest darkness of the abyss. Meanwhile, as when Demeter mourned inconsolably for her lost Persephone, all went ill in the upper world. Life and love had gone out of it; there were no marriages and no births, and the gods held council as to the release of Tshtar. The beneficent Ea conceived a plan. He created a phantom, Uddusunamir. "Go," he said, "to the Land whence

there is no return, and the seven gates of Arallu will open before thee. . . . Conjure Allat with the name of the great gods; stiffen thy neck and keep thy mind on the Spring of Life. Let the Lady (Tshtar) gain access to the Spring of Life, and drink of its waters." Allat in her fury beat her breast and bit her fingers with rage. She ordered Namtar to let Tshtar drink of the Spring of Life, and bear her from her sight. Namtar took the goddess through the seven enclosures, restoring at each the article of her attire that had been taken from her. At the last gate he said: "Thou hast paid no ransom to Allat for thy deliverance; so now return to Dumuzi, the lover of thy youth; sprinkle over him the sacred waters, clothe him in splendid garments, adorn him with gems." The last lines of the poem are mutilated, but it is evident that they bear on the reunion of Tshtar with her young lover.

Not only does this myth remind one of the legends of Demeter and Persephone, of Adonis, of Balder, the beautiful, and of Osiris, but what—if it were possible—seems like a variant of the same myth, is the legend amongst the Tee-Wahn[5] Indians of Nah-chu-ru-chu (the Bluish Light of Dawn) and his lost wife, the Moon-maiden. Nah-chu-ru-chu held the well-being of all his people in his hands for life and death. When the jealous Corn-maidens had thrown his wife down a deep well where none could find her, Nah-chu-ru-chu sat for days, neither speaking nor moving, his head bowed upon his hands. Then no rain fell and the crops died, and thirsty animals wandered, crying along the dry rivers. The coyote, the badger and the eagle went to seek the lost Moon, and when at last she was found, the choked earth drank and was glad and green, the dead crops came to life, and for four days the people danced and sang in the public square.

In innumerable ways have the Accadians been the priests and schoolmasters of mankind in Europe and Asia, for through the Bâk tribes of Elam, in Southern Chaldea, they are considered to have been the founders of the ancient civilization of China; and through the Semitic peoples they have conferred upon us gifts, good and bad; the art of writing, the signs of

[5]Tee-Wahn Folk Stories. St. Nicholas, March, 1892.

the zodiac, the measurement of the year, the early legends of Genesis, the keeping sacred of the seventh day, the belief in magic and witchcraft, and the mediæval devil. An Assyrian calendar mentions a day called Sabattu, "a day for completion of work, of rest for the soul." On that day it was not lawful to cook food, to change one's dress, to offer a sacrifice; the king was forbidden to speak in public, to ride in a chariot, or perform any civil or military duty"; a strictness equal to the Sabbatarianism of the most orthodox Jew.

On their way to a pure monotheism, the early Jews seem to have combined in their "Elohim," and their "Yahveh," the characteristics of the principal gods of the Sumiro-Accadians. We recognize the features, sometimes of the calm and beneficent Ea, and of his son Meridug, Intercessor for men; sometimes of the hasty, vindictive Sun-god, Bel, who "consumes in a moment" the victims of his anger, till the features of all these Nature gods fade away in the moral effulgence of the sublime God of Isaiah.

No object is commoner in Chaldean and Assyrian pictorial representations than the Sacred Tree, the Tree of Life, with and without the serpent. To the old Chaldeans the Sacred Tree was intimately connected with an original ancestral abode, an earthly Paradise, watered by springs which became great rivers.

The "serpent of Genesis we recognize as Mummu-Tiamat," the "Dragon," the "Great Serpent," who was the sworn enemy of the gods and their creation; the principle of opposition and destruction. The gods determine to fight the great Serpent; Anu, the heaven God, prepares the sickle-shaped sword, and the beautifully bent bow, whilst Bel goes forth in his matchless war-chariot, sending the lightning before him, and scattering his arrows around. Tiamat comes forth to meet him, attended by evil demons, and bearing death and destruction in her train. But it is Meridug, the intercessor for mankind, who "bruises the serpent's head"; who binds her and puts an end to her works, while her followers fly terror-stricken.

I have not space to give a tithe of the profoundly interesting and suggestive facts revealed by the deciphering of the cune-

iform inscriptions. We find ourselves looking at the cradle-land of our religion, our sciences and our literature; we find the most touching and passionate appeals to the Divinity in the very spirit of the finest Psalms of David, in a land looked upon as the seat of the grossest idolatry; we find a civilization old enough to have been the parent stock of the civilization of China; we look upon an early world, which knew nothing of the proud white race which now girdles the earth with empire.

Amidst the surging waves which have carried away so many beliefs, we find two anchors linking us to the Unseen, which become the firmer the more we know of evolutionary processes. One is the enormous strength of the religious instinct, even at the earliest stages of the civilization of mankind. And if the study of evolution teaches us one thing more than another, it is that *no instinct exists in vain.* The other foreign to my present subject is the inscrutable nature of the "*noumenon*," which lies behind all phenomena; that Energy, which, whether we think of it as "gods" with the old Accadians, as the "Supreme Being," or by whatever name we strive to approach the Unknown Reality, it remains equally Unknown, (though perhaps not forever Unknowable,) and equally the eternal object of search and worship.

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

By Clarence B. Moore.

(*Continued from January Number, 1893.*)

(*Second Paper.*)

West end of ridge on summit, 7x4x7½ feet deep. At a depth of 1 foot 6 inches, an arrow-head with bones of lower edible animals, was found. Two feet down were fragments of turtle shell, and a half a foot lower, a fragment of a bone awl was met with. At 5 feet, 6 inches, from the surface was a well defined fire-place, with bones of the turtle. The shells are almost exclusively *Paludinæ*, with occasional *Unionidæ* and few *Ampullariæ*.

EXCAVATION II.

North-east side of mound about ten feet vertically from the base. Besides the usual fire-places and bones of edible animals, a fragment of a *Fulgur* was found at a depth of four feet.

EXCAVATION III.

On summit near center of ridge, 9x9x11 feet deep. No clearly marked strata were met with, the excavation being carried through shell with a considerable percentage of broken shell and sand. The following objects were found;—flint flake at a depth of 6 inches; fragment of bone awl 1 foot down; small pendant ornament of shell 1½ feet from surface, (Fig. 4)

Fig. 4. Size, ½.

with bone implement; shell gouge (broken) 2 feet down; rude arrow-head on fire-place, 4½ feet down; flint flake 5 feet down; arrow-head lying on fire-place, at a depth of 6½ feet from surface; portion of arrow-head on fire-place, bearing marks of fire at a depth of 8 feet; fragment of bone awl 9 feet 9 inches down; rude bone awl 10 feet down; bones of edible animals, mainly of alligator, deer and turtle, at all depths.

EXCAVATION IV.

At margin of base north-east portion of mound. Trench 11½x10x6 feet deep at end. A piece of coquina, smooth on one side, evidently used for polishing, at a depth of 2½ feet, and a fragment of arrow-head with the usual bones of edible animals, were the only objects of interest met with.

As before stated, absolutely no pottery was seen in the excavation, and this, with the 600 feet of swamp between the mound and the river, would argue for Mt. Taylor a place among the earliest shell heaps of the St. John's. It was the habit of the builders of the shell heaps where solid ground was to be found, to locate their refuse heaps upon it, and it seems unlikely that a spot so far distant from the river's edge as is Mt. Taylor to-day, should have been selected. It is a much more likely hypothesis that the swamp is the result of a change of channel in the river, and has formed since the abandonment of the mound. Professor Wyman has graphically described in his memoir (page 83 et. seq.) the manner of formation of similar swamps. The time required to transform a portion of the river into swamp-land, the writer of this paper believes to be somewhat less than is generally supposed, owing to the great abundance of floating vegetation upon the river. At Little Orange mound, opposite Lake Dexter, is a steam boat wharf in use within eight years, according to the owner of the place. At present, masses of vegetation extending some distance into the river have made access impossible for a boat of any draught, and are speedily forming the nucleus of a future swamp.

Assuming this hypothesis of the formation of the swamp after the completion of the mound to be correct, an indication

of minimum age may be obtained in the case of Mt. Taylor through the size of trees growing between it and the water's edge. Between it and the river grow two cypresses, respectively 14 feet in circumference four feet from the ground, and 19 feet, 3 inches, 5 feet from the ground; while a little to the north-west of the mound in the swamp grows a cypress 23½ feet in circumference at a height of 5 feet from the ground. The cypress is a tree of slow growth, by some being placed next to the live oak in this respect.

Another point illustrated by Mt. Taylor is that neighboring shell heaps are by no means of necessity contemporary. In close proximity to it in the river, is Bird's Island,[1] covered with a shell deposit between five and six feet in thickness. Throughout this deposit to the very bottom unornamented pottery is found in great abundance. North of Bird's Island, on the western bank of the river, is the shell bluff described by Professor Wyman (Note A.). This shell bluff, by the absence of pottery and the small size of its *Paludinæ*, differs widely from Bird's Island, and is probably contemporary with Mt. Taylor.

Just what impelled the makers of Mt. Taylor to pile the debris of their meals to such a height and at such an angle it is impossible to surmise. No ridges of shell led to it, while no shell fields surround it, and it is evident that great care was taken looking to its isolation and to give to it its height and shape. In comparison with the shell deposits of Huntoon Island, of Bluffton, of Silver Spring (Lake George), of Tick Island and other localities where the shell deposit, though large, is spread over great areas and not piled at a single spot, the contrast is especially striking.

Shell Deposit Opposite Bluffton.

On the west bank of the river, opposite Bluffton, is a level deposit of shell bordering the water. About fifty yards inland is a small symmetrical mound, not over three feet in

[1]The *Paludinæ* on Bird's Island, it may be remarked, are far larger than any found at Mt. Taylor; well illustrating a point stated in the preceding paper that shell fish of the St. John's had a middle period of increased development, and a subsequent relapse to their earlier condition.

height, composed of the same material as the shell deposit, namely shell and powdered shell. An excavation was made in the center of the mound, and within a foot of the surface were found various parts of a skeleton, apparently of a woman. The jaws and all other facial bones were missing, as were one femur, one humerus, both tibiæ and all bones of the feet. Many of the bones had fractures not caused during the excavation, the area of the fracture being of the same color as the remainder of the bone. With the remains were several bits of pottery which seemed to be wanting in the mound, save in association with the bones, and this fact would indicate a burial, as would the symmetrical shape of the mound. The fractures can readily be explained by the proximity to the surface, where the tramping of feet could without difficulty separate and fracture the bones. On the other hand, the absence of so many important bones—for which very careful search was made—would seem to indicate that the entire body was not placed within the mound. The various conflicting facts connected with this case offer one of those questions, unfortunately without solution, which from time to time confront the explorer of the shell heaps.

Near this point Mr. Dease, of Volusia, found a small earthenware bowl clinging to the roots of an overturned palmetto, and presented it to the writer.

NOTE A.

As To A Natural Origin of any of the fresh-water Shell heaps of the River.

It will be remembered that at the time when Professor Wyman wrote, the agency of man in connection with the shell heaps of the St. John's was nowhere admitted. It is therefore quite natural that taking the initiative in this matter he should have been averse to making any sweeping assertions. There is, however, little room to doubt that all the shell heaps are the work of man. Of the shell bluff near Astor, (Fort Butler) he says[2] (page 38) "taken by itself, in view of the

[2] *Op. cit.*

absence of human implements we should hardly feel justified in saying that it was made by man; though in its general features it resembles his work." At the base of this bluff the writer picked up a chisel of shell, and, what is more conclusive (since objects not in place prove but little) a clearly defined fire-place was discovered at a depth of four feet from the surface. It is perfectly safe to say that no fresh-water shell heap can be found on the St. John's River where a careful search would not reveal unmistakable evidences of human agency in its origin.

THE ANCYLOPODA, CHALICOTHERIUM AND ARTIONYX.[1]

By Henry Fairfield Osborn.

Chalicotherium was the most unique mammal of the Miocene period. So far as known at present, it combined cheek teeth of a distinctively ungulate type, ankle and wrist joints resembling those of the Perissodactyla, with highly modified phalanges, terminating in large cleft ungues which were undoubtedly covered with strong pointed claws. It was widely distributed over Europe, Asia and North America from the oligocene Phosphorites of France (*C. modicum*) to the early Pliocene of the Siwalik Hills (*C. sivalense*).

The recent discoveries of Filhol and Depéret in France have fully revealed the structure of the skull and limbs, but with the exception of the axis, little or nothing is known of either the vertebræ or scapular and pelvic arches. As we learn from these authors the *Chalicotherium magnum* of Sansan (Middle Miocene) was an animal taller than the grizzly bear. The head was about nineteen inches long and raised five feet above the ground. The limbs were rather slender, and a striking peculiarity of this species is that the fore limb is nearly twice as long as the hind limb (as indicated by the proportions of the radius and tibia). This was not the case in its upper Miocene ally (*Ancyllotherium pentelici*) from Pikermi, in which the limbs were heavy and of the same length. There were three toes upon each foot, but in both manus and pes, the fourth or outer digit was the largest instead of the third or middle digit as in the Perissodactyla. M. Filhol has represented *C. magnum* as fully plantigrade, but this appears to me an error; the perissodactyl displacement of the carpals and

[1] Under the title "The Affinities of *Chalicotherium*," this article was written some months ago. While it was in press, *Artionyx*, a new type of the order was discovered, and at the editor's suggestion, the article was held back to include a description of it.

tarsals, the structure of the ankle and wrist joints, and the terminal facets of the metapodials all indicate that the feet were sub-digitigrade. Displacement is very rare in plantigrade types. The proximal phalanges are peculiar in having the metapodial facets directed obliquely upward; both these and the median phalanges are short; the distal phalanges are very peculiar, they present a deep terminal cleft and were evidently drawn up or retracted, as in the cats, instead of being drawn down or flexed, as in the Edentates. Thus, it is probable that *Chalicotherium* walked more like a clumsy-footed cat than like the bear. The soles of the feet were slightly turned inward and the fore-limb was adapted to digging or partial prehension.

Restoration. The axial skeleton in the accompanying drawing is mainly based upon Filhol's restoration, but the scapula and pelvis are independently restored upon the perissodactyl model; the sloping trunk leads us to expect a rather broad pelvic basin. All the above parts are purely conjectural.

The proportions of the fore and hind limbs with each other and with the skull are based upon the figures of Depéret. In Filhol's drawing the skull is proportionately too small. The side views of the feet are after Filhol's excellent drawings, but the articular positions are drawn differently, for M. Filhol makes the animal fully plantigrade, while the metapodial and phalangeal and higher articulations prove that it was digitigrade.

What is the explanation of this remarkable assemblage of characters? Where shall we place Chalicotherium, with reference to the two great orders between which it seems to stand midway. If, observing the teeth and the carpus and tarsus, we relate it to Perissodactyla, we find ourselves placing a clawed type among hoofed types. Or is it to be considered an Edentate because of its claws and edentulous premaxillaries as Filhol has suggested? Or is it representative of a distinct order midway between the Ungulata and Unguiculata? It is too early to attempt a final solution of these questions. We must wait for the discovery of the middle and upper Eocene Chalicotheriidæ. It is evident from Gaudry's discovery of the

feet in the Phosphorites, *C.* (Schizotherium) *priscum*, that the finding of other Eocene types is not far off. In the meantime I have tentatively offered the suggestion that *Chalicotherium* is

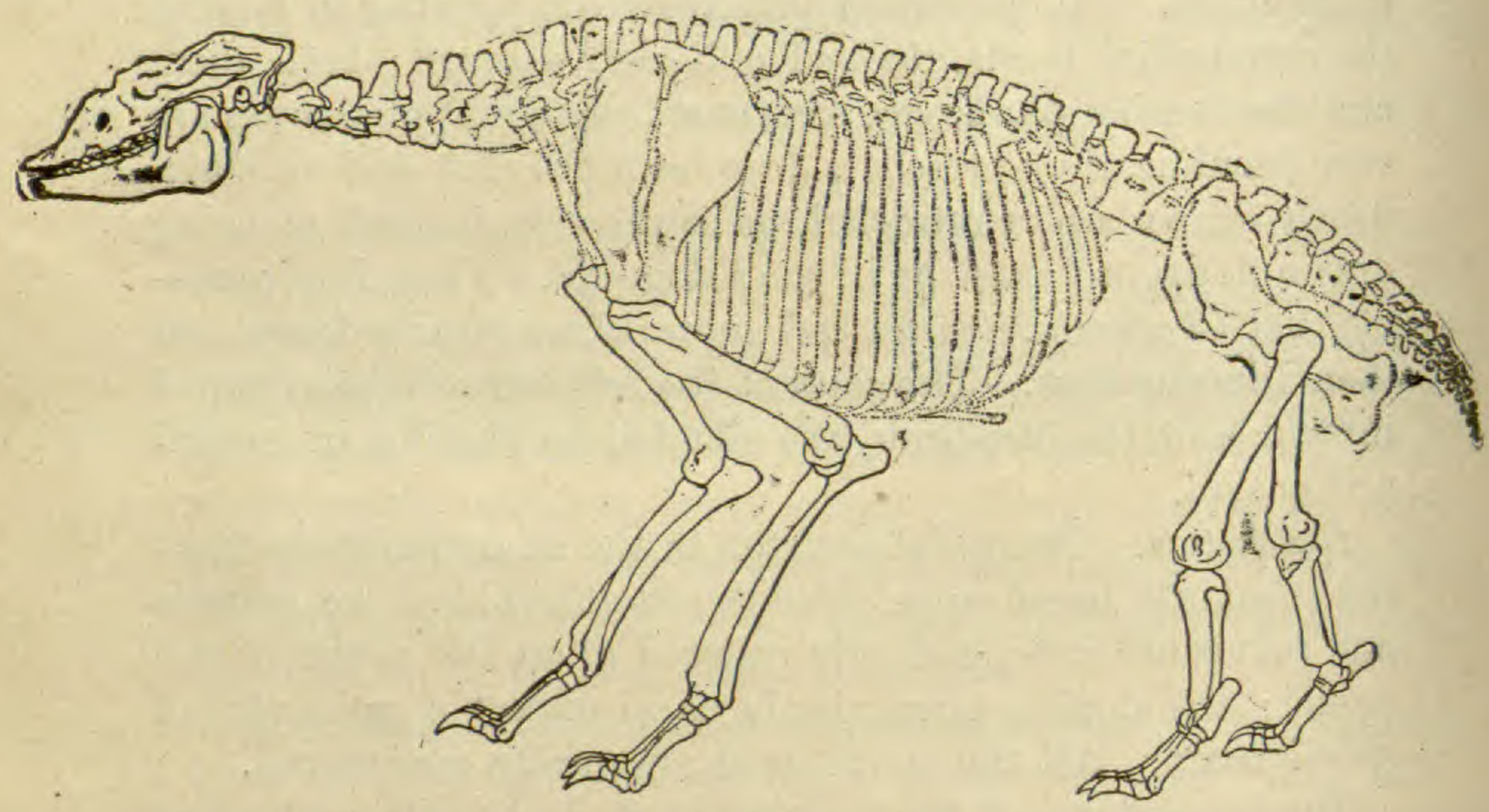


Fig. 1. Restoration of *Chalicotherium.* Modified from Filhol and Depéret.

distantly related to *Meniscotherium* of the lower Eocene (Wasatch), and that this may give us a clue to its zoological position. I will now expand and discuss this idea which may be expressed as follows:

That the group to which Chalicotherium belongs was derived from the Condylarthra of the lowest Eocene, with affinities to the Meniscotheriidae and primitive Perissodactyla. It represents a distinct order, the Ancylopoda (Cope). The likeness to the Unguiculates and especially to the Edentata is due to secondary adaptations and contains no proof of real affinity.

The *history of the discovery* of this animal is as unique as its structure, and illustrates the uncertain path of the vertebrate paleontologist. We are indebted for a full résumé, to Dr. Ch. Depéret, who has fully discussed the bibliography, structure and relations of this genus in his admirable memoir. Until

recently the skull and limb bones, wherever found, were placed not only in different genera but in distinct orders. The first remains discovered were the terminal phalanges, found in the upper Miocene of Eppelsheim in 1825; they were sent to Cuvier, who, noting the deep terminal cleft, named them *Pangolin gigantesque.* In 1833 Kaup found in the same beds the isolated upper molars which he naturally attributed to an ungulate, and named *Chalicotherium goldfussi* (syn. *antiquum*). Thus early began the confusion due to the wholly diverse affinities suggested by the phalanges and the teeth. In 1837 Lartet found the feet (in somewhat earlier Miocene beds of Sansan) which he supposed belonged to a huge edentate and termed *Macrotherium giganteum.* In 1853 Lartet also discovered a skull and teeth at Sansan; he was unaware of Kaup's priority and first called the skull *Anoplotherium,* but later separated it as *Anisodon*; Gervais, later, pointed out the priority of Kaup's term. In the upper Miocene of Pikermi Gaudry found feet and limbs quite different from the *Macrotherium* type; these he termed *Ancylotherium.* From the Phosphorites, in 1875, he described the teeth of a new species, *C. modicum,* and the feet of a supposed new genus, *Schizotherium priscum.* The skull and teeth were also found by Falconer in the Siwaliks of India and termed *C. sivalense.*

Considering this exceptional mingling in so many horizons, of one genus represented exclusively by skulls or teeth and another by feet and limbs, Filhol, in 1888, first advanced the conjecture that the two might really be one, and was happily able to confirm this by his own discoveries in Sansan. Forsyth Major independently arrived at the same conclusion from his explorations in the Pikermi beds. Finally, in his memoir, Depéret describes parts of a skeleton and skull found together at Grive St. Alban, in beds nearly contemporaneous with Sansan. In the meantime it is probable that a similar confusion has arisen with us. In 1877 Marsh announced the discovery of phalanges of a large edentate in the middle and upper Miocene of Oregon and Nebraska, and compared them with those of *Ancylotherium* rather than with any true edentates; he distinguished them by the coalescence of the first and sec-

ond phalanges as *Moropus* (species *distans, senex* and *elatus*). The first undoubted remains of *Chalicotherium* in this country were found by Garman in the Loup Fork (upper Miocene) and described by Scott and Osborn. Cope has also described a lower Miocene species (*C. bilobatum*) from the White River beds (Swift Current Creek) of Canada. It is not improbable that *Moropus* belongs to the same types.

Nomenclature and Synonomy. Depéret advocates an important modification in our nomenclature. He believes that the Eppelsheim type, to which the name *Chalicotherium* was originally applied, can be identified by the form of its phalanges with the Pikermi type (*Ancylotherium* Gaudry), and is, therefore, distinct from the Sansan type. For the latter he proposes to retain the name *Macrotherium* Lartet. If this proves to be correct these types should be distinguished as follows:

Middle and Lower Miocene. (Sansan, Grive St. Alban, ? Phosphorites.)	Upper Miocene, Lower Pliocene. (Eppelsheim, Pikermi.)
Macrotherium.	*Chalicotherium.*
Syn.: Anisodon, ? Schizotherium, ? Moropus.	Syn.: Ancylotherium.
Semi-arboreal and fossorial. Light skeleton. Fore-limb greatly elongated. Radius (= .70), tibia (= .29). Radius with large external, and small internal, fossa for humerus. Ulna distinct or very slightly coalesced with radius distally.	Quadrupedal. Heavy skeleton. Fore- and hind-limbs nearly equal. Radius and tibia of nearly same size; of heavy proportions. Radius with subequal external and internal fossæ of humerus. Ulna coalesced with radius.

While many striking differences separated these two types, especially in the proportions of the limbs, the teeth were substantially similar. A strong family relationship is also exhibited in a peculiarity of the feet pointed out by Gaudry, namely, the *proximal* phalanges were retracted and not the distal, while in the cats the *distal* phalanges are retracted and in the edentates the phalanges are not retracted at all but are flexed. In the edentates the foot is thrown upon its outer side; in the Chalicotheriidæ this was only partly the case.

Ungulate affinities of Chalicotherium. M. Filhol's view is that this genus belongs to a group which bridges the gap between the Edentates and Ungulates. When he showed me his newly discovered skeleton in 1889, I was especially struck by the perissodactyl character of the carpus and tarsus, and considered it best to leave the genus in the Perissodactyla as "an aberrant form, with nearest affinities to *Palaeosyops* and genera of that line." It has also been doubtfully placed near the Perissodactyla by Flower and Lydekker.

Depéret has now advanced sufficient evidence to exclude the edentate idea entirely and shows clearly that the resemblances which *Chalicotherium* bears to the sloths are purely superficial. As shown above the adaptations of the phalanges for prehension or digging involve an entirely different set of muscles from those employed in either the Cats or the Edentates. This genus has attained a somewhat similar functional result by a different route—a case of analogy but not of homology. So with the elongation and curvature of the fore-arm, the ultimate coalescence of the ulna and the radius, the backward direction of the olecranon, the cleft ungual phalanges. All these are independent and "parallel" or "homoplastic" adaptations. *Chalicotherium* is still more positively separated from the Edentates by the numerous ungulate characters which it displays.

Depéret is very much impressed by these ungulate structures and places this genus definitely among the Perissodactyla. Let us, therefore, examine the ungulate hypothesis. Upon the affirmative side is the structure of the molar teeth; they certainly bear a distant resemblance to those of *Anoplotherium* and a more striking likeness to those of *Palæosyops* and *Titanotherium*. The reduction of the upper cutting teeth may be regarded as a secondary adaptation which does not affect the question of ungulate affinity either way. There are really several questions involved; shall we waive the structure of the terminal phalanges and call this genus an Ungulate? Shall we then direct our attention upon the teeth and carpals and tarsals and call it a Perissodactyl, or shall we follow Cope and remove it entirely to the Unguiculata? Let us sum up some of its leading characters:

Characters of Chalicotherium.

Shared by Ungulates.	*Shared by Perissodactyla.*	*Not found in Perissodactyla.*
Radius transverse proximally, with two fossæ for humerus.	Tridactyl manus and pes.	Not mesaxonic.
Tibia with two fossæ, spine and crest.	Astragalus and all carpal and tarsal facets diplarthrous.	Main axis through fourth digit.
Calcaneum with broad sustentaculum.		Secondary unquiculate modifications of limbs and phalanges.
Diplarthry in carpus and tarsus.		Third trochanter absent.
Jaws with elevated condyle and broad angle.	Buno-selenodont molar type.	Large curved tympanic bullæ.
Molar teeth of sexitubercular origin.		Reduction of upper incisors.

This table shows that there are many characters, beside the form of the phalanges, which excludes this family from the Perissodactyla proper. The detailed comparisons of the skull which Depéret institutes with *Palæotherium* and *Palæosyops* relate to structures which are shared by all primitive Ungulates. The only structures in which there is apparently conclusive evidence of a remote relationship to this great division of the Ungulates is first in the teeth and second in the carpus and tarsus. It remains, therefore, to be seen whether these also are products of homoplasy or "parallel adaptation," or whether they really evince affinity.

Now let us turn to the broader question. Is *Chalicotherium* to be classed as an ungulate or as an unguiculate in the Linnæan sense? We should, of course, compare it first with the primitive ungulata which exhibit many unguiculate characters. We are again guided partly by the excellent figures and descriptions given by Depéret of *C. magnum* (race Rhodanicum). The skull resembles that of the Ungulata Condylarthra in many features. The occiput is very low and broad and widely overhangs the condyles. There is a well arched sagittal crest and a rather small cranium. The lower jaw has an elevated condyle and a deeply extended angle. The external auditory meatus is widely open below and there is a large mastoid pro-

cess. The maxillary bones are high. All these characters are very similar to those in the skulls of the primitive Condylarthra, such as *Periptychus*, *Phenacodus* and *Meniscotherium*. We should also mention many cranial features which we believe belong to the category of secondary adaptive modifications; among such are the following: (1) the large curved cylindrical tympanic bullæ, (2) the feeble character of the nasals, premaxillaries and anterior portion of the mandibular rami. The latter modifications are associated with the reduction of the cutting teeth. Filhol has shown that the young individuals of Sansan have a full set of incisors, while in the adult the upper incisors are rudimentary or wanting.

There are other secondary features of note. The condylar facets are prolonged forward upon the basi-occipitals. The posterior face of the centrum of the axis is directed upward; this and the preceding features point to peculiar flexibility of the neck. The centrum of the axis is long and slender, the odontoid process is round, the spine is unusually long and high.

Looking again at the limbs we observe that the radius covers the entire front face of the ulna and presents two distinct fossæ for the condyles of the humerus. The tibia closely resembles that of some of the short-limbed ungulates in its cnemial crest and two fossæ for the femur, in its spine and distal grooves for the double trochlea of the astragalus which is like that in the short-footed *Aphelops*. This likeness to the ungulates, and especially to the perissodactyls, in the form of the upper foot bones and of their articulations with the metapodials is most striking. The calcaneum has a long tuber and very broad sustentaculum. The astragalus rests widely upon the cuboid, its tibial trochlea is very similar to that in the short-footed rhinoceroses. The cuboid, navicular and cuneiforms are, however, extremely flattened and specialized. The diplarthrous character of the carpus is precisely like that of Perissodactyla, the lunar rests upon the cuneiform and the scaphoid upon the magnum, while the metapodials abut laterally against the unciform and magnum.

Upon the whole we find that primitive and secondary ungulate characters decidedly predominate in the skull, teeth and skeleton. The secondary characters, especially in the ankle and wrist joints, are parallel with those in the perissodactyls, and are not mingled with unguiculate adaptations until we reach the phalanges.

Relation to the Unguiculata. Cope was the first to advocate the more radical view that this genus represents a distinct order. He wrote: "It has little relation to the family of Perissodactyla to which it has given the name (Palæosyops). Unlike the serial manus and pes of the edentata the carpus and tarsus are here diplarthrous in structure or displaced upon each other. While the Condylarthra are ungulate with an unguiculate carpus and tarsus, this order Ancylopoda presents the antithesis of including unguiculates with an ungulate carpus and tarsus." This antithesis he assigned as the main character of the new order.[2] He still considers the form of the terminal phalanges as of fundamental importance and believes (in a letter of May 14, 1892) that *Chalicotherium* must have been derived from some primitive unguiculate.

The ancestry of Chalicotherium. Without any knowledge of the ancestors of *Chalicotherium* we thus reach a dead lock. Shall the unguiculate structure of the phalanges outweigh the ungulate structures in other parts of the skeleton? Is it possible to derive such a skull and skeleton from any unguiculate or such terminal phalanges from any ungulate? In looking about for relatives of this genus we must now entirely discard the Palæosyops group, and hunt among the lowest Eocene types. The lowest Eocene unguiculates are wholly dissimilar. The only form at all similar is the genus Meniscotherium. Meniscotherium was a little plantigrade slightly larger than Hyrax, and of very similar proportions. It is found in the beds between the Wahsatch and Puerco and was even older than Coryphodon. The teeth are of the ungulate type known as

[2]Gill's term "Chalicotheroidea" was applied to these forms, considered as a super-family, equivalent to the Camelidæ, Giraffidæ, etc., and not as a suborder. Arr. Fam. of Mamm., 1872, p. 71–77.

"buno-selenodont." The feet are in the border region between the unguiculates and ungulates. This genus also occupies an isolated position; although placed by Cope in the family Meniscotheriidæ among the Condylarthra it is not even remotely related to any of the contemporary ungulates. Its molar evolution was precocious in both jaws, far more so than in Phenacodus. I was led to the idea that this might possibly be the long sought ancestor of Chalicotherium by the structure of the molar teeth. In 1886 Wortman regarded Meniscotherium as an ancestor of the Hyracoidea. Later Schlosser recognized the striking likeness of its molars to those of Chalicotherium, and considered it with Macrauchenia as a representative of Perissodactyla which had retained a primitive foot structure.

The comparison of the entire dentition of Meniscotherium and Chalicotherium led me in 1891 to the discovery of many very significant details of resemblance. In both, the anterior portion (or cutting teeth) of the dental series is reduced and the posterior or cheek teeth are enlarged. In both, the true molars have identically the same pattern in detail in both jaws, including the absence of the third lobe upon the last lower molar, which separates Meniscotherium from all early Condylarthra and Perissodactyla. I was especially struck also by the presence of a short posterior crest formed of the hypocone and hypoconule in the upper molars, and by the reduplication of the antero-internal tubercle (metaconid) in the lower molars. At the time only the upper tarsals of Meniscotherium were known; these possess the unguiculate characters which are exhibited in Phenacodus and all early ungulates but are distinguished by a *fibular facet* upon the calcaneum. It appeared to me altogether probable that the Wahsatch form was related to the ancestors of Chalicotherium, and that the question would be decided by the discovery of its feet. This discovery was reported sooner than was expected in Marsh's recent paper upon *M.* (Hyracops) *sociale* in which the fore and hind feet are fully figured.

The feet of Meniscotherium present only one feature which definitely points to those of Chalicotherium, namely, they are

functionally tridactyl, the outer toes being much shorter than the three median toes. Marsh describes the terminal phalanges as *intermediate* between hoofs and claws, the extremities are thin, slightly expanded, and apparently covered by thin nails. In other respects the feet are very primitive and exhibit all the unguiculate features we now invariably expect to find among the primitive ungulates, namely, (1) the "centrale" and possibly (2) the "tibiale," (3) the fibular facet upon

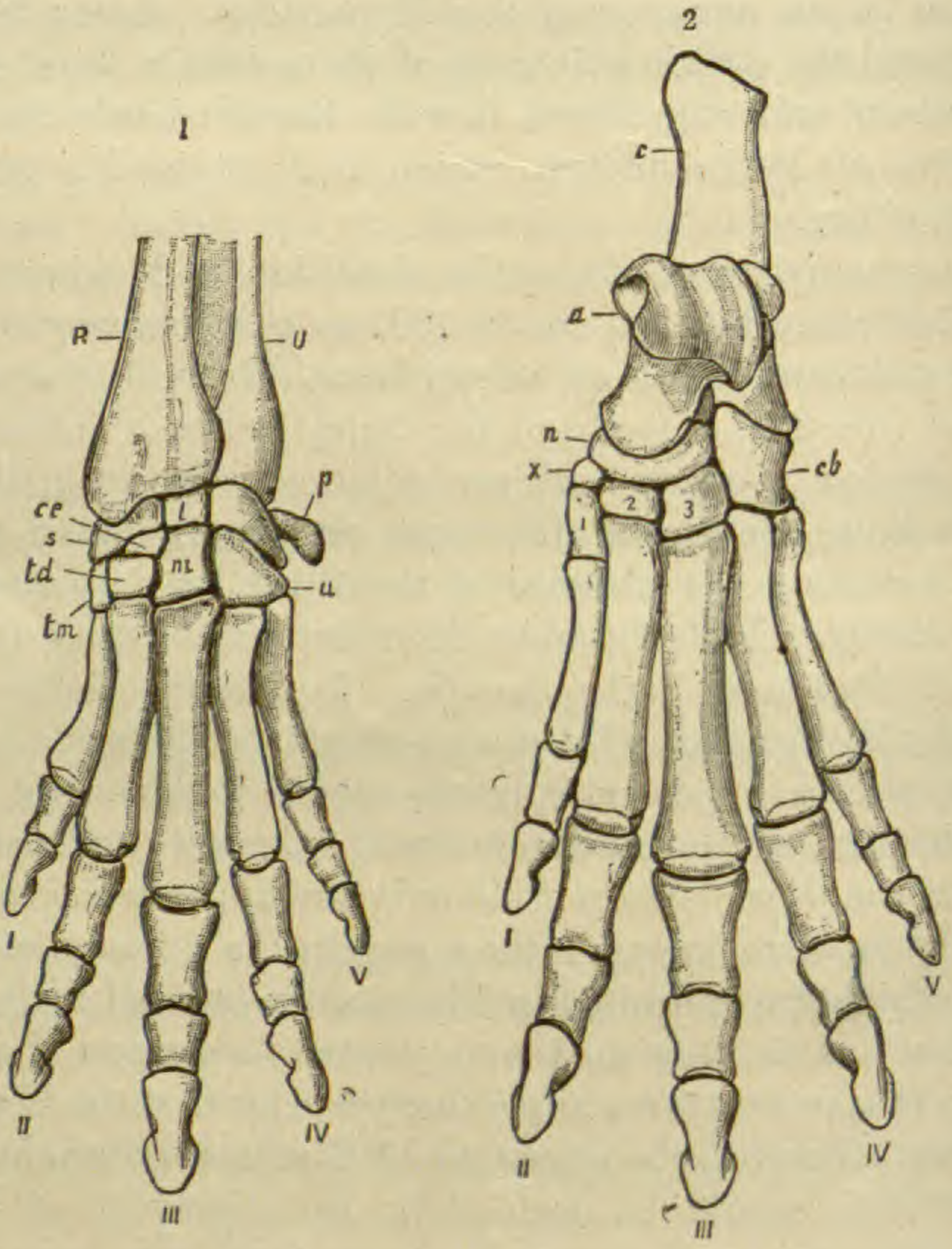


Fig 2. Fore and hind Feet of *Meniscotherium* (Hyracops) *sociale* after Marsh.

the calcaneum, (4) the "astragalar foramen," (5) the serial or undisplaced facets in both tarsus and carpus. As this was the parent ungulate type there is no insuperable difficulty in sup-

posing that the ungulate carpus and tarsus of Chalicotherium were derived from those of Meniscotherium.

The terminal phalanges present a greater obstacle; is it possible that having progressed only so far toward hoofs as to be called "intermediate," they have subsequently retrogressed into curved claw-bearing ungues? I consider this possible but not in itself probable. We must not forget the manus of the subungulate Lemurs which bears three or four terminal nails and one large claw; or the phalanges of the unguiculate Mesonyx which are cleft, but also flattened and very ungulate in appearance. The line of division between claws, nails and incipient hoofs was not very sharply drawn. Another difficulty is seen in the fact that the median toe (III) of Meniscotherium is enlarged, it is mesaxonic; while the lateral toe (IV) of Chalicotherium is enlarged.

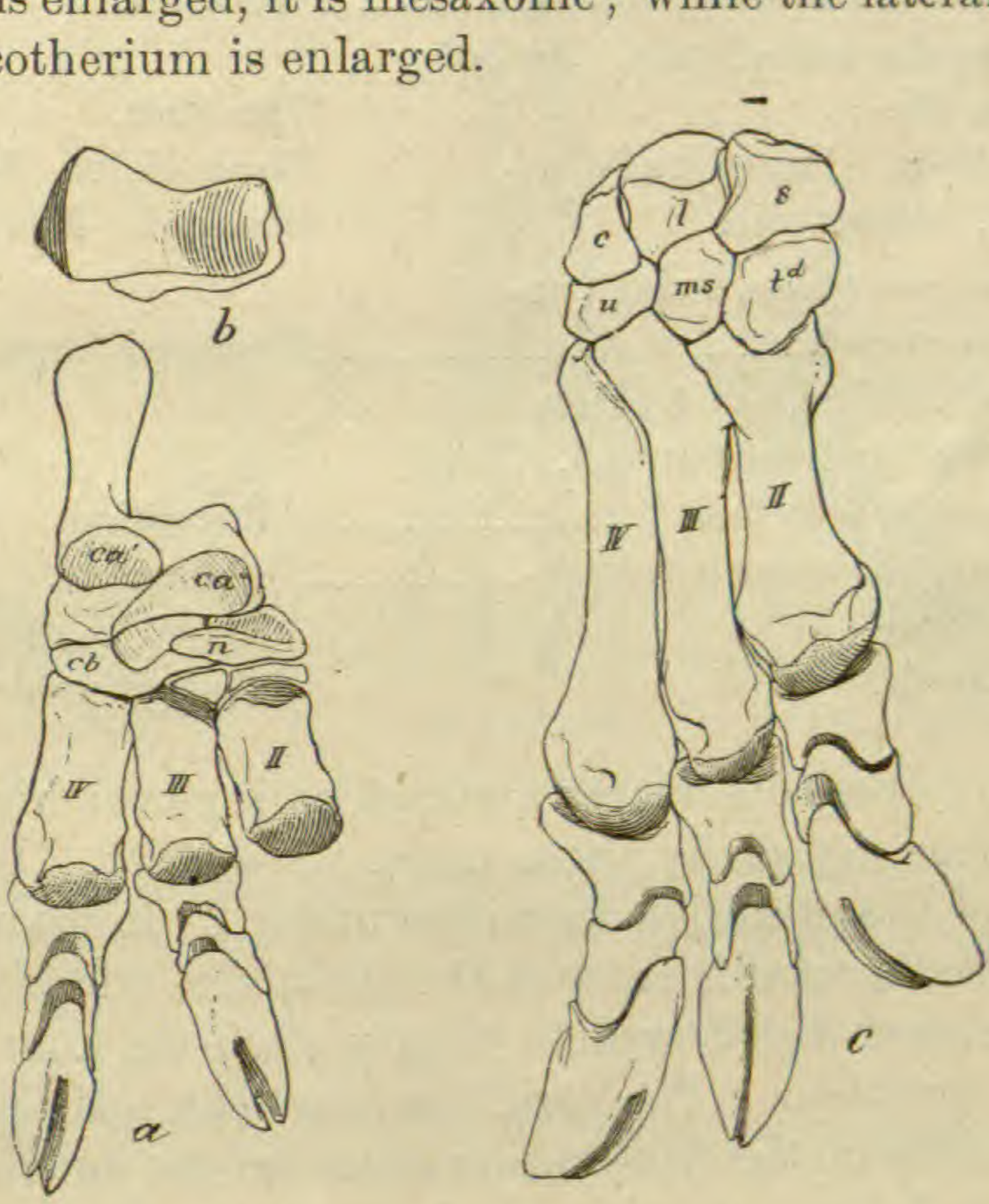


Fig 3. Fore and hind Feet of *Chalicotherium* after Gervais, (from Sansan.).

To offset these difficulties we find the striking similarities in the molar teeth already noted, and in the dental series as a whole. Meniscotherium is very exceptional in the absence of

a third lobe to the last lower molar. The resemblance between the skulls of these two types is also very marked in the whole region behind the infra-orbital foramen. We see the same form of cranium, occiput, and auditory region.

I conclude, therefore, by giving a table of the resemblances and differences between the two types. Both are numerous. The question is, which are most fundamental?

	Meniscotherium.	Chalicotherium.
1°	*Cutting teeth* somewhat reduced.....	Reduced or rudimentary.
	Upper molars, buno-selenodont.....	The same.....
	A short posterior crest. Protocon-ule large.	The same. Protoconule reduced.
	Lower molars lopho-selenodont.....	The same.
	Metaconulid reduplicate. No 3rd lobe on M^3.	The same.
2°	Five *digits*. Functionally tridactyl. Mesaxonic.	Three digits. Structurally tridactyl. Not mesaxonic.
	Carpus and tarsus, serial, (unguiculate type).....	Displaced (ungulate type).
3°	Centrale, tibiale, 3rd trochanter, entepicondylar foramen, Fibulo-calcaneal facet.....	All wanting.
4°	Terminal phalanges sub-ungu-late.	.....Unguiculate.
5°	Plantigrade.	Sub-digitigrade.

Many of these differences are such as separate higher from lower forms, especially those under 3° and 5°. We witness the loss of the primitive characters under 3° in many distinct phyla, also the modification of the characters under 2° and 5°.

I have now endeavored to clearly state the pros and cons of this question. The evidence for the original ungulate affinities of the Ancylopoda seems to me much stronger than that for its purely unguiculate origin. Supporting this view is the strong likeness of the skull and teeth of Chalicotherium to those of Meniscotherium, and finally the analogies which it presents to the perissodactyls in the modernization of the feet, wrist and ankle. My conception of its origin and zoological relations can be expressed in the following diagram.

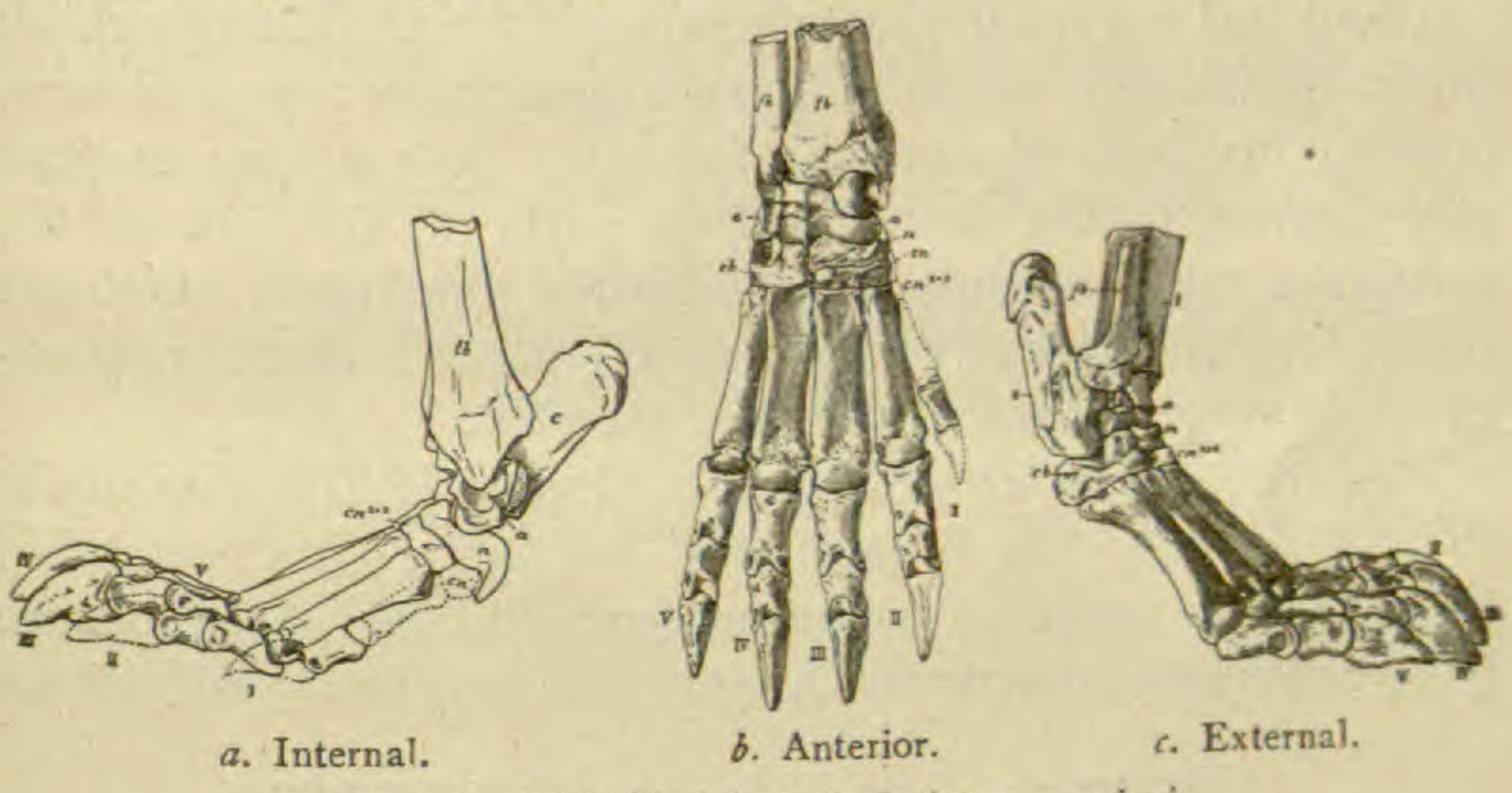
Ancylopoda Perissodactyla

Meniscotheriidæ Phenacodontidæ

Condylarthra

Protungulata
(unguiculate)

The purpose of this paper is not, however, to express a final opinion but to suggest inquiry. While agreeing with Cope that the Ancylopoda represent a distinct division of the mammalia, we must admit that the broad zoological relations of this division are yet to be determined.



a. Internal. *b*. Anterior. *c*. External.

Fig. 4. Right hind foot of *Artionyx gaudryi*.

Postscript.—The Discovery of Artionyx.

The hind foot of *Artionyx gaudryi* was found last summer by the American Museum party, under Dr. Wortman, in the White River Miocene of South Dakota.

The discovery of this foot was one of those complete surprises which render palæontological research so fascinating. As indicated in the above article, we were daily expecting to find remains of Chalicotherium in the lower Miocene of America, but no one could have anticipated finding a type related, and yet so entirely different.

As Chalicotherium may be broadly termed an unguiculate perissodactyl, so Artionyx may be called an unguiculate artiodactyl. This, in fact, sums up the main difference between these types when we add that the terminal phalanges in the former are cleft, and in the latter are uncleft.

If this foot of *Artionyx* had the metatarsals cut off half way down, no one would hesitate to call it truly artiodactyl. The tibia, fibula, astragalus and calcaneum, the navicular with its posterior hook for the great-flexor tendon, the conjoined ecto- and mesocuneiforms, the nearly even pairs of toes on either side of the middle line—all these structures bear a marked artiodactyl stamp. The entocuneiform is missing, but there is no doubt that it supported a first digit, of which the proximal phalanx is fortunately preserved.

The distal ends of the metatarsals and the phalanges exhibit the same sudden transition to an unguiculate type which we observe in *Chalicotherium*, in fact they bear a very marked resemblance to the corresponding parts in the feet of the carnivora, until we come to the terminal phalanges, which are short, deep and laterally compressed, but not hooked or retractile. As observed above, they are not cleft.

The foot differs as widely from that of Chalicotherium as that of the pig does from that of the tapir. It is somewhat hazardous to make a deduction from the foot alone, but we have ventured to divide the Ancylopoda into two subdivisions.

ORDER.	SUB-ORDERS.
Ancylopoda. Ungulate, with unguiculate terminal phalanges.	A. *Perissonychia* (odd clawed), with perissodactyl tarsus and mesaxial reduction. Ungues cleft. B. *Artionychia* (even clawed), with artiodactyl tarsus and paraxial reduction. Ungues uncleft.

Subsequent discoveries may show that these are merely two families—the Chalicotheridæ and Artionychidæ. This discovery rather strengthens the idea of the relationship of Meniscotherium to the Ancylopoda—for we observe in Artionyx the fibulo-calcaneal facet of the older genus, also the depression upon the inner side of the astragalus.

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EDITORIALS.

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

—Botanists are waking up to the fact that they have too long neglected to conform to the law of priority in nomenclature. The return to older names of genera, species, etc., produces temporary inconvenience, but it is in the interest of stability, which is the fundamental condition of convenience in this matter. Persons who are accustomed to use certain names find it difficult to change them, and endeavor to make exceptions to the general rule, as some leading botanists are now proposing. But the sooner a clearing up of the whole matter is made the shorter will be the discomfort, for the law of priority is fundamental and must be supported under all circumstances that fall within the scope of nomenclature.

It is evident, however, that in cases which violate other laws of nomenclature, the law of priority has no application. Such are typographic and orthographic errors; also terms which cannot be given a Latin or Greek form. Such rules are the conditions of ordinary scholarship. There is another rule which belongs to scientific scholarship which has been hitherto respected, but which a small number of American zoologists are endeavoring to set aside. This is, that no name or term is available for scientific use which has not been accompanied by a definition prior to the publication of any other name for the same thing published with a description. So self-evident is the necessity of this rule that it has been adopted without exception by all scientific societies and committees in all countries which have proposed or revised laws of nomenclature. The primary element in all exact language is the definition of terms, and to omit this condition from scientific nomenclature is to abandon science and to go into literature, if mere word-making can be dignified by such a title. When we remember what a passion this word-making becomes in some persons, it is clear that science must have some protection from it. The only way that this protection may be had is to demand a *raison d'etre* for every name that is proposed. The student then knows with what he has to deal, and the proposer places himself on record in an available form. The abuses of the neglect of this rule are self-evident, since it lays the sciences open to charlatanism and to pretence of every description, and makes scientific literature of the catalogues of the showman and the salesman.

The only body which has encouraged this abuse is the American Ornithologists Union, which in its rules straddles the question. One result of this position is that members of that body are not a unit in their opinions on this point. A concrete case is the lists of names published a half century ago by Fitzinger. In his early days this naturalist made a creditable beginning of scientific work, but he soon lapsed into a cataloguer and list-publisher. He projected comprehensive systems which have little or no correspondence with nature, and filled them out with names without definitions, many of which are not applicable to anything which can be defined. So well known has this been in Europe that this work of his has been long since relegated to the waste heap, where it should by all means be permitted to remain. But the love of change has induced a few Americans at this late day to resuscitate this rubbish. No better motive can be ascribed for this resurrection, for it is not in accordance with existing rules; it is very inconvenient; and it opens the door to continued inconvenience of the same kind. It is a blow at scientific scholarship, and a distinct encouragement to dishonest work.

It is hardly likely that the botanists will split upon this rock.

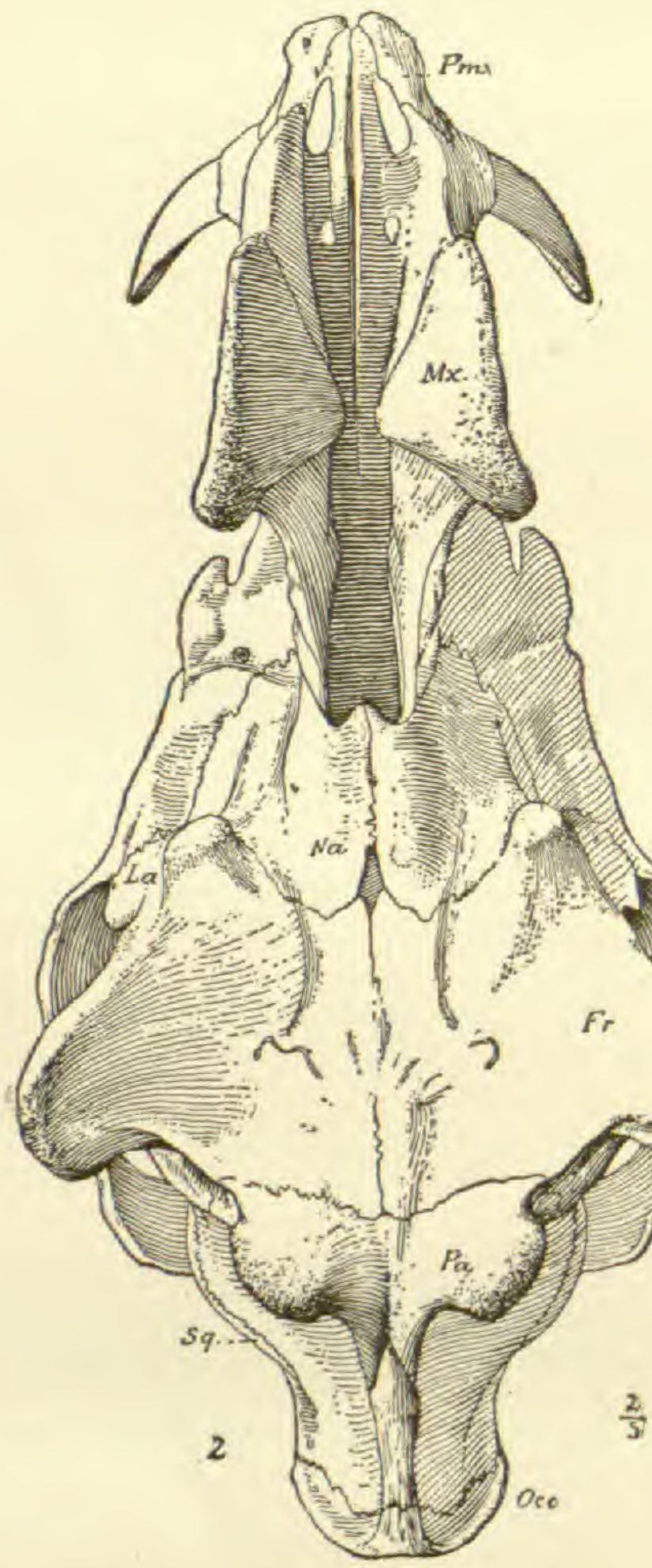
—The late meetings of the American Society of Naturalists and the allied societies of morphologists, anatomists and physiologists, held at Princeton, N. J., brought together a representative body of the most active workers in the natural sciences of the eastern part of the country. The west was ably represented by members from Cincinnati, Denison and Chicago Universities. These meetings add to the pleasures of the holidays, supplementing family reunions by professional reunions of men bound together by similarity of tastes and modes of thought. The advantages of these meetings are various, but one most obvious one is the stimulus to care and precision which results from free and friendly criticism. After living in an atmosphere of this kind, the mind more fully appreciates the contrast between the more or less careless, not to say disingenuous habits of thought that are so common, and the clear, rational, and truthful attitude of the mind which is so conspicuous in the workers in the fields of science. The welcome given by President Patton was as clear and honest as the minds of the men he faced, and it was a welcome to truth, let it come from what quarter it may.

The geologists were missed from an assembly which should include such a body of energetic workers as now constitute the Geological Society of America. In view of possible further segregation, a com-

mittee was appointed by the parent Society of Naturalists to suggest to the society some measures looking toward a combined organization, so that future cooperation might be assured. Such a combination would hold a winter meeting corresponding to the summer meeting of the American Association for the Advancement of Science, with the difference that it would consist of professional naturalists only.

—The Smithsonian Institution has been requested by a petition signed by a large number of American naturalists and by a resolution of the American Society of Naturalists, to pay for the support of a table at the Naples Marine Biological laboratory to be occupied by American students. It would seem that such an appropriation of money is within the objects of the Institution as defined by the will of Smithson. As a school for original investigators, the Naples Laboratory has been, and doubtless will continue to be, of the greatest utility.

PLATE I.



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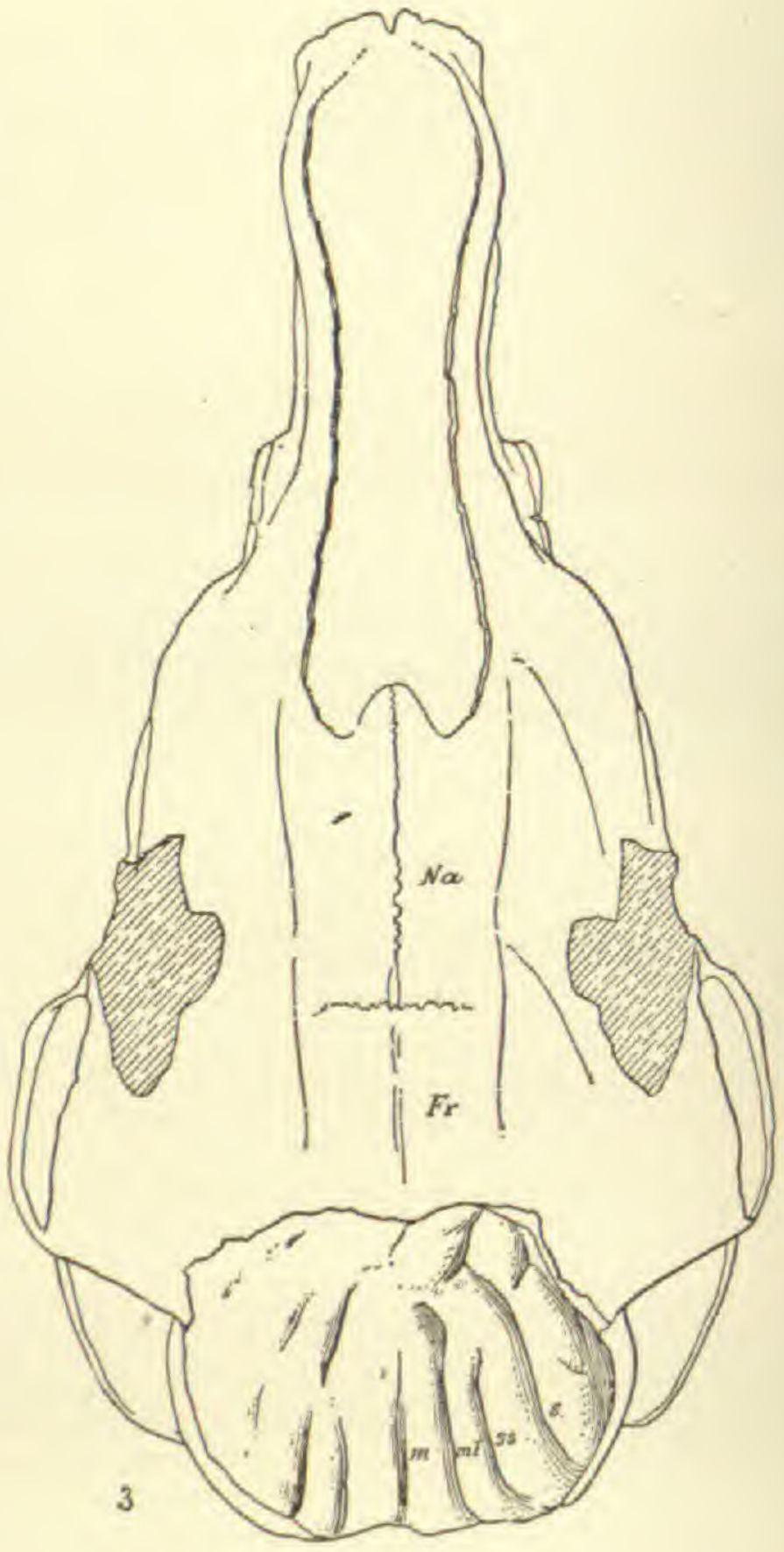

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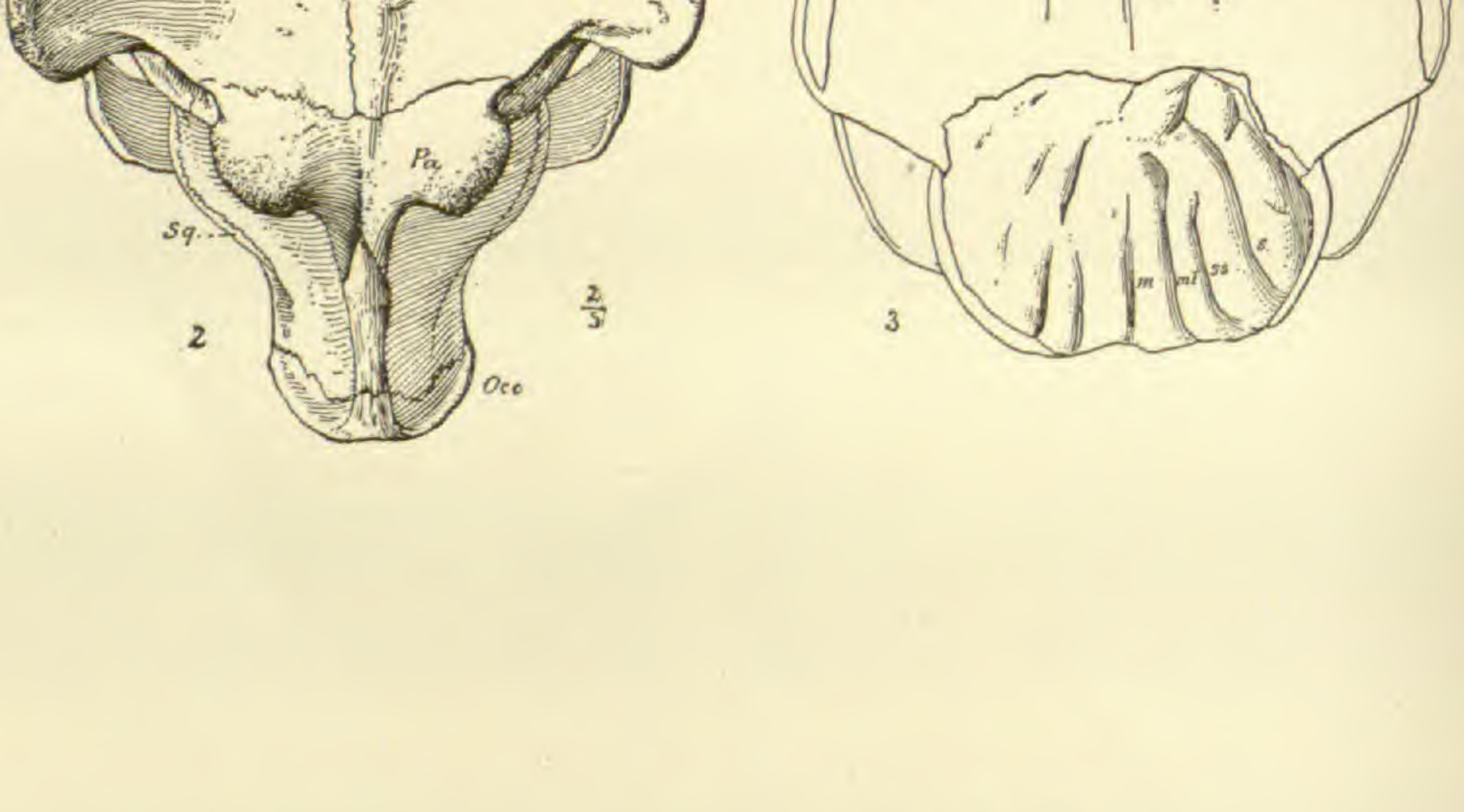

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Protoceras celer Marsh.

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RECENT LITERATURE.

Two Text-Books of Human Embryology.—Only a few years ago the physician who wished to know anything about the development of the human body found his whole supply of information in one or two chapters of his physiological text-book. In some respects the statements to be found there were reliable, but, at least in most American physiologies, they were strange misconceptions, as they could scarcely help being, for they were abstracts, at sixth or seventh hand of the wonderful researches of Bischoff, of Rathke and of von Baer, with never a bit of autoptic knowledge on the part of the compiler.

In the last two decades our knowledge of the embryology of man and of the other mammals has been greatly increased, so that the summary given by Balfour scarcely ten years ago is in many respects behind the times. So a new résumé in English is very acceptable. "It never rains but it pours." The same week brings to our table two works with essentially the same scope—that is the embryology of man and the mammals, with side lights on the lower vertebrates—but of greatly different treatment.

The first to be mentioned, Minot's Human Embryology,[1] is a large octavo volume, especially designed for the physician. That is, it seems admirably adapted to lead the medical student or practitioner into a clearer knowledge of the history of the human body, a knowledge of which the average physician has but the veriest smattering. Minot gives first an introduction in which he describes the uterus and outlines the stages of human development. Then the main portion of the book is divided into five parts. In the first we have an account of the history of the genital products and the theory of sex, together with a brief discussion of heredity. In Part Two the origin and meaning of the germ layers are discussed. This portion will prove more or less familiar to our readers, as several of its chapters have already been given in our pages. In the Third Part the chapters treat of the building up of the embryo, those of the Fourth of the fœtal appendages, while the Fifth Part takes up the fœtus. As an appendix given is an exceedingly condensed list of references to the authorities quoted in the text. Such a table of contents as that

[1]Human Embryology by Charles Sedgwick Minot. N. Y., William Wood & Co., 1892, pp. xxiii + 815.

given above must fail to give an adequate idea of this book, and yet it is about as much of detail as our space will allow. In general we may say that the book pleases us; that while we find a few statements here and there which we might question, we feel deeply indebted to Prof. Minot not only for the compilation of such a valuable résumé of the work of other embryologists, but for the numbers of new contributions which we find in his pages. One feature which is of especial value, and which cannot but strike the reader, is the richness of citation of the works of other students. The illustrations also are good, and while most of them are process cuts, the majority have a freshness which is very pleasing.

The other work upon our list, Prof. Mark's Translation of Hertwig's Embryology,[2] does not need very extended mention, as the original has already been noticed in this journal. Its plan is greatly different from that of Minot in that after the introductory chapters of Part One the history of development is followed for the organs of the different germ-layers: Entoderm, mesoderm, ectoderm and mesenchym. The translation is done in a very satisfactory manner, and a careful reading of a considerable portion of the translation fails to reveal many of the "awkward renderings and German idioms" to which Dr. Mark refers in the preface. One feature of the translation deserves mention. For anlage the term fundament is used. Had this translation been introduced several years ago it might hope for general acceptation, but now that anlage is being bodily carried over into English (Minot, for instance, uses it throughout), we hardly think that the translation will prevail, especially in the face of the other and not obsolete meaning of the word. The printing of the text is good, but some of the cuts of the translation (clichès from the German cuts) are muddy and lack the clearness and delicacy of the German edition.

It would have been difficult to find two men better adapted for their respective tasks than these. For ten years Dr. Minot has been accumulating the materials for his portly volume, and he has had exceptional facilities in working over the preparations of some of the European masters. Dr. Mark, on the other hand, brings to the position of translator an accurate and detailed knowledge of the subject matter, and an almost extreme care that every word in his translation shall express, so far as the genius of our language permits, exactly the

[2]Text Book of the Embryology of Man and Mammals, by Dr. Oscar Hertwig, translated from the third German edition by Edward L. Mark. London, Swan Sonnenschein; New York, Macmillan & Co. 1892, pp. xvi + 670.

idea of his author. A comparison of the two works is difficult. For the student who has already a good foundation in the broader features of general embryology, possibly Mark's Hertwig will prove the more useful, for it gives more the broader features of ontogeny without paying great attention to minor and, for him, unimportant detail. Minot's work, on the other hand, from its method of treatment, may be better adapted for the *student* of medicine, for it takes up the subject more in accordance with the ideas which he receives from the rest of his special training, and in those points which may prove of value in questions of medical jurisprudence it gives a fulness of detail which is foreign to the purpose of the other work. Yet the average practitioner will probably have little to do with either volume. All that he cares to know concerning the questions discussed, would occupy very few pages, and the 670 pages of Mark's Hertwig, and the over 800 in Minot's volume, will, we fear, scare away the very men who most need the information they contain. Yet it is difficult to see how the matter could be much more condensed. The fault is not, in either case, with the author, but rather with the extent of our knowledge. This, however, will prove no drawback for the student of morphology, and, we doubt not, these will be two of the most consulted books in his library, for they are the two most important additions in our language to the literature of biology for the year 1892.

To conclude, we would say that both books are valuable, and should be owned by all morphologists. Minot's volume is possibly the better adapted from its arrangement for the physician, and the greatest objection which we can see to its use by medical men is its size.

Geological Survey of Texas, 1891.[3]—This volume constitutes the Third Annual Report of the Geological Survey of Texas. It consists of the usual introductory statements of the State Geologist, E. T. Dumble, followed by the several reports of his assistants. The accompanying papers are reports on the geology and paleontology of important regions by specialists in those departments. Mr. Kennedy contributes the result of investigations which carried him across the post-cretaceous deposits, from Terrell, in Kaufman County, in a southeasterly direction to the mouth of the Sabine River. Mr. Cummins gives a detailed report on the geology of the Llaño Estacado. He traced the Carboniferous formation to its farthest outcrop in Central Texas, determined the northern extension of the Cretaceous along the

[3]Third Annual Report of the Geological Survey of Texas, 1891. E. T. Dumble, State Geologist, Austin, 1892.

eastern escarpment of the Staked Plains, and determined the extent of the Dockum and Blanco Canyon Beds and their relation to the underlying strata. The Stratigraphy of the Triassic formation in northwest Texas was assigned to N. F. Drake, who embodies his observations in a short paper of twenty-one pages. Mr. Steernwitz is still at work on the Trans-Pecos region. In his paper he states that rocks of Carboniferous age have been traced over a large area of this region, gives the age and relations of certain conglomerates, and the stratigraphic relationship between the schists and the red grit. Prof. E. D. Cope, who had in charge the fossil vertebrata, reports on collections from the Fayette formations, the Blanco Canyon bed, and the Triassic or Dockum beds. Dr. Sterki furnishes notes on shells found in a dry salt lake near Eddy, New Mexico.

The illustrations are numerous and compare favorably with those of previous publications of the survey.

Mineral Resources of the United States, 1889 and 1890.[4]— This volume is the seventh of the series of Mineral Resources of the United States, and carries the statistical data to Dec. 31, 1890. An idea of the amount and value of the various useful mineral products is given in a brief summary which forms the opening chapter. The remaining 530 pages comprise carefully prepared statistical papers containing much valuable information.

According to the report the year 1890 was a period of unexampled activity in mining, particularly so in iron, silver, copper, coal and petroleum. The total value of the product is put at $656,604,698, an increase far beyond any previous year.

In addition to its individual index, this volume contains the general index to the entire series from 1882 to 1890 inclusive.

[4]Mineral Resources of the United States, 1889 and 1890. David T. Day, Chief of the Division of Mining Statistics and Technology, Washington, 1892.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Paleozoic Formations of Southern Minnesota.—A systematic account of the Paleozoic formations of southeastern Minnesota, by C. W. Hall and F. W. Sardeson, is given in the Bulletin of the Geological Society of America for 1892. The rocks described occupy an area some 13,200 square miles in extent. They stretch eastward from a straight line between Mankato and Hinckley to the State of Wisconsin, and from Chengwatona southward to Iowa. These periods of geologic time are represented by three formations: Upper Cambrian, Ordovician, and Devonian. These Paleozoic rocks are underlain by the Archean and Algonkian, and lie beneath patches of Cretaceous and a covering of quaternary débris save in the extreme southeastern corner included in Chamberlin's "driftless area."

The Upper Cambrian is represented in this region by the Potsdam sandstone and the Magnesian series; the Ordovician by the St. Peter, the Trenton, and the Cincinnati beds. The Devonian is present in so thin a layer in which so few fossils occur that it cannot be assigned to any division of that group, but is supposed to belong near the middle.

The writers give the following summary of thickness and leading lithological characters based chiefly upon their own measurements and determinations:

						Feet.
Devonian.	Not subdivided.		Limestone and shale			10–15
Ordovician	Cincinnati.	Wykoff.	Limestone	20		70
		Maquoketa.	Shale and limestone	20		
	Trenton	Galena.	Maclurea limestone	50		120
			Lingulasina limestone	20		
			Camarella shaly limestone	30		
			Orthisina calcareous shale	20		
		Trenton.	Zygospira shale	8		95
			Fucoid shale	20		
			Stictopora shale	30		
			Stictoporella limestone and shale	10		
			Blue limestone	12		
			Buff limestone	15		
	Saint Peter, not subdivided, sandstone					75–164
	Upper Shakopie dolomite					10–65
	Elevator B (Richmond) sandstone					20
Upper Cambrian.	Magnesian, Lower Shakopie dolomite					75–175
	Jordan sandstone					75–200
	Saint Lawrence, dolomites and shales					30–213
	Potsdam, not subdivided, sandstones and shales					0–1,300
	Total thickness of Paleozoic strata in Minnesota.....					560–2,437

The Genus Hybodus.—According to Mr. A. S. Woodward, the genus Hybodus, which was determined solely from the evidence of the teeth and associated ribbed dorsal fin-spines, is now definitely determined by the other essential regions revealed by new specimens. The fossils in question comprise numerous skulls and two portions of the trunk of the typical *Hybodus basanus* from the Wealden of the Sussex coast.

The characters which afford information are (1) the presence of hooked cephalic spines, and (2) the occurrence of a vacant space between the neural and hæmal arches of the endoskeleton, which must have been occupied by a persistent notochord. Mr. Woodward is inclined to think that the presence or absence of cephalic spines will eventually prove to be a sexual character.—Proceeds. Yorkshire Geol. and Polytechnic Soc., Vol. xii, 1891.

On Some Dicynodont and Other Reptilian Remains from the Elgin Sandstone.—At the Aberdeen meeting of British Association in 1835, Dr. Traquair called attention to the skull of a *Dicynodont* which had been discovered in the Elgin sandstone of Cutlies Hillock (= New Spynie). Since that time several other specimens have been obtained from the same place, some of which are the property of the Elgin Museum, while others belong to the Geological Survey of the United Kingdom. These specimens are now being worked out by Mr. E. T. Newton, and the following is a preliminary note on the interesting results which have been obtained.

All the reptile remains obtained from Cutlies' Hillock are in the condition of hollow casts, the bones themselves having been dissolved away; this, it will be remembered, was the case with some of the examples of *Stagonolepis* from the Elgin sandstone, described by Prof. Huxley, and the method of taking casts from the hollow cavities which was adopted in that case, has been found of great advantage in the present instance. The blocks when brought from the quarry were more or less split open, exposing portions of the specimens. In some cases these cavities were traced out and developed with the chisel, while in others they were further split open, thus allowing casts to be taken. In many cases these casts had to be made in several parts and afterwards fitted together. The time and labor involved in this task have been repaid by the restoration of the skulls and parts of skeletons of several *Dicynodonts*, and one or two other equally remarkable forms of reptiles.

In most of these specimens, including that noticed by Dr. Traquair, the skulls are similar in form, although differing in minor details, and have a general resemblance to the South African *Dicynodon* and *Oudenodon*, some of them having small tusks in the maxillary bones. With most of these skulls parts of the skeleton have been found. Two or three show the position of the vertebral column and ribs, but up to the present no definite centra have been traced; besides this there is evidence of scapula, clavicle, humerus, radius, and ulna, the humerus having the characteristic anomodont expansion of the two extremities. In two specimens the ilia are preserved. These forms appear to be distinct from *Dicynodon*, and probably represent at least two or three species.

Another skull presents most of the characters of *Lystrosaurus*, but has a short muzzle and no teeth. The last, and by far the most remarkable skull of this series, is about six inches in length, and has the outer surface completely covered in by bony plates, the nostrils, eyes, and pineal fossa being the only apertures. The chief feature of this skull is the extreme development of horns upon the face and cheeks, there being about thirty of these formidable defences varying from about a fourth of an inch to nearly three inches in length, besides some smaller bones. The dentition is pleurodont, and resembles very closely that of the living Iguana; the palate is lacertilian, but with the pterygoids united in front of the pterygoid vacuity. This skull reminds one very strongly of the living *Moloch* and *Phrynosoma*, but it probably finds its nearest ally in the *Pareiasaurus* from the South African Karoo bed. The detailed description of these specimens is nearly completed and will, it is hoped, be shortly published.—Geol. Mag., Nov., 1892.

Cenozoic Insects.—In discussing the Rhynchophora of North America, Mr. S. H. Scudder refers to the variety and abundance of insect life during the early Cenozoic period as follows:

"In the earlier Tertiaries we not only possess in profusion representatives of every one of the orders of insects, but every dominating family type which exists to-day has been recognized in the rocks; even many of the families which have but a meager representation to-day have also been discovered, and though many extinct genera have been recognized, no higher groups, with a single exception or two, have been founded upon extinct forms. This is one of the most striking facts which confronts the student of fossil insects. It is the more striking from the delicacy, the tenuity, and miniatures of many

of the forms which are here concerned; and the statement can be enforced by the further fact that the parasitic groups—those which are entomophagous—are represented, as well as many of those which in the present time show peculiar modes of life; thus we have representatives of such microscopie parasitic insects as Myrmar, strepsipterons have been discovered, the viviparity of the ancient Aphides has been shown probable, the special sexual forms of ants and white ants were as clearly marked as to-day, and the triungulin larva of Meloe has been found enclosed in amber, showing that the phenomenon of hypermetamorphism had already been developed.—Proceeds. Boston Soc. Nat. Hist., Jan., 1892.

Uplifts in the Sierras of California.—A paper of Mills in the Bull. G. S. A., Vol. 3, contains the following account of the orographic movements from which result northern half of the Sierra Nevada range.

Along the axes of the greatest uplifting of the present range a pre-Mesozoic range arose carrying up both crystalline and metamorphosed sedimentary rocks, which partially disappeared through erosion and subsidence; then a mesozoic range arose and its strata became uptilted, and it in turn was reduced by erosion and subsidence to very small proportions, and then in Tertiary and Quaternary time has arisen the present range, which is now undergoing its erosion."

A New Pliocene Ruminant.—The right mandible of a large animal found in the lowest Pliocene formation in the vicinity of Oran has been referred to the order of Artiodactyla by M. Pomel under the name *Libytherium maurusium*. In dimensions it rivals Helladotherium, with which it has some affinities, but from which it differs unmistakably. The fossil measures 30 centimetres from the posterior border of the last molar to the posterior part of symphysis.—Revue Scientifique, July, 1892.

A Remarkable Artiodactyle from the White River Epoch.—In a late number of the Bulletin of the American Museum of Natural History, Drs. Osborn and Wortman describe a species of Artiodactyle which differs much from any form previously known. A considerable part of the skeleton was obtained, together with crania of both male and female. The superior premolars (except the last) are simple, thus excluding the genus from the Boöidea, and the cuboid and navicular bones are distinct, a character which separates it from

the Tragulidæ. The cervical vertebræ are undescribed, but the characters in general refer it to the Oreodontidæ rather than to any group of the camel series. The metapodial bones are distinct, and there are four in front and two posteriorly. Both sexes have a pair of low horn-cores or tuberosities on the parietal bones, but the male has other tuberosities and processes as follows: The superciliary borders are produced posteriorly into a prominent lobe, and a low tuberosity rises from the frontal at its anterior border, just in front of the orbit. Each maxillary develops an anteriorly projecting process above the last premolar tooth, and then rises into a huge elevated compressed plate with thickened apex at the side of the narrow nasal fissure. The latter opens far posteriorly, as the nasal bones are very short and wide. The molar teeth are Oreodontoid, and the superior canines are worn posteriorly, showing that there was a large inferior first premolar as in Oreodon. The canine has also the triangular section seen in that family. The inferior canine is recumbent, and resembles an incisor. No superior incisors.

The absence of superior incisors is a character which is uncommon in the Oreodontidæ, but is found in the genus Merycopater, and probably in Pithecistes. The discovery of a horned member of the group is interesting. The female of the species was first described by Marsh under the name of *Protoceras celer*. It is probable, however, that it is nearly allied to, if not actually pertaining to the genus Stibarus Cope, described in 1873. The latter was founded on a fragment of lower jaw with premolar teeth, a part which has not been found in the species described by Drs. Osborn and Wortman. The latter was found by Dr. Wortman in the upper White River beds; the *Stibarus obtusilobus* is a smaller species, and comes from the lower beds of the same series. I give figures of parts of the skeleton from clichés kindly furnished by Dr. Osborn (Plates I and II).—E. D. Cope.

The White Clays of the Ohio Region.—In southeastern Indiana and southwestern Ohio occur a series of clays overlying the glacial beds and differing from them in color and structure. There are similar clay deposits in southern Ohio outside the glacial boundary. Mr. Frank Leverett, in a paper published in the Amer. Geol., July, 1892, cites evidence to show that these deposits are synchronous, that they have a common origin, that that origin is independent of both ice-dams and organic agencies, but is best explained by a fluvio-lacustrine hypothesis. Furthermore, they furnish important evidence concerning the sequence of events in this region during the glacial period.

Geological News, General.—Mr. R. S. Tarr has published a paper in the Am. Geol., July, 1892, calling attention to the relation of secular decay of rocks to the formation of sediments. The essay is in the main a summary of the present knowledge of secular disintegration.——The rocks of the Guadalupe Mountains are referred by R. S. Tarr to the Upper Coal Measures instead of the Permian as determined by Shumard. Bull. No. 3, Geol. Surv. Texas.——A Geological and Agricultural Survey of the State of Louisiana has been undertaken in the interest of agriculture, the first publication of which has just been issued. It consists of a preliminary report on the northern part of the State, by Dr. Otto Lerch, covering the Topography, General Geology, Water Supply, Distribution of Soils and Useful Minerals.——M. Adolph Carnot states that the relative age of fossil bones can be ascertained by estimating the amount of fluoride of calcium entering into their percentage composition. His method was applied recently to determine whether a human tibia was contemporaneous with the bones of animals with which it was associated. The chemical analysis proved that the tibia contained only the same percentage of fluoride as a recent human bone, while the associated animal remains yielded seven to nine times as much fluoride as their recent analogues. Hence the tibia in question belongs to a later period than the other fossils with which it was found, a result in which M. Riviére acquiesces on other grounds.—Comptes-Rendus, Vol. cxv, pp. 337–339.

Archean.—Dr. Charles Barrois announces the discovery of Radiolaria in the Archean rocks of Brittany. The fossils occur in a fine siliceous matrix (phtanite) associated with fragments of graphite, in the neighborhood of Lamballe, Côtes-du-Nord. M. Cayeux, to whom the fossils were submitted, regards them as simple Radiolaria, of the family Monosphæridæ.—Natural Science, Oct., 1892.

Paleozoic.—According to Dr. Rüst, Radiolarian fossils are abundant in Paleozoic rocks, and nearly all of the Paleozoic Radiolaria can be referred to the genera recognized by Haeckel in the seas of to-day. —Palæontographica, Vol. xxxviii, pp. 107–200.

Three new species of fish—*Protodus jexii*, *Diplodus problematicus*, and *Acanthodes semistriatus*—have been added to the list of Lower Devonian Fish-fauna by Mr. A. S. Woodward. The fossils were collected by Mr. Jex at Campbellton, New Brunswick, and are now in the British Museum.—Geol. Mag., Jan., 1892.

Mr. J. C. White reports a small collection of fossil plants from the Wichita beds of Texas. They are essentially the same with the flora from southwestern Pennsylvania described by Prof. Fontaine. This makes an equivalency probable between the uppermost beds of the Carboniferous system in West Virginia, southwestern Pennsylvania and southern Ohio (the Dunkard Creek series), and those of the Wichita beds of Texas—Bull. Geol. Soc. Am., Vol. iii.

Mesozoic.—A Termite, discovered in the English Lias by Mr. Montagu Brown, exhibits even the patches of pigment on the wings. It is described by Dr. Henry Woodward in the May number of the Geol. Mag. under the name *Palæotermes ellisii.*——Mr. A. S. Woodward reports *Pholidophorus germanicus* from the Upper Lias of Whitby, Yorkshire. This Lepidosteoid fish was observed by Quensted in the Lias of Wüertemburg and named in 1858.—Geol. Mag., Dec., 1891.——A mammalian tooth discovered by Mr. Charles Dawson has been given the provisional name *Plagiaulax dawsonii* by Mr. A. S. Woodward, who describes and figures it in the Proceeds. London Zool. Soc., Nov., 1891. This fossil is the first evidence of a European Cretaceous mammal.——A fine specimen of Belonostomus from the Rolling Downs formation (Cretaceous) of Central Queensland is described and figured by Mr. Etheridge in the Trans. Roy. Soc. Victoria, 1891, under the name *Belonostomus sweetii.* The specimen is supplemented by four other fragments so that all the more important features in the skeleton of the fish are made known.

Cenozoic.—A proof of the identity of the diatomaceous beds of New Jersey, Delaware and the outcrops on the western shore of Chesapeake Bay is afforded by the presence of a single specific form of diatom, Heliopelta, which occurs at the base only of this bed, and has not been found elsewhere in the world, either fossil or recent.—Ann. Rep. State Geol. New Jersey, 1891.——Mr. Harlé reports the finding of the right mandible of a monkey in a cave in the stone quarry of Montsaunés. The fossil in question is that of a Macaque and as it appears to Mr. Harlé to be a distinct species, he has given the name *Macacus tolosanus.*—Comptes-rendus, fev. 1892.——A list of Birds from the so-called Post-Pliocene drifts of Queensland, by Mr. De Vis, is an interesting contribution to avian literature. The list comprises twenty-eight species referred to twenty-four genera. The whole of the twenty-eight species and seven or perhaps eight of the genera are extinct. This change is very much the same as that observed in the case of the marsupials.—Proceeds Linn. Soc. N. S. W., Vol. vi.

ZOOLOGY.

The Cercaria Stage of Amphistomum.—Dr. Albert Lang has completed[1] the life-history of *Amphistomum subclavatum*. The adult lives in the frog, the young in the small *Planorbis contortus* of Germany. He finds that the young become encysted upon the skin of the frog, and as this is eaten at the time of molting the young obtain access to the alimentary canal in that way. Lang also describes some points in the anatomy of the Cercaria. Especially interesting is the description of the excretory apparatus which cannot well be reproduced without a figure.

Fecundation of the Eggs of Clinus argentatus.—M. Frederic Gintel gives the following account of the habits of a fish known as *Clinus argentatus* during the deposition of the eggs and their fecundation by the male:

"The extrusion of the eggs occupies about half an hour, and they are deposited among the branches of a clump of seaweed, after which the female goes away and the male comes in his turn to the algæ to fertilize the eggs, of which he then becomes the guardian until they are hatched, driving away all the males and females that come near to the nest. If the latter, however, are gravid, he invites them to lay their eggs near those which he is already guarding. M. Gintel has seen a male fecundate successively, and to care for seven separate depositions by as many different females, at intervals of several days. —Revue Scientifique, Août, 1892.

Preliminary Descriptions of New Fishes from the Northwest.—In the November number of THE NATURALIST we described a few of the new species collected in western Canada. We shall here describe in a brief way the remainder of the new species. Full descriptions as well as a general report on the collections and a comparison between the fish faunas of the Red River of the North, the Saskatchewan, the Missouri, the Columbia, and the Fraser River will appear later, the MS. of the entire report being ready for the press.

1. *Pantosteus columbianus* E. & E.

Three specimens, 92–100 mm. Boise River, Caldwell, Oregon. Related to *P. generosus*, the eye larger, the caudal longer. Head

[1]Berichte Naturf. Gesell. Freiburg vi, 81, 1892.

$4\frac{2}{5}$–$4\frac{3}{5}$; D. II, $11\frac{1}{2}$ or $12\frac{1}{2}$; A I, $8\frac{1}{2}$; scales, 16–19–80–100–15; eye, $1\frac{1}{2}$–2 in. snout, $1\frac{1}{5}$ to $1\frac{3}{5}$ in interorbital, $3\frac{3}{4}$ to little more than 4 in head. All the fins pointed, the caudal lobes considerably longer than the head. Light brown, with indistinct clouds of darker.

2. *Notropis albeolus* E. & E.

One specimen 73 mm. long. Medicine Hat, Assiniboia.

Related to *N. maculatus* and *N. heterodon*. D. $9\frac{1}{2}$; A. $8\frac{1}{2}$; scales, 4–35–4; 15 scales before dorsal; teeth 4–4, 1, 2.

More slender than *heterolepis;* fins all small; origin of dorsal over ventral, equidistant from base of middle caudal rays and nares; scales closely imbricated, the exposed edges little higher than long. Lateral line decurved, the tubes developed on fewer than ten scales; ventral surface entirely white; a plumbeous lateral band overlaid with silvery; a dark vertebral line from occiput to caudal; sides with a few dark specks, dorsal surface more densely specked, the margins of the scales darker.

3. *Notropis heterolepis* E. & E.

One specimen 35 mm. long. Fort Quappelle.

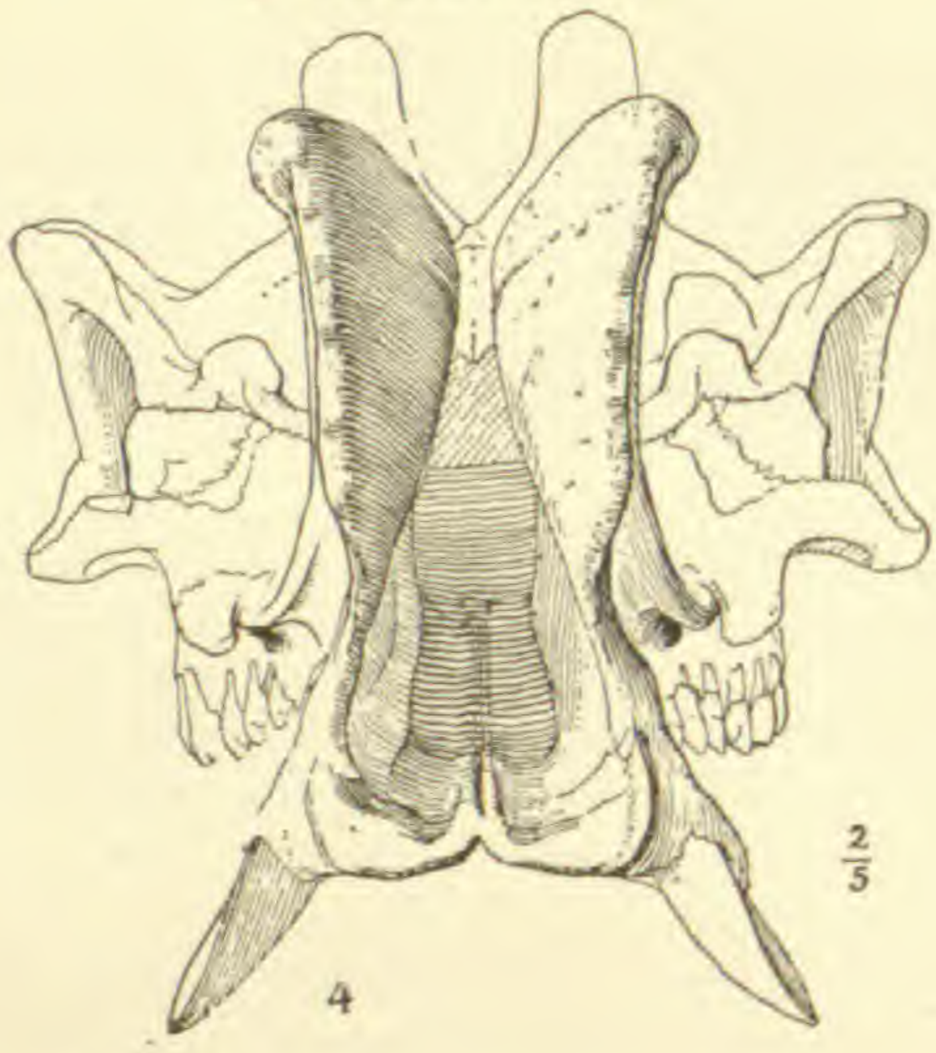
Related to *N. heterodon* and *N. anogenus*. D. $9\frac{1}{2}$; A. $9\frac{1}{2}$; scales 5–35–4; 15 scales in front of the dorsal; teeth 4–4; dorsal inserted equidistant between base of upper caudal rays and anterior margin of eye, behind the last ray of the dorsal; scales loosely imbricated, almost imbedded in front of the dorsal; scales along the median line with a deep notch near the middle of the posterior margin; the line nearly straight; a few black specks along the base of the anal, a dark line from anal to caudal; a dark band from tip of snout along the sides to the caudal; a conspicuous black curved line at the base of each scale of the lateral line; all the scales above the lateral band dotted with black; a narrow vertebral line from occiput to dorsal, a broad dusky band on the back between the dorsal and caudal, between this and the lateral band a lighter band; scales of back with dark markings; series of minute black dots along each ray of the dorsal, anal and anterior portion of pectoral; dorsal and caudal quite dark.

4. *Notropis reticulatus* E. & E.

Twenty-four specimens from Fort Quappelle. Thirteen specimens, the largest 76 mm. from Brandon.

Related to *N. spectrunculus, fretensis, nitidus* and *topeka*. It approaches nearest to *N. fretensis* and *topeka*. From the former it differs chiefly in the larger scales in front of the dorsal and from the latter in the naked breast.

PLATE II.



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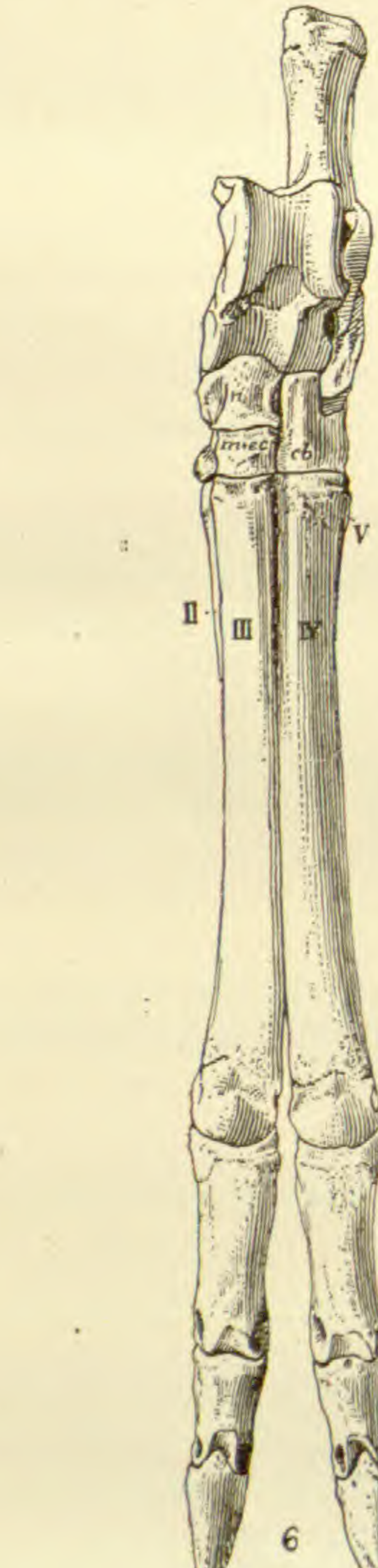

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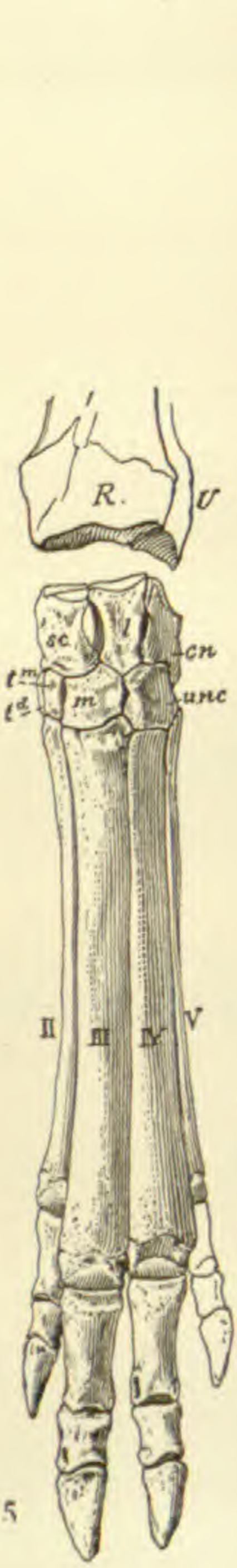


5

Protoceras celer **Marsh.**

Head 4, depth 4–4½; D. 9½ or 10½ (I or II, 8½); A. 9½ (II, 7½); scales 4 or 5–34–3 or 4; scales in front of dorsal, 12 or 14; teeth 4–4, hooked, with evident grinding surface; head pointed, broad above, and slightly convex; snout decurved, pointed, the lower jaw included; mouth oblique, the premaxillary on a level with the lower margin of the pupil or somewhat lower; maxillary reaching front of orbit; eye large, considerably longer than snout, 3 in head, greater than interorbital; origin of dorsal over ventrals, equidistant from tip of snout and base of upper caudal rays; longest ray scarcely extending beyond tip of last when depressed; anal low, the longest ray not extending beyond tip of last when fin is depressed, equal to snout and eye; ventrals reaching vent, slightly longer than the highest anal ray; pectorals little longer than head, less opercle; scales closely imbricated, the exposed edges considerably deeper than long in the largest specimens; lateral line decurved, complete; breast naked.

Dark streak from anal to caudal, lower parts otherwise plain; a dark vertebral line, a plumbeous band along the side: a faint spot at the base of the caudal about as large as the pupil; a series of spots along each side of the lateral line; upper parts of sides and the back profusely spotted, the edges of the scales are black, giving the whole part a reticulated appearance. The specimens from Quappelle are darker than those from Brandon.

5. *Notropis scopiferus* E. & E.

Many specimens from Winnipeg, Brandon, Fort Quappelle, Medicine Hat.

This species is evidently closely related to *N. luciodus*, from which it differs in having a conspicuous jet black spot about as large as the pupil at the base of the caudal fin.

Head 4–4½; depth 4½; D. 9½; A. 10½ (II, 8½); scales 6-36 to 42-4; 14–18 scales in front of the dorsal; teeth 2, 4–4, 2 grinding surface very narrow, on two teeth only; head heavy, compressed, flat above; snout blunt, much decurved; mouth small, little oblique; maxillary extending to eye; eye, 3 in head, little less than interorbital; lateral line complete, evenly and gently decurved to above origin of anal; a conspicuous black spot at the base of the middle caudal rays; a silvery lateral band, its dorsal margin distinct, color otherwise variable.

6. *Agosia falcata* E. & E.

Many specimens. Boise River, Caldwell, Idaho.

Scales larger and fins much longer than in *A. nubila*.

Head 3¾; depth 4½–5¼; D. 11½; A. 9½; scales 53–60, about ten above the lateral line; dorsal usually inserted directly over the origin

of the ventrals, the fin large, its anterior rays prolonged; origin of dorsal equidistant from base of middle caudal rays and nares; caudal deeply forked, the lobes acute, $3\frac{2}{5}$ to $3\frac{4}{5}$ in the length; anal rays $4\frac{1}{3}$–$4\frac{3}{4}$ in the length; ventrals always more posterior in position than in *nubila*, their tips extending to or past middle of base of anal; pectorals not reaching ventrals.

A dark band forward from eye; dark lateral band scarcely evident; silvery below; sides and back with numerous irregular, well-defined dark blotches; anal and sometimes ventrals with a dusky spot near base in front; dorsal and caudal faintly mottled; crimson spots on mandible, axil of ventrals and along base of anal.

7. *Agosia shuswap* E. & E.

Four specimens. Shuswap Lake, near mouth of Eagle River.

These specimens differ from *A. falcata* in a few characters; intergradations may be found, but none exist in our specimens.

Dorsal equidistant from base of middle caudal rays and posterior half of eye, inserted directly over origin of ventrals; lateral band well marked, otherwise as in *A. falcata*.

C. H. AND R. S. EIGENMANN.

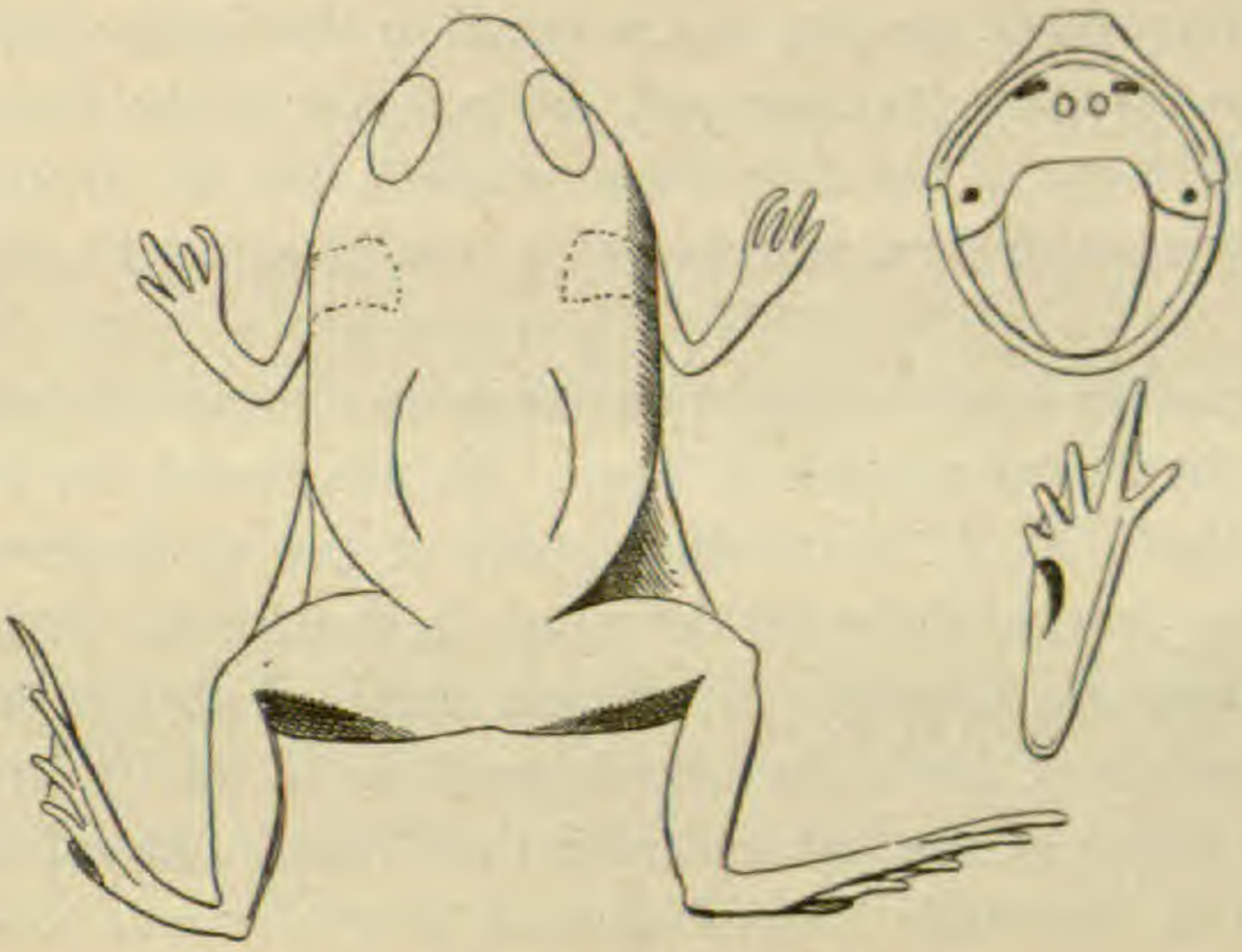
The Larynx of Batrachia.—Dr. H. H. Wilder states[2] that Amphibia typically possess two pairs of laryngeal cartilages, an anterior pair of arytenoids, while the posterior, containing tracheal rings as well as the future cricoids, are best called tracheal elements. In Proteus and Necturus but one pair is present, while in many Anura the tracheal elements fuse in the median line, forming a sort of cricoid. Wilder suggests, arguing from position, innervation, and musculature, that the arytenoids are the fifth branchial arches and are further homologous with the so-called inferior pharyngeal bones of Teleosts. The tracheal elements, on the other hand, are new formations.

The Kidney of Amphiuma.—Dr. H. H. Field has studied the kidney anlage in young Amphiuma and finds[3] that here as in the Cæcilians as described by Semon, there is a true metamerism. In his material (which has already served for other studies published in these pages[4]) the kidney reached back to the cloacal region, and it was possible to follow the different stages of formation of the canals. In the caudal region in the middle of each somite there was a wide, sharply

[2]Anat. Anzeiger, vii, 570, 1892.
[3]Verh. Deutschen Zool. Gesellschaft, 1892, p. 113.
[4]Hay, AM. NAT.. xxii, p. 315, 1888; Kingsley l. c. xxvi, p. 671, 1892.

bent tube which communicated on the one hand by a nephrostome with the body cavity, and on the other empties into the segmental duct. Immediately above the nephrostome was the malpighian body. Going forward the looping of the duct becomes more extensive, and extends from wall to wall of the somite, but no anastomoses occur and the nephrostome is always in the middle of the somite. The ontogeny of this organ will doubtless prove of extreme interest, and this point goes to support Cope's thesis of the relationships of Amphiuma to the Gymnophiona.

On a New Spade-Foot from Texas.—*Spea laticeps* sp. nov. —Frontoparietal bones without fontanelle, smooth. Form of head and body short and wide. Width of head at tympana entering length of head and body two and one-quarter times. Front wide and perfectly flat, its width entering the length of the tibia two and one-quarter times, and considerably exceeding the width of an eyelid. Muzzle



Spea laticeps Cope, nat. size.

projecting little beyond lip; nostrils nearly terminal; canthus rostralis not marked; tympanum concealed; vomerine fascicles small, posterior to a line connecting the choanæ. The latter exceed in diameter the well-developed ostia pharyngea of the eustachian tubes.

The heel of the extended hind leg reaches the position of the tympanum. Its digits are half-webbed, three and one-half phalanges of the fourth digit remaining free. On closing the fingers the second a little exceeds the third in length, and the third exceeds the fifth. The integument of the superior and lateral surfaces extends to or beyond the middle of the femur. It is obscurely tubercular, and the inferior surfaces are smooth. There are no distinct glandular aggregations of

crypts. The length of the head and body is 38.5 mm.; length of head (axial), including tympanic region, 14.5 mm.; width of interorbital space, 6 mm.; of head at tympana, 18 mm.; length of fore leg from axilla, 19 mm.; length of hind leg from urostyle, 41 mm.; length of tibia, 12.5 mm.; of foot, 20 mm.

Color of superior surfaces brown, varied with large obscure spots of dark brown.

There are no pale longitudinal stripes, but the borders of the sacral region are pale and contract posteriorly, enclosing a narrow dark band above the urostyle. This pale outline is bordered externally by brown, and from this dark spots or bands extend transversely. There is a dark spot on the canthus rostralis; one on each side of the end of the muzzle, one below the eye, and one posterior to the eye. Gular region light yellow, rest of lower surface dirty white. Sheaths of hallux black bordered.

The single specimen of this species before me is smaller than the average *S. hammondii* proper, and is equal to the larger individuals of the *S. h. bombifrons.* Its color and the position of its vomerine teeth are more like those of the *Scaphiopus couchii,* but the proportions and the perfectly smooth cranial bones with free integument, distinguish it readily.

This interesting species approximates more closely the genus Scaphiopus than the known species of Spea. It was found by Mr. Wm. L. Black, of Prof. W. F. Cummins' party of the geological survey of Texas, on the journey between Seymour, in northwest Texas south of the Red River, and Austin. Mr. Black obtained on the same expedition three species of Bufo, viz., *B. compactilis, B. debilis* and *B. punctatus.* The range of the last named is thus much extended eastward. A specimen of the snake *Tropidoclonium lineatum* was also obtained, which extends its range much westward, Dallas having been the previous limit in this direction.—E. D. Cope.

The Pedal Skeleton of the Dorking Fowl.—Mr. G. B. Howes has been studying the pedal skeleton of two Dorking chicks, reaching conclusions somewhat different from those of Mr. Cowper, who has recently published studies of the adult structure. As a result of his anatomical researches Mr. Howes advances the theory that the two innermost digits of the Dorking fowl's pes are the product of the cleavage of the hallux, and adduces the recent discovery by Kükenthal of an undoubted occasional splitting of the Cetacean pollex as a support of this argument. Mr. Howes states also that the types of the

hexadactyle limb met with in the Amniota, as well as the pentadactyle pes of the Dorking fowl, is a monstrous formation, and that arguments deduced from their study in support of hexa- and heptadactyle limbs are premature. The author calls attention to the fact that inasmuch as no observed amphibian either living or extinct is known to have borne more than two phalanges upon its second digit, neither the sauropsidian nor the mammalian types can be derived from that of the Amphibia except by a process of intercalation such as there is no evidence to support. As involving the Mammalia, the force of the argument against a belief in the amphibian origin of the class it is second only to that of the discovery of the mammalian condition of the limbs in the Theromorous Reptiles.—Jour. Anat. and Phys., Vol. xxvi.

EMBRYOLOGY.[1]

Experimental Embryology.—Under this title may be included two most interesting recent contributions to our knowledge of the significance of the cleavage phenomena in animal eggs. Both deal with the cleavage phenomena of eggs influenced by experimental interference; the one in the case of a Vertebrate, the other in an Echinoderm.

Prof. E. B. Wilson,[2] of Columbia College, finds that the cleavage cells of an Amphioxus egg when shaken apart are yet capable of developing into gastrulas or even into complete larvæ of perfectly normal structure. Yet the *size* of the gastrulæ or larvæ is determined by the size of the cleaving cell; thus if one of the first two cells is taken the resulting gastrula is half the normal size, if one of the first four is taken, the gastrula is one-fourth the normal bulk. Gastrulas of one-eighth the normal size occurred but were not products of isolated cells in the eight-cell stage; in fact, the experiments go to show that one of these first eight cells is incapable of forming a gastrula. There is thus an early limit set upon the potentialities of the cleavage cells. This, moreover, seems to be a qualitative and not a quantitative limit. The homogeneous, undifferentiated character of the cells is lost at the eight-celled stage.

When the cells are incompletely separated, double, triple, and even quadruple embryos are formed.

Comparing the development of the isolated cells of Amphioxus with what is known of similar phenomena in other Vertebrates as known from the work of Roux upon the frog, or with the facts established for Echinoderms by Dreisch and others, we find an important and fundamental difference in the time at which individuation and symmetry become apparent. While in the Echinoderm the partial development proceeds at first as if all the cells were present, and only later what may, improperly, be called a process of *regeneration*, forms that which was lacking to the completion of a normal symmetrical embryo, in Amphioxus, as the author shows by diagrams giving more accurate observations than had hitherto been made upon the exact mode of cleaving,—"the isolated

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]On Multiple and Partial Development in Amphioxus. Anat. Anz., 1892, Nos. 23–24.

blastomere develops as a unit, not as a half-unit; and the cells to which it gives rise cannot be individually identified with those of a normal embryo-half. The development is transformed from the beginning."

The second paper, by Hans Dreisch, of Zürich,[3] contains many important facts not presented in the preliminary article noticed in the December NATURALIST.

When the eggs of certain sea-urchins are exposed to high temperatures an acceleration in the rapidity of cleavage processes is not the only result—but at a temperature of 31° C. certain marked changes both in the size and position of cells, the entire absence of micromeres and other such fundamental effects are produced. Nevertheless eggs that cleave in these abnormal ways may develop into perfectly normal larval forms, plutei. Long continued exposure to such temperatures acts like the mechanical force applied in shaking eggs in a test-tube and results in the separation of cleaving eggs into two, rarely more than two portions, each of which may then develop by itself. As some of these portions form normal larvæ, high temperature may be one of the factors concerned in the formation of multiple embryos.

Returning to the cleavage of cells separated by shaking echinoderm eggs, a series of figures are given to illustrate the fact that the isolated cells continue to cleave, for a time, as if still in combination with their fellow cells. Thus three cells taken from a four-celled stage do not at once fill up the gap left by the removal of the fourth and this fourth cell divides by itself just as it would have done if remaining in contact with the three others. It is only at a later stage that the products of isolated cells arrange themselves so as to form a complete, symmetrical individual.

A portion of the paper is taken up with certain abnormal methods of cleavage, beginning with the simultaneous formation of four instead of two cells, at the first cleavage. In these cases the cleavage continues to be *double*, a sixteen-cell stage having two sets of each eight cells comparable to the entire eight-cell stage of a normal egg. No larvæ could be reared from such eggs, yet special interest attaches to them upon the assumption that they owe their dual nature to a double fertilization. The only evidence that these eggs were fertilized by two sperms is the assumption by Fol and others that double fertilization causes the formation of four in place of the normal two first cleavage cells.

A most important addition to the methods of experimentation has resulted in unexpected results. It consists in subjecting echinoderm

[3]Entwicklungsmechanische Studien. Zeit. f. Wiss. Zool., 55, 1892.

eggs to mechanical pressure by the very simple expedient of allowing a cover-glass to rest upon them with more or less force as controlled by a hair inserted under the glass.

Eggs flattened out to several times their original diameter do not lose their power to develop, even when the egg membrane is ruptured. If the eggs are fertilized and undergo cleavage under pressure the resulting cells are not arranged in the form of a sphere but form a flat disk. This arrangement of the cells results from the arrangement of the nuclear spindles. While in a normal egg the spindles of the first four cells would stand vertically, as it were, and produce a new set of cells by a horizontal cleavage, under pressure the spindles are found all lying at right angles to the compressing force; that is, parallel to the cover glass or horizontally, and hence give rise to cells all lying in one plane. When the pressure is removed the cells remain at first in a flat disk, though each cell becomes rounded. Subsequent divisions of these cells give rise to a spherical mass capable of forming a complete normal embryo.

With the aid of figures the author makes it clear that in such cases material which would normally have taken part in the formation of only one pole or side of the embryo must now contribute to opposite poles or sides. In the sea-urchin there is thus no early specialization or differentiation of the material found in the cleavage cells; the mixing up of the blastomeres would not prevent the formation of a complete normal animal: the author concludes they could be mixed in all possible ways without destroying the normal symmetry of the adult.

In the philosophical discussion that takes up the final portion of the paper, the author considers the methods of morphological research and upholds the experimental method, which tends to promise the reduction of Biology to a scientific basis sooner than the descriptive, historical or mechanical lines of inquiry possibly can.

Studies in Insect Embryology.—Dr. H. Henking[4] having previously published extensive researches upon the formation, maturation and union of the sexual cells in *Pieris brassica* and *Pyrrhocoris apterus* concludes this comparative study with additional facts upon the eggs of the latter insect as well as those of *Agelastica alni*, *Donacia lampyris*, *Tenebrio*, *Lasius*, *Rhodites*, *Bombyx*, *Musca*, and other representatives of nearly all the chief groups of insects and then summarizes the whole with the aid of most interesting comparisons and suggestions.

[4] Zeit. f. Wiss. Zool., 54, 1892; 51, 1891; 49, 1890.

Along with the observation of normal processes, attempts were also made in some cases to influence these processes by increasing or diminishing the atmospheric pressure, by placing the egg in horizontal and vertical positions, by surrounding them with CO_2 and with O; but the results are not definite enough to afford more than suggestions for future work.

Regarding the maturation of the egg the author holds views that depend upon the interpretation of peculiar appearances seen in insect eggs, where, as is well-known, the technique is a most difficult factor.

The first polar body receives one-half of the chromosomes, one-half the normal number of the ordinary cell, and also the first *thelyid.* This *thelyid* or "acromatic polar body," is a rather vague mass of acromatic substance including the connecting filaments and adjacent substances between the two separating sets of chromosomes.

The second polar body receives the same number of chromosomes as the first, these being formed by a division of each, so that a half of each remains to form the egg nucleus; in some cases there is a second *thelyid,* but this remains inside the ovum.

The two polar bodies may separate completely from the egg, but more often they remain either in protoplasmic processes of its surface or entirely beneath its surface; the first polar body may divide into two.

Even when the polar bodies are extruded they may be later taken into the egg again. Their nuclei may undergo changes similar to that of the egg nucleus, either retaining the separate chromosomes or forming a chromatic network. The first and second or the product of the division of the first and second may fuse with one another inside the egg, much as the sexual pronuclei do.

Meanwhile numerous sperms may enter an egg; polyspermy in insects has no apparent injurious results. The sperm passes into the yolk in a bent attitude, with the union of head and tail preceding. A clear area about the sperm, the *arrhenoid,* seems to give rise to radiating striæ in the protoplasm. This peculiar body is regarded as formed from the acromatic connecting filaments given to the sperm at the second division of its mother cell; is thus comparable, in a way, to the *thelyid.* Increase in size and change in the sperms take place simultaneously in all that penetrate the yolk; only one meets and unites with the female pronucleus.

The number of chromosomes in the nuclei of ordinary somatic cells and in the cleaving egg is 28, 24, 20, 18–20, 24–30, in five different insects studied; the number in the first and also in second polar bodies in these same species, 14, 12, 10, 9, about 12. As far as studied the

spermatocytes have also this same half-number after their first and second divisions; with some interesting exceptions the sperm and the polar body and the female pronucleus have the same number, in any species, and this is half the number of other cells of that species.

With the aid of a diagram the author emphasizes the close parallel between the formation of sperms and polar bodies. Starting from a mother cell with, say 24 chromosomes, a *reducing* division forms two sperm mother cells, or in the female an egg and a polar body, in each of which are only 12 chromosomes, and these are half of the original 24, unchanged or undivided individually. A second division of each cell results in the formation of four sperm mother cells or in the female of three polar bodies, and the remaining egg, in each of which are 12 chromosomes. These, however, are formed by an *equal* division, that is, from the previous 12, 24 arise by a division of each—not by the separation of the whole set into two sets as in division with *reduction*. Later the 12 chromosomes of a sperm may be added to the 12 of the egg nucleus to make the normal 24 of the cleavage nucleus, whence, by equal division, all subsequent cells have 24 also. Likewise, in the insects, one polar body may unite its 12 with the 12 of another polar body.

Utilizing the recent researches of Guignard,[5] the author draws a most interesting comparison between the processes taking place in insects and in plants. Without the aid of diagrams this can scarcely be rendered intelligible; the most novel part, however, is an attempt to explain the polar bodies of animal eggs as, in a sense, "larval organs," somewhat comparable to rudimentary structures within the embryo sac of a flowering plant.

The fact that in insects the polar bodies may remain within the egg and that they, or their descendants, may unite with one another, seems to form a parallel to what takes place in the flowering plant. As is well-known, the embryo-sac cell forms two sets of each 4 nuclei within its substance, 4 lower antipodal cells and 4 upper cells, of which one is the ovum.

The formation of these is directly comparable to the formation of polar bodies in the animal—supposing a second series of divisions to supervene and convert the 4, ovum and three polar bodies, into eight. In the embryo-sac a remarkable fusion takes place between one of the antipodal nuclei and the sister cell of the ovum; this union forms the endosperm. Compared with the insect, this union is like the fusion of polar bodies, only in a later generation. In the insect nothing appar-

[5]See this Journal, May, 1892.

ently results from the fusion of polar bodies; they are rudimentary larval organs.

The fact that we here compare union of later generations in the plant with that of earlier ones in the insect or animal is perhaps made less objectionable by considering the state of things in the infusoria, where, as Maupas has shown, the final fusion takes place between nuclei resulting from more numerous divisions than are employed in the formation of sperm and female pronucleus.

The observations of Henking upon the number and division of the chromosomes in insects conflict in an important particular with the facts necessary to support Weismann's theoretical explanation of the use of polar bodies. In his "Amphimixis" Weismann holds that *reduction* takes place in the formation of both polar bodies, and that there was previously a doubling in the number of chromosomes or *idanten* to allow of greater complexity of combination of the *iden* or hypothetical hereditary units found in the chromosomes. Hinking denies that the second polar body is formed by *reduction;* it is formed by an *equal* division. Moreover, there is no previous doubling of chromosomes; the apparent doubling is only a more or less pronounced division into parts still remaining subservient to the whole, not acquiring individuality.

Weismann's views are moreover limited in that they depend upon the occurrence of two polar bodies, two divisions in the formation of sexual cells; whereas in plants and in infusoria, nuclei that need to copulate result from more numerous divisions.

Parthenogenesis again, as seen in hymenoptera and lepidoptera, may occur where two polar bodies with a smaller number of chromosomes are present.

Though recognizing the strength of the evidence that heredity is closely associated with the chromosomes, the author thinks they are not unchangeable, and that at times they may be more intimately combined with the other parts of the nucleus. If the centrosomes are to be regarded in heredity as of like value with the chromosomes then we must seek in them a process of reduction before copulation.

All present theories of fertilization and of inheritance have only a provisional character.

ENTOMOLOGY.[1]

On a Small Collection of Coleoptera from the High Mountains of British Columbia.—A small series of Coleoptera furnished the writer by Messrs A. G. Smith and F. Russell is of interest sufficient to deserve notice; the collection was made near Donald, B. C., on the top of the first range of mountains to the northeast and above the base of the snow line. Some of the beetles are circumpolar species, others are melanistic forms of those found in more favored situations. A list of them with remarks is appended:

Carabus oregonensis Lec.

One specimen of the insect was taken; it is darker than those found on the coast and somewhat smaller.

Nebria sahlbergii Fisch.

Numerous specimens of small size and with rather dark legs. This seems to have been the most common beetle on the mountain, and is characteristic of boreal or mountainous districts; it extends from the White Mountains of New Hampshire to Alaska, and Dr. Hamilton writes that he has it from the Coast Range of the south of California.

Bembidium incertum Mots.

One specimen; this is reported from Sitka, Alaska.

Pterostichus riparius Dej.

Four specimens; these are a little smaller than those from the coast of Southern Alaska, but about the same as a number from the Stikine River of British Columbia. It has been reported from Gray's Peak, Colo., at an elevation of 12,000 feet. Dejean described it from our northwest coast in 1828 (Species General des Coleopteres, iii, 333).

Amara remotestriata Dej.

Three specimens were brought from the mountain top. It occurs in mountainous and northern regions of our continent.

Harpalus innocuus Lec.

Two specimens of this species are very black, but present no other difference.

Hippodamia 5-signata Kirby.

A series of five specimens show great variation in size and color the smallest one being also the darkest. One of them is remarkable

[1]This department is edited by Clarence M. Weed, Hanover, N. H.

in that the thorax has a large, perfectly regular fovea on each side near the middle.

Hippodamia convergens Guer.

One specimen showing nothing of interest.

Coccinella transversoguttata Fabr.

One specimen of an ordinary type. Widely distributed in North America, and occurs also in Northern Europe and Asia.

Psyllobora 20-*maculuta* Say.

A specimen of this species is the most thoroughly melanized of any seen. All of the elytral spots, excepting the sub-apical, are more or less confluent, forming two irregular vittæ—one near the suture, the other discal. This would go under the variety *tædata* Lec., but is larger than typical 20-*maculata* instead of being smaller, as is usual with that variety.

Byrrhus kirbyi Lec.

One specimen.

Byrrhus cyclophorus Kirby.

Two specimens. This and the preceding species are northern or montane in habit.

Buprestis lanta Lec.

One specimen.

Podabrus xanthoderus Lec.

Four specimens of a *Podabrus* which agree with Dr. Leconte's short description of his variety *a* (Trans. Amer. Ento. Soc., ix, p. 48), are referred here. The mandibles and sides of the head are yellow, as are also the antennal tubercles and the first two joints of the antennæ. One specimen (possibly a distinct species) has the thorax entirely black, except a very narrow margin on the sides in front of the middle; it is also a little less in size, but seems to agree in other characters.

Aphodius ursinus Mots.

Two specimens of this fine insect are in the lot. It is a black variety of *aleutus*, according to the latest researches and is known from Colorado (Dr. Horn, Trans. Amer. Ento. Soc., xiv, p. 13) and from Kamtschatka. Compared with examples of *aleutus* from Southern Alaska these latter are only about half as large.

Aphodius granarius Linn.

Four rather large specimens. This species is found over nearly all of North America and the rest of the civilized world.

Aphodius congregatus Mann.

One specimen of the variety with testaceous elytra.

Acmæops proteus Kirby.

A specimen of this variable species is almost exactly like one from Ottawa, Canada.

Syneta albida Lec.

One specimen. The suture is narrowly dark, the thorax and head also quite dark. The species of *Syneta* vary in color and it is quite unnecessary to erect new species on such characters until the extent of this variation is more definitely known.

Gonioctena arctica Mann.

Four specimens of this interesting species were taken, two of them nearly typical, differing from Mannerheim's description (Bulletin de la Societe Imp. des Naturalistes des Moscow, 1853, p. 166) only in the absence of the pale thoracic borders and dorsal line. The remaining two show both of these markings very well, but differ from each other in minor particulars. As the species is rare in American collections I

FIG. 1.

have prepared the accompanying figure, which will give some idea of the color variations exhibited even by a small set. This species is known from Northern Alaska, the Nelson and Churchill Rivers and from Arctic Siberia southward to the Amur, according to Dr. Hamilton, from whose valuable paper (Trans. Amer. Ento. Soc., xvi, p. 88 *et seq.*) much of the distribution herein quoted is derived.

Serropalpus barbatus Schall.

One specimen occurs "from Maine to Alaska, Central and Western Europe, Western and Eastern Siberia." (Hamilton.)

H. F. WICKHAM, Iowa City, Iowa.

A Peculiar Seed-Like Case-Worm from the Grand Canyon.—While collecting in the Grand Canyon, July 8 to 11, 1892, the members of our party frequently found themselves covered with num-

bers of very small, thin, seed-like bodies, which became attached to their arms, hands, clothing, and faces. Examination proved these to be the cases of a very small larva, which lived within. They were afterward observed to be very common on the narrow-leafed willows (*Salix* sp.), a round-leafed species of leguminous tree, and on many, other plants. They were usually found on the edges of leaves, the

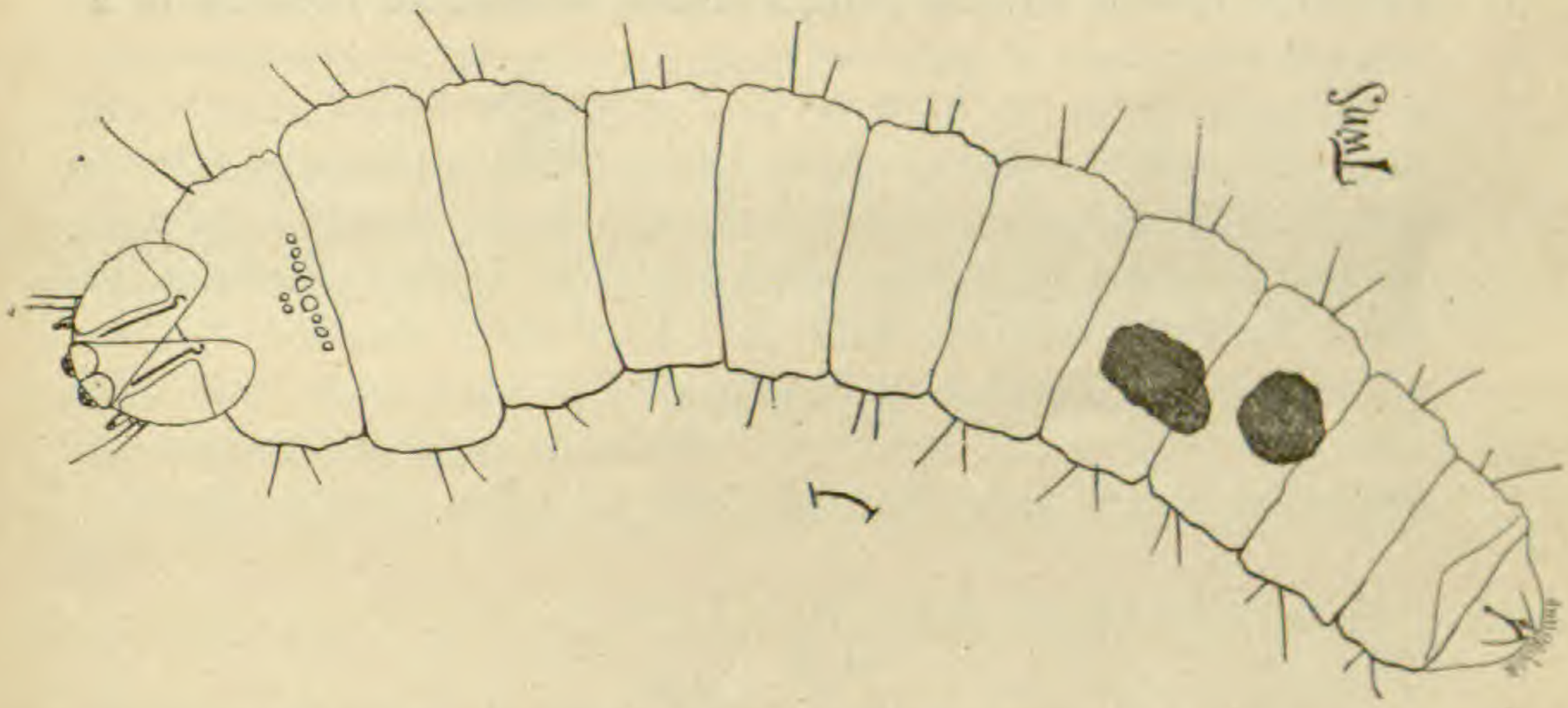


Fig. 2.—Larva, dorsal view—much enlarged. (Hair line shows natural size.)

case being attached thereto by a few extremely fine strands of silk. They occurred especially on the *Salix*, and were found at 2500 feet and more below the rim.

An examination of this larva proves it to be lepidopterous. It has not been bred, but the description of the larva and case given below, together with the figures, will serve to identify it. It is peculiar as exhibiting no trace of legs or prolegs, yet it is unmistakably lepidopterous.

Description of Larva.—Body 13-jointed, whitish, very sparsely clothed with weak hairs; head and second segment with anal hooks, somewhat rufous. Head narrower than second segment, a little more than one-half as wide, subcircular in outline from above, widely and deeply notched behind; two small approximated simple eyes on extreme outer anterior edge of lateral dorsal plates of head just back of antennæ, the anterior one slightly larger than the posterior. Antennæ small, short, 3-jointed; first joint stout, a little longer than wide, with terminal bristles on outer edge; second joint very small and short; third joint a little narrower and longer than second, coming to a point at tip. Mandibles stout, narrowed and twice-notched

(3-toothed?) apically. First pair of maxillæ 3-jointed, joints about equal in length, basal joint stoutest, second and third joints decreasing in width; two pairs of palpi springing from inner side of basal joint, these palpi apparently also 3-jointed, joints of equal length, basal stoutest, second and third successively narrowed. Second pair of maxillæ with one pair of palpi, these palpi apparently 2-jointed, first joint moderately narrow, terminal joint elongate, bristle-like, tapering to a

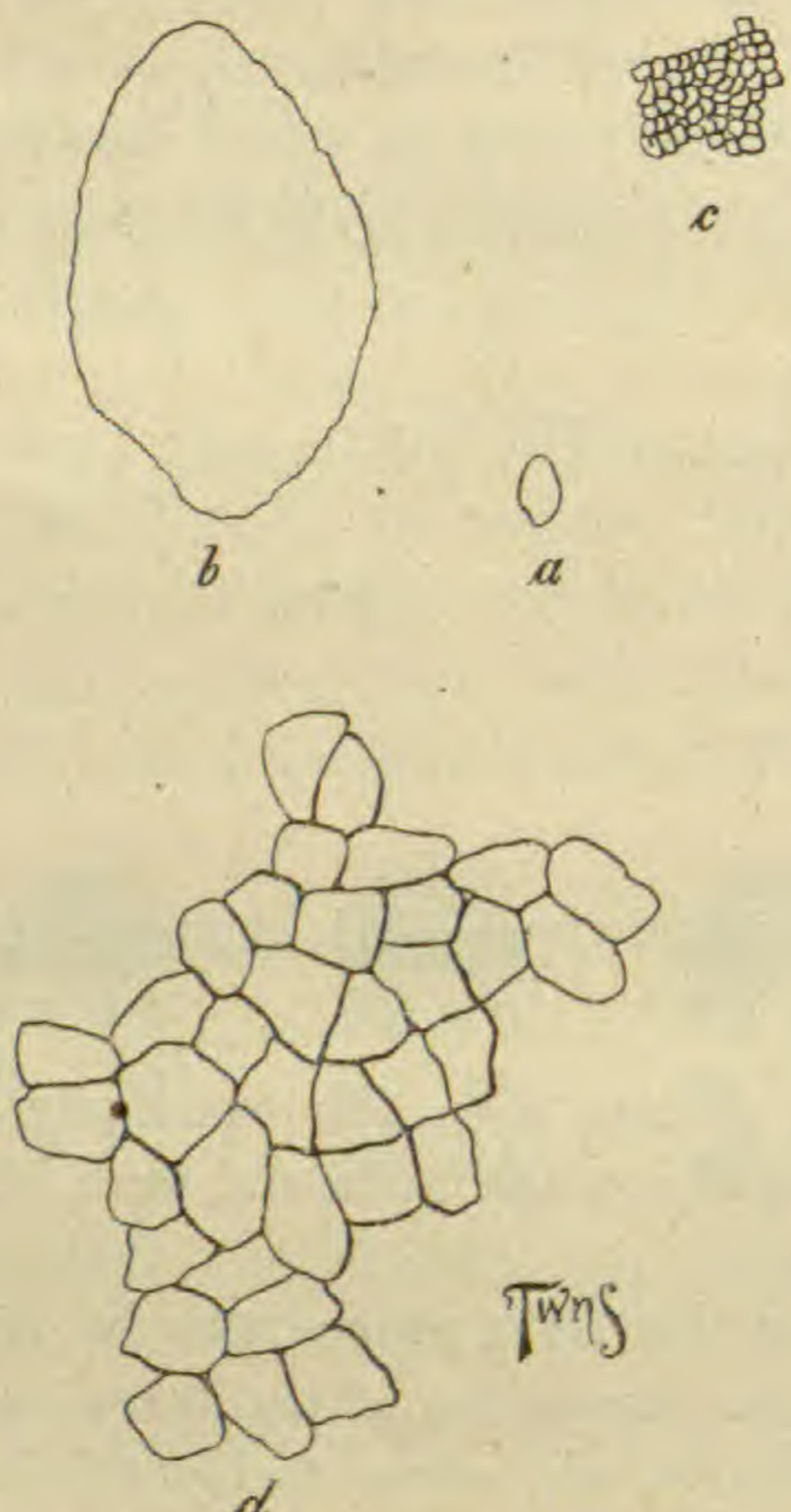


Fig. 3.—*a*, case—natural size; *b*, case—enlarged; *c*, portion of case—enlarged; *d*, portion of case—greatly enlarged.

point; spinneret 3-jointed, joints sub-equal in length, basal joint stout, terminal joint pointed. Second segment corneous, with a transverse row of about eight roundish markings near posterior margin, and a median pair just anterior to row. Other segments fleshy, the integument of all segments except head microscopically warted, in the present alcoholic specimen much wrinkled, especially on third segment; third segment somewhat wider than second, fourth a little narrower, segments 5 to 10 about same width, 11 to 12 nearly as wide; segments 2 to 12 subequal in length. Thirteenth or anal segment narrowed, shortened, longitudinally bifid on the median line posteriorly, fur-

nished with a pair of curved claw-like corneous hooks springing from sides of ventral surface, their tips closing on each other posteriorly. (Ninth and tenth segments each with a black circular or oblong contained body.) Spiracles showing on eleventh and twelfth segments as small nearly circular openings about the middle of segment near lateral margin, not apparent on other segments. No indication of true thoracic legs or of prolegs.

Length of larva (slightly curved as in drawing), $2\frac{3}{5}$ mm.; width of third segment (second from head), about $\frac{3}{5}$ mm.

Description of Case.—Case is small, seed-like in shape, very flat and thin, a little longer than wide, pale brownish in color, composed of two thin layers sub-oval in outline, glued together on edges, narrowly separated or free at one end, the larva living between the layers. Under the microscope a single layer presents a reticulated structure, appearing as if uniformly made up of very small irregular pieces of nearly equal size. It is apparently composed of vegetable tissue, probably very minute fragments of leaves.

Length of case, about $3\frac{1}{2}$ mm.; greatest width 2 mm., or hardly more.

C. H. Tyler Townsend.

Entomological News.—At the meeting of the American Association of Agricultural Colleges and Experiment Stations held in New Orleans, Nov. 15 to 18, Chairman Lawrence Bruner, of Nebraska, and Secretary F. M. Webster, of Ohio, of the Entomological Section, were reelected for another year. But few entomologists were in attendance at the meeting, most of the Station entomologists seeming to prefer the Association of Economic Entomologists for the presentation of papers in reference to their work. The report of the Chairman of the Section of Entomology, Prof. Lawrence Bruner, was read by Prof. Osborn. The report largely consisted in a statement of the equipment of the Station entomologists as a whole, to which was added a statement in detail of the entomological equipment of each station having an entomologist. The report showed that while some of the stations were well equipped with laboratory, insectary, and other requirements for work, yet there were many stations which had not given entomologists proper equipment. Some of the Station entomologists lack room for laboratory, others library, and many, microscopes. Valuable results of a practical as well as a scientific nature are rarely attained without proper apparatus, and the Station entomologists need something more than jack-knives with which to carry on their work.

It is gratifying to learn of the advancement being made by many of the entomologists of the experiment stations. Prof. H. A. Morgan, of Louisiana, and Prof. Popenoe, of Kansas, who were formerly entomologists and horticulturists of their respective stations, have, upon their urgent request, been made entomologists of their stations only. This is a step in the right direction.

Prof. John B. Smith will have charge of the entomological part of the biological exhibit of the office of experiment stations at the World's Columbian Exposition.

Howard Evarts Weed, of the Mississippi Agricultural College is making a special study of North American Myriopods, and would be glad to exchange insects of any order for Myriopods of any locality, especially the west. His address is Agricultural College, Mississippi.

Prof. C. H. T. Townsend is preparing a monograph of North American Tachinidæ, and desires material in this family from any locality, especially bred specimens. His address is Las Cruces, New Mexico.

A recent issue of *Psyche* says: "Entomologists everywhere will regret to hear that the serious illness which has, for the past two years, incapacitated Dr. H. A. Hagen, renders it improbable that he will be able to do any further work. Dr. Hagen has had charge of the collections of insects in the Museum of Comparative Zoology at Harvard University since Oct. 12, 1867, and during this long period of twenty-five years has applied himself with entire devotion to the interests of the department. The scientific value and present excellent condition of the collections are the result of his faithful and disinterested work. Recently the department has been placed in charge of Mr. Samuel Henshaw."

Dr. M. C. Cooke, the well-known English mycologist, has brought together an account of the fungi parasitic upon insects in a volume recently published by the Society for Promoting Christian Knowledge (London, 1892).

We learn from *The Entomologists Monthly Magazine* that Mr. Oswald Latter reported at a recent meeting of the London Entomological Society that the moth *Dicranura vinula* produces, probably from the mouth, a solution of caustic potash for the purpose of softening the cocoon.

An interesting summary of the value of entomological study has been sent out by Mr. James Fletcher in the report of his Evidence before the Committee on Agriculture of the Canadian House of Commons.

PSYCHOLOGY.

Vision in a Young Girl Six Years of Age, Operated Upon for Double Congenital Cataract.—M. Grafé has published in the *Revue Scientifique* July 16, 1892, an interesting account of an operation for double cataract, performed by M. Bribosia upon a blind girl 5 years of age, and discusses, in the same paper, some questions of sight psychology. This reminds me of a similar operation performed by myself several years ago upon a young girl 6 years old, born with a double white cataract. Some notes of that operation, which I have kept, will perhaps be of use to M. A. Grafé in the researches he has undertaken in a new field.

What are the sensory impressions and emotions of a person born blind when the veil which has hidden from him the marvellous world is suddently rent? Would he, at first sight, see, as has been taught, objects reversed, in consequence of the crossing of the rays of light from the object before their contact with the retina? Would he have intuitively an idea of distance and of the third dimension of matter, or would this idea be gained by observation and experience?

In order to succeed in solving the problems of optical physics and visual psychology, M. A. Grafé arrived a little late after the operation by M. Bribosia. I had opportunities in the case of the child 6 years of age, more advantageous for studying the curious phenomena which took place, not only during the operation, but also during the dressing of the wound and the first exercise of the newly acquired sense.

The following are the notes of the operation:

Julie D. had a double white congenital cataract at the age of 6 years. She perceived less and less from infancy the light of day, even after the local use of belladonna. Being intelligent, she had acquired a variety of knowledge from conversation. Touch and hearing had become very sensitive, and her memory was excellent.

I operated upon both eyes at the same time, as was my custom with double cataract in old people as well as young. But, in order to avoid a sudden flood of light, I operate always in a slightly darkened room; and before attending to the second eye, I hermetically seal the first with a simple bandage. The dressing of the wound for the first few days is done in the same manner in a similarly darkened room.

When I allowed Julie D. for the first time to remove the bandage from her eyes she had a slight sensation of dizziness, which made her

put her hands to her face. Then she saw at a little distance objects which she recognized by their shape; a coffee-mill, my hands, knives, forks, a plate, a cup, a watch, a handkerchief, etc., the forms of which she had become familiar with through touch during her long blindness. But she could not distinguish color. She would make hap-hazard guesses at red, green, blue, and yellow, but could sometimes recognize black and white. I was anxious to know her first optical impression as to the position of objects, whether they appeared right or reversed. With this idea in mind I showed her, first of all, a coffee-mill, held at the distance of a meter from her, and said, "What is this?" "My coffee-mill," said she without hesitation. "How do I hold it, with the drawer on top or on the bottom?" "It is below, as it ought to be." Thinking that the child was answering in accordance with her preconceived notions contrary to her first visual sensation, I showed her a knife fixed vertically by two threads to a sheet of white paper, and asked her to show me with her hand where was the handle of the knife, at the top or the bottom of the paper. She pointed immediately with her right hand to the handle, saying: "It is there, at the top." This was correct.

I did not indulge my scientific curiosity further at that time. At the second and third interviews which took place the sixth and seventh day after the operation, Julie was no longer deceived as to colors, but she still imagined as she had at first, that everything she saw was within reach. Space, height and volume did not as yet exist for her. However, she appreciated perfectly the distance of sounds. When objects were held for her at less than a meter's length, she would instinctively draw back, feeling, as she said, that they would strike her eyes. As to everything she saw that was at more than arm's length, they all seemed ranged on the same line, that is, all seemed equally distant. But this illusion did not last long. The sense of touch had given her such just ideas of the form, the size, and the different dimensions of buildings, persons and the objects in the midst of which she had lived, that ideas of perspective and appreciation of distances were speedily acquired.

At the end of fifteen days she said she had almost forgotten that she had ever been blind.

Had she, in the presence of what we call the wonders of nature, the flowers, the trees, the monuments, the country, the storms, the sky with its myriad stars, the sun and the moon, that awakening of the imagination roused by a spectacle as magnificent, as unexpected, which expresses itself in an ecstatic admiration? She was astonished at all,

but she admired nothing. Had she dreamed, perhaps, during that long night of six years more and better things than the realities which unfolded themselves before her eyes?

It is a fact that the persons who have lost their sight, and recovered it through an operation, have shown more pleasure at seeing again their relations, their friends, and their coffee-mills than did Julie D. at seeing for the first time all the objects of which she could have had only a feeble and imperfect idea gained either through the sense of touch or from descriptions given her by others.—H. Boëns, Revue Scientifique, Oct. 29, 1892.

ARCHÆOLOGY AND ETHNOLOGY.

Area and Population of European Countries.—M. E. Lavasseur, in a communication to the Academie des Sciences on March 21, 1892, calls attention to the diversity usually to be found in statistics of area and population in standard works of reference. Considering only such high class publications as "Die Bevölkerung der Erde," the "Almanach de Gotha," and the "Statesman's Year-Book," he points out that diversity does not necessarily convict any of error, as the approximation to the exact figures may be arrived at in different ways; that, in fact, absolute agreement in statistics is a sign that they have been copied by one writer from another. In some cases the areas of countries are officially derived from cadastral surveys, which, as a matter of fact, often do not include the whole land and water area of a country, geographers not being agreed as to what water areas should be reckoned along with the land. In other cases official or semi-official measurements are made on large-scale topographical maps, and the degree of approximation must vary with the scale, and with the technical skill of the computor. Some countries are content with measurements or estimates made by individuals, such as those of Strelbitsky and of Perthes' Institute. The calculation of population is still more uncertain, being dependent on census returns (themselves imperfect), calculated to any given intermediate date by estimates derived from registers of births, deaths, immigration and emigration. In a table brought down to the end of 1890 M. Levasseur gives a conspectus of the area, population, and density of population of the countries of Europe, classed in four groups, as follows:

	Inhabitants.	Area, sq. m.	Density per sq. m.
Western Europe.....	87,100,000	352,300	247
Central Europe.....	93,609,000	464,400	200
Southern Europe.....	71,826,000	557,800	130
Eastern Europe.....	98,000,000	2,106,500	47
Northern Europe.....	9,100,000	378,000	23
All Europe.....	359,635,000	3,859,200	93.1

Notes as to the various estimates are appended; those relating to the German Empire may be cited as an example. The "Bevölkerung der Erde" in 1872 gave the area as 207,816 square miles; in 1874 as 207,935; in 1876 as 207,943; in 1878, as in 1880 as 207,883; in 1882 as 207,899; in 1891 as 207,861; while Strelbitsky's measurement is 208,008, and that adopted in the tables from the "Statistisches Jahrbuch für deutsches Reich" for 1891 is 207,929 square miles.—Proceeds. Roy. Geog. Soc., July, 1892.

A Measure of Civilization.—Dr. Lamborn suggests that the proportionate length the artist gives the face or head to the body might be considered a measure of civilization. He finds that the late Spanish artists give 10½ faces to the height. Dürer 10 to 1. Earlier Spanish artists 9 to 1. The measurements of a number of wood cuts of the Fifteenth Century run 5½ to 1 and 6½ to 1. The Mexican images are 4 to 1, 3½ to 1, and 3 to 1. The gold figures of Peru make the head larger than the body. (Lamborn's History of Mexican Art.)

MICROSCOPY.[1]

On the Restoration of Osmic Acid Solutions.—The osmic acid so valuable to the histologist as a fixing reagent, is known to the chemist as osmium tetroxide, Os O_4, and is one of the series of osmium compounds with oxygen. It is readily reduced in the presence of an organic substance, giving up two atoms of oxygen and forming the deutoxide, Os O_2. This is the well-known black powder so familiar in specimens killed in any of the fluids into which osmic acid enters. Osmium tetroxide affects fatty substances first, and these are the substances that most readily undergo oxidation. Prolonged exposure to the action of the tetroxide blackens the tissue so that it is useless for histological purposes.

In preparing stock solutions of osium tetroxide the greatest care must be taken to exclude organic matter, even acetic acid in the quantity called for in Flemming's stronger fluid, is liable to cause the reduction of the tetroxide. A trace of impurity in the distilled water sooner or later produces the fatal blackening, while a solution made with pure water will keep indefinitely in the light. Let but a trace of dust fall into the bottle and reduction will take place to some degree.

During the summer of 1892, at the Marine Biological Laboratory at Woods Holl, Mass., a large number of solutions were treated with peroxide of hydrogen, H_2 O_2, and different investigators tested them with uniformly good results. The restored solutions acted in the same manner as the fresh solutions, and produced the same results; the only noticeable difference was a gradual weakening of the solution, as would naturally be expected. Specimens overblackened by the action of the peroxide were rendered colorless without perceptibly changing the character of the tissue, and a few experiments were made to determine whether the bleaching with peroxide could be so controlled as to leave certain tissues blackened while others were cleared. This quantitative bleaching with peroxide yielded no very good results in the few experiments made, but enough was accomplished to warrant further attempts.

The chemistry of the restoration and the bleaching further demonstrates that no injurious factor enters into the result as is shown by the following equations:

[1]This department is edited by C. O. Whitman, University of Chicago.

$Os\ O_4$ + organic substance = $Os\ O_2$ + oxidized organic substance.
$Os\ O_2 + 2H_2O_2 = Os\ O_4 + 2H_2O$.

That is, in bleaching a tissue, the $Os\ O_2$ is converted into $Os\ O_4$, and water is formed, with which the tissue is already saturated.

To restore 100 cc. of a 1% solution of osmium tetroxide requires from 10 to 20 drops of fresh peroxide of hydrogen, and clearing goes on better in full sunlight. To bleach tissue with peroxide requires about the same amount in 100 cc. of water, and the bleaching takes place better in the sunlight also. The amount needed cannot be stated with any more precision because the peroxide loses its strength somewhat with age. The peroxide made by the Oakland Chemical Co., 54 South Avenue, New York, is more stable and keeps better than many of the preparations in the market.—C. L. Bristol.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Geological Society of America.—The Fifth Annual Meeting was held at Ottawa, Canada, on December 28, 1892, and following days. The following papers were read: Notes on the Early Palæozoic Sponges, Sir J. William Dawson, Montreal, Can.; Notes on the Devonian Formation of Manitoba and the N. W. Territories, J. F. Whiteaves, Ottawa, Ont. The object of this paper was to show the relationship of Devonian formation of Manitoba and the N. W. Territories with that of Northern Europe. In Manitoba the Stringocephalus zone is remarkably well developed and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. On the Coals and Petroleums of the Crows's Nest Pass, Rocky Mountains, A. R. C. Selwyn, Ottawa, Ont.; On the Geology of Natural Gas and Petroleum in Ontario, H. P. Brumell, Ottawa, Ont. A brief résumé of work done in gas and oil explorations in Ontario, and dealing with the geological evidence adduced from record of wells sunk. Including also a short account of the geology of Southwestern Ontario. Some Features of the Phosphate Bearing Rocks of Ottawa County, P. Q., Elfric Drew Ingall, Assoc. Royal School of Mines, Eng. (Introduced by J. B. Tyrrell.) This was a preliminary paper, based upon field observations, discussing the phenomena exhibited by the Apatite deposits and their associated rocks in their bearing upon the question of the probable mode of formation of these deposits. Some Maryland Granites and Their Origin, Charles Rollin Keyes, Des Moines, Ia. A brief sketch of the granite

rocks of Maryland, with a summary of the reasons for regarding them as eruptive in origin. Epidote as a Primary Component in Granites, Charles Rollin Keyes, Des Moines, Ia. Occurrences of the mineral in certain granites regarded as eruptive described, the evidences of its original nature explained and its associations with the closely related Allanite considered. On the Laurentian of the Ottawa District, Robert W. Ells, Ottawa, Ont. The paper briefly reviewed the work of the late Sir Wm. Logan in this district, forty years ago, and discussed the structure of the calcareous portion of the system, more particularly as regards the relationship of the crystalline limestones to the underlying gneiss; with a brief statement of the several kinds of intrusive rocks which penetrate both the gneiss and limestone, and their apparent influence upon the occurrence of the economic minerals, such as graphite, apatite and mica. The Contact of the Laurentian and Huronian North of Lake Huron, Robert Bell, Ottawa, Ont. The line of contact between the Great Huronian Belt to the northward and the Laurentian area to the southward was traced from near Killarney on Lake Huron to its intersection with the Ottawa River. The two sets of rocks in this region were described with regard to their structure and their relations to one another. The nature of their contact here and in other instances in Canada was described in connection with the question of the conformability or otherwise of the two systems. Reference was made to the extraordinary development of quartzite in the LaCloche region, to certain forms resembling fossils lately discovered by the writer in the Huronian rocks of the vicinity, to the greenstone masses and dykes, to the nature of the granites and to other points in connection with the geology of the district. The marked dependence of the physical geography upon the phenomena of crystalline rocks of the region was likewise pointed out. The Archæan Rocks West of Lake Superior, W. H. C. Smith, Ottawa, Ont. (Introduced by R. W. Ells.) This paper gave a brief description of the rocks and their distribution between the Lake of the Woods and Lake Superior north of the International boundary and referred to some of the theories of origin and structure of the various members of the Archean system and to the iron ores and gold-bearing rocks of the region. On the Archean of Sudbury Mining District, Alfred E. Barlow, M. A., Geological Survey Department, Ottawa, Ont. This paper related in detail the various phenomena in connection with the contact between the Laurentian and Huronian to the northeast of Lake Huron, with a discussion of the origin and relative age of each, based on these observations. Notes on Cambrian Fossils from the

Selkirks and Rocky Mountain Region of Canada, Henry M. Ami, Ottawa, Ont. This paper was based mainly upon a collection of Lower and Middle Cambrian fossils made by the author in the summer of 1891. It contains notes on some eight species of Lower Cambrian (Olenellus zone) fossils from the gray, glossy and calcareous schists and limestones of the entrance to the Selkirks, some two miles west of Donald, British Columbia. The latter part of the paper dealt with the forms met with in the Middle Cambrian of Mount Stephen in the Rocky Mountains, near Field, B. C., where the terrane is highly fossiliferous. Upwards of twenty species have been recorded from this locality, many of which are very interesting and well preserved. On the Potsdam and Calciferous Terranes of the Ottawa Paleozoic Basin, Henry M. Ami, Ottawa, Ont. The stratigraphical, lithological and paleontological relations of the Potsdam and Calciferous terranes, as seen and known in the Ottawa palæozoic basin and elsewhere were discussed in this paper; also the reference of these two terranes to the Cambro-Silurian or Ordovician Epoch instead of to the Cambrian Epoch, inferred from the internal evidence. The Criteria for the Recognition of Separate Ice Epochs, R. D. Salisbury, Chicago, Ill.; Note on the Geology of Middleton Island, Alaska, George M. Dawson, Ottawa, Ont. This short paper was devoted principally to the description of a boulder-clay or till from Middleton Island, which is found to contain some marine fossils. Eskers Near Rochester, N. Y., Warren Upham, Somerville, Mass. The Pinnacle Hills, a very remarkable esker series in the southeastern suburbs of Rochester, were described and attributed to deposition by a glacial river flowing between walls of ice and open above to the sky. Their material, which is shown to have been englacial, is chiefly gravel and sand, but also comprises in some parts very abundant and large boulders, some of which are lified 200 feet or more above their sources within a few miles on a nearly plain country. Similar explanations are also applicable to other eskers in Pittsford, several miles farther southeast. Comparison of Plistocene and Present Ice-Sheets, Warren Upham, Somerville, Mass. The Plistocene ice sheets of North America and Europe were compared with the now existing Malaspina, Greenland, and Antarctic ice-sheets, as to their areas, surface slopes and probable thickness, rates of erosion and ablation, subglacial and englacial drift, and manner of deposition of various drift formations. The Malaspina glacier or ice-sheet, covered on its wasting borders by much drift and growing forests, is believed to afford explanations of forest beds between deposits of till, and of the peculiar drift accumulations named drumlins, both

being attributable to stages in the general recession of the North American ice-sheet when increased snowfall and onflow of the ice slackened its retreat or caused it temporarily to re-advance. Under this view, the Ice-Age seems probably to have comprised only one great epoch of glaciation, with moderate oscillations of the ice-front, and to have been geologically brief. Plistocene Phenomena in the Region Southeast and East of Lake Athabaska, Canada, J. B. Tyrrell, Ottawa, Can. The paper was the result of an exploration conducted by the writer during the past summer in the hitherto unexplored region lying southeast of Athabaska Lake and north of Churchill River. The region has some strongly marked glacial features. The writer disdiscussed the striation and character of the rock surfaces, the occurrence of till, drumlins, kames, and other glacial phenomena. Some high-level beaches, terraces, and other post-glacial deposits were also noted. Notes on the Glacial Geology of the Northeast Territories, A. P. Low, Ottawa, Ont. A short account of the geography and surface geology of the western water-shed of Labrador Peninsula, derived from explorations on the Rupert, East Main, Big, Great Whale and Clearwater Rivers, and along the east coast of Hudson Bay. Notes on the Gold Range in British Columbia, James McEvoy, B. A. Sc., Ottawa, Ont. (Introduced by H. M. Ami.) A short description of the topography of the Gold Range and part of the adjoining Interior Plateau country, with notes on the glacial geology of the same. The Glacial Gravels of Glacier Bay, Alaska, Harry Fielding Reid, Cleveland, Ohio (Introduced by J. S. Diller). The Post-glacial Outlet of the Great Lakes Through Lake Nippissing and the Mattawa River, G. Frederick Wright, Oberlin, O.; The Height of the Bay of Fundy Coast in the Glacial Period Relative to Sea Level, as Evidenced by Marine Fossils in the Boulder Clay at Saint John, New Brunswick, Robert Chalmers, Ottawa, Ont. Description of locality, area and thickness of boulder-clay. Divergent striæ on underlying rocks. The materials of the boulder-clay from the north. Intercalated stratified portions and their fossils deposited in the sea. Sections at Fern Ledges and Negrotown Point given. The conclusions are that the climate was Arctic or subarctic; that the boulder clay here was formed by a number of successive accretions in a zone of oscillation of the ice-front, and that its upper portion at least was thrown down when the lands stood 100 to 200 feet below its present level. On Certain Features in the Distribution of the Columbia Formation on the Middle Atlantic Slope, N. H. Darton, Washington, D. C. This paper was a description of relations indicating an interval of erosion between the depositions of the

high-level and low-level portions of the formation, beginning in Southern Maryland and gradually increasing northward to New Jersey. A Geological Reconnoissance in the Central Part of the State of Washington, Israel C. Russell, Ann Arbor, Mich. The region traversed embraces about 10,000 square miles in the arid region east of the cascades and drained by the Columbia. The reconnoisance was made for the purpose of learning how far the conditions there existing favor the project of obtaining artesian water for irrigation. The following is a syllabus of the paper.

Geography of the region explored.
Geological formations.

Crystalline rocks. Kittitas system. Columbia lava. John Day system.	Tertiary.	Glacial records, Lake Lewis,	Pleistocene.

Geological structure. Existing lakes. Artesian water supply.

The Abandoned Strands of Lake Warren, Andrew C. Lawson, Berkeley, Cal. The strands of Lake Warren, on the north side of Lake Superior, up to an elevation of 1200 feet above sea-level are post-glacial. It was not an ice-dammed lake. There was an outlet northward corresponding to one of its higher stages. A post-glacial depression of Central Canada whereby the James Bay slope was covered with marine sediments to a present altitude of 450 feet above tide and only 150 miles distant from Lake Superior is correlated with the maximum fullness of Lake Warren, and the subsequent uplift is correlated with its subsidence. The strand lines show no evidence of deformation. In the absence of ice dams and of a gorge of permanent drainage, the Level of Lake Warren could only have been lowered by epeirogenic depression along its southeastern margin, *i. e.*, in the region south of Lakes Huron and Michigan, which depression is thus coeval with the post-glacial uplift of central Canada. High terraces and beaches are known to extend along the north side of Lake Huron from Sault St. Marie eastward and they are reported on the high lands of the Peninsula of Ontario; so that Lake Warren must have been the greatest of the known Quaternary Lakes. Its area is roughly estimated at 150,000 square miles. The Importance of Photography in Illustrating Geological Structure, R. W. Ells, Ottawa, Ont. In connection with this paper was shown a series of large photographs by Topley, taken under the direction of the writer, showing more clearly the mode of occurrence of the apatite in the deposit of the Buckingham and Lievre district, as well as the relations of the intrusive

apatite-bearing rocks to the surrounding gneiss. Two Neocene Rivers of California, Waldemar Lindgren, Washington, D. C. It was the purpose of this paper to briefly indicate the direction and grade of the *principal forks* of the Neocene equivalents of the present Yuba and American Rivers. These streams now drain an area in which many important Neocene gravel deposits are located, and to trace the old water courses is of the highest importance in order to successfully open and mine the auriferous channels. The results recorded here have been reached during the course of the investigation of the Gold Belt carried out under the direction of Dr. G. F. Becker, by the U. S. Geological Survey.

The geological events related to the accumulation and covering up of the Neocene channels were briefly sketched and the different systems of channels described. The fact was accentuated that the Neocene rivers closely correspond to those of the present day in the extent of their watersheds, although by no means always in the direction of their principal forks. A short statement was given of the work previously done in the same field by other investigators.

The course of the Neocene Yuba and American Rivers was described, by the aid of a map, on a small scale. In places where differing results have been obtained from those of other observers, or where new facts have been brought out, a more detailed statement was given. *Practical results:* The greater part of these Neocene channels is now covered by heavy masses of volcanic material and many of them, though auriferous, have not yet been opened for mining operations. The continuity of certain channels under the lava cap can be asserted and their approximate positions indicated; some of them, most likely to prove remunerative, but which have not yet been opened up, were mentioned; among them are the Blue Tent Channel, the Long Canyon Channel, and the Webber Creek Channel.

Boston Society of Natural History.—Dec. 21.—The following papers were read: Some New Experiments on the Absorption of Liquids by Aerial Parts of Plants, Mr. W. F. Ganong; The Abdominal Pouch of Butterflies of the Genus Parnassius, Mr. S. H. Scudder; Columnar Structure in Stratified Rock, Prof. W. H. Niles.

January 4, 1893.—The following papers were read: Account of Some of the Botanical Establishments of Europe (photographs were shown), Prof. W. G. Farlow; Application of the Microscope to the Study of Rocks (colored stereopticon views were shown), Dr. J. Eliot Wolff.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Biological Section.—Meeting of Dec. 12.—The following is a synopsis of the papers: On the Miocene Deposits of the White River, by Dr. J. L. Wortman; These deposits were arranged in three groups, *lower* or *Menodus* beds, *middle* or *Oreodon* beds, and *upper* or *Protoceras* beds. The *Protoceras* beds were regarded as in part contemporary with the *John Day* beds of Oregon. On the ileo-colic junction of Procyon lotor and allied Arctoids, by G. S. Huntington. The absence of cæcum in Procyon was noted as repeating the condition found in Hyæna and the Ursidæ. The provision for preventing return of contents of large intestine appears to consist in a series of constrictions in the terminal part of the ileum together with increase in the circular muscular fibres in these situations as well as at the ileo-colic junction itself. There is a complete absence of an ileo-colic valve. On the Origin of West Indian Bird Life, by F. M. Chapman. Conclusions from study of bird and mammal life were (1) distinctness geologically of Lesser from Greater Antilles; (2) independence of islands from mainland since the appearance of the present fauna; (3) original connection of West Indies to Central America by way of Jamaica; Central America at this time an archipelago created by passage leading from Pacific to Carribean Sea; (4) the older faunal forms of the West Indies represent survivors of the insular Tertiary species; (5) the newer forms are immigrants and become differentiated under new conditions of living. H. F. Osborn reported the discovery in the Miocene of South Dakota of a horned artiodactyle represented by male and female skulls and complete fore and hind feet. The female skull is comparatively hornless and proves to be identical with *Protoceras celer* Marsh. The male skull exhibits no less than five protuberances upon each side or ten altogether. Two of these upon the frontals and sides of the maxillaries are very small; the parietal, supraorbital and maxillary protuberances are very prominent and had apparently a dermal covering as in the giraffe. There are four toes in front and two behind as in the early Tragulidæ. The types were found by Dr. J. L. Wortman, and are in the recent collections of the Am. Mus. Nat. Hist.

BASHFORD DEAN, *Sec. Biol. Section.*

Natural Science Association of Staten Island.—Nov. 12, 1892.—The election of officers for the ensuing year resulted as follows: President, Walter C. Kerr; treasurer, Thos. Craig; recording secretary, Joseph C. Thompson; corresponding secretary, Arthur Hollick. A paper on Our Historic Landmarks, by Mr. Ira K. Morris, was read by

title, and will be published as a "special" later on. Dr. N. L. Britton presented specimens of *Aspidium cristatum* (L.) Sw., collected by Mrs. N. L. Britton, near Oakwood. This fern is exceedingly rare on Staten Island, having been previously reported from but two localities, in one of which, the Clove Lake Swamp, it has been since exterminated.

Mr. Arthur Hollick read the following paper Upon Additions to the Cretaceous Flora of Staten Island.

At the meeting of January 2, 1892, I gave a preliminary account of the Cretaceous fauna and flora of the island so far as studied up to that date. At the meeting of March 12, the rediscovery of fossil leaves in the Kreischerville clays was recorded, and also the discovery of a large fossil leaf near Richmond Valley. At the meeting of September 10 the discovery by Mr. Heinrich Ries of fossil leaves in the Cretaceous clay at Green Ridge was recorded and since that time Mr. Wm. T. Davis has turned over to me a number of other specimens found by him in the clay at Kreischerville.

All this new material and such of the old as had not been critically examined has been the subject of careful study by me during the past few months with the result that there has been added at least thirty-eight species to our Cretaceous flora.

Most of them were known previously from the clays of Woodbridge or Amboy, N. J., but others have not before been reported from Eastern North America and we here have their first recorded occurrence in this region. Of these fourteen represent species new to science.

The specimens have all been shown from time to time at our meetings, and from these careful drawings have been made. The entire subject will be presented before the New York Academy of Sciences shortly, with full descriptions and figures of all the new species, which will be published in the Transactions in due time.

We have forty-seven species representing the flora of the Cretaceous formation on Staten Island. All the specimens from Tottenville, Richmond Valley, Princes Bay and Arrochar are in ferruginous rock of a concretionary character and are well preserved. Those from the clays of Green Ridge and Kreischerville soon began to disintegrate upon exposure to the air and are now mostly useless for purposes of identification.

Dec. 17, 1892.—A specimen of European "Gorse" or "Furze," sent by Dr. F. Hollick, was shown and the following memorandum read:

The accompanying specimen was obtained Nov. 10, from a small bush, about a foot in height, of European furze (*Ulex europæus* L.), which is growing wild on Ward's Hill, Tompkinsville. I first discov-

ered it during the early autumn. To all appearances the plant is self-seeded, and is remote from any garden or cultivated ground. The only other vegetation in the vicinity is short stunted grass, so that the bush in spite of its small size, is a conspicuous object and has probably only escaped destruction by reason of its sharp prickly foliage. The locality is strikingly similar to the "commons" or "downs" where it grows in Great Britain. How it came here is a mystery, as the only other place where it is known to occur in America, so far as I am aware, is on the Island of Nantucket, where it was introduced about 1860, and has since spread to some extent. If protected and encouraged it would doubtless become established here and spread as it has done in the latter locality.

Mr. William T. Davis exhibited *Cecropia* cocoons which had been partly destroyed by woodpeckers, and read the following paper on woodpeckers and cecropia cocoons.

The caterpillars of the *Cecropia* moth spin their cocoons in a variety of places; occasionally on the flat side of a board fence, sometimes at the base of bushes such as the elder, and sometimes at the ends of swaying branches when the food plant happens to be a tree. The cocoons spun near the ground are often devoured by mice that gnaw through the silken coats to the edible pupa within. Specimens which had been thus destroyed were shown to this Association by Mr. Joseph C. Thompson on Dec. 12, 1889. Cocoons that are placed on tree branches are more safe from the attacks of mice, but are liable to be eaten by woodpeckers.

On January 14, 1888, I saw a downy woodpecker investigating a *Cecropia* cocoon in a white maple, the woodpecker thrusting its bill in and pulling it out of the cocoon quite frequently. After a while it flew to another cocoon a few feet away, but it being on such a small branch it was unable to successfully pick it open, as the branch swayed up and down. It was then plain what a great protection it was to the insects to place their cocoons near the branch ends, though no doubt they are sometimes killed by the swaying of these branches during a storm.

When the woodpecker was gone I cut the cocoon off and found a small hole on its side quite near the branch, where it was easiest to drill because the silken fabric gave way the least to the strokes of the bird. Cutting open the other side of the cocoon, I found that the pupa shell was sucked nearly dry of its contents.

The *Cecropia* cocoons, occurring commonly on white maples, are generally placed near the ends of the long drooping branches, and it will be seen from the foregoing that it is probably the safest situation afforded by the tree. Near my home there is a small white maple that has eight *Cecropia* cocoons on its branches, but only two of them, from their position, can be injured by a woodpecker.

If a woodpecker is successful in making a hole into a cocoon it is nevertheless sometimes disappointed at its contents. I have found a cocoon that contained the tough case of an Ichneumon fly pupa (*Ophion*), which had been drilled in the side by a woodpecker, and then abandoned, leaving the parasite unharmed.

Mr. Davis also submitted the following note:

The tawny thrush or Veery (*Turdus fuscescens*), has not been reported as nesting on the Island, but during the last spring and summer it was not uncommon at Watchogue. Several would often be heard singing at the same time, or be seen walking, hopping or running, for they do all three, along the wood paths and stopping by the way to turn over a countless number of dead leaves for the insects to be found beneath them. In every instance they frequented the edge of the close timber near to some open or half cleared ground, whither they often flew.

On June 26 I noticed a Veery carrying food in her bill, and was thus enabled, after a time, to discover a young bird perched on a log in a thick growth on the edge of a swamp. On July 10, with Mr. Walter Granger, of the American Museum, I heard many Veeries singing, but we were unsuccessful in finding a nest of the second brood.

It seems probable that this thrush has only been plentiful at Watchogue during the past summer, for just as close attention has been given to the district for a number of years, and yet only once before, namely in May, 1891, was a Veery heard singing.

Mr. Arthur Hollick read Notes on Staten Island Clays collected for the World's Fair.

Mr. L. P. Gratacap exhibited berries of *Smilax rotundifolia* and submitted a memorandum in connection with them.

Mr. Gratacap also exhibited drawings from microscopic examination of rocks to which seaweed had been attached, and read the following note:

The great quantity of rock used in constructing the roadbed of the Rapid Transit Railroad along our north shore has introduced upon the island a very representative collection of N. Y. Island rock, including mica schists, gneiss and granite. It serves the double purpose afford-

ing the local mineralogists an opportunity to study and collect feldspar, quartz and mica, with associated garnets and tourmalines and is a suggestion as well of the underlying reefs of archæan metamorphic masses upon which our own island is built, and our geological relationship with New York from whose ledges the rocks have been transported. Wherever these fragments have rolled down to the waters' edge or are so placed as to be inundated by the high tides, a very vigorous growth of the green filamentous seaweed (*Calothrix?*) has appeared. I am not sure that it is more marked than the similar growth over the traps, sandstones and shales which were the previous occupants of the shores of the Island, and which have been somewhat displaced from their intimacy with the waves and currents of the Kill van Kull by these later arrivals, but it does seem to me as if it had developed with interesting rapidity. The schistose flaky character of many or most of these fragments may have conduced to facilitate this luxuriant development; and where, as in the case of granite veins, the feldspar is coarsely brecciated, the interlacing lines of angular definition between the crystals offer a crevice for attachment. As a fact the lamellar fragments are more quickly invaded.

Placing under a microscope flakes of mica, feldspar and quartz, we can see the delicate filaments of the alga penetrating the films of the mica or occupying pits and irregular surfaces of the feldspar with distributed spots of green granules. Sometimes lacunæ or minute cavities, situated a little way within the edge of mica flakes, will be filled with the green spore-like groups. A few rude drawings show approximately some of the phases in this process of investment of the rock by the seaweed.

Cumulative effects have of late been much emphasized, and it is not unlikely that the alternating drying and swelling, from exposure to the sun at low and submergence at high water, of this alga may sensibly determine the duration, as a mass, of the more schistose or friable rocks, when the tiny extensions of this subtle enemy have effected an entrance within their substance.

The American Psychological Association—Met at Philadelphia, University of Pennsylvania, Tuesday and Wednesday, Dec. 27 and 28, 1892. On Tuesday, Dec. 27 there was a business meeting at which the nature of a permanent organization and other important questions will be discussed. The following papers were read:

Errors of Observation in Physics and Psychology; Prof. J. McK. Cattell, Columbia College; Experiments Upon Pain, Dr. Herbert

Nichols, Harvard University; Tactile Estimates of Thickness, Prof. Edward Pace, Catholic University, Washington; Some Experiments Upon the Æsthetics of Visual Form, Prof. Lightmer Witmer, University of Pennsylvania; Investigations of Reaction-times of Various Classes of Persons, Prof. Lightmer Witmer, University of Pennsylvania; History and Prospects of Experimental Psychology in America, President G. Stanley Hall, Clark University; Experimental Psychology at the World's Fair, Prof. Joseph Jastrow, University of Wisconsin.

Wednesday, Dec. 28.—Certain Phenomena of Rotation, Dr. Herbert Nichols, Harvard University; Note Upon the Controversy Regarding the Relation of the Intensity of the Stimulus to the Reaction Time, Prof. W. M. Bryan, University of Indiana; Minor Studies at the Psychological Laboratory of Clark University, Dr. E. C. Sanford, Clark University; Preliminary Notes Upon Psychological Tests in the Schools of Springfield, Mass., Prof. W. M. Bryan, University of Indiana.

Anthropological Society of Washington.—Dec. 20, 1892.—The program of exercises was as follows: Is Simplified Spelling Feasible? (Symposium.) Discussion by Prof. F. A. March, of Lafayette College, Hon. A. R. Spofford, Hon. Wm. T. Harris, Hon. Edwin Willits.

January 3, 1893.—The program of exercises was the following: Is Simplified Spelling Feasible as Proposed by the English and American Philological Societies? (Close of the Symposium.) Discussion by Prof. Lester F. Ward, Prof. Wm. B. Powell, Mr. James C. Pilling, Prof. Benj. E. Smith, Editor Century Dictionary; Dr. Charles R. G. Scott, Editor Worcester Dictionary; Mr. E. T. Peters, Major John W. Powell and Weston Flint. The discussion was closed by Hon. A. R. Spofford and Dr. Wm. T. Harris.—Weston Flint, *Secretary.*

The Biological Society of Washington.—Dec. 17, 1892.—The principal topic of the evening was What Should be the Scope and Object of a Biological Society? Introduced by Mr. B. E. Fernow. The following communications were read: Frost Freaks of the Dittany, Prof. Lester F. Ward; Notes on Peach Rosette, Dr. Erwin F. Smith; Destruction of Lichens on Pear Trees, Mr. M. B. Waite; Notes on Apple and Pear *Fusicladii*, Mr. D. G. Fairchild.

Frederic A. Lucas, *Secretary.*

Indiana Academy of Science.—The eighth annual meeting was held in the Capitol Building at Indianapolis Dec. 28 and 29.

There was a large attendance of members and visitors. President J. L. Campbell, Wabash College, Crawfordsville, Ind., presided. The large number of papers entered made imperative the meeting of the Academy in three sections in the afternoon of the first day. These were so constituted that papers on mathematics, physics, chemistry and geology were read in one section; on botany in another; on zoology and anthropology in a third. On the evening of the first day the President delivered his address on The Independence of Liberal Pursuits. The following officers were elected for the next year: President, J. C. Arthur, Purdue University, Lafayette, Ind.; vice-president, W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., secretary, A. W. Butler, Brookville, Ind.; assistant secretary, Stanley Coulter, Purdue University, Lafayette, Ind.; treasurer, C. A. Waldo, De Pauw University, Greencastle, Ind.; auditors, Thomas Gray, Rose Polytechnic Institute, Terre Haute, Ind.; W. S. Blatchley, High School, Terre Haute, Ind. L. M. Underwood, De Pauw University, Greencastle, Ind.; and W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., were appointed program committee. The Academy decided to hold its spring meeting the third week in May in Parks County, Ind., closing with an evening meeting Friday at Terre Haute, Ind.

The following papers were presented: Notes on the Reproduction and Development of *Grinnellia americana* Harv., M. A. Brannon; Evidence of Man's Early Existence in Indiana from the Oldest River Gravels Along the White Water River, A. W. Butler; On the Construction of a Sensitive Galvanometer, Benj. W. Snow; Some Facts as to the Varying Conditions of Rock Deposits as Observed in the Hudson River Beds of Indiana and an Inquiry as to the Cause of the Same, Joseph Moore; A Simple Air Thermometer for the Determination of High Temperatures, W. A. Noyes; Tests of the Torsional Strength of a Steel Shaft, Thos. Gray; An Extreme Case of Parasitism, Robert Hessler; Exhibition and Explanation of a Geological Chart, Elwood P. Cubberly; Local Variations, C. H. Eigenmann; Botanical Field Work in Western Idaho, D. T. MacDougal; The Quaternion Treatment of the Motion of Two or More Bodies Under the Law of Gravitation, A. S. Hathaway; The Electrical Oxidation of Glycerin, W. E. Stone and H. N. McCoy; Notes Concerning Tests of the Purdue Experimental Locomotive, W. F. M. Goss; The Electrostatic Theory of Cohesion and Vander Waal's Equation, Reginald A. Fessenden; On Sulphon-pthaleins, Walter Jones; Quartz Suspensions, Benj. W. Snow; Observations on Glacial and Pre-glacial Erosion at Richmond, Indiana, Joseph Moore; A Modification of Grandeau's Method for

Determination of Humus in Soils, H. A. Huston and F. W. McBride; Experiments with and Phenomena of Vacuum Tubes, R. A. Fessenden; The Extraction of Xylan from Straw in the Manufacture of Paper, W. E. Stone and W. H. Test; The Electro-magnetic Inertia of a Large Magnet, Thos. Gray; The Determination of Chlorine in Natural Waters, W. A. Noyes; Some New Electrical Apparatus, R. A. Fessenden; Thiofurfurol and its Condensation Products, W. E. Stone and Clinton Dickson; On the Construction and Use of a Bolometer, B. W. Snow; On the Determination of Valence, P. S. Baker; An Application of Mathematics in Botany, Katharine E. Golden; On the Fertilization and Development of the Embryo in *Senecio aureus*, D. M. Mottier; Distribution of the North American Cactaceæ (by title), John M. Coulter; *Marchantia polymorpha*, not a Typical or Representative Liver-wort, L. M. Underwood; Notes Concerning Certain Plants of the Southwestern Counties of Indiana, John S. Wright; Spines and Epidermis of the Cactaceæ (by title), E. B. Uline; Preliminary Notes on the Genus Cactus, E. M. Fisher; An Auxanometer for the Registration of Growth of Stems in Thickness, Katharine E. Golden; The Apical Growth of the Thallus of *Fucus vesiculosus*, D. M. Mottier; Symbiosis of Orchidaceæ, M. B. Thomas; Notes on Pediastrum, W. L. Bray; The Genus Corallorhiza, M. B. Thomas; Notes on Root Tubercles of Indigenous and Exogenous Legumes in Virgin Soil of the Northwest (by title), H. L. Bolley; Notes on Archæology in Mexico, J. T. Scovell; Notes on the loss of the Vomerine Teeth with Age in the Males of the Salamander, *Desmognathus fusca* (by title), F. C. Test: Modern Geographical Distribution of Insects in Indiana (by title), F. M. Webster; New Species of Indiana Hymenoptera, reared at LaFayette, Ind. (by title), F. M. Webster; Description and Elevation of Mount Orizaba, J. T. Scovell; The Climate and Glaciers of Mounts Orizaba and Popocatapetl, J. T. Scovell; A Mite, Probably *Hypoderas columbæ*, Parasitic in the Pigeon, W. W. Norman; The Locustidæ of Indiana with Description of New Species, W. S. Blatchley; Early Stages in the Development of Cymatogaster, C. H. Eigenmann; Some Remarks Regarding the Embryology of Amphiuma, O. P. Hay; Some Structural Peculiarities of Pacific Slope Fishes (by title), A. B. Ulrey; Peculiar Death of an Oriole (by title), T. B. Redding; The Range of the American Cross-bill (*Loxia curvirostra minor*) in the Ohio Valley, with Notes on its Unusual Occurrence in Summer, A. W. Butler; A Note on *Loxia curvirostra*, W. S. Blatchley; Notice of a Terrapin to be Restored to the Fauna of Indiana, O. P. Hay; A Migration of Birds and one of Insects, T. B. Redding: The South American Catfishes Belonging to

Cornell University (by title), E. M. Kindle; Notes on the Genus Lytta, W. P. Shannon; The Ichthyologic Features of the Black Hills Region, B. W. Evermann; Explorations in Western Canada, C. H. Eigenmann; Ancient Earthworks Near Anderson, Indiana, Francis A. Walker; The Work of the U. S. Fish Commission Steamer Albatross in the North Pacific and Bering Sea in 1892, B. W. Evermann; A Thermo-regulator for rooms Heated by Steam, J. C. Arthur; Archæology of Tippecanoe County, O. J. Craig; Some Indian Camping Sites near Brookville, A. W. Butler; Relation of Kings County Traps to those of Cumberland County, N. S., V. F. Marsters; The Traps of Red Head, N. B., V. F. Marsters; On Birds in Western Texas and Southern New Mexico (by title), A. W. Butler; An Account of Vegetable and Mineral Substances that Fell in a Snow Storm in LaPorte County, Jan. 8–9, '92 (by title), A. N. Somers; How a Tendril Coils, D. T. MacDougal; Remarkable Prehistoric Relic, E. Pleas; The Brun's Group of Mounds, H. M. Stoops; Some Points in the Geology of Mount Orizaba (by title), J. T. Scovell; Two-ocean Pass (by title), B. W. Evermann; The Blattidæ and Phasmidæ of Indiana, W. S. Blatchley; Forestry Exhibit of Indiana at the Columbian Exposition, Stanley Coulter; The Yolk Nucleus, J. W. Hubbard; Some Causes Acting Physiologically Toward the Destruction of Trees in Cities, J. C. Arthur; British Columbia Glaciers, C. H. Eigenmann; A State Biological Survey—a Suggestion for Our Spring Meeting, L. M. Underwood; The Mounds of Brookville Township, Franklin County, Ind., H. M. Stoops; How the Colleges could aid the Public Schools in Teaching Biological Subjects, W. W. Norman; Notes on the Flora of the Chilhowee and Great Smoky Mountains, Stanley Coulter; The Need of a Large Library of Reference in Cryptogamic Botany in Indiana—What the Colleges are Doing to Supply the Deficiency, L. M. Underwood; Exhibition of a Series of Grouse and Ptarmigan from Alaska, B. W. Evermann; Botanical Assemblies in the United States Announced for the Year 1893, J. C. Arthur; Development of Ovule in Aster and Solidago (by title), G. W. Martin; Remarks on Archæological Map Making (by title), A. W. Butler; The Lilly Herbarium and its Work, John S. Wright; Additional Facts Regarding Forest Distribution in Indiana, Stanley Coulter; Rotary Blowers, John T. Wilken; Some Effects of Mutilation on the Forms of Leaf and Sex of *Morus alba* and *Morus nigra* (by title), A. N. Somers; The Crawford Mound (by title), H. M. Stoops.

SCIENTIFIC NEWS.

What Is an Acquired Character?—I suppose that I am the person to whom Prof. Nutting refers (December, p. 1009) as "the member" who, at the Rochester meeting, "had the temerity to confess that he was not sure that he knew the exact nature of an 'acquired character.'" I have been strongly impressed with the feeling that argument against the position of Weismann and his followers is useless, from the method of these writers in explaining away whatever proofs of the hereditability of acquired characters one may bring forward. The definitions of an acquired character are themselves sufficiently vague and various, but the treatment of individual instances by the Neo-Darwinians seems to preclude the possibility of argument. Prof. Ward has well said that Weismann's "treatment of this point (hereditability of acquired characters) often borders on the dogmatic." The practice seems to be to use the definition as a stalking-horse to shield the philosopher from the onslaughts of his opponents. If he is driven into a corner it is easy enough to say that the character in question is not acquired, but that there existed a predisposition to it; and while he cannot afford any proof of the assertion and may not be able to bring forward any reason for it beyond its convenience as a method of escape, his opponent cannot dislodge him from his position. It seems to me, as I said at Rochester, that much of this argument is but a war of words; and Prof. Nutting has precisely indicated my own difficulties concerning it.

I have been growing plants for a single generation in soils of different chemical composition, the seeds having been taken from the same fruit. These plants show characteristic differences, and when the seeds from the different lots are sown in one soil the resulting plants show that some of the novel characters become hereditary for a generation or more. If I were to bring these experiments forward as proof of the transmission of acquired characters, my opponents would simply say, "Oh, well, these are not acquired characters; there was a predisposition to them."

I may remark here that an inexhaustible field for study of contemporaneous evolution is afforded by common cultivated plants; and if we are to consider acquired characters in the Darwinian sense, I fancy that no one could long be a horticulturist without becoming a confirmed believer in their transmission.—L. H. Bailey, Cornell University.

The Geological Survey of Alabama.—The Legislature four years ago reduced the tax rate, unwisely, as now appears, for it has caused the money in the treasury to run now about $200,000 short of what is needed to carry on the affairs of the State. When the present Legislature met and was confronted with this deficiency in the treasury, the first thought was to reduce the expenses of the State within the present income by retrenching in every direction. Accordingly a number of bills were introduced aiming to cut off everything that we could possibly do without. Among these bills was one prohibiting the payment of any money to the survey for the next two years, saving $15,000 on this item. Many of the members both of the House and of the Senate were disposed to support this wholesale retrenchment if by it the raising of the tax rate could be avoided; for the raising of the rate would be an unpopular measure as a matter of course, and would be made the most of by the enemies of the party in power. Upon closer examination it has become perfectly evident to every one that the tax rate must be raised, for all the retrenchment proposed and in any way possible will fall far short of remedying the trouble. But some of the members are afraid to vote for raising the rate without, as an offset, voting to cut down every expense in the State to its minimum. While it is not likely that the extreme measures at first proposed will pass, there may have to be some compromise that will cut off part of the sum usually coming to the survey. There is no one fighting the survey, for the sentiment is very favorable to us, but they may have to show that they have economized.—Eugene A. Smith.

Recent Deaths.—John Obadiah Westwood, M. A., F. L. S., honorary president of the British Entomological Society, died January 1. Prof. Westwood was born in Sheffield in 1805. He was educated at Litchfield and was appointed in 1861 to the professorship of zoology founded at Oxford by the munificence of the late Rev. F. W. Hope.

In 1855 the Royal Society awarded bim one of the royal medals for his scientific works, and in 1860 he was elected to fill the place of the illustrious Humboldt as corresponding member of the Entomological Society at Paris. He wrote "Introduction to the Modern Classification of Insects," "Entomologists' Text Book," published in 1838; "British Butterflies and Their Transformations" in 1841, and a number of other works of a similar nature. The number of his memoirs on special groups of insects is large, and he introduced many important forms to the scientific record.

Prof. J. G. Joessel, of the University of Strasburg, is dead. He was born April 27, 1839, and was ordinary professor of anatomy.

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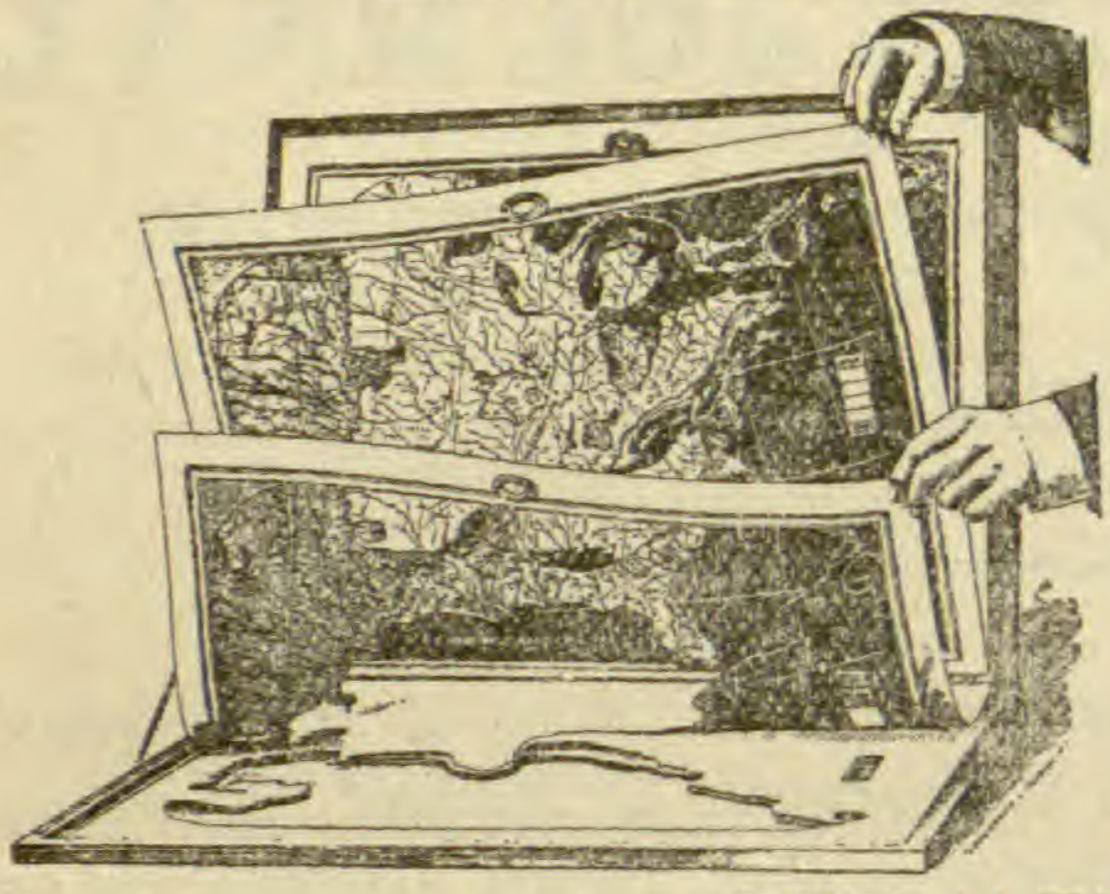

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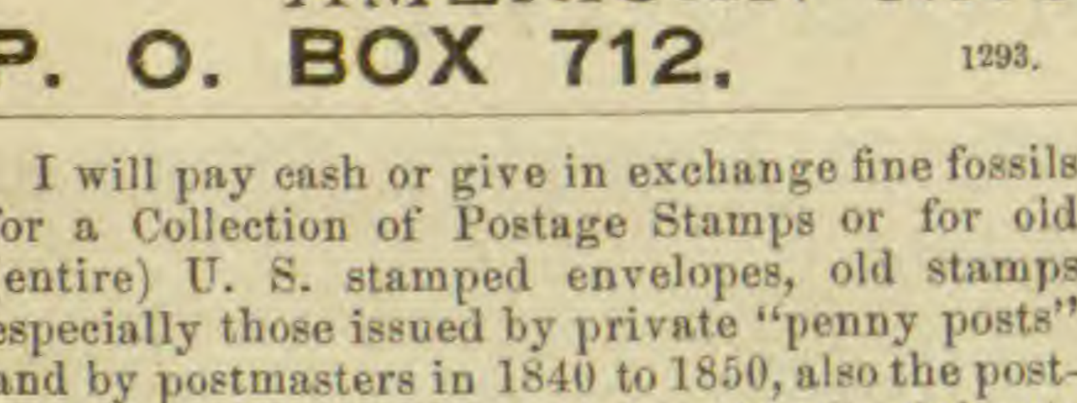

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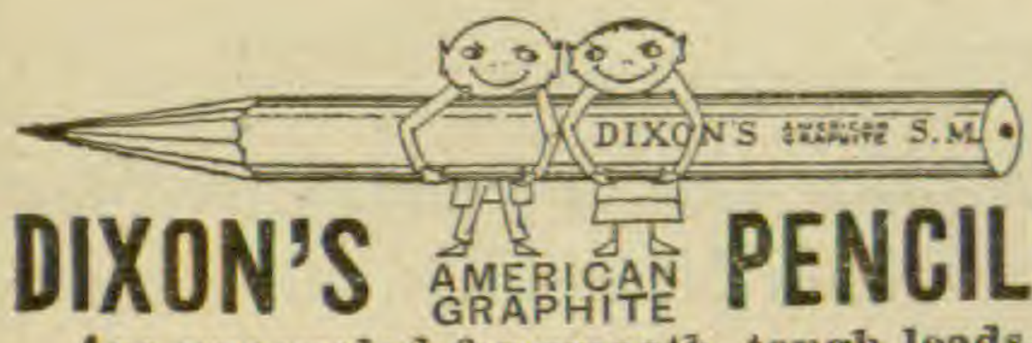

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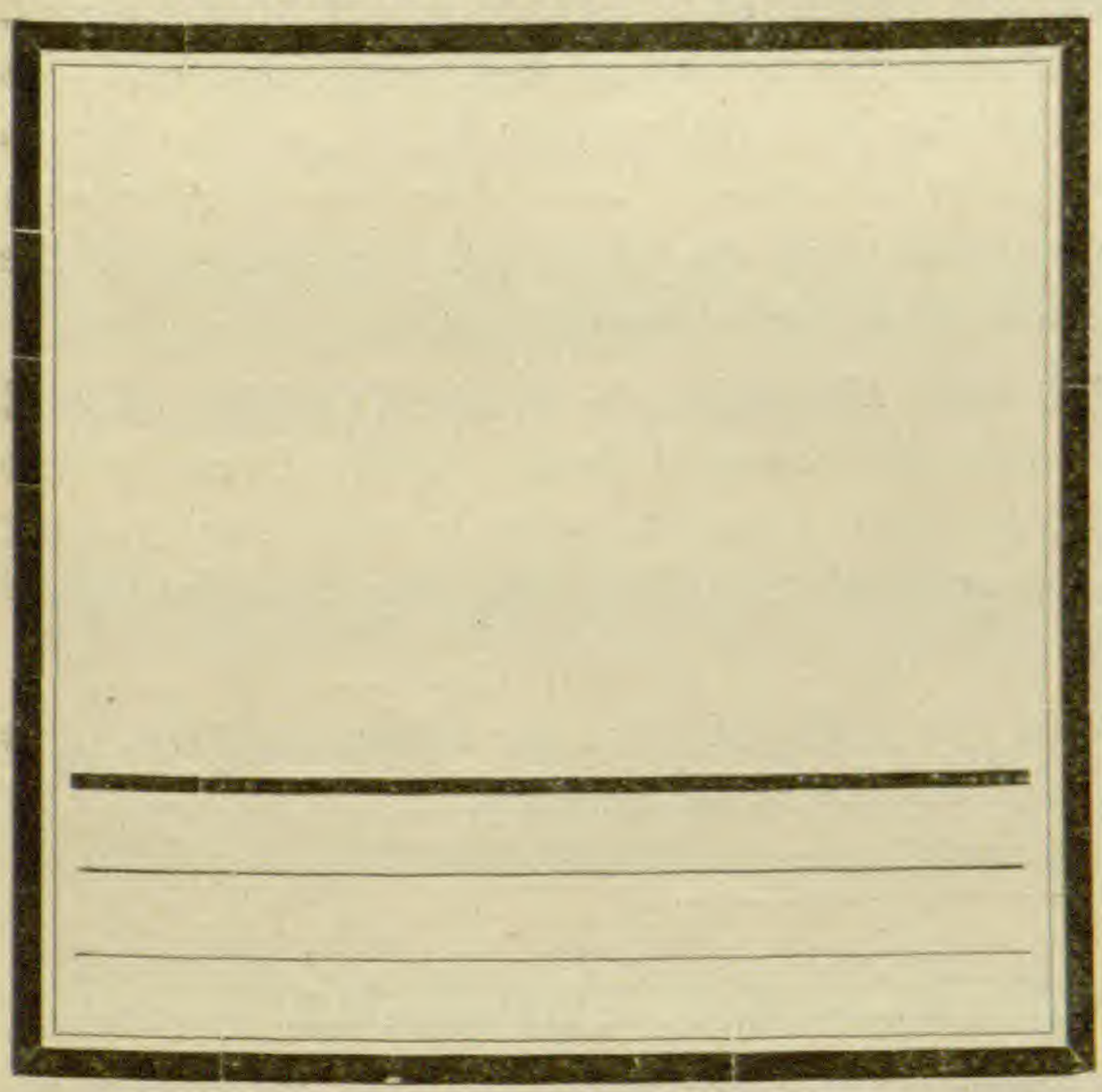

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THE QUANTITY OF HUMAN LIFE.

BY J. LAWTON WILLIAMS.

Compared with periods of terrestrial history the duration of a human life even at the very longest is exceedingly brief. In our own time only a very few people ever live to see their hundredth birthday, and the average age is now calculated on the basis of elaborate statistics to fall between thirty-three and thirty-four years.

It seems to be a prevalent opinion among unreflecting people, that the quantity of an individual life is expressed by the number of days and years recorded on his or her tombstone. That such an opinion is erroneous will be rendered evident by a little consideration. First of all, in estimating the quantity of human life, we must possess some well defined conception of what we mean by the term life. This point settled, we can proceed with some degree of certainty in our calculation. Whoever has devoted a little thought to the subject, cannot fail to be deeply impressed with the multitude and diversity of the factors which enter into the experiences of a life-time. There are the ever changing phenomena of the external world awakening and controlling the states of consciousness. There are the equally changeful individual activities perpetually giving rise to new internal changes. In other words, there is the physiological life utilizing the forces of nature, and making them subservient to the wants of the individual economy;

and, by its side, generating and directing its activities is its ever present companion the psychological life. Here then, we have a duplicate existence, extending over a finite period of years, incessantly changing from the time of its beginning, throughout the periods of growth, maturity and decay, and ultimately resolved, so far as human observation goes, into other existences of a lower order.

Life, then is an existence. It is an existence characterized by incessant changes, and those changes are the manifestations of force. Hence, disregarding all ontological questions, the quantity of life may be measured like any other force, by the product of its intensity into the time of its duration. Let us now consider the factors which enter into and control the intensities of human life. Subjectively considered, life is obviously made up of a series of conscious experiences; objectively considered, it is made of a succession of molecular and molar motions. To avoid too great complications we will consider it only subjectively, since the objective life has much in common with the motions of dead matter.

Hobbes has well said "it is almost all one for a man to be sensible of one and the same thing, and not to be sensible at all of anything." For instance the ticking of a clock continued unintermittently through days, months, and years, forms a rhythm in the conscious life which is equivalent to silence. Not until it ceases are we aroused to a consciousness of its former existence. The same is true of all familiar and oft repeated experiences. No matter how intense and vivid may have been the first appeal of an experience, sooner or later its reiterated occurrence establishes itself in the rounded and frictionless ruts of an indifferent consciousness. It might at first be inferred from this law, that for the conscious life to attain to its maximum intensity, it should experience the rarest stimuli; and those stimuli should be as intense as possible. There is a limit however, beyond which novelties fail to be impressive, and the over stimulated and flagging consciousness relapses into apathy and indifference. But as a general rule we may be guided by Hobbes' statement, and from its converse deduce the proposition, that the intensity of

conscious life varies as the number and rarity of its experiences. But the number and rarity of its experiences depend upon a great variety of circumstances.

They depend upon the diversity of external conditions. They also depend upon the extent and acuteness of surfaces of contact, and the rapidity with which those surfaces are transported into new environments. Finally they will depend upon the stock of vitality of the individual. All these factors must be considered in estimating the quantity of the conscious life. The diversities of external surroundings are very great. Even in primitive communities, and amid the habitual isolations incident to a nomadic life, the differences in the attitudes and groupings of the objects of inanimate nature, and of the lower orders of animate nature, are ever stimulating the conscious life to new and intense experiences. Surprises, alarms, friendship, apathies, pleasures and pain are ever appealing in new and varied relations to the would-be slumbering sensibilities. But when we pass from the primitive condition of solitude to the later condition of society where the wide play of forces concerned in human interests is brought to bear in a multiplicity of combinations upon the individual life, the number of conscious experiences increases with the members of the community not in an arithmetical, but in a geometrical ratio. This holds up to a certain point when the maximum of conscious experiences during a given time is reached.

The limit is a subjective and not an objective one. It is determined by the capacity for reception of the individual. Amid the intricacies of modern civilized life that limit is speedily reached. Even the most capacious and versatile minds soon weary of the endless solicitations of the senses and the trains of ratiocination to which they give rise. The keen activity of such minds is rapidly dulled by the continuous impact of stimuli, and soon falls back upon the restful reiteration of former experiences. But even the repose of such reminiscences is disturbed by the jars and turmoils of inevitable environments, and the drowsy sensibilities are spurred on to renewed activities day after day so long as life continues. Thus it happens that the average life of the social individual

is much more intense than that of the inhabitant of solitudes. The reason is, that the sociological stimuli affect us more than stimuli of equal or even greater intensity proceeding from inanimate nature, or the lower orders of animate nature. Society also engenders wide differences in the experience of its various members on account of financial, political and other differences. The humdrum life of the common laborer is much less varied, and, therefore much less intense than the life of the gentleman of affluence and leisure who diversifies his experiences by travel, letters, society and recreative sports.

The lavish distribution of cheap literature within the last quarter of a century has immensely augmented the differences in the quantities of living among people of the same social standing. It is not uncommon to find two men engaged in the same occupation one of whom cannot read or write, while the other is conversant with the widest questions of political and social progress. Literature thus tends to obliterate the quantitative differences of life arising from certain social accidents of birth, and places all men, so far as the intellectual consciousness is concerned, on pretty much the same level as quantitative experiences. Much more might be said as to the diversities of the external conditions, but this must suffice.

We now pass on to consider the surfaces of contact. Under this designation are included all the external integuments of the body as the skin, eyes, hair, and so on. For the sake of mathematical simplicity we will assume at present that equal surfaces of contact possess equal degrees of sensibility in two individuals during equal periods of time. Then if one person present twice as much surface of contact as another, that person will, other things equal, receive twice as many peripheral stimulations as the other. (We here assume that an equal number of stimulations come from every direction against the unit of the surface.) Now the surfaces of contact vary as the square of some lineal unit. Suppose the surfaces of contact be 4 and 8 respectively; then the linear units are 2 and 2.8+. But the masses and weights of the bodies whose surfaces are 4 and 8 vary as the cube of the linear units, or as

$2^3 = 8$ and $(2\text{-}8+)^3 = 22\text{-}4+$. Now in order that the individual with double the surface of contact may encounter twice as many stimuli as the other, when both are moving through their environment, it must move the same distance as the other. In moving such a distance however, it will perform not twice but nearly three times the amount of work that the other performs since it will transport nearly three times the weight. Thus, if the expenditure of muscular energy detracts from the stock of vitality, and hence dulls the keenness of the sensibilities, even though the surfaces of contact of the two individuals possess initially the same degree of sensibility by reason of that impairment, the larger animal would experience less than twice as much consciousness as the smaller. Viewed from another standpoint, the smaller animal could execute more than twice the velocity of the larger with equal expenditure of strength, (disregarding the resistance of the medium), and hence it would encounter more than an equivalent number of experiences.

It was here assumed that equal surfaces of contact conveyed equal quantities of sensibility in the two individuals, but it is well known to physiological psychologists that there are immense differences in the relative acuteness of the different sense organs in the same individual, and in the same sense organs in different individuals. The optical, auditory and tactile powers are quite variable. Probably the experiential products of all the other senses combined do not equal those which come through the medium of vision. It will thus be readily inferred that the extent of surfaces of contact is less important in relation to the experiences of the conscious life than their quality; and the movements of the individual tending to multiply experiences are less important than the movements of the environment. For example, an observer standing on a street corner in a great city, or riding in a railway coach at forty miles an hour, will gather more experiences than he would were he to run at the top of his speed in a deserted field. Doubtless he might experience a high degree of exhilaration at first, yet experience of effort would prevail. Such experiences like all other somatic feelings have a place

in consciousness, but they certainly do not have that vivid and definite character which distinguish peripheral sensations. Moreover they must detract from the general vitality, and lower the tone of the higher orders of experience.

There can be no doubt that the stock of vitality, and the natural endowments of body and mind immensely transcend all the other differences hitherto considered. Not only do they give rise to differences in the intensity, but also in the duration of life. The vigorous, alert, and impressionable nature has a livelier consciousness of all that it experiences, responds more keenly to all its enjoyments, and resists more stubbornly the wracking and dissolution of conflict and disease. Hence such an individual lives longer and lives more. There are still other differences of a psychological character which give rise to still more important variations in the quantity of the conscious life. Owing to the absence of any standards in the higher fields of psychometric research, it is hard to discriminate between quantitative and qualitative differences. Yet viewed from a rational standpoint it cannot be doubted that different kinds of consciousness are quantitatively different, though there is no perceptible disparity in their relative intensities. That the untutored savage feels as intense gratification in the pursuit of his game, as the astronomer in the pursuit of undiscovered asteroids, cannot reasonably be doubted. But how totally different the quality of the feeling, and the psychological grounds upon which it is based! Where the thoughts and emotions are different in kind, this disparity is even greater. There are certain thoughts and emotions accessible to the few which are totally beyond and above the range of the average mind. Such thoughts as those of Laplace and Kant, and such emotions as those of Schiller, are of this order.

While it may not be easy to defend the position, yet we feel forced to believe that there are quantitative differences between such thoughts and emotions, and the stolid apathy, and gross materialistic conceptions of the mediocre mind.

Up to this point we have considered the conditions which modify the quantity of the conscious life in a general way. But the quantity of the life of every human being is subject to

innumerable vicissitudes both accidental and periodic. While there is an endless influx of disturbing forces which augment or deplete the quantity of life at all times, yet there are certain periodic causes which promote recurrence of cycles of consciousness. Such are the alterations of day and night, the recurrence of the seasons, and the widely extended observance of days and customs. How much the quantity of life is temporarily augmented by the convivialities of Christmas and other commemoration days! Then there is a diurnal rise and fall in the conscious life. The morning with its vivid and buoyant sensations; the rising of the energies and their temporary lull at midday, and their slow descent with the descending of the sun. Then the twilight comes on with its calm reflections and feelings, succeeded by the serenity of sleep. But even here the pulse of consciousness rises and falls, summoned into being by the vague apparitions and muffled ounds of dreams. At length these increase in vividness and frequency, the pulse of consciousness grows more intense until we are again ushered into the hazy realities of another morning. Then there are the periodicities arising from the changing seasons.

To one who dwells during a period of years in the same place, the events which are repeated from year to year are much in excess of those which are variable. Hence the annual rhythms of consciousness are quite well marked. The conscious life throughout the time of its existence is subject to quite well defined periods of change. There are several striking analogies between the consciousness of infancy and that of extreme old age. Both are oblivious of details, apprehending only to the salient outlines and strong qualities of things. Both repeat and re-repeat simple things, the babe its lullaby, the old man his favorite story. The consciousness of old age is reminiscent because the powers are feeble, and reminiscences are paths of least resistance. Quite otherwise is the consciousness of youth and the prime of life. It is vigilant and aggressive, and ever seeking new combinations of experience. Not only is the quantity of the conscious life extremely varied in its different periods of development, but also in its quality. In

early years and even far into the period of maturity the physiological activities prevail. Childhood and early youth are characterized by the aimless movements of spontaneity and the prodigal expenditure of physical force; later on the psychological life rises in importance and attains its maximum when the physiological life is on the wane. This continues until the decay of old age sets in.

A grander series of changes remains yet to be considered. This is suggested by the query, how does the quantity of human life existing on the globe at the present time compare with the quantity of the antecedent times? Whoever reviews the history of the race during the nineteenth century as related to its history in previous times will observe a tremendous acceleration in the rate of living, and a vast augmentation in the intensity of human life. Notable among the causes which have secondarily conspired to this end, may be mentioned the centralization of populations. Within a century, according to the London *Journal of Statistics* the relative populations of the country and city of England have changed sides. Up to about 1840 the rural population exceeded the urban. About that year they were equal, and ever since, the cities have had a constantly increasing majority. The same is true in general of other civilized countries. Facts like these tend to show that the society of modern life is becoming more consolidated, and hence the aggregate of human experiences is becoming increasingly intense from year to year. Among the primary causes which have brought about this consolidation, are the improved facilities of travel, commerce, and communication between mind and mind. Not only have they done this, but they are the indispensible conditions of an intricate co-operative existence. But these are only a few of the many factors which enter the problem of this augmentation of life. The differentiation of pursuits and the widely diversified products of human genius, all minister to the ever broadening possibilities of human experience. To-day the child under its teens is much more sophisticated than was its semi-savage ancestors of four-score years who lived only a few generations ago. Even the lower animals in the bustling communities

lead a more varied life than primitive men, probably more varied than our contemporary the Fuegian, whose life is a monotonous ordeal of physical suffering, or the Esquimau whose days are passed in the unbroken solitudes of Arctic America. In view of these unprecedented changes, and the steady increase of population, it is but a step to the conclusion that the quantity of human life on the globe to-day is greater than ever before. In all probability the aggregate quantity of conscious life which has been experienced during the nineteenth century is far greater than the life experienced in any antecedent period of equal duration. Never was there a recorded time when the drain upon natural resources was so great as it is to-day. These resources are all turned either directly or indirectly toward the furtherance of human experience. Not only do these agencies of civilization add to the multiplicity of human experiences, but they also add to their pleasurableness. Thus undaunted by the clamors of pessimism we may firmly believe that the sum of human happiness is greater to-day than ever before.

The marked feature with which we are impressed in reviewing the evolution of human life, is its growing complexity. But by the very terms of a previous proposition, this signifies a growth in the quantity of conscious experience. All primitive life was simple and plain. Monotony was stamped upon its music, language, gesture, and the rounds of domestic, social and political life. The frequent repetitions of barbarian speech, and the sing-song tones of their music are in pitiable contrast to the sweeping climax and anti-climax of the civilized orator or opera singer.

The principle is of general application. All orders of experience are more varied in the civilized than in the savage state. Hence the quantity of life for each individual is greater, and the totality of human experiences immensely greater with the diffusion of civilization. We have now considered some of the factors which determine the quantity of human life. The final inquiry remains, how are we to live most? and how is the race to live most? Judging from the foregoing conclusions we would say in the case of the individual, that this end is

insured by multiplying the number, intensity, and variety of his experiences. Spinoza had for a motto, "to live is to think.' Surely the quantity and quality of our thinking has much to do with the quantity and quality of our living, but from considerations already discussed, this utterance seems to be wanting in comprehensiveness. If this statement were true without qualifications, then he who thinks most lives most, but we have already seen that other experiences than those of thought have perhaps an equal degree of intensity, and involve an equal amount of living. Any conclusion which can be reached on this question is necessarily colored by personal prejudices, and cannot be set up as a general standard. To me, at least, he seems to live most who enjoys the greatest possible range of conscious experiences of the highest order, during the longest period of time. And the quantity of life seems to be truly greatest which embodies the fullest and highest expression of the attributes of the intellect, the emotions and the will.

Not where the experiences are confined to one of these alone, but where all three have equal sovereignty in the dominion of the mind. He seems to me to live less whose life embodies one or all of these in a less degree, or who has sullied their original purity with baser purposes and ends. Perhaps this may seem too ethical for a scientific statement but until that same ethical spirit shall more fully actuate the promoters of science, its highest beauty and usefulness cannot be completely realized. Even the best of us lead much more diminutive lives than our circumstances require. If we would but remember that it is as easy to think great thoughts as to think little thoughts, and feel great emotions instead of base and belittling ones, we might all enter into a largeness of life which far exceeds its present dimensions. But we must pass on to consider the question how can the race live most? One thing is certain, while all are permitted to think and feel and will, all cannot be brain workers. There must be doers as well. Society is so organized that no small part of its members must perform physical labor. This being the case, to realize the maximum of conscious life, there must be the greatest possible number of mental laborers, and the least pos-

sible number of physical laborers; and in each case the maximum of consciousness must be sought. Speculative as these views may appear yet they are substantiated by historical fact. To-day when the quantity of human life is greatest, the physical laborers effect most with the least effort, and the mental laborers are constantly diminishing that effort. So that were a given status of living to continue, the physical laborers would decrease, and the mental laborers would increase until finally equiblibrium should be attained.

Such equilibrium however, is indefinitely postponed by the constantly ascending standard of living. But as the standard of living ascends, all live more, and, since the physical laborers diminish and the mental laborers increase, the quantity of life is still further augmented. This would happen were the population to remain constant. But as the standard of life rises, the possibilities of existence increase, and the death rate diminishes. Consequently the population increases as the quantity of the individual life increases, and hence the total quantity of human life is augmented by both of these reciprocating factors. How great the quantity of human life may some day be is a question which the developments of the future alone can decide.

If the present rate of its growth shall continue unabated, sooner or later the time will come when it can increase no more. All the resources of the earth will be utilized and strained to the utmost to augment that life. But they cannot. Gradually the potential energies of nature which support life will be dissipated as energy of motion. And as those energies dwindle and disappear, the quantity of human life will fall away contemporaneously. The time must come when that quantity will be zero.

THE TITANOTHERIUM BEDS.

By J. B. Hatcher.

In 1857 Meek and Hayden gave the name *Titanotherium* bed to the lowest member of the fresh water, Miocene, lake deposits of the White river, Bad Lands of Dakota and Nebraska.[1] They named these beds from the genus *Titanotherium*, established by Leidy in 1852.[2] This genus embraces the largest, most abundant, and most characteristic vertebrate fossils found in these beds. In 1870 Professor Marsh discovered, in northeastern Colorado, an exposure of these beds, farther south than they had then been reported.[3] He then referred them to "The true Titanotherium beds." In 1877 Professor Marsh proposed the name Brontotherium beds for this same series of strata, from his proposed genus *Brontotherium*.[4] Since there can be no doubt that the *Titanotherium bed* M. and H., and the *Brontotherium beds* Marsh, are identical, and since the former has a priority of at least twenty years, it should be retained.[5] In this paper the plural will be used, as expressing more nearly the true nature of the deposits.

Geographical Distribution of the Titanotherium Beds.

The Titanotherium beds are known to have a surface exposure in various portions of the western interior plains region. That exposure from which they were first named and described and from which Hayden first made and published a section of them in 1863,[6] is of far greater extent than any other. The Titanotherium beds of this exposure are known to occupy a

[1]Proc. Phila. Acad. Nat. Sci., 1857, p. 120.

[2]Ancient Fauna of Nebr., Leidy, 1852, p. 72.

[3]Am. Jour. Sci., Sept., 1870, p. 292.

[4]Am. Jour. Sci., 3d series, Vol. xiv, p. 354.

[5]Titanotherium, Leidy, 1852, is antedated by Menodus Pomel, 1849; but Menodus is essentially preoccupied by Menodon von Meyer, 1838.

[6]Proc. Am. Phil. Soc., 1863, Vol. xii, p. 31.

considerable portion of that country embraced between the Cheyenne, Missouri, and White rivers in S. Dakota, with a western continuation, extending along the eastern and southern slopes of the Black Hills, and westward to near the town of Douglas in Wyoming. While this exposure is seen to have a considerable extent from east to west, yet from north to south it is of very limited extent. This is due to a very slight dip of these beds to the southeast, where they soon pass under the overlying Oreodon and Loup Fork beds. That range of bluffs in southwestern S. Dakota, northwestern Nebraska and central Wyoming, known as Pine Ridge, may be considered as the southern limit of this exposure of the Titanotherium beds. The beds of this region occupy a considerable portion of southwestern S. Dakota, extreme northwestern Nebraska, and a very narrow strip in central and eastern Wyoming. Besides this exposure of the beds, there are other isolated exposures at Long Pine, Nebraska; in northeastern Colorado; in Wyoming, along the Rattlesnake Range, north of the Sweetwater; and Professor Cope has described remains of Titanotheriidæ from Canada.[7]

Although the surface exposures of the Titanotherium beds are of comparatively small extent, yet from the distribution of these exposures the beds are known to extend over a considerable portion of S. Dakota, Nebraska, Colorado, Wyoming, and perhaps portions of Montana and N. Dakota.

Description of the Deposits.

The Titanotherium beds may be briefly characterized as a series of usually light colored, sometimes variegated clays, alternating with less extensive deposits of sandstones and conglomerates, situated at the base of the Miocene and containing among other fossils the remains of Titanotherium and allied forms.

The typical locality from which Meek and Hayden first named the Titanotherium beds and from which the latter first made and published a section of them, is also that locality in

[7]Contributions to Can. Pal., Vol. iii, p. 8.

the Bad Lands of S. Dakota, which has been more thoroughly explored for vertebrate fossils than any other locality in these beds. It is located in that portion of Washington county embraced between the White and Cheyenne rivers, at that point where they approach nearest to each other. This particular region has not only proved especially rich in vertebrate fossils, but the Titanotherium beds and the entire Miocene series, up to the Loup Fork, has attained a development here unsurpassed, if not unequaled, elsewhere. In no other region has erosion done more to aid the investigator than here; whether his aim be to study the country from a purely geological standpoint, to collect material for the paleontological laboratory, or to study the laws and observe the rate and effects of erosion, under the many and varied circumstances which this region presents. Since the materials composing the Titanotherium beds are very similar throughout the entire distribution of the beds, a description of the deposits at the typical locality may be considered as representing fairly well the character of the deposits at any other locality.

The section published by Hayden in 1863 agrees in all important points with those published since by other authorities. As stated by Hayden, the beds vary in thickness at different localities. At no locality has he given a thickness of more than 100 feet. The writer has found, by actual measurement, that they attain a thickness in some places at least, of 180 feet. As stated before, they are composed of clays, sandstones, and conglomerates. The clays greatly predominate, consist of very fine particles, and are quite compact. In places they are composed almost entirely of pure kaolin, but they often contain a considerable portion of sand. Near the bottom of the beds the color is often red or variegated, due to the presence in them of small quantities of red oxide of iron; but the prevailing color is a very characteristic and delicate greenish white. The clays usually contain little or no cementing substance, and are held together almost entirely by adhesion. Occasionally, however, there are quite persistent layers of clay nodules, or concretions in which the clays are firmly cemented by carbonate of lime. Owing to the extreme min-

uteness of the particles forming the clays and the absence of sufficient cementing material in them, in most places they readily yield to the action of water and are quite rapidly eroded. The clays of the Titanotherium beds were probably derived from two sources, viz., from the Cretaceous clays and shales, and from the kaolinization of granitic feldspars.

The sandstones are never entirely continuous, and never more than a few feet thick. They present every degree of compactness, from loose beds of sand to the most solid sandstones. They are composed of quartz, feldspar and mica, and are evidently of granitic origin. When solidified the cementing substance is carbonate of lime.

The conglomerates, like the sandstones, are not constant, are of very limited vertical extent, never more than a few feet thick. They are usually quite hard, being firmly held together by carbonate of lime. A section of the beds taken at any point and showing the relative position and thickness of the sandstones, clays, and conglomerates is of little value, since these vary much at different and quite adjacent localities.

The varying hardness of the different strata of the Titanotherium and overlying later Miocene beds, by offering unlike degrees of resistance to erosion, have succeeded in producing in this particular region an exhibition of characteristic Bad Lands scenery, unsurpassed elsewhere in the Miocene. The surface of the country in this region is scarred by numerous deeply eroded canyons. The intervening ridges are rugged and barren, often terminating for miles in sharp, serrated crests. The walls of these canyons present a series of terraces or projecting ledges from top to bottom, due to different degrees of hardness in the different strata. Sometimes these ledges are but a few feet wide, or just wide enough to allow a person on foot to pass along on them. At other times when the harder layers of which they are composed are of greater thickness, they may be several hundred feet wide, and their surface strewn with the fossil bones of Titanotherium, Elotherium, Hyracodon, Hyænodon, Oreodon, turtles, etc., washed

out of the overlying beds, by the slow process of denudation, presents a remarkable, not to say, sepulchral appearance.

Toward the interior of the Bad Lands, midway between the White and Cheyenne rivers, side branches of the main canyons have cut their way entirely through the dividing ridges and have produced particularly picturesque effects. Characteristic among these are the Devil's Tower, at the south end of Sheep Mountain, in the eastern portion of the Bad Lands; Chimney Rock, near their center, and the Tabled Rocks along their western border.

The location of such especially characteristic Bad Land scenery, in this particular region, is doubtless due to the near approach of the White and Cheyenne rivers to each other at this place. Since the Miocene deposits of this region are essentially horizontal, and form the summit of the divide between these two streams; this divide would be of essentially the same altitude, in reference to the beds of these streams, whether the latter were *near together* or *far removed* from each other. Therefore these streams upon approaching nearer to each other, as they do in this region, where they are only about 20 miles apart, would greatly reduce the length of their respective, intervening tributaries, without decreasing the height of the divide which separates them. This would necessarily increase the average rate of fall of the tributaries, and correspondingly the rapidity of the flow of their waters, and therefore the erosive power of the latter.

In various portions of the Titanotherium beds there are numerous vertical veins of chalcedony running through the beds in every direction. These veins vary in thickness from that of a sheet of paper to about two inches. On first thought the writer was inclined to attribute their origin to mud cracks, any particular region where they now occur having been for short periods, during seasons of low water, above the water level and subjected to the action of the atmosphere and the heat of the sun became baked and cracked; just as we now so often see at low water along the mud flats of our streams and lakes. But it is obvious that if these veins owe their origin to mud cracks they would be filled, not with chalcedony, but

with the same materials as the overlying beds; for when the waters again covered this region, the mud cracks would be immediately filled by sedimentation and with the same materials that now compose the overlying beds. It has since occurred to the writer, that these cracks were not made while the particular strata in which they now appear occupied the immediate bottom of the lake, but after the overlying beds were deposited. The extreme fineness of the particles forming the clays of the Titanotherium beds in those places where these veins occur is evidence that the clays were deposited by a slow process of sedimentation in still waters. The bottom of a lake where such materials were being laid down would consist for several feet of a very thin mud or ooze. This would gradually become firmer toward the bottom as deposition continued, but would still mechanically retain a considerable per cent. of water. Later, when the entire overlying series of strata were deposited and the region brought permanently above the water level this imprisoned water would gradually disappear, by filtration or otherwise, aided perhaps by the pressure of the superincumbent beds. This loss of moisture in the clays would diminish their volume and bring about a readjustment of the particles composing them. The decrease in volume would be taken up in two ways: First, as in the case of mud cracks, the particles would tend to collect about certain centers in the beds, and these centers of adhesion would increase laterally by the attraction of adjacent particles until cracks of varying thickness would form between the peripherys of adjacent centers of adhesion. The pressure of the overlying beds would determine the vertical direction of these cracks, and would also afford the means for the second way, by which the decrease in the volume of the clays would be taken up, viz., by a decrease in the vertical thickness of the beds. These cracks, thus formed far beneath the surface, were afterward filled by chalcedony dissolved out of the overlying beds by heated waters percolating through them. Occasionally other minerals, as ordinary calcite and its less common variety known as Iceland spar, are found in small cavities in these veins. Localities containing

these peculiar veins of chalcedony resemble both in appearance and structure a huge septaria, except that the veins in the former are much smaller in comparison with the area of the intervening spaces than in septariæ. A singular fact in connection with the position of areas exhibiting this peculiar structure is also thought to afford in itself evidence in favor of this view of the origin of the veins. These veins occur only in certain localities of limited area. Any single locality is never more than a few square miles in extent. These small and isolated areas, wherever it has been possible to determine their relation to the underlying beds, have been found to have been deposited in an eroded valley or depression of the latter. Such depressions would afford a natural basin for the waters, held mechanically by the clays, and would prevent a rapid drainage during their deposition.

Stratigraphical Position of the Titanotherium Beds.

The Underlying Beds.

The Titanotherium beds are underlaid by various older formations, from the Laramie to early Paleozoic or perhaps Archean. In most places they rest unconformably upon the eroded surface of some member of the Cretaceous, most frequently the Fort Pierre shales. At the mouth of Beaver creek, a tributary of White river, near the Nebraska and Dakota State line, the writer in 1886 observed the Titanotherium beds resting upon the eroded surface of the chalk of Cretaceous No. 3, so well developed in central and western Kansas. This is believed to be a more northwestern extension of these beds than had then been reported.

The Titanotherium Beds.

The Titanotherium beds may be divided into Lower, Middle, and Upper beds, each characterized by different forms of the Titanotheriidæ. Accepting a total thickness of 180 feet as the maximum thickness of these beds, 50 feet of this would belong to the Lower, 100 feet to the Middle, and 30 feet to the Upper beds. The different forms of Titanotheriidæ, especially

characteristic of these three divisions will be pointed out and figured later in this article.

The Overlying Beds.

The Titanotherium beds are everywhere overlaid by the Oreodon beds, except where the latter have been removed by erosion. So far as noticed there are in the Bad Lands of S. Dakota no evidence of any unconformity between the Oreodon and Titanotherium beds, unless the sudden change from one fauna to another should be regarded as evidence of an unconformity or at least as indicating a considerable break in sedimentation between the two beds.

Southwest of the Dakota Bad Lands in the extreme northwestern portion of Nebraska there seems to be some evidence of an unconformity between the Titanotherium and Oreodon beds, or at least that for a considerable period immediately following the deposition of the Titanotherium beds, this region became dry land and that the Oreodon beds were subsequently laid down upon the eroded surface of the Titanotherium beds. At the extreme head of Cottonwood creek, a small tributary of White river, from the northwest, in the northwestern part of Dawes county, there is an isolated butte composed entirely of the Titanotherium beds and containing many Titanotherium bones. The different strata composing this butte are horizontal. About one mile south of this isolated butte is a range of bluffs of the characteristic Oreodon beds, containing numerous bones of Oreodon and other associated animals.

In the first mentioned butte Titanotherium bones are found at the same altitude at which Oreodon bones occur in the bluffs to the south. Whether this occurrence of Titanotherium and Oreodon bones at the same altitude in quite adjacent beds is due to the Oreodon beds having been deposited upon the eroded surface of the Titanotherium beds, or to differences in the level of the bottom of the lake, at the beginning of the Miocene period, could not be determined. The horizontal position of the strata composing the Titanotherium butte would seem to favor the first conclusion, since if these

strata had been laid down upon a sloping bottom they would, in their lower members at least, partake of the inclination of the bottom of the lake.

About six miles northeast of the town of Chadron, in Dawes county, Nebraska, on a small branch of the west fork of Dry creek, the writer, in 1886, while collecting missing portions of the skeleton of Professor Marsh's type of *Titanotherium* (*Brontops*) *robustum*, discovered by H. C. Clifford in 1875, observed several feet above the horizon in which this remarkably complete skeleton was found, and certainly not far from the top of the Titanotherium beds, positive evidence of a break in sedimentation at this place at least. This evidence consists in the occurrence at this place of a very dark colored layer of vegetable mould about two feet thick, accumulated no doubt during a period of elevation above water level.

Owing to the fact that the Titanotherium and Oreodon beds of S. Dakota and Nebraska are approximately horizontal, it is almost impossible to determine there, just what their stratigraphic relations are. Farther west, near the head of Lance and Harney creeks, in Wyoming, the Titanotherium beds, at least, dip to the southward at a considerable angle. The writer has been unable to make any but the most superficial observations in this region, which, if carefully examined, would doubtless furnish a solution of the actual stratigraphic relations of these beds.

Professor W. P. Jenney, of the U. S. Geol. Survey, has reported to the writer an account of the discovery of a small Miocene lake in the Black Hills. As a description of this singular and interesting deposit a portion of Professor Jenney's letter is quoted. He says: "About 1879–'80 I was informed that fossil bones . . . . had been found in a prospecting shaft near Lead City. I visited the locality and obtained possession of three nearly perfect skulls . . . . These fossils I sent to Professor Marsh at New Haven, accompanied by a letter giving a sketch and full description of the occurrence, and received a reply stating that they were all *Oreodon culbertsonii* (this specific name is from memory but I think correct).

"This Miocene deposit is situated about half a mile south-easterly from Lead City, South Dakota, and nearly five miles south of the city of Deadwood, at an elevation of about 5,200 feet above the ocean. . . . . Of the extent of this tertiary deposit very little is known. It does not outcrop at the surface and appears to occupy a small, deep channel or basin eroded in the Archæan slates which outcrop on all sides within a radius of 1000 to 3000 feet. . . . . This occurrence is peculiar not only in forming an outlier to the great Miocene deposits and in occupying a basin eroded in a range of steep Archæan hills where lakes are now unknown, but also in the nature of the deposit itself, which so closely resembles, in appearance at least, the deposits of the same age on the plains. The clays of the latter were probably derived from Cretaceous shales, but the sediments filling this lake would naturally be expected to be very different, the rocks in the vicinity being Archæan slates capped by Potsdam sandstone and shales, and locally overlaid by masses of eruptive post-Cretaceous porphyry. . . . ."

That this small lake was, during Miocene times, entirely isolated from the great body of water to the eastward can hardly be questioned. The similarity just referred to by Professor Jenney as existing between the deposits of the small lake and those of the larger one is probably due to the materials composing both having been derived largely from a common source. The prevalence everywhere throughout the Miocene of large quantities of sands and conglomerates, composed of coarse grains or pebbles of quartz, feldspars, and mica, is sufficient evidence that the materials composing the beds of the Miocene were derived largely from sources other than the Cretaceous shales, which contain little sand and are always very fine grained. The coarser sands and conglomerates were doubtless derived from Jurassic, Paleozoic, and Archean rocks, and a considerable portion of the Miocene clays probably owe their origin to the decomposition of the slates of these older formations and the kaolinization of granitic feldspars.

Division of the Titanotherium Beds Into Lower, Middle and Upper Beds.

During the seasons of 1886, 1887, and 1888, the writer spent fifteen months in the White River Miocene beds of S. Dakota and Nebraska, collecting material for Professor Marsh's Monograph on the *Titanotheridæ* (*Brontotheriidæ*). Among the material collected was 105 nearly complete Titanotherium skulls, and many portions of skeletons and disarticulated bones; besides the remains of many other associated animals.

Early in the season of 1886 it became apparent that certain forms of skulls were characteristic of certain horizons in the beds. This fact showed the importance of keeping, so far as possible, an exact record of the horizon from which each skull or skeleton was taken. From actual measurement the vertical range of the Titanotheriidæ was found to be about 180 feet. For convenience in keeping a record of horizons the beds were divided into three divisions of 60 feet each, and each of these three divisions was subdivided into three divisions of 20 feet each. The different skulls and skeletons, when dug out, were each given a separate letter or number, and this letter or number was placed in that subdivision of the beds from which the skull or skeleton was taken.

At present about 60 of these skulls and several more or less complete skeletons have been freed from their matrix. When studied in connection with the horizons from which they were taken, these remains show that a regular and systematic development took place in these animals from the base to the top of the beds. The most noticeable change which took place in the Titanotheriidæ was a gradual and decided increase in their size from the lowest to the uppermost beds, as is shown by the increase in the size of the skulls, fore and hind limbs, and other portions of the skeleton. Individuals found near the bottom of the beds are little, if any, larger than the living rhinoceros. From this they gradually increase in size as we go up until at the top we find a type described by Professor Marsh as Titanops, rivaling the modern elephant in size.

This increase in size from the base to the summit of the beds

was attended by a very marked development in certain portions of the skeleton, noticeable among which are the following: A variation in shape and an increase in the size and length of the horncores as compared with the size of the skulls, attended, near the summit of the beds at least, by a decided shortening of the nasals.

There were also changes taking place in the dentition of these animals, especially in the number of incisors and in the structure of the last, upper, true molar. The number of incisors, though probably never constant, even in the same species, shows a tendency to decrease in skulls found near the summit of the beds. At the base of the beds the number of incisors is from one to three on a side, while at the top there are never more than two on a side, often only one, sometimes none. In skulls from the very lowest beds the incisors have already become so rudimentary as to be no longer functional. As would be expected, the number of incisors decreased after they became of no functional value. In the matter of incisors the Titanotheriidæ were, at the time of their extermination, in a fair way to accomplish just what the somewhat related but more persistent Rhinocerotidæ have very nearly succeeded in doing, viz., the elimination of the incisor dentition. The number of incisors in the Titanotheriidæ varies with age in the same individual. These teeth were but loosely set in the comparatively thin alveolar border between the canines, and showed a decided tendency to drop out in old age, their alveoles afterward becoming entirely closed. This is well shown in several instances where on one side of a jaw there may be 1, 2, or 3 incisors, while on the other side of the same jaw there will be 0, 1, or 2 and no alveole for the missing tooth. The number of incisors can hardly be considered as of either generic or specific importance in the Titanotheridæ where they are no longer functional and vary with individuals in the same species and with age in the same individual. The same may be said of the presence or absence of the first premolar.

In the structure of the last upper true molar we find a change taking place in the development of a posterior, inner

cone. Individuals from the base of the beds show scarcely any indications of this cone, but as we proceed upward in the beds, there is a marked increase in the development of the inner basal ridge on the inner posterior angle of the last upper true molar. This development frequently succeeds near the middle of the beds in producing a perfect posterior inner cone.

Other variations are noticeable in the dentition and in the character of the nasals, but they are common to individuals from any horizon whatsoever, and are thought to be of sexual importance only. Among variations of this nature may be mentioned the following: Differences in the size of the canines as compared with the molars and premolars; presence, absence, or want of continuity of an inner basal ridge on the superior premolars; comparative strength and rugosity of the nasals. Since slender and delicate nasals, small canines and upper premolars with only a very slight or no basal ridge on the inner border, are associated in the same skulls; these skulls are considered to have belonged to females, while those skulls in the same horizons, with stronger and more rugose nasals, larger canines and a well developed inner basal ridge on the upper premolars represent their male companions.

There were also changes taking place in other portions of the skeletons of these animals, important among which may be mentioned the development of a third trochanter. Femora from the bottom of the beds were quite small and with only a rudimentary third trochanter. Toward the middle of the beds they increase in size and show a well marked third trochanter, while at the top of the beds this process has become quite well developed and is of moderate size.

The most important change that took place in the Titanotheriidæ, and the only one perhaps of generic importance, is to be found in the fore foot. Early in the season of 1886 the writer discovered near the base of the Titanotherium beds a portion of the skeleton of a very small individual with both fore feet and limbs in position. The carpus of this individual was found to possess an additional bone (*the trapezium*) hitherto unknown in the Titanotheriidæ. This fortunate discovery of a skeleton, at the base of the deposits, with a distinct trapezium

showing a perfect articulation with the trapezoid, may be found to be of considerable importance as establishing a closer relation of Titanotherium to Diplacodon from the upper Eocene than has yet been pointed out, especially if this latter form should prove to possess a trapezium, as it is now almost certain it did. The trapezium, though present in the earliest forms of the Titanotheridæ, was quite small and soon disappeared entirely, leaving no vestige of a first digit. Among many more or less complete fore feet found in the upper part of the Lower, in the Middle, and Upper beds, no trapezium has yet been found, while several have been found at the base of the beds.

It is quite probable that those forms of Titanotheriidæ with three incisors described by Professor Marsh under the generic name of *Teleodus* will be found to possess a trapezium.[8] If such should prove to be the case, the genus *Teleodus*, Marsh can then be considered as distinguished from that of *Titanotherium*, Leidy by a definite and constant character, viz., the presence of a trapezium. Individuals with three incisors collected by the writer have invariably been found at the bottom of the beds and the small size of other individuals with three incisors, discovered by other collectors, indicate that they also were taken from the same horizon. There would appear, therefore, to be little doubt that the presence of a trapezium and three incisors are associated in the same individuals. That the latter character was not constant is shown by the presence of three incisors on one side and two on the other in the same jaw, with no alveole for the missing tooth.

Variations occur also in the number of sacral vertebræ. But since these are clearly dependent upon the age of the individual they are not considered here. All fully adult specimens show four sacrals, younger ones only two or three.

In figure 3 the side view of a skull from the base of the Titanotherium beds is represented, showing the small round horncores and long nasals which are characteristic of skulls from this horizon. In figure 2 the side view of a skull from the Middle beds is represented, showing horncores and nasals of medium length. Figure 1 represents the side view of a

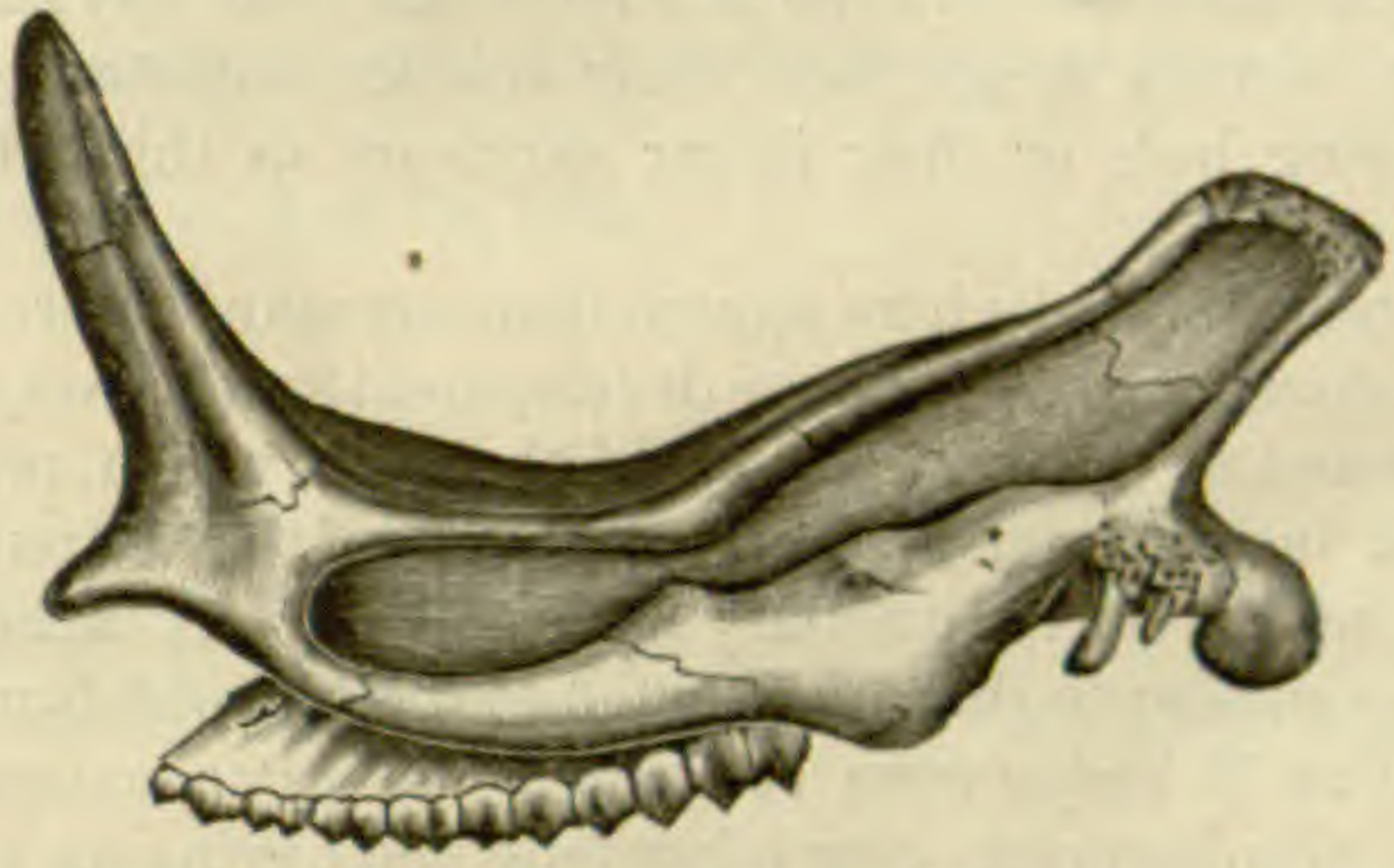
[8]Am. Jour. Sci , June, 1890, p. 524.

Oreodon Beds.		Reddish brown clays, with occasional concretionary layers, Remains of Oreodon, Hyracodon, Hyænodon, Elotherium, etc. About 500 feet thick.
TITANOTHERIUM BEDS, 180 FEET THICK.	Upper Beds, 30 ft.	Characterized by Titanotheriidæ of large size. Horns 10–18 in. long, elliptical to sub-ovate in cross-section. Nasals very short and pointed. Incisors never more than 2. Internal cingulum on upper premolars not strongly marked in either sex. Posterior inner cone on last upper molar. Third trochanter present. Trapezium absent. General form of skull shown in fig. 1.
	Middle Beds, 100 ft.	Characterized by Titanotheriidæ of medium size. Horns 4–10 in. long, circular to sub-triangular in cross-section. Nasals of moderate length, with broad or pointed extremities. Incisors never more than 2. *Strong* internal cingulum on upper premolars of males only. Posterior inner cone on last upper molar. Third trochanter present. Trapezium absent. General form of skull represented in fig. 2.
	Lower Beds, 50 ft.	Characterized by Titanotheriidæ of small size. Horns rudimentary or from 1–4 in. long, circular in cross-section. Nasals long and pointed. Incisors occasionally as many as 3. *Strong* internal cingulum on upper premolars in males only. No posterior inner cone on last upper molar. Third trochanter somewhat rudimentary. Trapezium present in earliest forms. General form of skull shown in fig. 3.
Underlying Beds.		Represented by various formations from Laramie to Archean.

Section of Titanotherium Beds showing relative thickness of Upper, Middle, and Lower Beds, with brief descriptions of forms of Titanotheriidæ common to each.

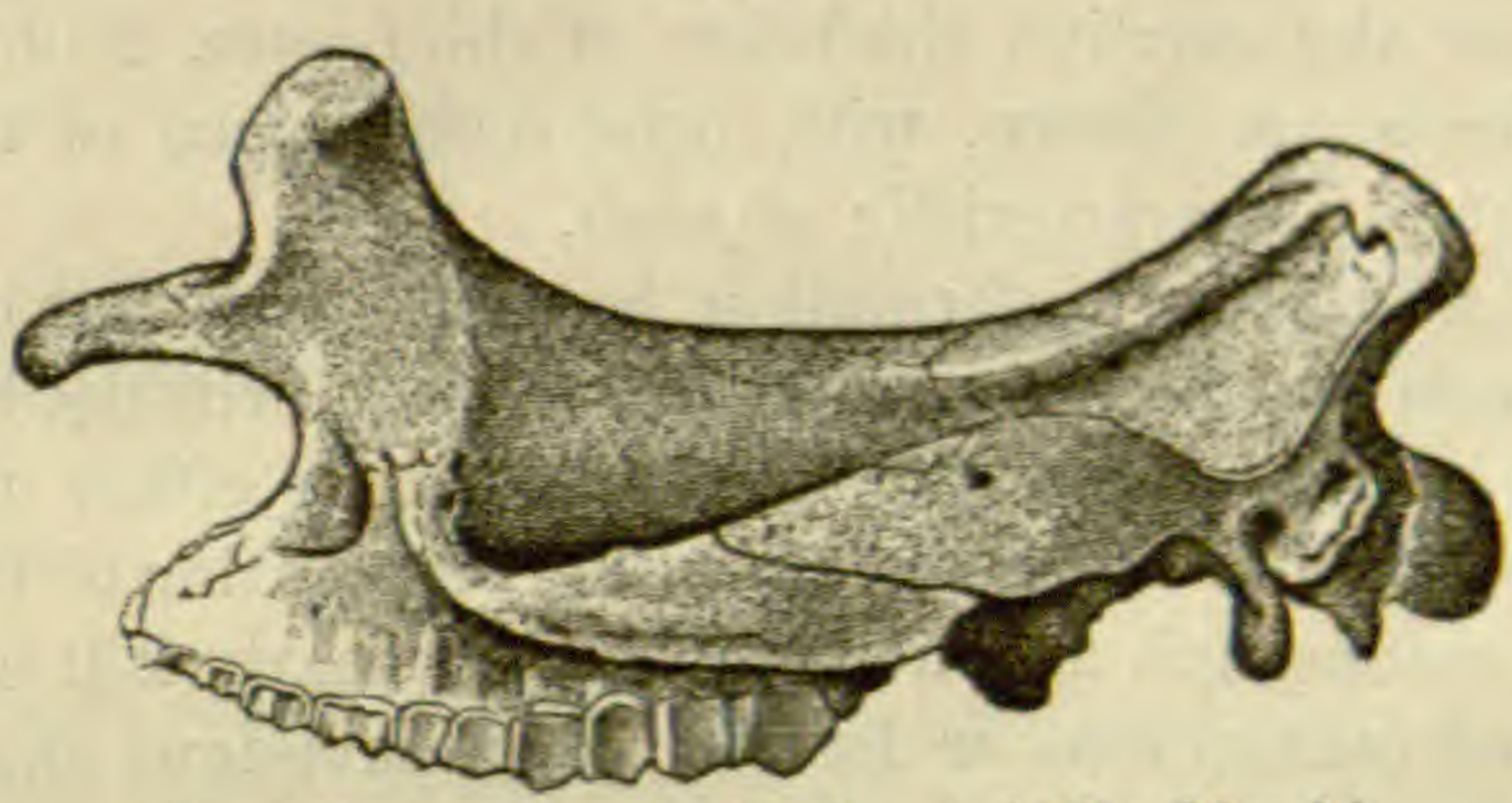
skull from the Upper beds with the characteristic long horn-cores and short nasals. The nasals are not so short in this

FIG. 1.



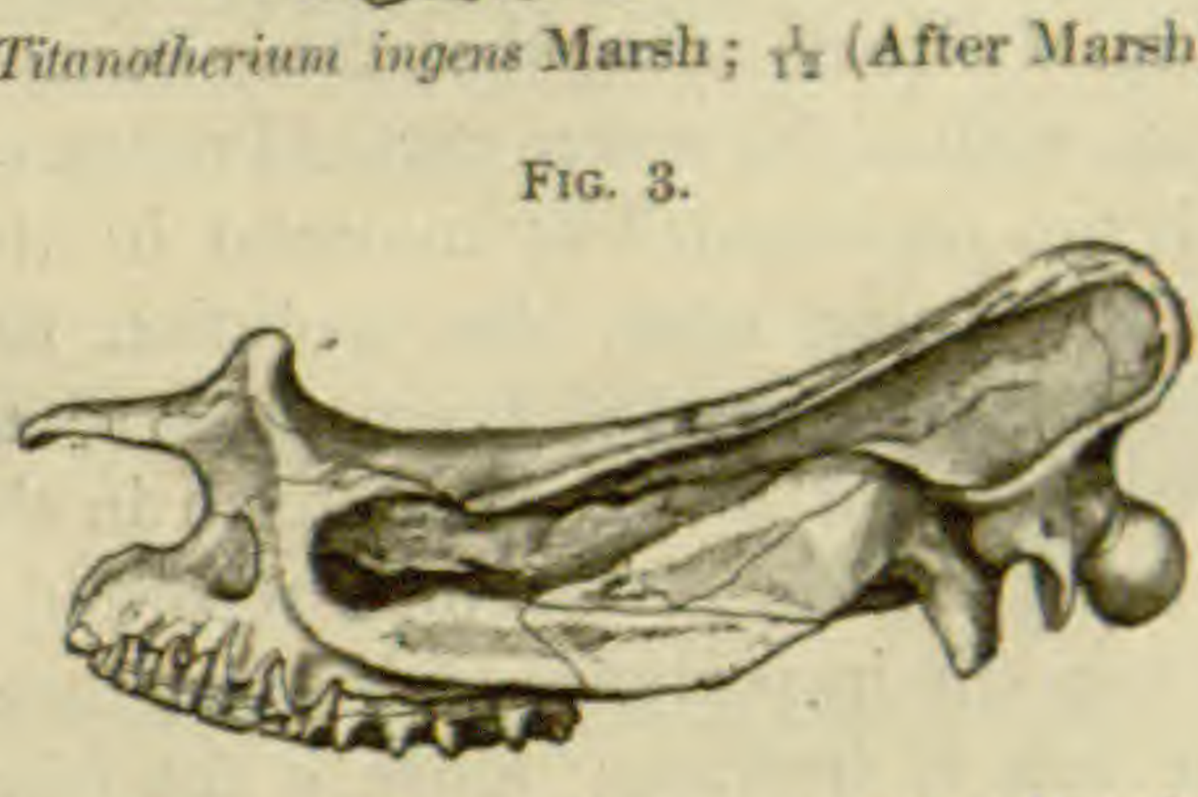
Titanotherium acre, ½ Cope.

FIG. 2.



Titanotherium ingens Marsh; ½ (After Marsh).

FIG. 3.



Titanotherium heloceras Cope; ½ (After Marsh).

skull as in many others. The figures are drawn to the same scale, one-twelfth natural size, and represent well the increase

in the size of the skulls from the base to the summit of the beds. They are arranged on the opposite page in the order in which they occur in the beds commencing at the top.

Intermediate forms in the middle of the beds have a much greater vertical range than their smaller ancestors in the underlying beds or their larger survivors in the overlying beds.

Between the skulls here figured there are many intermediate forms, showing every stage of development from a very small skull found at the very bottom of the beds, which measures only 22 inches from occipital condyles to the extremity of nasals, with very rudimentary horncores only $1\frac{1}{8}$ inches high to forms similar to that represented at the top, which measure more than 36 inches from occipital condyles to extremity of nasals, with horncores over a foot long and having an expanse of two feet or more.[9]

In the section of the Titanotherium beds accompanying this paper the relative thickness of the Lower, Middle, and Upper beds are shown, with brief descriptions of forms of Titanotheridæ characteristic of each.

Much additional information bearing upon the development which took place in the Titanotheriidæ will doubtless be brought to light, when the large collections either made or purchased by the writer for use in the preparation of Professor Marsh's monograph and now numbering nearly 200 complete skulls and many more or less complete skeletons shall have been worked up. It is safe to say that there is scarcely a single foot of sediment within the entire vertical range of the Titanotheridæ that is not represented by material in this collection. Only those facts bearing upon the evolution of the Titanotheriidæ which have presented themselves to the writer in connection with his field work are set forth in this paper. It is to be hoped that the few results here recorded may suggest to other collectors the importance of keeping, as nearly as possible, accurate data of horizons; since a familiarity with the

[9]These facts were communicated by the writer to Professor Marsh in 1886, and were referred to by the latter in the Am. Jour. Sci., Feb., 1889, p. 163, and the Ninth Ann. Report U. S. Geol. S., p. 114.

different horizons as characterized by different and closely related forms is clearly indispensible in making an intelligent classification of any group of fossils, more especially when they are as highly specialized and as susceptible to the influence of constantly changing environments as were the Titanotheriidæ.

Yale Museum, Jan. 16, 1893.

AN ORGANISM PRODUCED SEXUALLY WITHOUT CHARACTERISTICS OF THE MOTHER.

By Th. Boveri.

[In offering a translation of Dr. Th. Boveri's paper, entitled Ein geschlechtlich erzeugter Organismus ohne mütterliche Eigenschaften, I have been guided by two motives. First, to make this paper, which will certainly become a classic in Biological literature, accessible to American students, since the journal in which it appeared "Sitz. d. Gesellschaft für Morphologie und Physiologie zur München" × Sitzung am 16 Juli, 1889, has a very limited circulation in this country.

In the second place, to point out the new avenues of research that such work opens. Results of this kind are of the utmost importance, inasmuch as they touch the very heart of the question of Heredity. Each advance in our knowledge gained by experimental work of this sort, carries forward rapidly our understanding of the most vital phenomena of life.

Results of this importance must be verified over and over again, until all chances of error (by no means small) are eliminated. Dr. Boveri writes that during the present Winter it is his hope to carry forward this work at Naples.

Three small wood cuts were given in the original paper. Dr. Boveri has most generously placed at my disposal the original drawings as well as five additional figures. These are added to the present account. The original figures gave side views of the Echinus larva, the Sphærechinus larva, and the side view of the bastard larva (Echinus ♂, Sphærechinus ♀). Three of the new figures give posterior views of the same larvæ and two of the *Dwarf Larvæ*.

Weismann, referring to Boveri's work, in his essay on Amphimixis affirms that *two spermatozoa enter the enucleated* egg to form the segmentation nucleus. I wish to call attention to the foot note in Boveri's paper, where it is positively stated that only *a single spermatozoon enters the enucleated egg.*

T. H. Morgan.]

Although the law, that the substances giving the definite and hereditary characters to the cell are entirely contained in the nucleus, is at times spoken of as a very probable hypothesis, but again even as a fact, yet it may be easily shown that this can be known to us neither in the well known phenomenon of fertilization of the egg, nor through the researches already carried out, concerning the rôle of the nucleus in the protozoa.

Simple reflection shows moreover that the determination whether or not this Theory of Inheritance (Vererbungs-Theorie) is true, can be settled in one way alone, viz., to take two different sorts of cells, utilizing the nucleus of one and the protoplasm of the other, to form a new cell. If the nucleus and protoplasm are so constituted that they can exist together, then will the properties arising from this cell, made artificially, answer our question. For then either the exclusive qualities of that cell will develop which had held the nucleus, or those will arise that come from the protoplasm, or lastly, from a mixture of both; showing whether the nucleus alone or the protoplasm alone (or both of the two constituents) is able to transfer to the other the properties it possesses on account of its origin, so as to bring about a reverse result in the other.

The idea of inheritance in the narrower sense corresponds to such a choice of the two cells, that the cell produced artificially out of the nucleus of the one and the protoplasm of another forms a cell capable of development.

Moreover in the case of the egg, as in no other, an opportunity is given to solve the question; because for no other cell do we possess so accurate a method of judging of its qualities as is given in the egg by means of the adult organism that comes from the egg.

Rauber[1] has already carried on a research of this sort. He describes it as follows. "The nucleus of the first segmentation sphere of a frog's egg was drawn out an hour after fertilization, by means of a pipette stuck into it. The same process was carried out in a fertilized toad's egg. These two pipettes were exchanged, and the nucleus of the toad's egg placed in

[1]Rauber Zoologischer Auzeiger 15 March, 1886, pp. 17–.

the frog's egg, and the nucleus of the frog's egg into the toad's egg. Now if the nucleus alone carries the hereditary functions then there must develop out of the frog's egg a toad, and out of the toad's egg a frog." As was to be anticipated, the eggs did not develop further, and at first sight there seems to be no reason to expect that such an experiment should succeed. For if we were in a position to take out, without further injury, the nucleus from cells, still we could scarcely introduce by artificial means a new nucleus, without causing such fundamental alterations of the one or the other part, as to make further life impossible.

But just here Nature herself offers the solution by means of which we can accomplish our purpose, because it makes the second and more difficult part of the experiment an entirely normal process—the entrance of the spermatozoon into the egg may be utilized.

The basis for my research is founded on the discovery of the Hertwig brothers.[2] When these investigators shook for a long time the eggs of the sea-urchin in a test tube, containing a small amount of water, in order to alter them mechanically, they found that in consequence of the shaking some of the eggs fell into pieces, and while some of the pieces contained nuclei, others did not. It was further shown that these enucleated (non-nucleated) fragments, as well as the nucleated ones could be fertilized, and that an active segmentative process took place in them. What followed in these cell masses was not determined by the Hertwigs. I have myself verified this discovery during my last visit to the Zoological station of Naples, and found *that the enucleated and fertilized fragments of eggs developed as far as and formed as complete larvæ as did the perfect nucleated* egg. From the enucleated fragments which I isolated I reared in a series of dishes larvæ[3] (about half of

[2]O. and R. Hertwig. Ueber den Befruchtungs und Theilungs-Vorgang des Thierischen Eies unter dem Einfluss ausserer Agentien Jena 1887.

[3]In a more extended account of my experiments I will describe in detail the methods which must be used in order to be certain that we are dealing with pieces without nuclei, and on the other hand the best method to give the more delicate pieces favorable conditions of development. Here I may remark that in order to obtain positive results, a sufficient size of the fragment is necessary, also that they have a nearly spherical form and sufficient amount of water for their development, and that

them developing normally) that formed *dwarf-larvæ*. These were in some cases only one-fourth as large as the normal larvæ, but otherwise agreed perfectly with these, and even lived for the same length of time, i. e., about seven days.

This result is in itself certainly full of interest. It shows that the sperm-nucleus itself possesses all of the properties necessary to function as the first segmentation nucleus, and the result, which shows the prevailing opinion concerning the nature of fertilization to be erroneous, gives an important support to my view, published in several places, concerning the interpretation of the process. I desist from considering the point further here, in order to turn to the interpretation of the experiments dealing with the questions raised concerning inheritance.

With the possibility of fertilizing enucleated egg-pieces and of bringing these to a normal development, we have fulfilled all of the conditions in order to reach the end which Rauber failed to attain. We have an enucleated egg—for the fragment has the value of an entire egg, and we are able by means of a process of fertilization to introduce another nucleus into the egg, the egg still possessing the power to develop. And now instead of using a spermatozoon of the same species, we introduce the spermatozoon of another in order to produce the hypothetical case of "the toad's egg and the frog's nucleus."

It is even possible to bastardise the egg fragments (obtained by shaking) of one species of sea-urchin with the sperm of another species, and to rear them far enough to determine whether the developing organism shows the qualities of both species or only of the one species. For such an experiment the sea-urchin presents favorable conditions. It is possible, although the results are somewhat variable, to cross-fertilize two species standing quite far apart. And in the second place the larva of the sea-urchin shows in a very few days, principally through the development of the calcareous skeleton, a very well defined shape. This is constant for each species and so well defined for each species, that at the age of four days we can distinguish the two species of larvæ just as easily and surely as in the adult condition.

The two species that I have used in my research are *Echinus microtuberculatus* and *Sphærechinus granularis.* I am certain that a more favorable combination than this can be found, for although the two species are well adapted inasmuch as their larvæ differ very considerably from one another, yet there is to

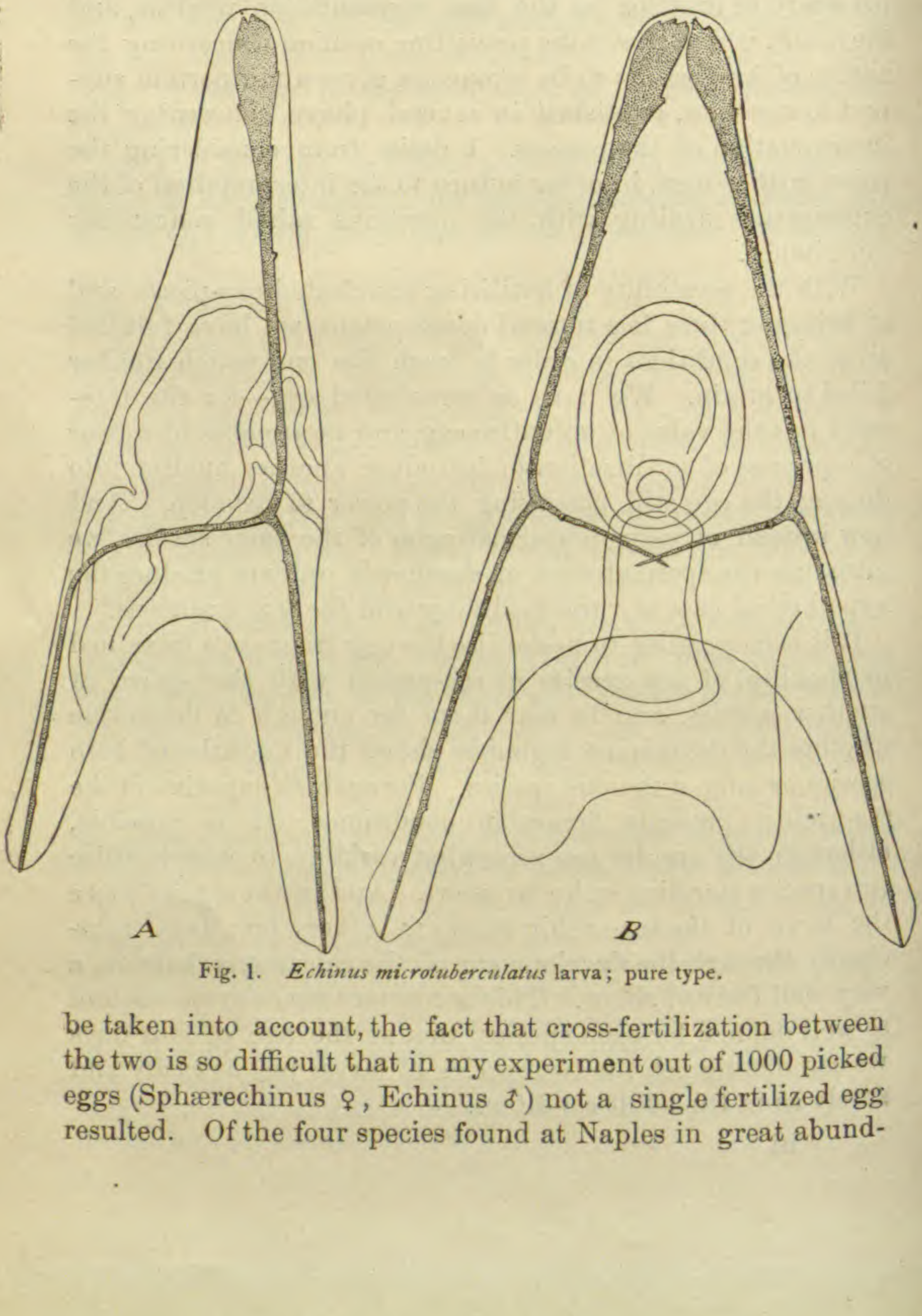
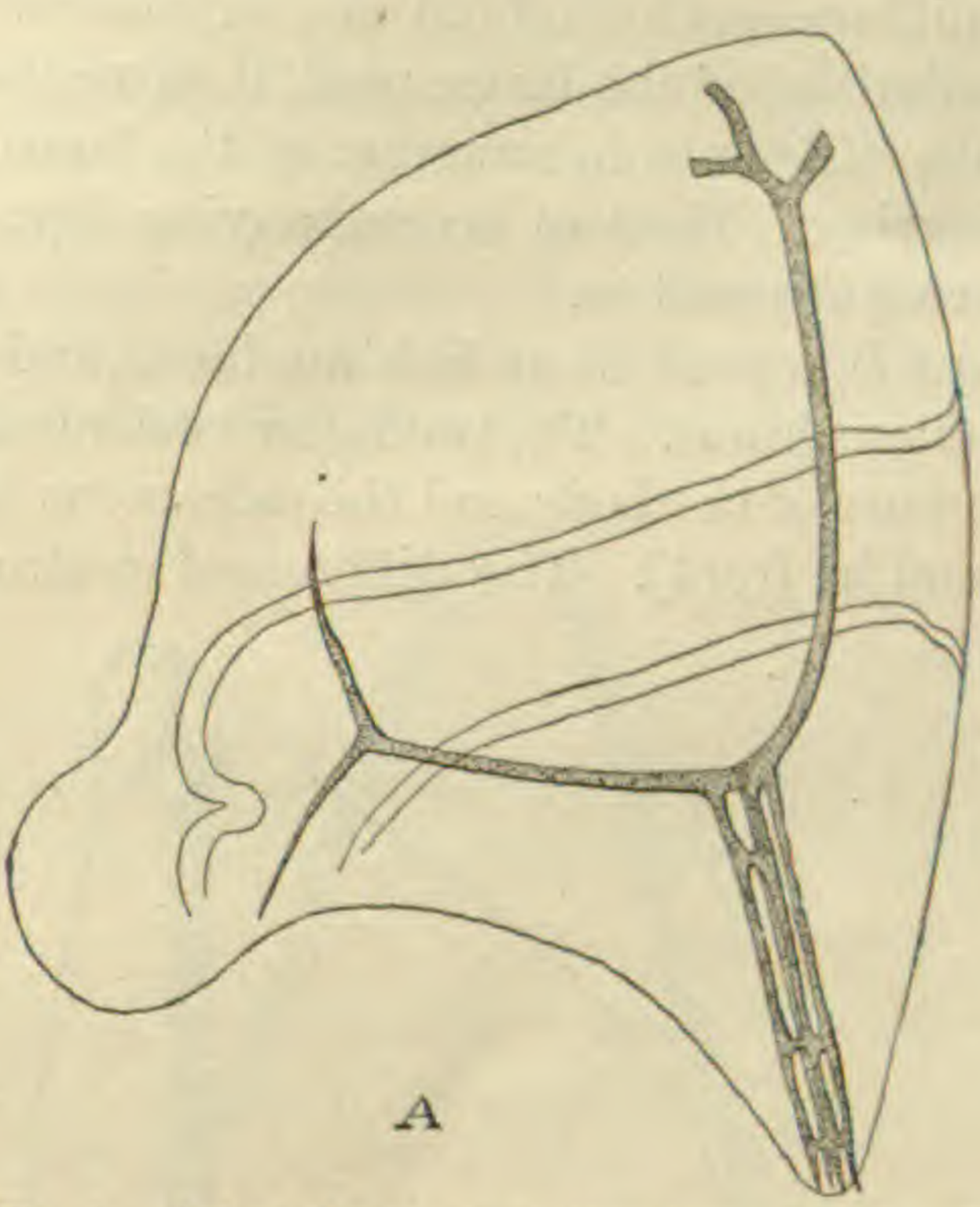


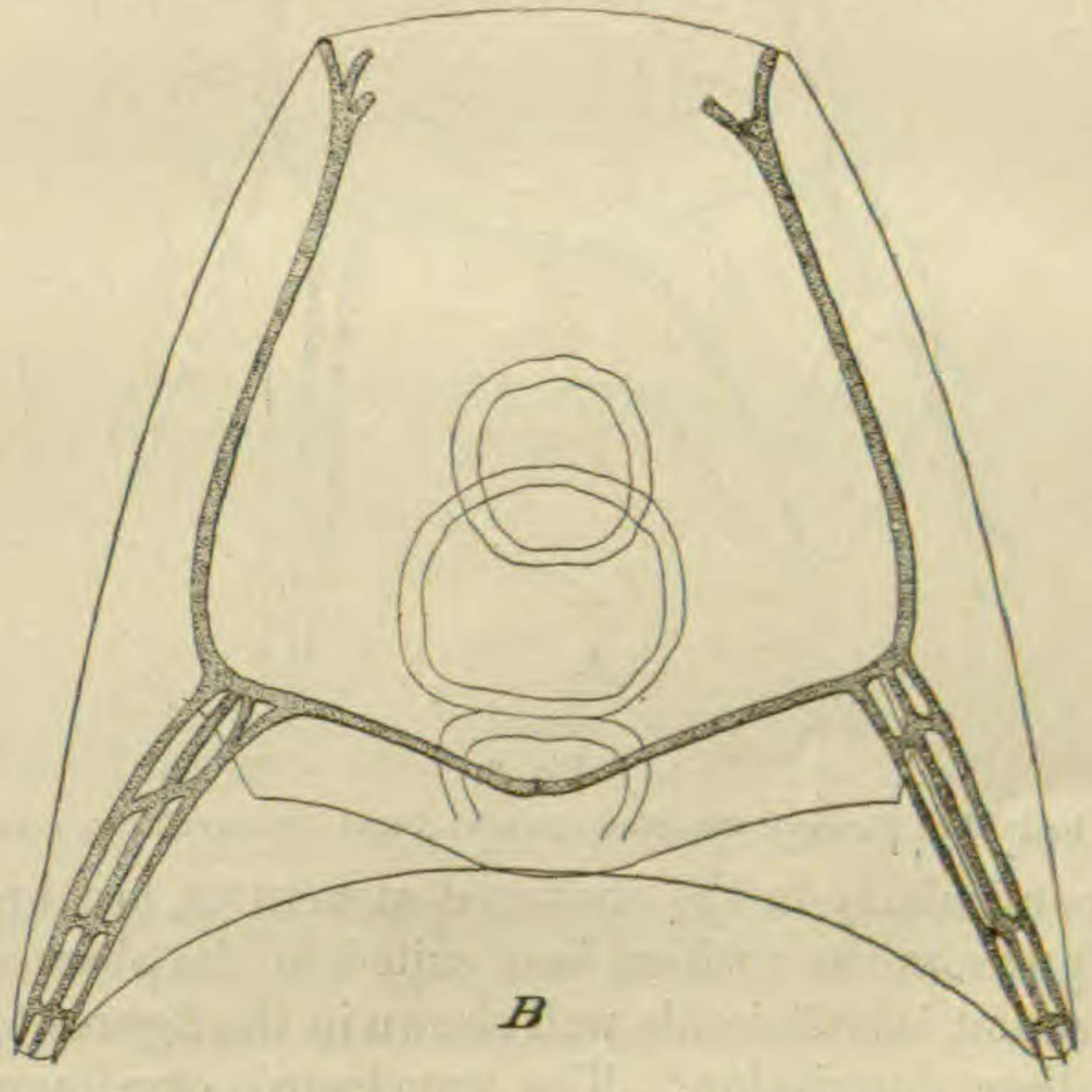
Fig. 1. *Echinus microtuberculatus* larva; pure type.

be taken into account, the fact that cross-fertilization between the two is so difficult that in my experiment out of 1000 picked eggs (Sphærechinus ♀, Echinus ♂) not a single fertilized egg resulted. Of the four species found at Naples in great abund-



A

Fig. 2. *Sphærechinus granulatus* larva; pure type.



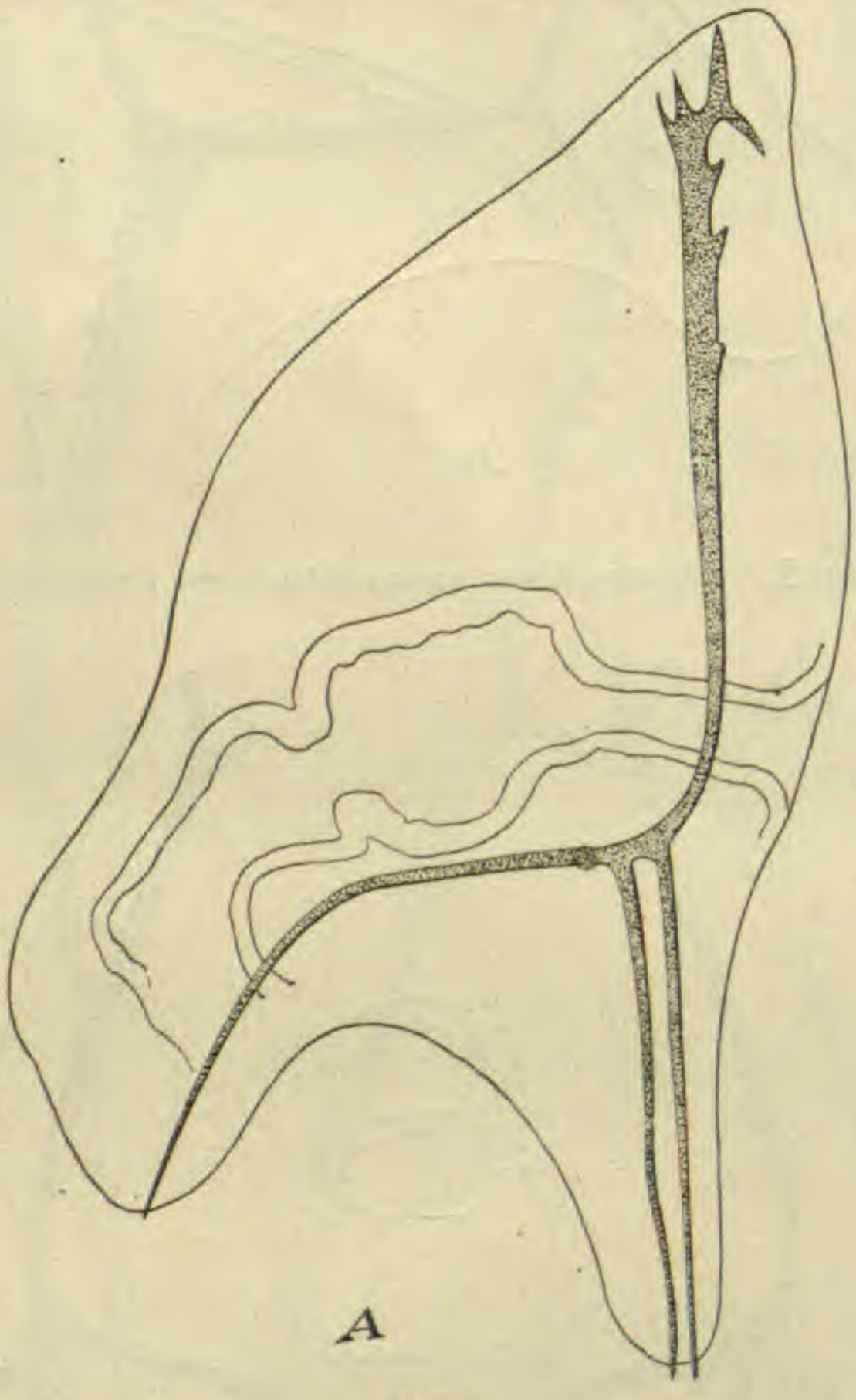
B

Fig. 2. *Sphærechinus granulatus* larva; pure type.

ance, these two alone are useful, and lend themselves to the solution of our problem.

Since the differences throughout are dependent on the distinctive peculiarities of the larvæ used, it is necesssry first to make clear the difference in structure of the larval forms that we are considering. The two accompanying figures will render a long account needless.

Fig. 1, A and B, represents an Echinus larva, and fig. 2, A and B, that of Sphærechinus. The two figures oriented alike, show the circumference of the body and the calcareous skeleton seen in profile [and in front]. The differences in structure of the



A

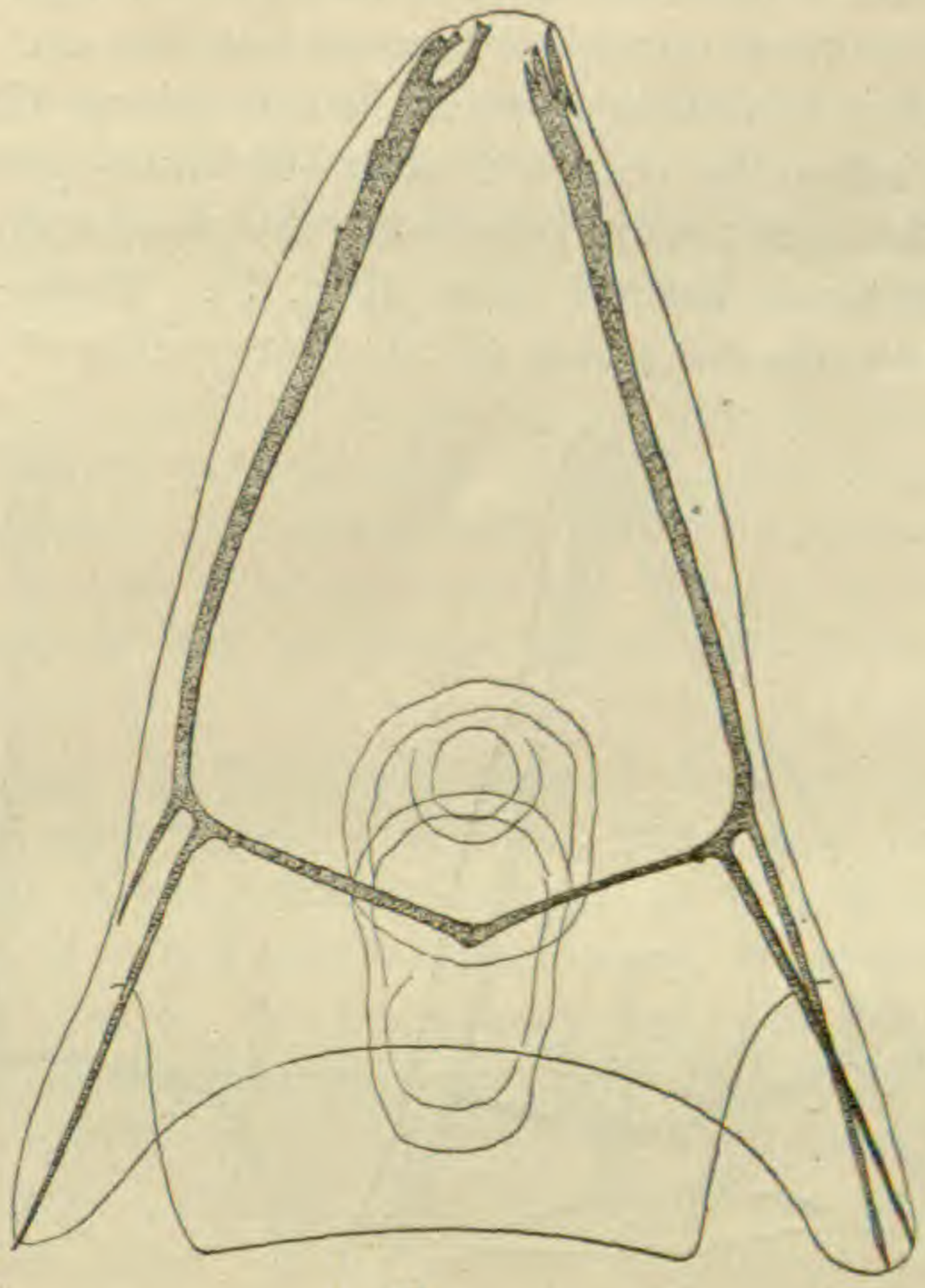
Fig. 3.

Larva of bastard of *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀.

body, particularly in the sheltered structures, are brought in these figures in the position best suited to the observer. The arrangement is sufficiently well shown in the figures to obviate any further description.[4] The enucleated egg-fragments of Sphærechinus were brought together with the sperm of Echinus.

[4]The generic name will suffice, from this on, in speaking of these two species.

If the nuclear substance alone is the bearer of the parental qualities, then larva of the pure Echinus type will be produced (Fig. 1). It is clear that in the experiment this conclusion can only be proved, if the bastards produced from fertilized eggs (we will call these the genuine Bastard larvæ) give a middle-form standing between the larvæ of the two parental species. For it is conceivable that the particular structures of the two



B

Fig. 3.

Larva of bastard of *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀.

species might not be able to commingle, so that the larvæ would, according to their surroundings, develop either the paternal or maternal qualities alone (the qualities of the other parent in each case remaining latent). In this case there would be no true bastard.

I have reared such larvæ in great numbers and from many different individuals, and have in all certainly seen more than

a thousand of them. The result was always the same. All genuine bastards, with not a single exception, represent both in the shape of the body as well as in the skeleton an almost exact middle form standing between the two parents. This is a new well defined form, and is always as such to be recognized and cannot be confused with either of the two parent larval forms. Fig. 3, A and B, which shows such a genuine Bastard larva, illustrates, as compared with figs. 1 and 2, this law better than many words could possibly do.

The result is otherwise if we shake into pieces the Sphærechinus egg before the entrance of the Echinus-spermatozoon. Certain of the eggs remain intact after the process, and these do give the genuine bastard form (Fig. 3). These are those formed from nucleated pieces, but another portion of the crossed

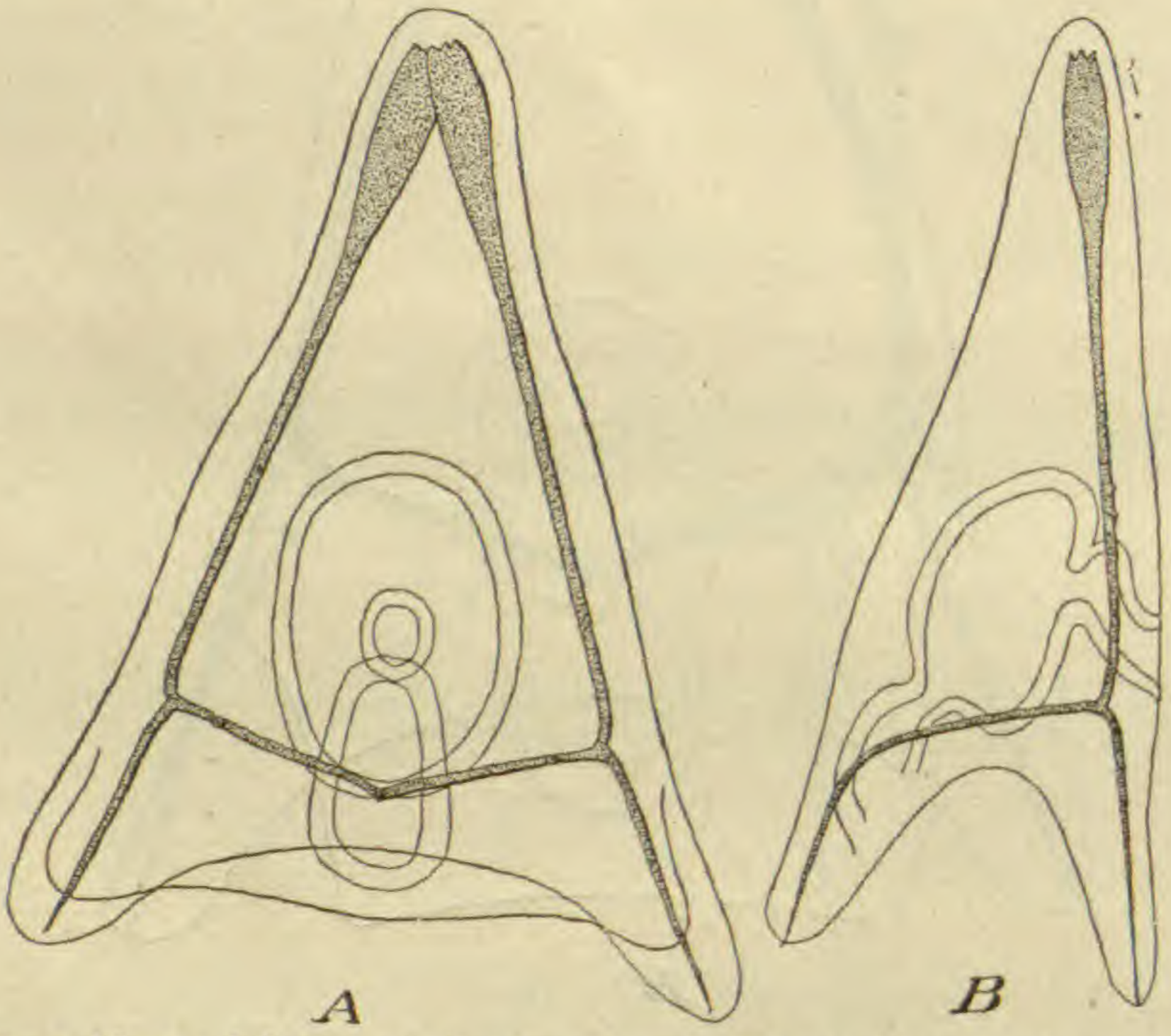


Fig. 4. Dwarf bastard larva of *Echinus* ♂ and *Sphærechinus* ♀ (fragment) of pure *Echinus* type.

larvæ agree entirely with the simple larva derived from the egg and spermatozoon of *Echinus microtuberculatus* (Fig.1). These must have been produced chiefly from enucleated fragments. (Fig. 4 A and B.)

That this is the correct interpretation is more clearly demonstrated by rearing in isolation the enucleated pieces. · My

results in this direction are on the whole not successful, and the explanation for this is to be found in the circumstance cited above, i. e., that the cross-fertilization between *Echinus microtuberculatus* ♂ and *Sphærechinus granularis* ♀ were scarcely ever successful out of 1000 cases. This small percentage of the whole number fertilized, where many millions of eggs or egg-fragments may be used, lends great improbability to the chance of getting successful results by isolating a few chosen examples of eggs. It is such a long and tiresome procedure to pick out and isolate the enucleated fragments from the shaken mass that in the limited time of my stay at the sea-shore I did not have the good fortune to see them develop in a single example.

I hold as sufficiently strong proof, in absence of direct knowledge, the result of those experiments in bastardization where enucleated were mingled with nucleated fragments, and with entire eggs. For after I have been able to reach the conclusion on the one hand by observing eggs and spermatozoa of the same species that enucleated pieces still develop, and on the other hand after it has been shown that the fertilization of nucleated eggs of Sphærechinus with Echinus sperm larvæ occasionally arise standing between the parent forms, there remains no other interpretation as to the origin of the dwarf-larva of pure Echinus except out of the enucleated fragments found there. But there remains a more definite result pointing to the correctness of such a conclusion. One can distinguish in a preserved and colored larva whether or not it has originated from a nucleated or enucleated egg, and this from the size of its nuclei. If the fertilized enucleated egg-fragment was the first segmentation nucleus which is formed entirely from A SPERMATOZOON NUCLEUS, the nucleus is half as large as a normal first segmentation nucleus, and this difference in size is handed down to all of the descendants of the egg cell, even to the larval stage. If now we kill larvæ of the same age derived from Sphærechinus eggs and egg-fragments fertilized by Echinus sperm, we have mixed together with the Bastard-type the true Echinus type, and the latter (true Echinus type) shows proportionately considerably smaller nuclei than the preceding one.

All doubt is thus removed, and it may be regarded as conclusive that by bastard fertilization of whole eggs or protoplasmic pieces having nuclei, larvæ are formed that stand midway between the larval forms of the parent species; but the larvæ arising from the *enucleated* fragments of eggs have entirely the characteristics of the parent (*male*) species. Herewith is demonstrated the law that the nucleus alone is the bearer of hereditary qualities. With the removal of the maternal nucleus are removed at the same time the maternal hereditary tendencies of the egg. And the maternal protoplasm, although in this case furnishing a large share of the material for the development of the new organism, is without influence on the form of the organism.

The phenomenon of growth of the enucleated protoplasmic mass is entirely governed by the introduced spermatozoon, and indeed to conclude by analogy, by the nucleus of the sperm. Whether the spermatic nucleus penetrates the egg protoplasm of its own species or of another species, the same result appears, namely, the larva is that of the male species. I might say that the nucleus possesses an assimilating power toward the protoplasm, since it produces the same sort of organism from material that appears to be different, according to our standards of truth. That the egg-protoplasm is similar in the two cases in every respect pertaining to its chemical constitution, I cannot admit, and do not even hold to be probable. Still such differences may, if they were present, be very easily explained, as due to the previous action of that nucleus, to which the enucleated protoplasm was at one time united, and any difference would thus not be incompatible with the law that all changes of form of the protoplasm are dependent on the constitution of the nucleus.

ON THE CLASSIFICATION OF THE LONGIPENNES.

By R. W. Shufeldt.

Few groups of birds there are that have received a greater amount of attention at the hands of comparative morphologists than the one I here consider as the Longipennes.

Considered apart from related ones, the suborder is fairly well circumscribed, and structurally, very surely a most homogeneous collection of bird-forms. It is abundantly represented in the United States avifauna, and here, as in nearly all other parts of the world, consists chiefly of the Gulls and Terns, the Skuas and Jaegers, and the Black Skimmer of the family *Rhynchopidæ*. We have the Skuas represented by but one species, *Megalestris skua;* and there are three Jaegers of the genus *Stercorarius*. There are upward of thirty Gulls referred to the genera *Gavia*, *Rissa*, *Larus* (20 species), *Rhodostethia*, and *Xema*, and about seventeen Terns, which are referred to the four genera *Gelochelidon*, *Sterna* (13 species), *Hydrochelidon*, and *Anous*.

Among the earlier classifiers of the *Laridæ*, we find P. Bruch and C. L. Bonaparte, the former being the author of two celebrated papers[1], and the latter of another which appeared between the times of their publication[2]. The confusing and

[1]Bruch, P., *Monographische Uebersicht* der *Gattung Larus Lin. J.* f. *O.*, i, 1853, pp. 96-108, pl. ii, iii.

Ibid. Revision der Gattung Larus Lin. J. f. O., iii, 1855, pp. 273-293, pll. IV, V.

[2]Bonaparte, C. L., Notes sur les Larides. Naumannia, IV, 1854, pp. 209-219. Of these two exploits Coues says in his *Ornithological Bibliography*, "It may be remarked, in fine, of this article [Bonaparte's], that it is worse than worthless, being pernicious. It is ostensibly a review of Bruch's paper of 1853 [*supra*]; this being itself a very incompetent performance, confusion is here worse confounded by Bonaparte's criticisms and "rectifications." It seems to have had, among other undesirable results, the effect of setting Bruch at the business anew, as appears by the latter's paper of 1855, [above cited]. The two authors together made as complete a muddle as can be found in ornithology; woe to the confiding student who trusts either of them—*Crede experto!* Bruch and Bonaparte are "Scylla and Charybdis of Gull literature." (p. 1001.)

misleading statments made in these three memoirs were subsequently to a large extent, eradicated by the excellent labors of Coues which appeared a few years after them,—although Coues, as he himself admits, suffered from the reliance he placed in their observations.[3]

But we are more interested in those works wherein the taxonomy of the *Longipennes* is based largely upon the structure of the various species, and this Dr. Coues gave us later in his "Birds of the Northwest," a very solid contribution to the subject.[4] Here a very thorough study was made of the Gulls, Terns, Skimmers and others. His final classification, however, appeared ten years later, or in 1884[5] and stood thus:

SUB FAMILIES.

ORDER.	SUB-ORDER.	FAMILY.	
Longipennes.	Gaviæ.	Laridæ.	Lestridinæ. Larinæ. Sterninæ. Rhynchopinæ.

Other Laridists have also ably treated the group and we can here but refer the student to the works of Nitzsch, Huxley, Schlegel, Blasius, Saunders, and Sclater and Salvin, bringing us down to the year 1880. Of these Huxley's work is deserving of especial mention,[6] and he upon certain structural characters placed the Gulls and their allies in his group "*Cecomorphæ*," remarking that "This group contains the *Laridæ* (*Longipennes* Nitzsch), the *Procellariidæ*, the *Colymbidæ*, and the *Alcidæ*." (p. 458). As a knowledge of the morphology of a number of these families became extended, this classification has been very much modified and altered. For instance, Alfred Newton in the 9th edition of the *Encyclopædia Britannica* under the article GULL (v. XI, p. 274) says, "The Family Laridæ is composed of two chief groups, *Larinæ* and *Sterninæ*—the Gulls

[3]Coues, E., Revision of the Gulls (Larinæ) of North America; based upon specimens in the Museum of the Smithsonian Institution. *Proc. Acad. Nat. Sci.* Phila., XIV, 1862, pp. 291-312. Also a review of the Terns (Sterninæ) of North America. *Proc. Acad. Nat. Sci. Phila.* XIV, 1862, pp. 535-559.

[4]Coues, E., Monograph of the North American Laridæ, 1874, pp. 587-715.

[5]Coues, E., Key to North American Birds, 1884, p. 732.

[6]Huxley, Thomas H., On the Classification of Birds; and on the Taxonomic Value of the Modifications of certain of the Cranial Bones observable in that Class. P. Z. S. 1867, pp. 415-472.

and Terns, though two other sub-families are frequently counted, the Skuas (*Stercorariinæ*), and that formed by the single genus *Rhynchops*, the Skimmers; but there seems no strong reason why the former should not be referred to the *Larinæ* and the latter to the *Sterninæ.*" Without being especially a classificatory work, W. K. Parker has given us some valuable researches on the development of the skull of *Gavia ridibunda* that has materially furthered our knowledge of the structure of the Gulls.

In the Check List of the American Orinthologists' Union, (1886, p. 84) we find the *Longipennes* divided into the three families *Stercorariidæ*, (2) *Laridæ* and the (3) *Rhyncopidæ*,—the second group being again sub-divided into the two sub-families, (1) the *Larinæ* to contain the Gulls, and (2) the *Sterninæ* to contain the Terns.

Finally, I have examined the classifications of Stejneger, Cope, and more particularly the one proposed by Fürbringer, and that distinguished ornithologist presents us with the following arrangement[7]:—(p. 1566.)

O. Charadriornithes.	S. O. Charadrii-formes.	G. S. lat. Laro-Limicolæ.	G. s. str. Charadrii.	F. Charadriidæ.
				F. s. str. Glareolidæ.
				F. s. str. Dromadidæ
				F. Chionididæ.
				F. Laridæ.
				F. Alcidæ.
		G. Parræ.		F. Thinocoridæ.
				F. Parridæ.
		G. Otides.		F. Oedicnemidæ.
				F. Otididæ.

His order *Charadriornithes,* is also made to include the Im. S. O. Gruiformes and the Im. S. O. Ralliformes, but we are not especially concerned with them here. Among the most recent classification we find that of Doctor Sharpe; and the *Longipennes* correspond to his *Lariformes*[8], thus:—

Order XVII LARIFORMES.	SUB-ORDER.		FAMILIES.	SUB FAMILIES.
	Lari.	1.	Stercorariidæ.	Larinæ
				Sterninæ
				Rhynchopinæ
		2.	Laridæ.	

[7]Fürbringer, Max, *Untersuchungen Zur Morphologie und Systematik der Vogel,* Amsterdam, 1888.

[8]Sharpe, R. Bowdler, A review of Recent Attempts to Classify Birds. (An address delivered before the 2d Intern. Ornith. Cong., on the 18th of May, 1891.) Budapest, 1891. A most valuable contribution to scientific ornithology, and of great aid to all workers.

and he places his Lariformes between his Alciformes and Charadriiformes. (p. 72.)

My own cabinet contains numerous skeletons of Longipennine birds, and, thanks to the U. S. National Museum, I have had the opportunity of examining very many more.

Recently I have gone thoroughly over this material and written out full descriptions of the characters presented on the part of our American *Longipennes*, and chiefly from osteological data it would seem to me that the following classifications can be sustained as being probably the most natural one.

SUB-ORDER.	FAMILIES.	SUB-FAMILIES.
LONGIPENNES.	LARIDÆ.	Larinæ.
		Sterninæ
	STERCORARIIDÆ.	
	RHYNCHOPIDÆ.	

So far as our American *Laridæ* are concerned, and it is fair to presume that the fact obtains elsewhere in the world, we observe that certain genera among the Gulls almost insensibly approach in their structure and merge into certain genera of Terns. *Xema sabinii* is closely related to such a species as *Sterna paradisæa*, while *Gelochelidon* comes near some of the heavier built *Larinæ*.

I am of the opinion that the Skuas and Jaegers (*Stercorariidæ*, stand between the *Laridæ* and the *Rhynchopidæ*, being more nearly related to the first named than they are to the Skimmers. Indeed it would seem that the family *Rhynchopidæ* is more remotely related to either of the other two families of the Longipennes, than has heretofore generally been supposed. *Rhynchops* I have shown in a memoir that I have sent to the Journal of Anatomy (Lond.) for publication, is, in some of its osteological characters notably in the skull, the vetebral chain, and pelvis, not very unlike the fossil cretaceous bird *Ichthyornis*, and this is a very remarkable fact.

Through the *Laridæ* of the present SUB ORDER, the Longipennes are found to be not so very distantly connected with the *Alcæ*, the genus *Uria* among the Auks standing between certain Gulls and the more ancient types, such as *Plautus* and

Alca. Huxley has already shown that in another direction "the Gulls grade insensibly into the *Procellariidæ*" (P. Z. S. 1867, p. 445), and it is now generally admitted that through an easy gradation, the osteological characters of a Gull or Tern, pass into those of the Plovers and their allies among the *Limicolæ*.

Beyond the Plovers, we are led on the one hand to the Rails through the *Otididæ*, the Cranes, the *Rhinochetidæ*, and the *Psophiidæ*, while on the other, through other branches we find the Plovers linked by *Hemipodius* with the *Gallinæ*.

EDITORIALS.

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

—In the States of New York, New Jersey, Pennsylvania, Alabama, and some others, the governments have been alive to the importance of retaining in the office of State Geologist a tried and competent expert. In this way they have secured the best results with the least expenditure, and have escaped the inevitable loss which results from changes in the personnel of an expert office. This loss is serious in consequence of the continuous nature of the work of a geological survey. Collections are in process of being formed, and reports of being written, and at no time can a change be made without a loss of work already done, and a loss due to the lack of continuity of work already in hand. Some States have pursued a different course, notably Indiana and Michigan, where competent men were replaced by incompetent men, and the surveys have been of little value since those changes were made. Good geologists competent for both scientific and administrative work are rare, and their excellence is in no way related to their political affiliations.

It is proposed, we regret to learn, to remove from his place the present very competent State Geologist of Illinois, Professor Lindahl. Not only has this officer had an excellent training for the place, but he has already done a vast amount of unpretentious work of the greatest value to the State of Illinois. He not only secured to the State great collections of its minerals and fossils which would have otherwise passed into private hands, but he has reduced them to order, so that they are available to the student and business men of the commonwealth. He is now engaged in making sections across the State with the view of preparing a full and final geological map. The accomplishment of this enterprise can be safely entrusted to the hands of Dr. Lindahl, and he should be supported by larger appropriations than those he has been receiving. He has done much with the limited funds at his disposal.

—M. Gréard has proposed to the French Academy that it authorize a number of changes in orthography. Among these are two which especially commend themselves to writers on scientific subjects, since they relate to words mostly derived from Greek roots. He proposes to abolish the vowel Y, and the diphthong PH, using I in place of the

former, and F in place of the latter. These reforms have been before the American public for many years, and their utility is self-evident. If the French Academy of Letters gives them the weight of its authority, we may hope to see them generally adopted. In anticipation of such approval, the Revue Scientifique initiates the movement by writing "fisiologie," "fisiognomie," "psichique," "il i a," etc. (Feb., 1893, p. 175). The American Naturalist will follow the example of the Revue Scientifique so far as it can do so at present consistently with the liberty of action of contributors and other persons, whose prejudices in favor of the old orthography it is necessary to respect.

—It is to be hoped that the present severe Winter has materially reduced the number of English sparrows in this country. Some benevolent persons have been feeding them, and no doubt have thus reduced the mortality to some extent. Such persons should remember that their benevolence is misplaced, since they are sustaining the most active enemy of the farmer known among the feathered tribes. It has been thoroughly proven that the English sparrow is not an insectivorous bird, but that it destroys great quantities of grain and fruit. It also drives away the insectivorous birds, thus doing double injury. It is not even ornamental, and the loss of the beautiful or melodious native species from our parks, which it has occasioned, is greatly to be regretted.

—The American Entomological Society occupies a room in the hall of the Academy of Natural Sciences of Philadelphia. Anxiety has been expressed by some of the members of the former lest they be compelled to vacate their quarters in the Academy Building. On the other hand some of the members of the Academy have expressed some fear lest the Entomological Society vacate voluntarily. Under the circumstances it would seem that both parties have the same object in view. This being the case, cooperation and mutual admiration must be the result, and the satisfaction of both parties be guaranteed.

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RECENT LITERATURE.

Memoirs of the National Academy of Sciences, Vol. V.—The memoirs of 1891, five in number, are published in the usual quarto form under the following titles: Energy and Vision, by S. P. Langley; Contributions to Meteorology, by Elias Loomis; Report of Studies of Atmospheric Electricity, by T. C. Mendenhall; The Embryology and Metamorphosis of the Macroura, by W. K. Brooks and F. H. Herrick; On the Application of Interference Methods to Astronomical Measurements, by A. A. Nicholson. The illustrations are numerous and good.

Brooks and Bruce on the Embryology of the Macroura.[1]—The two hundred and fifty quarto pages of this memoir are not easily summarized in a page or so of THE NATURALIST, for they include a wide range of subjects. After an introduction by Professor Brooks comes an account of the life-history of *Stenopus hispidus* by Professor Herrick; next the habits and metamorphosis of *Gonodactylus chiragra* by Professor Brooks; fourth the Metamorphosis of *Alpheus saulcyi* by Brook [*sic*] and Herrick, while the bulk of the volume is taken up by Dr. Herrick's paper: Alpheus, a study in the development of the Crustacea, which extends from page 371 to the end.

The most interesting facts connected with the reproduction of the almost cosmopolitan Stenopus are the hatching of the larva as a protozoæa with enormous mandibles and its later metamorphosis into a larva with an enormously developed fifth pereiopod, the use of which as a swimming organ has doubtless played an important part in the wide distribution of the species.

Much more important are the observations on Gonodactylus, for every fact concerning the early embryology of the Stomatopods is a positive addition to knowledge. Gonodactylus, like the others of its tribe, deposits its eggs at the bottom of its burrows, where they are aërated by the currents produced by the pleopoda of the parents. From these eggs the young hatches in an advanced condition, five abdominal segments with their appendages being outlined before the young escapes from the chorion. Professor Brooks was enabled by this material to conclusively show that the larval Stomatopod to which he

[1]The Embryology and Metamorphosis of the Macroura, by W. K. Brooks and F. H. Herrick. Memoirs Nat. Acad. Sci., Vol. v, pp. 321–576, 57 pls. Washington, 1892.

had previously given the name Gonerichthus is the young of Gonodactylus.

The account of the various species of Alpheus is most detailed and one of the most striking facts brought out is that the same species in different localities may have an almost totally different development. Thus, in the Bahamas, *Alpheus heterochælis*[2] hatches from the egg with all its appendages functional as far back as the third pair of maxillipeds, while the pereiopoda 1, 2, and 5 are bud-like rudiments, and the joint between abdominal segment 6 and the telson has not appeared and no pleopoda are outlined. At Beaufort, N. C., the species is much more advanced before leaving the egg, but the stage at which it hatches is not directly comparable with any stage in the life history of the Bahaman form. At hatching all the appendages of the adult are present, and all become functional after the first molt. In the Bahamas there is a long series of larval stages, while at Beaufort there is a great acceleration, and even this is not all; the Beaufort stages are so modified that at no time can exact parallels be drawn between them and the more southern form. In the Bahamas there are three, then four, then five, and then seven schizopodal feet with functional exopodites, while at Beaufort there are never more than three. Yet these different types of metamorphosis result in the production of adults which are almost exactly alike. It must be noted that Packard has described still another type of development for what he regards as the same species at Key West. For the details of the development of the different species of Alpheus studied we have but little room; those interested must seek the memoir itself. The segmentation in *A. saulcyi* and *A. heterochælis* is typical centrolecithal, with the formation of yolk pyramids; in *A. minus* it is irregular and has no yolk pyramids, but the statement (pp. 427 and 457) that it is amitotic deserves further investigation. All of the nuclei resulting from segmentation migrate to the surface and there by delamination they produce "wandering cells" which pass into the yolk and give rise to both mesodermal and entodermal structures. The subject of degeneration of certain nuclei is also very interesting. Dr. Herrick has carefully followed the increase of nuclei in the various parts of the embryo, and has plotted curves illustrating the distribution of primary yolk nuclei, of wandering cells,

[2]There is a great diversity in this memoir as to the spelling of various scientific terms. Thus we have usually *heterochelis* regardless of the fact that Say, who described the species, wrote *heterochœlis; Alpheus minus* appears as *minus, minos* and *minor;* centrolecithal sometimes as centrolycethal; Lucifer as Leucifer.

and of all other cells, from which the reader can almost reconstruct the eggs for himself.

Only a few points more can be noted in the later history. The mouth invagination occurs on a line between the bases of the antennular buds; the history of the eye is followed, the author agreeing well in most points with Parker, but affording little support to Watase's theoretical views. The antennal gland (green gland) is regarded as mesodermal, but its opening was not found even in the larval stages; the alimentary canal proper is almost wholly made up from stomodeal and proctodeal invaginations, the true entoderm, which arises by the migration of yolk cells to the posterior end of the yolk being chiefly confined to the hepato-pancreatic diverticula and their ducts.

The greatest fault which one can find with the paper is that which is due to its composite nature, the result being an apparent lack of arrangement, so that it is difficult to follow in detail certain structures. This possibly was unavoidable where two authors were each contributing their parts and also where the composition of the text was done at different times. The volume is filled with valuable facts and cannot be ignored by the student of Crustacean ontogeny. It is by far the most valuable zoological memoir yet published by the National Academy.

Campbell's Biology.[3]—It is rarely that such a veritable hodge podge as this comes to our table. It is an example of absorption without assimilation on the part of the author. The plan of the work is fairly good but it is a misfortune for any student to have it as a guide in his studies. It is worse than the notorious works by the late Dr. Steele, for their faults were largely negative; they taught absolutely nothing good or bad, but this is "filled with lots of things that are not so." The work intends to be a companion to the laboratory work, and gives much space to protoplasm, the cell and the like, and then takes up without any apparent order the structures and classification of animals and plants. A few passages out of over a hundred which we have marked will illustrate the chief shortcomings of the work.

P. 137. The lungs "develop as an outgrowth of the alimentary canal. This outgrowth becomes completely separated off from the oesophagus, and at its lower end divides into two or more tubes, which communicate with the pharynx by a single tube, the trachea."—Pp. 145–6. The statement is made without a single qualification that the ureter of ver-

[3]Text book of Elementary Biology, by H. J. Campbell, M. D., Lond. London, Swan Sonnenschein, New York, Macmillan & Co., 1893. 12 O., pp. xii + 284.

tebrates is developed from the ectoderm and in the development of the nephridia "as a rule the ciliated funnel which was present during development, becomes completely closed." P. 85. Between the ectoderm and the entoderm of the sponges "is a gelatinous layer, the mesoglœa, amongst the cells of which crystals of lime salts occur," which we suppose to be the spicules, silicious as well as calcareous, of these organisms. P. 83. The animal kingdom is divided into Protozoa, and Invertebrate and Vertebrate Mesozoa. The Invertebrates are defined as follows: "They possess no backbone, the nerve cord or nerve cords are never dorsal, . . . and the heart is always placed in the dorsal region." The Invertebrata are subdivided into Cœlenterata and Cœlomata, but never a word that the Plathelminthes are not Cœlomata and that the vertebrates are. But enough. The work is well illustrated, mostly by cuts from Claus, Sachs, Prantl and other recent textbooks.

Correlation Papers of the U. S. Geological Survey Neocene.[4]—This memoir is the fifth of a series, having been preceded by essays on the Carboniferous and Devonian by Mr. Williams, on the Cambrian by Mr. Walcott, on the Cretaceous by Mr. White, and on the Eocene by Mr. Clark. To an excellent summary of published material on the subject discussed the authors have added important original matter based on personal investigations by Mr. Dall in the field and laboratory. The following is an outline of the memoir as given in the introduction:

"This paper, after discussing general principles connected with the study and description of the Tertiary or Cenozoic rocks and fossils contained in them, takes up the Neocene deposits of the United States in particular.

"A chapter is devoted to a summary of what is known in regard to the Neocene of the eastern coast of the United States, each State in geographical order being separately considered, beginning at the north. The State of Florida, in regard to which much unpublished information was available, being entirely composed of Cenozoic rocks, and therefore as a type of such structure peculiarly interesting, is treated of in greater detail and at more length than in other cases. The part of this essay relating to the State of Florida is really a preliminary geological report on that State, of which the structure has hitherto been very little known. The important fact that until the Pliocene

[4]Bulletin of the United States Geological Survey No. 84. Correlation Papers—Neocene, By W. H. Dall and G. D. Harris. Washington, 1892.

period, Florida, so far as it was elevated above the sea, was an island separated from the mainland by a wide strait, is here first demonstrated. It is also shown that the strata are probably gently folded lengthwise of the peninsula, and that in the trough now occupied by the "lake region" of Florida in Pliocene time a large lake probably existed, to which the name of De Soto has been applied. The age of the remains of fossil vertebrate animals, which in south Florida are associated with the so-called "pebble phosphates," is here definitely determined."

After discussing by States the character and distribution of the Atlantic Neocene, a chapter is devoted to the consideration of the general geological movements and fluctuations of land, sea, currents, and water temperatures which appear to have been concerned in producing the characteristics described.

"In like manner the Neocene geology of the Pacific coast has been treated, and in addition to that of California, Oregon, and Washington, a synopsis of data relating to British Columbia has been included, together with a summary of what is known in relation to Alaska during this epoch. The latter discussion contains a large amount of material extracted from unpublished notes covering some fifteen years' study and exploration by W. H. Dall in the Alaskan region, and therefore adds materially to the sum of our knowledge in regard to that part of the United States.

"The Great Interior region of the west is then taken up, and a summary of our knowledge in regard to its Neocene geology is brought together for the first time. While this is necessarily far from perfect, the very fact that such gaps exist will stimulate the collection of information to supply the missing links.

"The essay closes with a list of names proposed for geological beds, groups, and formations in the American Cenozoic strata, and a description of the data upon which the coloration of the general map is based."

The work while an eminently important and useful one, is very unsymmetrical, as the authors themselves recognize. They are very full in describing the formations that they have seen, those of Florida, for instance, and deficient in those which they have not seen, as the lacustrine formations of the interior. The latter yet remain to receive adequate treatment from the U. S. Survey, since to do this requires the aid of a competent paleontologist of the vertebrata.

The geological map of Florida contained in this volume expresses clearly the latest discoveries in that state. The coloration will surprise

geologists who supposed that Major Powell had abandoned his extraordinary position on the question of coloration of geological maps. We seem to see in Florida a good representation of the Archean, Paleozoic and Mesozoic beds, as well as the Cenozoic. For this Mr. Dall is in no way responsible. It is a pity that expense should be incurred in printing such maps, since they will have to be republished with the customary colors.

Cary on the Evolution of Foot Structure.[5]—We have in this paper a study of the fore foot of Palæosyops, from a specimen in the museum of Princeton College, conducted with a view of ascertaining the mechanical relations of the parts when in action. The ultimate object is to determine whether the structures presented (facets, etc), can have been produced by direct mechanical impacts, strains, etc., as is alleged by the Neolamarckian school of evolutionists. The study is conducted with care, so far as it goes, but it is not always easy to understand the drift of the author's argument. He reaches but one definite conclusion, viz.; that the trapezoid is too small to express properly a result of direct mechanical causes. This fact, the author says is incompatible with the Lamarckian principle. He informs us that in reaching this result he has applied geometrical methods. "First, the volume of the bones was got at. Next the area of the bearing surfaces and their inclination to the digits were measured. Then giving to the thrust of each metacarpal a value proportional to its volume, the distribution of that thrust can by resolution and composition of forces, be traced through the foot, and the pressure on each surface and bone approximately obtained." Further than this the author does not explain how he reached the result that the trapezoid is too small. It is quite essential that this demonstration should be given if we are expected to accept his conclusion. An essential part of the problem is, however, unnoticed by Mr. Cary; and that is the condition of the trapezoid in the reptilian ancestors of the Mammalia. The phylogeny of an element must be known, since it furnishes the "physical basis" of the problem.

Mr. Cary then proceeds to criticize the explanations offered by Professor Osborn and myself, in accounting for the origin of certain structures. He finds our explanations to be self-contradictory, and that we also contradict each other. Osborn has supposed that the conules of the molars are produced by friction of the molars of opposite

[5]A study in Foot Structure; by Austin Cary. American Journal of Morphology Dec. 1892, p. 305.

series on each other. I have expressed the opinion that the shear of the sectorial teeth of Carnivora was produced by lateral friction during vertical movement of the lower tooth on the upper. I have also asserted that the forms of facets of limb articulations are due to pressure. Mr. Cary sees here the attempt to explain the origin of totally different structures through identical mechanical processes, and believes that the attempt is a failure. Were the conditions of the problems alike, as Mr. Cary thinks them to be, he would have good reason for this opinion. But the conditions in the three cases are entirely different, and our author's conclusion is due to neglect of the elementary facts of the proposition.

The development of conules at the points indicated by Professor Osborn, has been supposed by him to be due to friction between existing ridges of enamel which cross each other when in action, at the points in question. In the case of the development of the sectorial shear, the faces between which the shearing motion takes place are smooth, and without ridges or crests. Hence the entire surface receives a homogeneous friction. In the third case, that of the foot articulations, there is no friction, but there is pressure which when abruptly applied in movement becomes impact. There is really no parity between the three cases.

The author of this paper also thinks that the explanation of the elongation of bones through use of different kinds is not a permissible hypothesis. He cites my attempt to account for the elongation of the leg bones of higher mammals through impact-stimulus; and of other limb bones of other mammals through stretching. But he does not prove that similar results may not flow from mechanical stresses applied in different ways. I suppose that any mechanical stress which determines nutritive processes to a part, will increase its size, caeteris paribus; and the stretch as well as the impact has this effect.

Use is a term which is too indefinite for purposes of exact demonstration, and I have endeavored to reduce it to precision so far as regards the skeleton, by defining it as "friction, pressure and strain." Precisely how these processes affect nutrition is not yet clear. We refer the production of various animal fluids to "secretion", knowing that the products of secretion are most various, as bile, gastric juice, saliva, etc. The exact cause of the diversity remains unknown. So with the effect of stimuli on bone nutrition, we see the cause and the effect, but the ultimate process, as in all nutrition, has as yet eluded our view.

In concluding, Mr. Cary admits one of the two contentions of the Neolamarckians in his two closing propositions. He says "Plasticity

of bone, using the word *plasticity* not in a physical sense merely, but to include absorption under pressure, will probably account for much structure in the foot and elsewhere, especially the connection with the joints, and in the fields of variation and correlation." In the second proposition he says that facts have been adduced by him which are inconsistent with the theory that the size of bones has been increased by the stimulus they receive, and with the theory that regions of growth are determined by regions of pressure and strain. "The testimony of the literature as to the latter point he says is conflicting." I have shown that the supposed conflict is due to a misunderstanding on the part of the author of this paper. The proposition that pressure does not affect growth is in contradiction to the admission made by the author in his first proposition, where he admits that pressure determines structure; for in such change of structure there is always growth. Finally Mr. Cary remarks "That race changes follow those produced in the individual life, or that they are directly caused by their mechanical surroundings, I do not think it has been satisfactorily shown." The fact that the characters of bone structure admitted by Mr. Cary to have had a mechanical origin appear in the young before birth, is evidence that race characters are produced, and that they are produced by mechanical surroundings.

Such criticisms as are contemplated by the author of the paper reviewed above, are important and are what the subject needs. It is along the line followed by him that the ultimate demonstration of the problems involved will be made. We trust that we shall hear from him again in this field, and that in his labors he will be well supplied with the phylogenetic details as a foundation.

E. D. COPE.

Earle on the Species of Coryphodontidæ.[6]—In preparing this paper Mr. Earle had the advantage of the use of the material in the collections of the New York American Museum of Natural History, and the private collection of Professor E. D. Cope. He presents us with a brief résumé of the results of his comparisons, and adds considerably to our knowledge of the characters of the skeleton and dentition of some of the species. He gives a list of the described species, which number twenty-one, and which were referred by Cope to five genera. He concludes that these should be reduced to ten

[6]Revision of the species of Coryphodon, Art. xii, Bull. Am. Mus. Nat. History New York, iv, pp. 149–66; Oct. 18, 1892.

species and three genera, viz., Coryphodon Owen, Ectacodon Cope, and Manteodon Cope.

Mr. Earle's conclusion that the supposed genus Bathmodon is not distinct from Coryphodon may be well founded, as the material at his disposal is better than mine. The difference in the forms of the astragali of the two types is, however, greater than is usual in a single genus, and is seen in material from all localities. The character on which the genus Metalophodon rests is a strong one, provided it be constant. Mr. Earle says it is not constant, and if his material demonstrates this to be the case the genus must be abandoned. I do not, however, think that he demonstrates his case in the paper under review.

Let us now see the evidence on which he reduces my reputed twenty-one species to ten. In the first place he fails to state that I had already reduced two of the names to the rank of synonyms, leaving nineteen species to my credit; that is to say, nine specific names remain which are alleged to be superfluous. One of these is, however, admitted to be good by Mr. Earle. He refers *C. simus* and *C. latidens* to *C. elephantopus*, but says also that the former two are "quite radically distinct." Both cannot, therefore, be synonyms of the same species unless "things *not* equal to one another are equal to the same thing." I described the lower molars which probably belong to the *C. elephantopus*, and they are totally different from those of the *C. latidens*. The superior last molar of *C. simus* is different from that of the *C. elephantopus*. The three species are in my opinion well distinguished. This reduces the supposed superfluous names to seven.

Mr. Earle does not admit the *Metalophodon armatus* for reasons which are insufficient. As I took the greater part of the dental series from one decayed skull, and an almost equally large series from a second skull, and as the two series confirm each other, I believe the species to be one of the most distinct of the family. This reduces the supposed excess to six. As to the *C. cuspidatus*, the last inferior molar teeth of three individuals are now known, and they confirm each other not only by their characters but by their inferior size. Mr. Earle admits this species with doubt. The *C. marginatus* is rejected by him as probably founded on a milk tooth of *C. anax*. But it is not a milk tooth,[6] but an unworn permanent tooth of a species of hardly half the bulk of the *C. anax*. Coryphodon did not possess milk teeth of this form. The surplus is now five names. There are three forms of approximately similar and smaller size, viz., *C. latipes*, *C. molestus* and

[6] I have represented the milk dentition of Coryphodon on Plate liv, fig. 3, of the U. S. G. G. Survey, Report Capt. Wheeler, iv, 1875.

C. simus, which Mr. Earle refers to the *C. elephantopus*, but of which the second and third do not exhibit the form of the last superior molar which he regards with me as characteristic of the latter species. It is not unlikely that *C. simus* and *C. molestus* are one and the same, but the evidence is not yet in favor of their being identical with the *C. marginatus*. It is probable that these specimens represent at least one distinct species of rather small size.

In conclusion I think that Mr. Earle has been hasty in his wholesale reductions, and that instead of ten species in the American Wasatch beds there are at least fifteen recognizably described. It is evident that more material and more research are necessary before a larger number than this can be demonstrated and before those which are admitted can be fully defined. A considerable part of Mr. Earle's conclusions may be due to the fact that, as he says, he has "labored under the disadvantage of not being able to study any of the types of Coryphodon from New Mexico which have been described by Professor Cope."

The Coryphodontidæ were the predominant type of the Wasatch (Suessonian) Eocene, and they were probably numerous in species and varied in character. If the bones and teeth of the existing African antelopes were mixed up and discovered piecemeal, they would puzzle naturalists, who would at first be incredulous as to their representing over forty species.—E. D. Cope.

General Notes.

GEOGRAPHY AND TRAVELS.[1]

Africa.—GARENGANZE.—Garenganze, the land ruled by Mshidi, between Lakes Mwero and Tanganyika, has recently been visited both from the east and from the west. Mr. Alfred Sharpe, proceeding from Lake Tanganyika, discovered west of that lake and east of Mwero another Mwero into which run the rivers Mkabe, Mwambezi, the Choma from the north, and the Chisela from the north-east. This lake is now partially desiccated, and consists of an extensive salt-marsh with several pools of water, including a large central one about fifteen miles long by ten wide. The former outlet of this lake was by the Movu river-bed to the Kalongwizi River, a feeder of Lake Mwero. Kazembe, the powerful chief who resides on the Luapula, above Lake Mwero, though very polite to the traveller, would not permit him to cross because of his enmity to Mshidi, so that, finding all attempts useless, Mr. Sharpe was compelled to retrace his steps to Abdallah's near the salt-marsh, and from thence to make his way westward round the north of Lake Mwero. Abdallah is an agent of the famous Tippo Tib, and bears sway eastward as far as Kabunda, near Tanganyika. The highest point between Chipenbiri, on the level of the swamp, (3050 feet) and Lake Mwero, is at an elevation of 3850 feet. The eastern watershed of the northern part of Mwero is not more than six to eight miles from the shore, and that lake is 2900 feet above the sea. The streams Luao and Luchinda flow into the lake from the north, and Mpweto's town, east of the Luabula, is subject to Abdallah. The Luapula, at its point of exit from the lake, is of less volume than above. Beyond the lake rises one of those plateaux so frequent in Africa, and the country beyond this, after passing Chuako (subject to Mpweto), belongs to Mshidi. The Luvule River falls into the Luapula not far from its exit, and the next river reached after crossing the watershed is the Luvula, an affluent of the Lufira, into which it falls a few miles above the junction of the Lufira with the Likulwe, from its left bank. The Lufira itself like the Lapula, is a tributary of the Congo. The soil of Garenganze is rich, but the country shadeless. Mshidi is now an old man; originally he was a trader from the Wa-Nyamyezi, but became chief. He has many wives. On his return by the same route

[1]This department is edited by W. W. Lockington, Rugby, England.

that he had entered, Mr. Sharpe explored the salt-swamp, and found it rich in large game. Lake Bangweolo is placed at 4260 feet above sea-level; thus, as the sources of the Chambezi are only 4400 feet, the fall of that river must be very slight. Our traveller states that the practice of maiming the person is rife among the natives southwest of Tanganyika, among whom the Wa-Wemba are perhaps the worst in this respect.

The visitor to Mshidi from the west, was Lieutenant Paul Le Marinel, the service of the Congo State. The route necessitated the crossing of the Sankuru, Lomami, and Lualaba basins. The first is situated further to the east than has before been supposed, and the travellers discovered the Luembe, an affluent of the Lubilash, itself a tributary of the Sankuru. The source of the Lomami was found in 8° 45′ S. and 24° 55′ E. long; the river occupies a long narrow basin, running almost due north and south for 750 miles. During the whole of this course it does not stray more than a degree from a straight course, and it receives only two important tributaries, the Lurimbi and the Lukassi. South of the plateau in which the Lomami rises, is a district named Samba, with a most European aspect. Marinel gives Bunkeia as the name of Mshidi's capital. East of the Lualaba the country is mountainous.

African Notes.—One of the chief discoveries of Dr. Stuhlmann, who last year accompanied Emin Pasha into his old Equatorial province, was the river Kifu, which is stated to have a course of 250 miles before it falls into Lake Albert-Edward, and is thus the most southerly source of the Nile yet known. Dr. Stuhlmann started from Kafure, on the Muta, a tributary of the Kangere, on the west shore of Victoria Nyanza, descended to the Kagere, then crossed the Mpororo Mountains to the Ruchuru and to Lake Albert-Edward (Mwutanzige) at Vichumbi (0° 44′ S., 2850 feet). The country to the south was a vast savannah with mountains in the distance, among which Kisigali, 13,000 feet, seems to be the highest. Beyond this is the active volcano of Virungo Viagongo. Along the west shore of the lake the mountains approach almost to the edge. From Karevia he attempted to ascend the snowy mountain (probably a peak of Ruwenzori), and reached 12,500 feet. He found bamboo and grasses from 3850 to 5350 feet; colocasia beans, grass, and the upper settlements up to 6700; then deciduous forests with Erica and bamboo to 8530 feet, followed by a belt of Erica and Vaccinium to 11,800, above which, to the snow line at 13,000 feet, the vegetation was reduced to mosses, lichens and

Senecio. The plateau west of Lake Albert is known as Lendu. He reports a considerable shrinkage of the waters of the Albert Nyanza since it was first discovered, so that islands have become peninsulas.

M. Crampel and his party was set upon by Snoussi and his fanatical Arabs, who killed all the whites, asserting that they had no business in the country, but did not hurt the Senegalis who composed his escort. M. Nebout, who was coming up, carried back the sad news, and the fate of Crampel was avenged by M. Dybovski, who entered the country with a considerable force.

On the Mobangi, Captain Van Gele has "forged the last link" between that river and the Welle, which is thus definitely included in the Congo basin.

The Kong Mountains of the maps have been found to have no actual existence, proving to be but an elevated watershed.

The Italians are endeavoring to explore Somaliland, but some of their recent expeditions have not been successful. Captain B. de Vesme, however, passed from Berbera by Harrar, over the waterless plains of Milmil to the rivers Kishen and Amaden, and then to the upper course of the Webbe.

America.—The Ecuadorian Andes.—Dr. Wolf, who has devoted much time to the study of the Andes of Ecuador, describes them as consisting of two ranges, connected at intervals by cross chains, and thus enclosing basins. The eastern cordillera is as a whole more prominent, geologically older, and of greater average height than the western, the rocks of which are much more heterogeneous, while its elevation exhibit greater diversity and irregularity. A porphyritic cross ridge at the mountain knot of Acayana and Guagrauina has much gold-bearing quartz, and is the richest mining district of the country. From this the eastern cordillera continues onward, broad and lofty, into the province of Cuenca, with a wide bend, and a second cross ridge of porphyry forms the knots of Portete and Tinajillas. The lofty basin of Cuenca is one of the most beautiful in the Andes, and the chief town is situated at an altitude of 8460 feet. North of there is the irregular mountain mass of Azuay, which sends spurs in every direction, two of which reach the western cordillera. Beyond this the eastern cordillera becomes of greater extent, and rises into the gigantic volcanoes of Sangay (17,880 feet), the most active volcano in the world, Altar, or Collares (17,710 feet), and Tunguragua, (16,696 feet). Opposite to these, on the western cordillera, rises the still loftier Chimborazo (20,660 feet). Here commences a third cordillera, parallel with and

geologically resembling the western range. The waters of the Lacatunga basin flow south and burst through the eastern range. The drainage of the basins of Quito and Ibarra goes to the Pacific. The western cordillera, by the Quito basin, is quite low, not more than 10,000 feet, but is raised by superimposed volcanic rock into the lofty volcanoes of Corazon, (15,804), Atacoza, (14,390) and Pichincha. The eastern cordillera is here more complicated, and bears the giant volcanoes of Cotopaxi (19,480), Sincholagua (16,360), Antisana (18,885) and Cayambe (19,450). Northward the eastern range is continued into Columbia, increasing in height and breadth, but without any volcano north of Cayambe. In the province of Quito the western range rises into the volcanoes of Cotocachi (16,295) and Yanaurai (14,000.)

Both Dr. Wolf and Mr. Whymper describe travelling in the Ecuadorian Andes as depressing in the extreme. The lower regions, up to ten thousand feet, are thickly covered with a forest, within which it rains forever, the home of fever and dysentery. The higher regions are relatively healthy, but past expression dreary, all the more or less rounded heights being covered with coarse brown olive paramo grass, and presenting quite a contrast to the picturesque ruggedness of the Alps. These bleak paramos, as the tracts 10,000 feet or more above the sea are called, are poorly populated and badly tilled, while the huts are windowless and the people in rags. Here and there are fertile valleys with forest in sheltered spots. The temperature has little variety, ranging from 39° to 46°.

Mr. Whymper describes the climate of the paramos as a perpetually wet afternoon, and speaks of Chimborazo as a long extinct volcano, and states that the existing centres of volcanic activity are Cotopaxi and Sangai. The whole of the Andes of Ecuador are, according to Dr. Wolf and Mr. Whymper, situated more to the east than they are shown on Humboldt's and other maps.

The Ucayali.—The Ucayali, generally considered the leading affluent of the Amazon, has been found to be navigable for 1040 miles. The junction of the Perene with the Ene forms the Tambo, and that of the Tambo with the Urubamba forms the Ucayali. The Perene, which curves westward toward the Andes, can be navigated ten miles above its junction with the Ene, while the Huallaga, a large tributary to the north, can be entered by large steamers to 100 miles from its mouth. Iquitos, on the Amazon, on the frontiers of Peru and Brazil, is 350 feet above sea level, the mouth of the Ucayali 370, that of the Tambo 800, and that of the Ene 1000 feet. The native population of

the Ucayali Valley, according to Col. Church, is not more than forty thousand, and this is as many as can be supported with their modes of life. Life is not plentiful ; fish are scarce in the waters, and in correlation with this, birds are not abundant. The natives cannot procure iron. The eastern slopes of the Peruvian Andes are clothed with thick forests, among which cinchona trees abound.

Asia.—The Pamirs.—During the last few years much has been written about the Pamir, a region the very name of which was unknown until recently. Many travellers have found their way across this now celebrated plateau, or rather congeries of plateaux, which may be considered to form the western and narrower end of the great Tibetan table-land, the knot, in fact, from which the bounding ranges of that plateau take their origin. Among its late visitors have been the Frenchmen Bonvalot, (in company with the Prince of Orleans), and Sauvergne, the Russian Grombchevsky, the Englishmen Younghusband and St. George Littledale, accompanied by his wife. The main object of the latter seems to have been the destruction of *Ovis poli*, yet they could scarcely avoid adding to our knowledge of this not readily accessible tract.

The Pamir, or rather Pamirs, for there are several, the Little Pamir, the Great Pamir, that of Tagh-dum-bash, Alichur Pamir, and Sarikol, consist of a series of flat valleys surrounded by mountains, the really lofty crests of which do not rise greatly above the level of the valley streams.

The Pamir is situated at the junction of three great empires, and the ownership of the comparatively barren region may lead to war. The lake on the Great Pamir has been named Victoria Lake, but is called by the Kirghis, Gaz Kul, a name also given to two or three other lakes. Victoria Lake is 13,980 feet above sea level, while the Khargash Pass to the north is 14,500 feet, and the Andenin Pass, between it and the Little Pamir, 15,500 feet. The Pamir River from this lake flows west into the Wakhan, which seems also to bear the name of Kala-i-Panj, and which, after its junction with the Murghab, becomes the Amu-Daria or Oxus. The Little Pamir Lake is said to be 13,850 feet above sea level, and its outlet is by the Aksu, which, after running northeast until it has rounded the Great Pamir, unites with the Aik Bailul to form the Murghab affluent of the Oxus, flowing through Roshan Valley. Between the westerly courses of the Wakhan River and the Murghab flows the Ghund-Dara, the chief sources of which seem to be Lake Yashil-Kuhl and the Alichur River—the valley of the Ghund-

Dara is known as Shignan. Littledale's encampment on the Alichur Pamir, was at a height of 13,625 feet. Lake Kara Kul, north of the Akru-Murghab, is 12,400 feet above the sea.

East of the Great and Little Pamirs are Tagh-kum-bash and Sarikol, the streams from which, among them the Markhan-su, flow into the Kashgar and Yarkand Rivers, and thus geographically fall to China, which has, in fact, raised her banner on the Sarikol plateau. The two maps which have been published in the Proc. Roy. Geog. Soc. during the past year exhibit differences in the course of these affluents.

The important range of the Hindu Kush separates the Chitral and Hunza district from the Pamir and more northern valleys. This range is crossed by the extraordinary depression, two to three miles wide, known as the Baroghil Pass (12,480 feet). Through Chitral Valley flows the Yarkhun River, rising in a small lake bearing the title of Gaz Kul, and flowing somewhat south of west toward the Indus. Close to this Gaz Kul, even if not occasionally united with it, is another small lake, from which issues the Karambar River, which with the Gilghit and Hunza Rivers, join the higher course of the Indus, where it flows toward the west, before bursting through the Himalayas. The western part of this Indus-draining region is known as Chitral, and is situated at an average elevation of 5200 feet on the southern slopes of the Hindu Kush, amid spurs from fourteen to twenty-five thousand feet above sea level. On the south it is bounded by the petty States of Asmar and Dir. The valley is reputed to be very fertile, and is said to have a population of a hundred and fifty to two hundred thousand, without reckoning the Bushgali Kafirs. The Mehtar or Badshah of Chitral, is said to be able to bring into the field 6000 fighting men, all careful marksmen. Chitral, about 150 miles from the town of Gilghit, is an aggregation of six large villages situated along the river, which in the Geographical Journal is called the Kashkar. The names Yarkhun and Kashkar seem to be identical with the Yarkana and Kashgar of Chinese Turkistan.

Mr. and Mrs. Littledale reached the Pamir region via the Russian Trans-Caspian railway. The route from Samarkand to Marghilan, the capital of Kokhand, is described as an alternation of barrenness with gardens of Eden. Continuing southward, they followed the Gulcha River and crossed the Alai plateau over the Little Alai range. Through the passes of Taldik (11,600), Shart (12,800), Terek (over 12,000), Kalin Art (10,800) and Kizil Art (14,200), they reached Kara Kul Lake, and then, after encamping within sight of Lake

Yashil Kul, crossed the Great and Little Pamirs, and proceeded through Baroghil Pass to Chitral, Darkot and Yasin, whence they made their way to Gilghit. From the Great Pamir they enjoyed a view of magnificent mountain peaks over 20,000 feet high. They describe the Pamirs as flat valleys, with lakes having low shelving banks; barren areas with little grass. In Chitral the climate was much better, the warmth and the abundance of apricots contrasting sharply with the barren coldness of the Pamirs.

D. W. Freshfield thus speaks of the Pamirs, after stating that the different strips of table-land form a district 280 miles long, from 120 to 140 wide, and twelve thousand feet high, "tent-shaped glacier-covered mountains divided by broad easy gaps, bare heights naked of verdure and shorn of forests by bitter winds and frosts; desolate lakes, a region which for the most part has neither fuel nor food; an Engadine of Asia, with nine months of winter and three months of cold weather; the home of wild sheep and that of a few wandering shepherds; nomads' land if not no man's land." The Chinese name for the district signifies the "half-way house to heaven," while the word "Pamir" appears to be a Turki term for a plateau. Grombchevsky gives a more favorable account of the district. Wakhan, Shignan and Roshan are at present claimed by the Amir of Afghanistan. Mr. Younghusband found his way to Hunza in 1889 and to the Pamirs in 1890. Between Leh and Hunza, or Kanjut, four passes, from 17,500 to 18,500 feet high, must be crossed, amid glaciers and the grandest scenery. The home of the robber Kanjuts, or Hunza, (in which latter name some think to find the origin of the Huns), is eastward of Chitral. The villages of the Hunza are stone-walled forts, the entrance into which would be difficult if resisted. The sovereign, who made his way to power in good old Oriental fashion, by the murder of his relatives, owes allegiance to the Maharaja of Kashmir. The Taga-dumbash Pamir descends as low as to 800 feet.

Another recent traveller in this region is the Frenchman Dauvergne, who entered by Srinagar and Leh, over the Karakoram Pass to Sanju Kurgan, took a new route to the sources of the Oxus, crossed Baroghil Pass into Chitral, and then through unexplored passes found his way into Karambar Valley, and via Gilghit back to Srinagar. Beyond Kilian Pass (17,450), at Namelong, Dauvergne turned west and reached Kugiar Valley by the following passes, Namelong (12,140), Saraghar (13,250), Tuslar Dawan, (14,500), Tupa Dawan (15,400), (a great opening in a chain parallel to the Kuen Lun, not yet marked on the maps, with peaks sixteen to nineteen thousand feet in height); Sanich

Dawan (16,170), and Kichokin Dawan, a double pass, 15,300 feet above sea level. The Tisnaf Valley, Egisarak Kurgan, where copper is found, the village of Langar on the Zarafshan, an affluent of the Yarkand, are other points in his journey. He followed the Zarafshan to its junction with the Tung, and then turned S. S. W. to the plateau region, where he reached 16,350 feet. According to him, the real sources of the Oxus are those of the Panjah. The difficult Karambar Pass was crossed with ten horses.

Australasia.—The Glaciers of South New Zealand—The glacier region of the southern island of New Zealand has been to a great extent explored during the last thirty years. The smaller glaciers, which lie north of the larger, were first visited, the earliest visit to the latter being that of Sir J. von Haast in 1862. After his exploration of the headwaters of the Godley and Tasman rivers, came the visit of E. P. Seely between 1867 and 1870. Little more was done until 1882, when the Rev. W. S. Green almost ascended Mt. Cook, the loftiest peak of the region (12,349 feet). Dr. Lendenfeldt followed next year, and ascended Hochstetter Dome (9,258 feet). Since that year many ascents have been made by G. E. Mannering, Dixon, Johnson, Inglis, Brodrick and A. P. Harper, the contributor of a notice to the Royal Geographical Society. From the account and accompanying map it may be gathered that there is a great difference between the conditions, character and scenery of the eastern and western parts of the range. The glaciers of the east slope descend gradually from elevations of 5,300 to 8,600 feet to their terminations, 2,354 to 2,882 feet above the sea; the comparatively flat surface of their ice is hummocky, and for about a quarter of the length of the glaciers is covered with a considerable quantity of rough moraine; the old lateral moraines of these eastern glaciers are also distinct, especially that of the Hooker glacier, where in one part there are no less than five. On the Mackenzie plains terminal and lateral moraines have been followed for forty miles. The glaciers of the east slope have been tolerably well explored; the principal ice sheets are Tasman, 18 miles long, 1.25 to 2.14 wide, and covering 13,664 acres; Murchison, 5,800 acres, and eleven miles in length; Müller, 3,200 acres, and eight miles in length; and Hooker, 2416 acres, and seven and a quarter miles long. North of these lie the Classen glacier of 1,707 acres, 4.70 miles long, and Godley glacier, covering 5,312 acres, extending over eight lineal miles. The Aletsch glacier of Switzerland is fifteen miles by about a mile, and thus is inferior in dimensions to the Tasman glacier.

The western slopes have not yet been thoroughly explored, but it is known that they are subject to a very large rainfall, amounting to about 120 inches against 25 or 30 on the eastern slope. Though Mt. Cook is nearer to the equator than Switzerland, the glaciers descend some 3,000 feet lower than in that country. The Fox glacier, indeed, on the western slope, descends to 700 feet, and one or two others to less than 1,300 feet. These western glaciers are steep ice-falls to a short distance from their terminations, and their surfaces are almost free from moraine stuff—in consequence of the steep dip and smooth surface presented by the rock strata on this face, as compared with the jagged edges on the east slope. The lower parts of the Fox glacier, and of some others on the west, is overhung by tree-ferns and bushes growing almost on the moraine, and near to the terminal face of the Fox issues a hot spring with a temperature of 100°. A phenomenon of the same kind, on a larger scale, occurs at Mount Ruapehu (9,100 feet) in the northern island. This mountain is covered with snow and ice to the summit, where is situated a boiling lake, into which the ice melts.

These glaciers seem on the whole to be receding, especially those at the head of the Rangitata River, but last year the Müller advanced so as to dam up the Hooker River, and the Ball glacier is certainly advancing. The daily rate of flow varies; on the Ball it is from ten to eighteen inches, on the Murchison from 2.6 to 8, on the Hooker very slight, on the Müller from 3 to 12.

In 1890 Mannering and Dixon discovered that the loftiest peak, Mt. Cook, was not situated on the main range, but on its eastern side, so that it sends no water to the west coast. The next most lofty peaks are Dampier (11,823), Tasman (11,475), and a peak which bears no title on the map, though it reaches the altitude of 11,844 feet. There are several other summits that attain above ten thousand feet. The writer states that he has not seen vegetation at above 6,200 feet, and that 6,500 may be considered the highest limit. The flora is not so varied as that of the Swiss Alps.

Europe.—The Caucasus.—The Caucasus still continues to be a favorite region for Alpine exploration by English and other clubs. Mr. D. W. Freshfield, himself an ardent climber, from time to time contributes a note to the Royal Geographical Society. In one of these it is mentioned that new maps show in the central Caucasus one peak over 15,000 feet, nine over 14,000, and five others over 13,000, also that in Suanetia four elevations of more than sixteen thousand feet are known, two over 15,900, three more over 15,000, and three over 14,000.

The Ossete villages, built upon summits, are stated to abound in interesting antiquities.

The Black Sea.—A hydrographical exploration of the Black Sea, recently conducted by the Russian Government, has proved that the waters of that large area exist under anomalous conditions. The 100 fathom line follows the coast outline closely save in the north-west where it crosses with a slight northern inflexion, from Varna to the Crimea. From this the bottom descends at the tolerably steep gradient of twelve degrees to a depth of 800 fathoms, and from thence with a slighter inclination to 1,200 fathoms. The 1,200 fathom line encloses an oval in the center, with 1,219 to 1,227 fathoms as its greatest depths.

The upper stratum of twenty-five fathoms changes in temperature with the seasons; between this and 100 fathoms the coldest water, as low as 44° is found, while below 100 fathoms the constant temperature is 48°. In August the upper surface of the cold layer sinks to from thirty-five to fifty fathoms. The vertical circulation of the water is limited to the upper one hundred fathoms, and there is no trace of organic life below this level. The lower layers contain much sulphuretted hydrogen, besides sulphates of alkaline and earthy metals, yet the principal reason of the absence of life is probably the deficiency of oxygen in a dissolved state. The bottom from ten or twenty to a hundred fathoms is covered with a light gray mud; from 100 to 800 fathoms the mud is dark gray, and at greater depths it assumes a bluish tint through the prevalence of carbonate of lime. Remains of brackish water mussels, of which species some still live in the Caspian, while others inhabit the rivers flowing into the Black Sea, are found at depths of from one to six hundred fathoms. It has been assumed that at the beginning of the Quaternary and end of the Pliocene periods, the Black Sea was a brackish lake, without any communication with the Mediterranean, and that at the end of the glacial period the very salt waters of the Mediterranean bursting in through the newly opened Bosphorus, accumulated at the bottom, prevented circulation, and annihilated the brackish water fauna.

The Mediterranean.—The depths of the eastern Mediterranean have been explored by the Austrian expedition in the *Pola*. A depth of 4,400 metres was found in 35° 44′ 20″ N., and 21° 44′ 50″ E. long., at a distance of only about fifty knots from Cape Matapan. A few miles farther eastward 4,080 metres was found—these are the greatest

known depths in the Mediterranean. Between Candia and Alexandria 3,310 metres was found twenty miles south-east of Grandes Bay, and this depth gradually diminished to the east, to 2,120 metres near Alexandria.

The Polar Regions.—Dr. Nansen's Voyage.—The opening article of the Geographical Journal for this month is a reprint of the address read before the Royal Geographical Society on November 14, 1892, by Dr. Fridtjof Nansen, the adventurous traverser of Greenland, and the daring aspirant to the honor of reaching the North Pole by drifting with the currents.

Of the existence of these currents ample proofs were adduced in the course of Dr. Nansen's speech, but of their sufficiency, their regularity, as well as of the character of the region to be traversed, whether largely open ocean, or whether cut up into intricate channels by a maze of islands, the bold argonaut could not say anything convincing.

As proofs of the general course of the currents, Dr. Nansen stated that ships turned back by floe ice drifting southward were carried between Greenland and Spitzbergen, through which passage he estimated that in every twenty-four hours a startlingly enormous quantity of water passed southward; also that other southward currents ran through Smith, Jones and Lancaster Sounds; and that undoubted relics of the unfortunate Jeannette were picked from a floe at Julianehaab three years after she sank near the New Siberian Islands. He believes the regions around the pole to act like an enormous pump, sucking in the water from Bering's Strait and East Siberia, and returning it by the Greenland Seas. Among other facts, he mentioned that several years ago, a throwing-stick of a peculiar form used only by the natives of Port Clarence, Norton Sound, Alaska, was found near Goathaab on the west coast of Greenland, also that the driftwood which reaches every year the shores of Greenland and Spitzbergen, is the timber of American and Siberian species. At the New Siberian Islands the ice is thin, while on the east coast of Greenland it is thick, and the speaker maintained that it grew in bulk as it drifted across the pole.

Specimens of mud, collected by Nansen from floes between Iceland and Greenland, had been examined by Dr. Tornebohm, of Stockholm, who had come to the conclusion that it consisted of mud from the great Siberian rivers. Dr. Cleve, of Upsala, had also examined the dust from the snow of these floes, and had identified sixteen species of diatoms, all of which were known to be found at Cape Wankarena, near Behring Strait, and twelve of which were only known from there. The pumice

abundantly strewn on some parts of the shores of Norway, Spitzbergen and Greenland, is stated by Bäckström to be andesitic, and must therefore have been derived from some andesitic volcano near Bering Sea—this proves a post glacial communication. A great deal of this pumice is now, probably on account of the rising of the land, at from thirty to seventy feet above sea-level.

In order to guard, as far as possible, against the danger of being crushed in the solid ice, a ship of small size and great strength, yclept the *Fram*, has already been built. She displaces about 600 tons, is large enough to accommodate twelve men with food and fuel for five or six years, and has engines of 160 horse power, enabling her to steam some six knots hourly. The sides slope from bulwarks to keel, so that the pressure of the ice may tend to lift her out of the water (as occurred in the case of the *Tegethoff*); she is broad in proportion to width, pointed at both ends, flat-bottomed near the keel, which is almost covered by the boarding, and has a considerably curved stem. A special point is the arrangement for raising the screw clear out of the water —two reserve screws are to be carried. The sides are planked with pitch-pine, oak, and greenheart to a total thickness of over twenty-eight inches. The length at water-line is 113 feet, and the sailing speed is reckoned at from 8 to 9 knots. The *Fram*, or Forward, was launched at Laurvik, October 28, 1892, and will start on her hazardous cruise in the Spring. She has ten boats of various kinds, including two specially large and strong, intended for the homeward voyage in case the ship should be crushed; a dynamo will also be taken.

The reading of this paper was followed by a long discussion, in which various objections were brought forward by distinguished Arctic navigators. Some of these were successfully answered by Dr. Nansen, who, however, seemed inclined to follow the advice of Captain Wiggins, and to start by way of the Kara Sea, rather than from the New Siberian Islands. Sir George Nares pointed out the danger of disregarding the usual maxim to keep close to shore, and said that several years would be required for the drifting, during the whole of which time the vessel would be in danger. A vessel frozen-in became a solid block with the ice. He accepted the homing current as proven, but doubted the existence of the out-going one, or at least its power to overcome the force of the winds. The largest fresh-water rivers lost all influence at a distance of 200 miles from their mouth. The *Fram*, he said, could not at best expect to reach more than sixty miles north of 76° 30′ before meeting with the ice-pack, and would thus be frozen-in 730 miles from the Pole and 600 from the home current. He believed that

the wind would be more likely to drift the vessel to the west than to the east.

Sir A. Young said that the greatest danger arose from the land. The remains of the Jeannette had probably found their way through narrow channels, in the course of years. He considered the fact that a tame reindeer had once found its way from Siberia to Upernavik, in Greenland, proved the existence of land. The advice of Captain Wiggins was not to wait for a squeeze, but to endeavor to run the vessel on to the top of the ice.

To all these Dr. Nansen answered by a declaration that, as he had abandoned his ships to cross Greenland, so he meant to abandon the coast to reach the Pole; he believed that the winds acted with and caused the currents.

Admiral Sir G. H. Richards, in a written communication states his belief that the enormous ice-cap of the pole, and the weight of snow, cause an outflow in all directions. Solid ice north of 78° is his conception of the Arctic.

Finally Sir J. D. Hooker writes a word of earnest warning. The lines of a ship may be of use in an open pack, but not when forced against land, amongst floes and bergs, or when the vessel is on her beam ends. He then enlarges upon the depressed spirits produced by the long confinement in close quarters, ever in prey to a haunting uncertainty, to say nothing of the risk of scurvy.

General Notes—The Geographical Journal, the first number of which appeared in January, can scarcely be called a new magazine, since it is but the well-known "Proceedings of the Royal Geographical Society" in a new dress, a dress which will, it is hoped, tend to popularize the study of Geography, and thus gain for itself a wider circle of subscribers than was reached by the "Proceedings." One of the most noticeable new features is the more extended reviews of recently issued books, printed in the same type with the principal articles.

Before the outbreak of the war with Chili, a Geographical Society had been founded at Lima, by D. Manuel Pardo. This was broken up by the war, but was again started on April 15th, 1891. The first volume of the "Proceedings" contains much of interest; among other things an article on the phenomenon known as the "Callao Painter," by S. Raimondi, and others on the River Purus, the geology of Huanta, and on the subsidence of Lake Titicaca. The president is

D. Louis Carranza, a physician and a close observer, the secretary of the philologist, G. P. Zegarra.

Among well-known geographers who have passed away during 1892 may be mentioned Bates, the "Naturalist on the Amazon"; Grant, Speke's companion to the sources of the Nile; Lord Arthur Russell, Professor Moseley, and Sir Lewis Pelly, who, while stationed at Bushire, adventurously penetrated in British uniform to the stronghold of the fanatical Wahabis. This was in 1865. At Riyadh he met the blind Saiyid Amir, and was allowed, in appearance, to depart in safety, but on their homeward march the party found that their water-bottles had been poisoned, and suffered agonies of thirst, the only refreshment they could gain being to pour the water over their wrists.

In an address delivered before the Berlin Geographical Society, Professor J. Walther compares the desert regions of America with those of Africa, and finds the similarity greater than is generally supposed. Both are characterized by four distinct types of denudation, gravel beds, sand-dunes, loam regions and salt deposits. In both the mountains rise out of the plains like so many islands, without any intervening debris, and in both the "amphitheatre" formation is common. Both exhibit the denudating powers of heat and dryness, the first splitting the rocks into fragments, while the dry winds whirl the dust into heaps. No doubt water, even here, is the chief agent, but it has not more than sixty days in which to accomplish its work. The chief difference between the American arid lands and those of North Africa is the steppe vegetation of the former.

GEOLOGY AND PALEONTOLOGY.

Geology of Eastern Siberia.—The *Investia* of the East Siberian Geographical Society (Vol. xxiii, 3) contains an account of M. Obrutcheff's further researches in the Olekma and Vitim highlands. In the northeastern part of this region the author found a further continuation of the "Patom plateau"—that is, a swelling from 3500 to 4000 ft. high, devoid of trees, with ridges and mountains rising over it to heights of from 5000 to 5600 feet. They consist of granite and crystalline schists, probably of Laurentian age, covered with younger, probably Huronian, gneisses and schists. The other parts of the highlands consist of Cambrian and Ordovician deposits, while Silurian limestones and Devonian Red sandstones are met with in the Valley of the Lena. We thus have a further confirmation of the hypothesis, according to which the great plateau of northeastern Asia is a remnant of an old continent which has not been submerged since the Devonian epoch. Further traces of mighty glaciation have been found in the southeastern part of the region. As to the gold-bearing deposits, they are pre-glacial in the south and post-glacial in the north. The high terraces in the valleys are indicative of a considerable post-pliocene accumulation of alluvial deposits, and of a subsequent denudation on a large scale. (Nature, Jan. 12, 1893).

Geological Features of Arabia Petræa and Palestine.—At a recent meeting of the London Geological Society, the following communication was read by Professor Edward Hull on the Geology of Arabia Petræa and Palestine:

The most ancient rocks (Archean) are found in the southern portion of the region; they consist of gneissose and schistose masses and are penetrated by numerous intrusive igneous rocks. They are succeeded by the Lower Carboniferous beds of the Sinaitic peninsula and Moabite tableland consisting of bluish limestone with fossils, which have their counterparts chiefly in the Carboniferous limestone of Belgium, and of a purple and reddish sandstone (called by the author "the Desert Sandstone," to distinguish it from the Nubian Sandstone of Cretaceous age), lying below the limestone. The Nubian Sandstone, separated from the Carboniferous by an enormous hiatus in the succession of the formations, is probably of Neocomian or Cenomanian age, and is succeeded by white and gray marls, and limestones with

flint, with fossils of Huronian and Devonian ages. The Middle Eocene (Nummulitic Limestone) beds appear to follow on those of Cretaceous age without a discordance, but there is a real hiatus notwithstanding the apparent conformity, as shown by the complete change of fauna. In Philistia a calcareous sandstone in which no fossils have been discovered is referred to the Upper Eocene; for the Miocene period was a continental one, when faulting and sliding were taking place, and the main physical features were developed—e. g., the formation of the Jordan-Arabah depression is referable to this period.

In Pliocene times a general depression of land took place to about 200–300 feet below the present sea-level, and littoral deposits were formed on the coasts and in the valleys. To this period belong the higher terraces of the Jordan-Arabah valley. The Pliocene deposits consist of shelly gravels. Later terraces were formed at the epoch of the glaciation of the Lebanon Mountains, when the rainfall was excessive in Palestine and Arabia.

The volcanoes of the Jaulân, Hauran, and Arabian Desert are considered to have been in active operation during the Miocene, Pliocene, and Plistocene periods, but the date of their final extinction has not been satisfactorily determined. (Geol. Mag., Jan., 1893).

The Vertebrate Fauna of the Ordovician of Colorado.—Mr. Charles D. Walcott has recently published a paper on the vertebrate fauna in strata of Ordovician age near Canyon City, Colorado, already noticed in THE NATURALIST. The fossils consist of what appear to be the plates and scales of fishes and the ossified chordal sheath of a fish allied to the recent Chimæra. The remains occur in a sandstone which is correlated with the lower Trenton and the lower Bala of Wales. Microscopic sections of a dermal plate belonging to an *Asterolepis*-like form, examined by Dr. Otto Jaekel, show (1) the dentine tubules that are characteristic of vertebrates; (2) the occurrence of true osteoblasts, which exclude the forms from the Elasmobranchii, and relegates them to other low divisions of the fishes; (3) the absence of enamel and the distinct concentric lamination of the dentine tubules which indicate a low stage of development.

In view of the objections that can be made to a classification based entirely upon the characters of the dermal plates and scales Mr. Walcott has made his classification tentative and has only outlined the characters of the fragmentary remains. For the present, then, the fossils will be known respectively as *Dictyorhabdus priscus*, a supposed chimaeroid, and *Astraspis desideratum* and *Eriptychus americanus*,

rhipidopterygians. It is, however, extremely unlikely that these forms are fishes, but they are more likely Agnatha.—Bull. Geol. Soc. Am., Vol. 3, pp. 153–172. C.

The Loess in Southern Russia.—In his notes on Russian Geology Mr. W. F. Hume gives an interesting account of the Russian Loess, its character and distribution, together with a theory of its origin.

The Russian Loess is a yellowish-brown sandy clay, often rich in grains of quartz and mica, and in many places rich in carbonate of lime and humus. In lies unconformably on all the principal formations. To the west of the Dnieper it conceals the broken and contorted gneisses and granites of the Archean axis in S. Ekaterinoslav and the Don Cossack country it covers the shales and sandstones of the Carboniferous, whilst in the more central governments of Kursk, Karkoff, and Tchernigov it overlies the Cretaceous and the whole Tertiary series. Also along a definite line running to the north of these governments it rests upon the Boulder-clays and sands of the Glacial period. From its general appearance Mr. Hume considers the Loess of Russia to be more or less coeval with that of Central and Western Europe, and the paleontological evidence seems to confirm his view.

In discussing the origin of the Loess Mr. Hume calls attention to the relation, pointed out by Professor Suess between the Loess and the Glacial Drift, and gives in detail the theories of Professor Armachevsky and Baron von Richthofen, neither of which is sufficient in itself to account for the distribution of the Loess.

In conclusion the author gives the following statement of the probacle sequence of events:

1. The Loess particles may be originally derived from the finely ground material resulting from the wearing of the subjacent beds by the ice-sheet.

II. The same have been deposited in tundra-like depressions under the influence of slowly moving waters or by the action of rivers in flood.

III. This deposit under more temperate conditions dried up, and was then suitable material for the redistributive action of the wind.—(Geol. Mag., Dec., 1892).

Sources of the Texas Drift.—Mr. Dumble divides the Texas drift area into four districts. First the Trans-Pecos Texas, the valley of the Rio Grande, and the Rio Grande Divide. The origin of this

drift is traceable to the mountainous region of Trans-Pecos Texas, where nearly every variety of pebble can be found in its original location. Second, the country between the Nueces and the Brazos. This region is covered with pebbles, gravel and sand derived from the rocks found in the Central mineral region. Third, from the Brazos to the Sabine, where the gravel is largely made up of ferruginous material which had its origin in the iron-capped hills which cover so large a portion of Eastern Texas. Fourth, the area known as Northwest Texas according to the survey division. The drift of this region came from the hills enclosing the waters under which they were deposited, viz., Wichita Mountains and the mountains of New Mexico.—Trans. Texas Acad. Sci., Vol. i, 1892.

Archean.—According to Mr. H. V. Winchell, Minnesota possesses the greatest iron district known in the world to-day. It lies in the Mesabi range and extends from the Canadian boundary line in a direction a little south of west, beyond the Mississippi River, a distance of 140 miles. The ore on the eastern end is hard, black and magnetite, owing to the heat of the gabbro overflow. In the central and western portions of the range the ore is soft hematite, limonite and geothite. As to the source of the iron, it is believed by Mr. Winchell to be largely the result of oceanic deposition, both chemical and mechanical, and to have been concentrated in its present situations. (Twentieth Ann. Rept. Minn. Geol. Surv., 1892).—Mr. T. R. Struthers advances the theory that the primitive rocks, *i. e.*, granite, were formed by the cooling of the exterior of the globe under the primeval deep. The pressure of the sea at the depth of two miles would be sufficient to account for the structure of granite. This theory explains the features presented by the bedded or stratified granite of the British islands and many other parts of the world. (Geol. Mag., Dec., 1892.)

Paleozoic.—A skull of *Dinichthys intermedius* recently examined by Professor E. W. Claypole supplies details previously unknown regarding the plates of which it is composed. The especial points of interest are the forms of some of the plates and the over and underlap which has not been represented, and some additions to the structure of the upper jaw. (Am. Geol., Oct., 1892.)—Mr. Herbert Bolton reports a triolobite from the Skiddaw slates of the Isle of Man. The specimen belongs to one of two genera, *Asaphus* or *Æglina*, both of which are Ordovician forms. This in connection with the occurrence of two specimens of Palæochorda (an Arenig form) is strong evidence that

the Skiddaw slates are of Llandeilo age. (Geol. Mag., Jan., 1893).—A species of Cyclus from the Coal Measures of Lancashire, England, is described and figured in the Geol. Mag., Jan., 1893, by Dr. Woodward. The fossil is about as large as a shilling and resembles *C. agnotus* H. von Meyer. Mr. Woodward considers it a new species, and names it *Cyclus scottii.*

Mesozoic.—A new crustacean, *Prosopon etheridgei*, from the Cretaceous beds of Queensland is described by Dr. Henry Woodward. This crustacean is closely related to *P. verrucosum* Reuss, and *P. tuberosum*, von Meyer, two Neocomian species from the Cretaceous of Boucheraus, Dept. Jura. It differs from both, however, in several important points. (Proceeds. Linn. Soc. N. S. W., Vol. vii, 1892).—Mr. R. Etheridge reports a new fossil Phyllopod from the Upper Coal Measures of the Newcastle District, N. S. W., belonging to the genus Leaia. This is the second genus of that family known from the whole of Australia. Mr. Etheridge has named the species *Leaia mitchellii* in honor of its discoverer, Mr. Mitchell. (Proceeds. Linn. Soc. N. S. Wales, Vol. vii, 1892).

Cenozoic.—Mr. J. H. Cooke reports finding the jaw of an Arctic bear, *Ursus arctos* in pleistocene strata of Malta. The fossil, consisting of an entire ramus with its canine and molar teeth, was found in a cavern together with bones of elephants, hippopotami, a stag, and a large dog. (Knowledge, Dec. 1, 1892).—According to Baron DeGeer the Pleistocene changes of level in North America as well as in Europe, are closely connected with the local structure of the earth's crust and with the local extension of the glaciations, and that these changes cannot be accounted for by changes in the level of the sea. (Amer. Geol., Jan., 1893).—M. Bureau has described two fossil plants from the Calcaire *grossier parisien.* The first, called by the author *Aralia eocenica*, is represented by an impression of a leaf remarkable for the slender, long petiole. The second, *Monochoria parisiensis*, resembles strongly certain species of living Monochoria found in India, Ceylon, Malay, China and Japan. (Revue Scientifique, Jan., 1893).

MINERALOGY AND PETROGRAPHY.[1]

The Rocks of the Thalhorn.—In the Thalhorn of the Upper Amariner Thal are found a porphyritic granite, between conglomerates composed of gabbro pebbles in a schistose matrix, and also serpentines, massive gabbro, schists, and various contact rocks. Linck[2] gives a good petrographical description of all these, and geological notes of their occurrence. The main granite mass is a portion of the well-known Kamm granite. It is found in dykes and flows, and it varies in its composition and structure from a typical granitite containing two feldspars, through porphyritic granite and syenite to lamprophyric minettes. The unaltered sediments near the eruptive are graywackes. On the contact with the granite the clastics are altered to knotty schists that are predominantly biotite schists flecked with light spots, consisting mainly of quartz and feldspar in micropegmatitic intergrowths, surrounded by biotite. Extreme alteration gives rise to hornstones, of which the writer recognizes several varieties. In these biotite, feldspar, hornblende and micropegmatite are so orientated as to resemble the poicilitic structure of many diabases and other basic rocks. Hornblende is abundant in them as needles scattered through the groundmass and as large phenocrysts. The conglomerates occupy the greater share of the writer's attention. In one group acid pebbles occur in a sandy or clayey matrix of basic detritus, in which biotite, feldspar and hornblende are new products of alteration. A second group includes rocks made up partly of gabbro material. Here the author again recognizes two groups, in one of which diallage and other gabbro constituents are occasionally present in the groundmass, and a second in which gabbro material forms a very large portion, either of the matrix or of the pebbly portion of the rock. In either case the rock is much altered, with the resulting formation of plagioclase and hornblende. The serpentine of the region was originally an olivine-enstatite rock and not a gabbro as has been supposed.

The New Jersey Eleolite-Syenite.—The New Jersey Eleolite-syenite dyke described by Emerson[3] is again studied by Kemp,[4] who

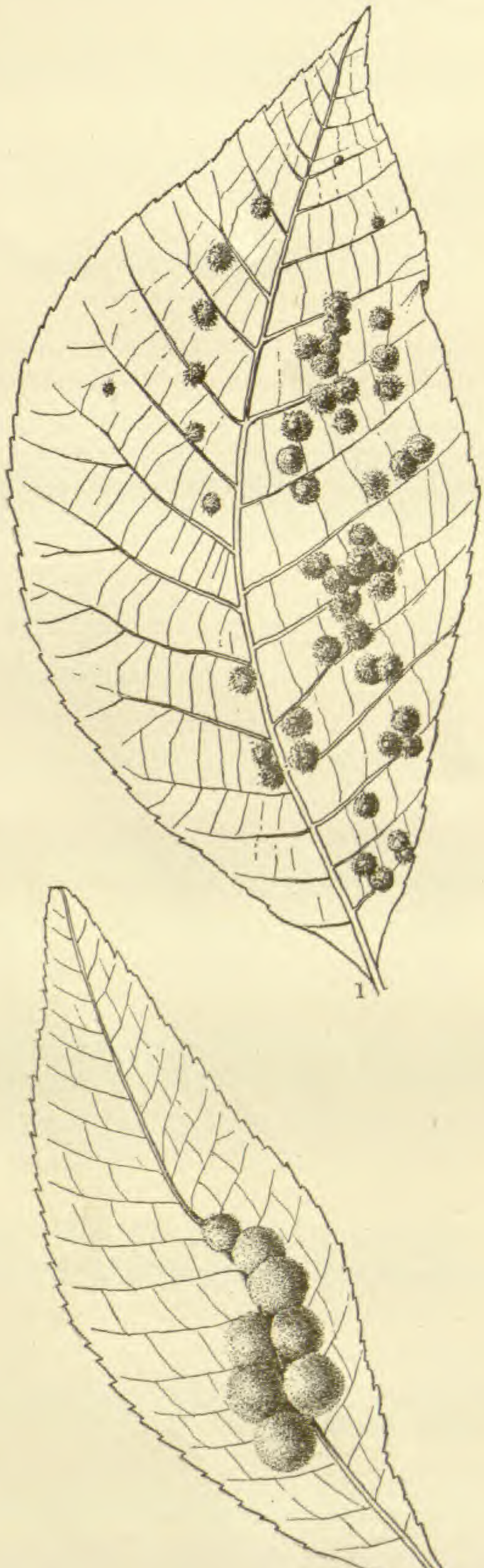
[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Mitth. d. geol. Landesanst v. Elsass-Loth., iv, 1892.

[3]Amer. Jour. Science, iii, xxiii, p. 302.

[4]Trans. N. Y. Acad. Sci., Vol. xi, p. 60.

PLATE III.


1

2

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1. *Cecidomyia holotricha* O. S.
2. *Cecidomyia caryœcola* O. S.
3. *Cecidomyia persicoides* O. S.
4. *Cecidomyia tubicola* O. S.

declares that the earlier description applies only to that phase of the rock occurring in the northern and the southern portions of its extent. The pyroxene throughout the dyke is aegerine. Cancrinite and sodalite are both fairly abundant in it. An analysis of specimens collected from about the point visited by Emerson gave:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	Loss	Total
50.36	19.34	6.94	.41	3.43	not det.	7.17	7.64	3.51	=98.80

Eleolite porphyries with a tinguaitic groundmass are closely associated with the more abundant syenite, and along the eastern side of the great dyke are smaller ones of ouachitite and fourchite. The basic material of these small dykes, when first[5] studied, was regarded as porphyrite. Contact effects produced by the intrusion of the syenite through the surrounding shales are noticed on the east side of the dyke, where the sedimentaries have been changed to biotitic hornfels.

Mica Peridotite from Kentucky.—A mica peridotite[6] from a dyke in Crittenden Co., Ky., is composed essentially of biotite, serpentine, and perofskite, with smaller proportions of apatite, muscovite, magnetite, chlorite, calcite, and other secondary products. The biotite and serpentine constitute about 75% of the entire rock. The mica is in large plates in which are scattered the grains and shreds of serpentine. The composition of the rock follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	CO_2
33.84	3.78	5.88	7.04	5.16	9.46	22.96	2.04	.33	7.50	.89	.43

and small quantities of Cr_2O_3, MnO, NiO, CoO, BaO and Cl. The rock represents a new type of peridotite in which biotite takes the part of an amphiboloid in the more usual types.

Rhyolites in Maryland and Penn.—G. H. Williams[7] has identified an extensive series of old volcanic rocks in the South Mountain region of Pennsylvania and Maryland. The rocks have hitherto been considered sedimentaries, but to the writer they exhibit all the peculiarities of eruptives, though some of the beds are fragmental tufas and breccias. The two principal types are rhyolite and basalt. The former possesses all the features of recent eruptives, such as flowage

[5]Amer. Jour. Sci., III, xxxviii, p. 130.

[6]J. S. Diller, Amer. Jour. Sci., xliv, 1892, p. 286.

[7]Ib., xliv, 1892, p. 482.

lines, spherulites, lithophysae and amygdaloidal cavities. Quartz and an alkaline feldspar are the prevailing phenocrysts, while the groundmass is a quartz-feldspar mosaic. The basalts are much altered, but their structure is clearly that of an eruptive. A detailed account of the rocks is promised later.

The Nepheline and Leucite Rocks of Brazil.—A more careful study of a few of the Brazilian nepheline and leucite rocks undertaken by Hussak[8] has resulted in the discovery of leucite in some of the phonolites, and in the detection of leucite-tephrites containing pseudo-crystals. The leucitophyres consist of phenocrysts of sanidine, augite, nepheline and pseudo-leucites in a groundmass of small zeolitized leucites, augite, magnetite and nepheline. The leucite-tephrites are all characterized by the possession of the pseudo-leucites. In many cases these are nothing but spherical masses of the rock material surrounded by biotite plates. In other cases the biotite surrounds analcite or mixtures of analcite and calcite. The structure of several of these rocks is the diabasic. With these the author would place a rock described by Eigel[9] from the Cape Verde Islands, and the augite-porphyrite described by Kemp[10] from Deckertown, N. J., in both of which traces of leucite are thought to have been discovered. Hussak has also found a leucitite dyke in phonolite near Poços de Caldas, and a leucitite tufa composed of fragments of basalt, isolated crystals of leucite changed to analcite, pieces of augite and crystals of magnetite. The author concludes his paper with remarks on 'pseudo-crystals' combating the view of Derby that they are true leucite crystals filled with inclusions of the rock's groundmass.

The last named writer[11] has examined the Peak of Tingua with some care, finding eleolite-syenite, phonolite and dykes of basic rocks. The syenite and phonolite are thought to be phases of the same magma, as they apparently grade into one another. The phonolitic phase occurs both in dykes and in flows associated with phonolite tufas. The origin of the pseudo-crystals is discussed briefly.

Petrographical News.—Brauns[12] has discovered hauyne in the pumice sandstone near Marburg, a mineral hitherto unobserved in the

[8]Neues. Jahrb. f. Min., etc., 1892, II, p. 141.

[9]American Naturalst, Feb., 1892, p. 165.

[10]See above under 'The New Jersey Eleolite-Syenite.'

[11]Quart. Jour. Geol. Soc., May, 1891, p. 251.

[12]Zeits. d. deutsch. geol. Gesell., xliv, 1892, p 149.

rock because of the loss of its characteristic blue color through alteration. The list of minerals common to this rock and to those of the Laacher See is now complete, so that the belief in a common origin for them is rendered almost a certainty.

C. W. Hall[13] gives a few notes on rocks collected from Central Wisconsin, describing very briefly hypersthene and quartz gabbros in which there is much secondary hornblende, and quartz diorites and gneisses regarded as squeezed gabbros.

A fourchite boulder in which are large arfvedsonite phenocrysts is mentioned by Kemp[14] as occurring at Aurora, Cayuga Co., N. Y. The same author mentions the existence of rhyolite, hypersthene, andesite and andalusite-hornstone from near Gold Hill, Toole Co., Utah.

Spherulites[15] of andalusite occur in the carboniferous clastic schists of Beaujeu, France. The schists are composed of black and white mica fragments in a paste of sericite and hematite.

Turner[16] makes brief mention of basaltic, andesitic and rhyolitic lavas, whose source was the late Tertiary cone Mt. Ingalls, in California.

Crystallographic Study of Diopsides.—Some very careful crystallographic observations have been made by A. Schmidt[17] upon the diopsides of the Alathal, of Achmatowsk, of Nordmark, of the Zillerthal and the Arany-Berg. Many crystals from each of these famous localities were examined, and much new data was obtained concerning the mineral. The following new planes were discovered: $4P\bar{2}$ and $5P\frac{5}{3}$ on the white diopside from Achmatowsk; $\frac{1}{5}P\infty$ on the green variety from the same place; $\infty P6'$ in the Nordmark species; $\infty P\bar{10}$, $\infty P4'$ and $\infty P\frac{7}{5}$ on the nearly colorless small crystals from Schwarzenstein in the Zillerthal, and $\infty P\bar{7}$ and $P\bar{4}$ on the black Arany-Berg mineral. The form $P\bar{4}$ appears in Goldschmidt's 'Index,' but no reference to it could be found by the author in the original memoirs. The axial ratios of the different varieties are:

Alathal.....	$1.0895 : 1 : .5894 \quad \beta = 74°15'47''$
Achmatowsk (white).....	$1.0909 : 1 : .5899 \quad \beta = 74°10'42''$
Achmatowsk (green).....	$1.0951 : 1 : .5985 \quad \beta = 73°31'8''$

[13]Minn. Ac. Nat. Science, III, No. 2, p. 251.

[14]Trans. N. Y. Acad. Sci., xi, p. 92.

[15]Lévy. Bull. Soc. Franç d. Min., xv, 1892, p. 121.

[16]Amer. Jour. Sci., Dec., 1892, p. 455.

[17]Zeits. f. Kryst., xxi, 1892, p. 1.

Nordmark.....	1.0915 : 1 : .5848 $\beta = 74°38'59''$
Zillerthal (colorless).....	1.0922 : 1 : .5887 $\beta = 74°16'28''$
Arany-Berg (yellow).....	1.0945 : 1 : .5918 $\beta = 74°19'38''$
Arany-Berg (black).....	1.0913 : 1 : .5875 $\beta = 74°\ 4'53''$

The optical angle for the Nordmark crystals is $2Vna = 60°44'$, and $C \wedge c = 45°21'$. For the dark Zillerthal diopside $2Vna = 58°56'$ and $C \wedge c = 34°4'$.

Herderite from Hebron, Maine.—A single specimen of Herderite from Hebron, Maine, is described by Wells and Penfield[18] as a few yellowish white crystals on albite. The crystals have a tabular habit, with oP, ∞ P, 3P and $\frac{3}{2}$P the only forms observed. The density is 2.975 and composition :

P_2O_5	BeO	CaO (by diff.)	H_2O	F	Insol.	Total
40.81	15.32	32.54	5.83	.40	5.27	= 100.17

Corresponding to Ca Be (OH) PO_4, or a herderite in which nearly all of the fluorine is replaced by hydroxyl.

Mineralogical Notes—A *calcium carbonate* of secondary origin from the Marble Mountains of Wolmsdorf in Glatz has been analyzed by Kosmann[19] with the following astounding result: Ca $CO_3 = 4.32$; chemically combined $H_2O = 1.54$; mechanically combined $H_2O =$ 94.13. The author believes the mineral to be a hydrated carbonate $CaCO_3 + 2H_2O$ capable of absorbing a large quantity of water, similar to the 'Mountain Milk' of Rose.

The *friedelite* of the Manganese mine of Sjogrube, Orebro, Sweden, occurs in large quantity in clefts, veins, etc., that are partially filled with calcite. An analysis yielded Igelström:[20]

SiO_2	Cl	MnO	FeO	CaO	MgO	NaO	H_2O	Total
34.36	3.00	45.88	1.35	1.50	1.50	2.79	9.00	= 99.38

On the *Azurite* from the Laurion Mts., Greece, Zimanyi[21] has found 28 forms, three of which ($\frac{2}{5}P\overline{\infty}$, $\frac{4}{5}P\overline{\infty}$ and $\frac{6}{5}P\overline{\infty}$) are new. The crystals have the usual habit of the mineral, and they compare favorably in beauty with those from Chessy, Arizona and Utah.

[18]Amer. Jour. Sci., xliv, 1892, p. 114.

[19]Zeits. d. deutsch. geol. Ges., xliv, 1892, p. 155.

[20]Zeits. f. Kryst., xxi, p. 92.

[21]Ib., xxi, p. 86.

Tremolite[22] pseudomorphs after sahlite from the limestone of Canaan, Ct., have the composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
60.98	.10	.12	.19	14.64	23.62	.13	.21

The controversy over the nature of *Melanophlogite* is not yet ended. Bombicci[23] has recently defended himself against the attack of Friedel, and in his defense he accuses his opponent with misquoting him.

New Minerals.—*Ganophyllite*, from Harstige, near Pajsberg, Sweden, is a manganese zeolite[24] that is associated with barite, lead, and rhodonite. It occurs in large brown monoclinic, prismatic crystals, in which ∞ P is combined with the base and the clinodome. $a : b : c = .413 : 1 : 1.831$. $\beta = 86°39'$. On cleavage plates parallel to oP a percussion figure may be produced, one of whose rays is parallel to a and the other two inclined at 60° to this. Plane of optical axes is perpendicular to $\infty P\breve{\infty}$, with c the first bisectrix. 2E (air) = 41°53′ for sodium light, and 2V = 23°52′. The pleochroism is strong $c = A$ = yellow-brown; $a = B$ and $b = C$ = colorless. The density is 2.84 and hardness = 4. A mean of two analyses gave Hamberg a result that may be represented by $8SiO_2 Al_2O_3 7MnO + 6H_2O$.

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	PbO(?)	K_2O	Na_2O	H_2O	Total
39.67	7.95	.90	35.15	1.11	.20	.20	2.70	2.18	9.79	= 99.85

Pyrophanite, described by the same author as occurring in the same mine, is a manganese titanium compound isomorphous with ilmenite. An analysis gave:

SiO_2	TiO_2	MnO	Fe_2O_3	Sb_2O_3	Total
1.58	50.49	46.92	1.16	.48	= 100.63

It is found as brilliant, deep red, transparent tables, associated with ganophyllite. $a : c = 1 : 1.369$. The double refraction is strong, and the indices of refraction for sodium light are $\omega = 2.481$, $\epsilon = 2.21$. Density is 4.537.

Synthesis of the Members of the Sodalite Group.—The minerals of the sodalite group have been manufactured by Morozie-

[22]W. H. Hobbs. Amer. Geol., July, 1892, p. 44.

[23]Bull. d. l. Soc. Franç d. Min., xv, p. 144.

[24]Ref. Neues. Jahrb. f. Min., etc., 1892, II, p. 234.

wics[25] as microscopic crystals. A mixture of 65 parts SiO_2 + 3Aq, 44 parts Al_2O_3 + 3Aq, and 33 parts gypsum, heated in a platinum crucible with an excess of Glauber's salt, yielded tiny cubes and dodecahedra of hauyne or sodalite. When heated with an excess of Na_2SO_4 + Na Cl a substance was obtained that is supposed to be an isomorphous mixture of the two minerals above mentioned, and in addition some sodalite crystals were produced. When heated with Na Cl alone sodalite only resulted.

Methods and Instruments.—A simple method for determining the value of the optical angle in thin sections of minerals is described by Lane.[26] It consists essentially of the measurement of the angular distance between the hyperbolas of the biaxial interference figure by means of the sub-stage mirror.

A cheap form of crystal refractometer constructed on the same principles as the larger Zeiss instrument has been made by Czapske.[27] The height of the complete instrument is only 25 cm. It is suitable for all ordinary refraction work.

An Appendix to the "Gems of North America."—Mr. Kunz has issued an appendix to his valuable 'Gems and Precious Stones of North America'[28] that brings the volume up to date. Most of the material in the appended chapter has appeared in the journals, but some of the information it contains is new. The author states that the sapphire gravels of Ruby Bar, Montana, and the turquoise mines of New Mexico are now being worked by companies that expect their outlay of capital justified by a goodly yield of gem material. The turquoise company has already taken from their diggings about a hundred thousand dollars worth of gems.

[25]Neues. Jahrb. f. Min., etc., 1892, II, p. 139.

[26]Science, Dec. 23, 1892, p. 354.

[27]Neues. Jahrb. f. Min., etc., 1892, I, p. 209.

[28]Cf., AMER. NATURALIST, Dec., 1891, p. 1119.

BOTANY.

An International Botanical Congress.—After careful consideration of all the conditions it has been thought advisable to take steps toward securing an International Congress of Botanists in connection with the meeting of the American Association for the Advancement of Science in Madison next August. Upon the return of Professor Underwood from Genoa with his report of what was done there, as well as of what was left undone, such a Congress seemed a necessity, especially when it was learned that the delegates to the Genoa Congress expected one to be held in America this year in order to complete the work left by them. Moreover, the Columbian Exposition will doubtless bring many foreign botanists to this country during the year, and most of these will attend our scientific meetings whenever it is possible to do so. It seems wise, therefore, to take advantage of these favorable conditions and to arrange for a formal Congress.

After a good deal of consultation on the part of those who could more readily do so, it was suggested that the Chairman of the Section of Botany of the American Association for the Advancement of Science and the President of the Botanical Club (Dr. Wilson) should appoint a committee to take the matter in hand. In accordance with this suggestion notices were sent on Dec. 9 to the following gentlemen with the request that they serve on such committee: J. C. Arthur, L. H. Bailey, N. L. Britton, D. H. Campbell, J. M. Coulter, B. T. Galloway, Conway MacMillan, B. L. Robinson, William Trelease, L. M. Underwood, George Vasey.

It is to be hoped that the heartiest support will be given to the committee in their effort to bring to a successful issue the purpose for which they were appointed.—CHARLES E. BESSEY, *Chairman of Section G (Botany), A. A. A. S.*

Botanical Notes.—Mr. B. M. Davis, in the December number of the "Annals of Botany" describes and figures all the stages of development from the carpospore to the young growing plant of *Champia parvula*, one of the common red seaweeds of both the Atlantic and the Pacific coasts. It is a valuable contribution to the embryology of the Florideæ.—A. P. Morgan describes in the "Journal of the Cincinnati Society of Natural History (October) a singular new fungus of the

family Phallaceæ, for which he proposes the generic name *Phallogaster*. It appears to connect the Phallaceæ with the Lycoperdaceæ; in fact it is difficult to say why it may not be placed near the Puff-Balls rather than near the Stink-Horns. The single species is *P. saccatus*. Specimens have been collected in Ohio, New York and Connecticut, showing that it is not local in its distribution.—In the "Contributions from the U. S. National Herbarium," issued in December, 1892, J. M. Holzinger publishes lists of the plants collected by C. S. Sheldon and M. A. Carlton in the Indian Territory in 1891. The novelties are, a variety (*fasciculata*) of *Solidago missouriensis;* a species of trailing morning glory (*Ipomæa carletoni*) with narrowly lanceolate leaves and large flowers (2 to 2½ inches long) which are solitary or occasionally in twos or threes; and a new Euphorbia (*E. strictior*), with very narrow leaves. Dr. Engelmann's *E. polyphylla*, the description of which has hitherto not been published, is here characterized and distinguished from *E. wrightii*, *E. strictior* and *E. discoidalis*.—In the same publication Mr. Carleton publishes some useful "Observations on the Native Plants of Oklahoma Territory and Adjacent Districts." His observations upon the native grasses are especially valuable.—Mr. B. B. Smyth, of Topeka, Kansas, has published a useful "Check-list of the Plants of Kansas," with especial reference to his proposed distribution of botanical specimens.—The Contributions to American Botany from the Herbarium of Harvard University which the writings of Gray and Watson have made familiar to botanists throughout the world, have been resumed by Dr. B. L. Robinson, the Curator of the Gray Herbarium. His latest contribution consists of Descriptions of New Plants Collected in Mexico by C. C. Pringle in 1890 and 1891, with notes upon a few other species. Among the more notable things is a new genus of Umbelliferæ to which he gives the name *Coulterophytum*, which suggests that the author has taken the hint given by Otto Kuntze in regard to the manufacture of names! *Geissolepis*, a new genus of Compositæ is represented by a single species of prostrate plants from San Luis Potosi.—Dr. Britton, in the Transactions of the N. Y. Academy of Sciences (Nov., 1892), discusses "*Ranunculus repens* and its Eastern North American Allies." He recognizes six species as follows: 1. *R. repens* L., sparingly introduced from Europe; 2. *R. macounii* Hook, Canada and in the Rocky Mountains of U. S.; 3. *R. hispidus* Michx., Ontario to Georgia and west to Michigan, Northwest Territory and apparently to Texas; 4. *R. fascicularis* Muhl., widely distributed; 5. *R. septentrionalis* Poir., eastern Canada to Minnesota, south to Pa. and Ky.; 6. *R. palmatus* Ell., South Carolina, Ga. to Fla.—In a "Prelim-

inary List of American Species of Polygonum" in the *Torrey Bulletin* for December Mr. John K. Small enumerates seventy-nine species. Some changes are made in the nomenclature, and two new species (*P. mexicanum* and *P. pringlei* are described from San Luis Potosi, Mexico.)—"Amherst Trees," by Professor J. E. Humphrey, and "The Woody Plants of Manhattan in their Winter condition," by Professor A. S. Hitchcock, are two pamphlets which indicate the increasing interest in forest trees as constituents of the flora of a locality. The first named is the more popular and treats of many New England trees from the standpoint of the tree lover and the landscape gardener; the second is quite scientific, and is intended to aid the people of the plains (Kansas) to identify trees in their winter state.—A. W. Bennett has published in the "St. Thomas Hospital Reports" (London) a useful paper entitled "Vegetable Growths as Evidence of the Purity or Impurity of Water." He discusses the subject under four heads, as follows: I. Flowering Plants; II. Fungi; III. Algæ; and IV, Characeæ. The presence of the first is "a sign of comparative purity of the water;" of the second of the impurity of the water. The blue-green algæ (*Cyanophyceæ*) "should be regarded as rendering it (the water) unfit for domestic purposes." The chlorophyll-green algæ (*Chlorophyceæ*) are probably innoxious, in spite of the prevalent opinion to the contrary. The Characeæ are regarded as noxious "since when decaying they give off a strong fetid odor, accompanied by evolution of sulphuretted hydrogen gas."

ZOOLOGY.

Allen's Faunal Areas of North America.—In a paper on the Distribution of North American Mammals, Mr. J. A. Allen gives the following tabular synopsis of the faunal areas of North America:

Realms	Arctic.	
	North Temperate.	
	American Tropical.	
Regions	North American.	< North Temperate Realm.
	Central American.	< American Tropical Realm.
	Antillean.	< American Tropical Realm.
Subregions	Cold Temperate	=North American Region.
	Warm Temperate	=North American Region.
Provinces	Humid.	=Warm Temperate Region.
	Arid.	=Warm Temperate Region.
Subprovinces	Appalachian.	=Humid Province.
	Austroriparian.	=Humid Province.
	Campestrian.	=Arid Province.
	Sonoran.	=Arid Province.
Districts	Great Plains.	=Campestrian Subprovince.
	Great Basin.	=Campestrian Subprovince.
	Pacific Coast.	=Campestrian Subprovince.
Faunæ	Barren Ground.	Arctic.
	Alaskan-Arctic.	Arctic.
	Aleutian.	Cold Temperate.
	Hudsonian.	Cold Temperate.
	Canadian.	Cold Temperate.
	Sitkan.	Cold Temperate.
	Alleghanian.	Humid Warm Temperate.
	Carolinian.	Humid Warm Temperate.
	Louisianian.	Humid Warm Temperate.
	Floridian.	Tropical.
	Tamaulipan.	Tropical.

(Bull. Am. Mus. Nat. Hist., Dec., 1892.)

The Madagascar Fauna.—At a recent meeting of the Royal Geographical Society, Canon Tristram made the following remarks on the Fauna of Madagascar:

"Madagascar has an extraordinary natural history. One would suppose, from its position, that this would be African, but it, like its people, is thoroughly un-African. The monkeys and lemurs of Madagascar are not to be found in Africa, while all the great African animals of prey are absent. Among the lemurs is one known as the ayeaye, the formation of whose digits is unique. The botany is almost as peculiar.

"We saw, at the last meeting of the Zoological Society, a specimen of the egg of an extinct bird of Madagascar, which is fifteen times the bulk of an ostrich egg, and yet the bird itself does not appear to have been larger than—as far as we can judge from remains—the New Zealand moa, an extinct bird, to which it had an affinity. This same peculiarity runs through all the birds of Madagascar. Of course, the water-birds and sea-fowl are the same as those of Africa, but there are one or two extraordinary exceptions. There is the snake-bird, a long-necked bird of very great beauty and grace, allied to the cormorant, which it resembles in its habits, and of which there are four species in the world—the Madagascar one is certainly Indian. Then, again, another puzzling bird to naturalists is the *Mesites*, a water-hen peculiar to Madagascar. These birds are usually distinguished by a small tail and a short tarsus, whereas, the Madagascar, which is related to the others, has a long tail and tarsus, and no one, until M. Audebert, thought the bird was allied to the rails. There is a group of cuckoos entirely peculiar to Madagascar—the coua—of which there are nine or ten species, which have no relations at all in Africa or India. Then, in another group, we have a bird allied to the thrushes, but not African, although allied to a species in the Mauritius and all the Mascarene Islands—the *Hypsipetes*. Altogether, we cannot explain the Madagascar Fauna, but it shows that Madagascar must have been separated from Africa for an infinity of ages; and its natural history affinities are certainly rather with India than Africa, and yet they are entirely distinct and peculiar. No doubt there is a great deal more to be found out than we have yet obtained. The most peculiar specimens seem to come from the northwest part, which, I believe, has been but slightly explored. We know less of it than of any other part, and that leads one to hope that we may still have further specimens, and that we may get something which will throw light generally on the Madagascar fauna, which is represented also in the Seychelles Islands, in the Rodrigues, and in Réunion, also in the Mauritius." (Proceeds. Roy. Geog. Soc., Nov., 1892.)

The Nephridia of Amphioxus.—Boveri, in an article[1] which deserves more space than we can give it, describes the nephridia of Amphioxus, and, in conclusion, summarises his results in the following words: There are present in Amphioxus all the elements of the nephridial system of the Craniata, part with the same function (pronephric tubules), part in combination with other functions (peribranchial

[1]Zool. Jahrbücher. Abth. f. Anat. u. Ontog. V., 1892.

chamber=pronephric duct), part in wholly other associations (genital chamber=mesonephric tubules). As in the whole of the rest of its organization, Amphioxus, in its urogenital system, shows in contrast with the Craniata, a condition of simplicity and indifference, which is recapitulated by the latter in their ontogeny.

These facts show that we may recognize the conditions of the excretory and sexual apparatus of Amphioxus as primitive from which the relations found in the Craniata have probably developed. Amphioxus is therefore to be taken from its former isolated position, and it shows itself to be, as in all its other organs, so with reference to its urogenital system actually as the primitive type of the vertebrates, as the true primitive vertebrate.

The Position of the Marsipobranchs.—Prof. G. B. Howes has reviewed[2] the various conflicting views as to the systematic position and affinities of the lampreys and hag-fishes, and reconsiders the various structural points of value in that connection. He points out that these forms must be regarded as aberrant gnathostomata; that their urogenital apparatus with that of the Teleosts is the least modified survival of an hermaphroditic apparatus possessed by the ancestors of the vertebrates; that the sucking mouth of these forms has been secondarily acquired, and is not genitically connected with that of the batrachian larva. The arguments from the hypophysis are also considered and assigned great weight, and the rasping tongue is given a greater value in uniting the lampreys and myxinoids than is the sucking mouth. As a result, dismissing, as shown above the term Agnatha for these forms, Howes divides the Vertebrata proper into Epicraniata and Hypocraniata, basing the division upon the position of the hypophysis; the Epicraniata containing only the Marsipobranchs. He has also a secondary division into Euthorchidic and Nephrorchidic series—the lampreys, Teleosts and Dipnoi belonging to the former; all other vertebrates (except, possibly, some ganoids) belonging to the latter series. He thinks that Haeckel's famous aphorism that the Marsipobranchs "are further removed from the fishes than the fishes are from man," fails to express the enormity of the gap between these forms and the higher vertebrates.

Degeneration of the Clitoris.—In a paper read before the American Association of Obstetricians and Gynecologists at the St. Louis, N. W., meeting in 1892, Dr. Robert T. Morris stated that about 80 per cent. of all Aryan American women have adhesions which bind

[2]Trans. Biol. Socy. Liverpool, VI, 1892.

together the glans of the clitoris and its prepuce. These adhesions may bind down the prepuce so closely that not a particle of the glans clitoridis is in sight. They may involve half of the glans, or they may form only a small band. Adhesions which involve the whole, or a large part of the glans clitoridis cause profound disturbances in the physical and mental health of the individual, and probably form the most common single factor in invalidism in young women.

In compiling statistics upon the subject, Dr. Morris found that preputial adhesions are rare among negresses, and seem to occur only in those possessing a large admixture of white blood.

The author considers the degenerate clitoris a characteristic of the civilized white race. (Am. Journ. of Obstetrics, Vol. xxvi, 1892.)

Zoological News—Reptiles.—Professor O. P. Hay has a valuable paper[3] on the breeding habits, eggs, and young of certain snakes, to which reference must be made by all who wish information on this subject. The same author also notes[4] the ejection of blood from the eyes of the horned toad. The same habit on the part of Phrynosoma has been noted by other observers, but Professor Hay has settled, by microscopic examination, the fact that it is really blood which is squirted out from the outer canthus of the eye.

Dr. Oppel, of Freiburg, i.B., deals[5] with the fertilization of the Reptilian Egg. His observations were made upon *Anguis fragilis*, *Tropidnotus natrix* and *Lacerta viridis*. The article deals with the behavior of the male and female pronuclei and the accessory sperm nucleus, the questions relating to the latter being still left open.

Dr. H. K. Corning, of Prague, deals with some points in the development of the vertebræ and the myotomic cœlom in Anguis and Tropidonotus[6]. The myotomic cœlom persists until after the formation of the neural arches of the vertebræ, hence it is easy to see that the segmentation of the vertebræ results from the formation of inter-vertebral splittings which correspond in position to the divisions between the primitive myotomes. The whole question of resegmentation of the vertebral column is not, says Corning, so simple as has been thought.

The subject of Variation in the snakes of North America, treated of by Cope in a late paper,[7] is taken up by Hay, in his Presi-

[3]Proc. U. S. Nat. Mus. XV., 385, 1892; cf. Proc. Ind. Acad. Sci., 1891, p. 109, 1892.

[4]L.c., p. 375.

[5]Archiv. f. mikr. Anat. xxxix., 215., 1892.

[6] Morph. Jahrbuch., xvii., p. 611, 1892.

[7] Proc. U. S. Nat. Mus., xiv., 589, 1892.

dential address before the Indiana Academy of Science,[8] where he finds in four species of snakes that in *Eutaenia sirtalis* the variation from the average number of body vertebræ amounts to 14 per cent., in *Bascanion constrictor* to 6 per cent., in *Cyclophis vernalis* to 4.5 per cent., and in *Diadophis punctatus* to 13 per cent. In the caudal vertebræ the variations amount to 35, 20, 23, and 23.5 per cent. respectively, while in proportion of tail to body the per cents are 9.4, 28, 25, and 35. Hay states that were breeders interested, they could very soon produce breeds of snakes with long bodies and short tails, and short bodies and long tails, or any other combinations that might be desired. The same author has also some interesting notes[9] upon the systematic names and the habits of the species of *Malaclemys.*

A. J. Bigney notes[10] the occurrence of *Elaps fulvus* in Ripley County (south eastern) Indiana.

Some observations on the growth of the rattle of the rattlesnake are given by Dr. Feokistow, who studied specimens sent him from America. He finds[11] that the rattle is frequently shed, and (his snakes were kept in a very warm room) in three or four months two rattles were present, and that their formation has nothing to do with ecdysis. The snakes were made to register the vibrations of the rattle on smoked paper, and it was found that the vibration was a compound one, consisting of the vibration of the tail as a whole, and of the rattle independently of the tail vibrations. The approximate figures of vibrations are given for the tail seventy-five, of the rattle one hundred and ten per "minute."

Mr. W. E. Taylor has published a paper on the Snakes of Nebraska, giving descriptions of both the adult and the young of every species found in Nebraska, together with remarks upon their habits and peculiarities. (Rept. State Board Agric., 1891.)

At the November meeting of the London Zoological Society, Dr. Gunther read a paper descriptive of a collection of reptiles and Batrachians from Nyassa land, transmitted by Mr. Johnston, containing examples of several remarkable new species, amongst which were three new Chameleons, proposed to be called *Chameleon isabellinus, Rhampholeon platyceps,* and *R. brachyurus.* (Nature, Nov. 17, 1892.)

[8]Proc. Ind. Acad., 1891, p. 37.

[9]Proc. U. S. Nat. Mus. xv., 1892. Cf. Proc. Ind. Acad. Sci., 1891.

[10]Proc. Ind. Acad. Sci., 1891, p. 151, 1892.

[11]Mélanges Biolog. Acad. Imp. St. Petersburg, xiii. Translated in Annals and Mag. Nat. Hist. vi, xi, 54, 1893.

Batrachia—Mr. Stejneger reports a blind Salamander from Rock House Cave, Missouri. This is one of the most interesting herpetological events of recent years, since it is the first and only blind form among the true salamanders. Mr. Stejneger considers it a new genus of the family Desmognathidæ, and gives a preliminary description of it under the name *Typhlotrition spelæus*, in the Proceeds. U. S. Natl. Mus., Vol. XV.

EMBRYOLOGY.

The Star-fish Larva.—Dr. G. W. Field[1] has published a fully illustrated study of the development of our common star-fish obtained at the U. S. Fish Commission Laboratory, at Woods Holl, Mass. Special attention was directed to the mesenchyme, mesodermal pouches, ciliated bands and watervascular system of the larva with a view to, solving the meaning of the echinoderm larva.

The two symmetrically placed outgrowths of the archenteron acquire connection with the exterior by uniting with two dorsal ectodermal invaginations. These invaginations form two water pores, which are both open for awhile. The one on the right closes up. This double condition is not, as has been maintained, an abnormal condition, but as Professor W. K. Brooks showed, a normal and significant fact.

In discussing the application of these and other facts to the phyllogeny of the Echinoderms, the author holds that–"the Echinoderm ancestor was probably a free-swimming animal, in general characters not far removed from the ancestors of the Turbellarians; a creature with a well-differentiated digestive tract, ciliary locomotor apparatus, excretory system, respiratory surface not localized; cœnogenetrically modified by the acquirement of transparency, long arms and particularly by modification of the external form, by changes in the direction of the ciliated bands, as pointed out by Johannes Müller, into the forms characteristic for the various Echinoderm groups."

Germ-layers of Amphioxus.[2]—Basilius Lwoff has recently published a short paper in which he gives the results of his observations on the early stages of Amphioxus so far as they differ from those arrived at by Hatschek.

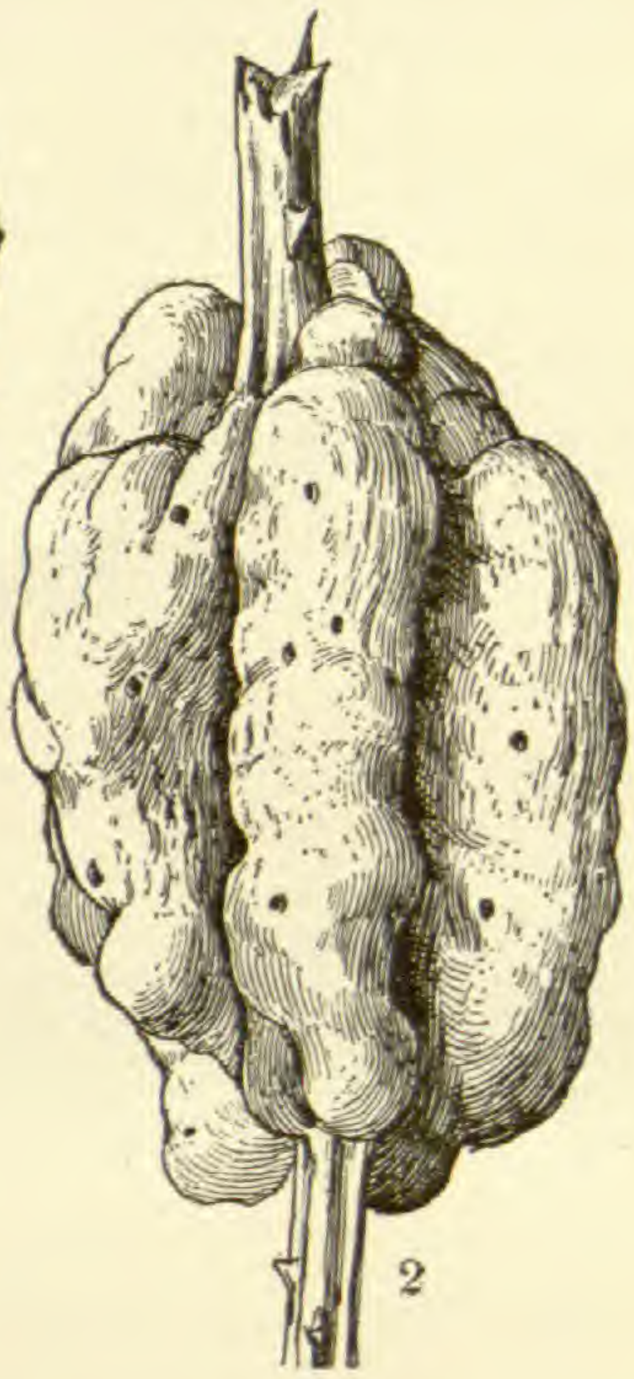
He finds that there is no period of rest at the end of the cleavage, at least as far as the smaller ectoblastic cells are concerned, for they continue to divide frequently. This causes a change in the relative position of the cells at the boundary between the micromeres and macromeres, and results in the passive invagination of the entoblast, ectoblastic cells being the active agents.

[1]Q. J. Mic. Sci. 1892.

[2]Biol. Centralblatt, 12, 1892, pp. 729-744, 8 figs.

PLATE IV.

1



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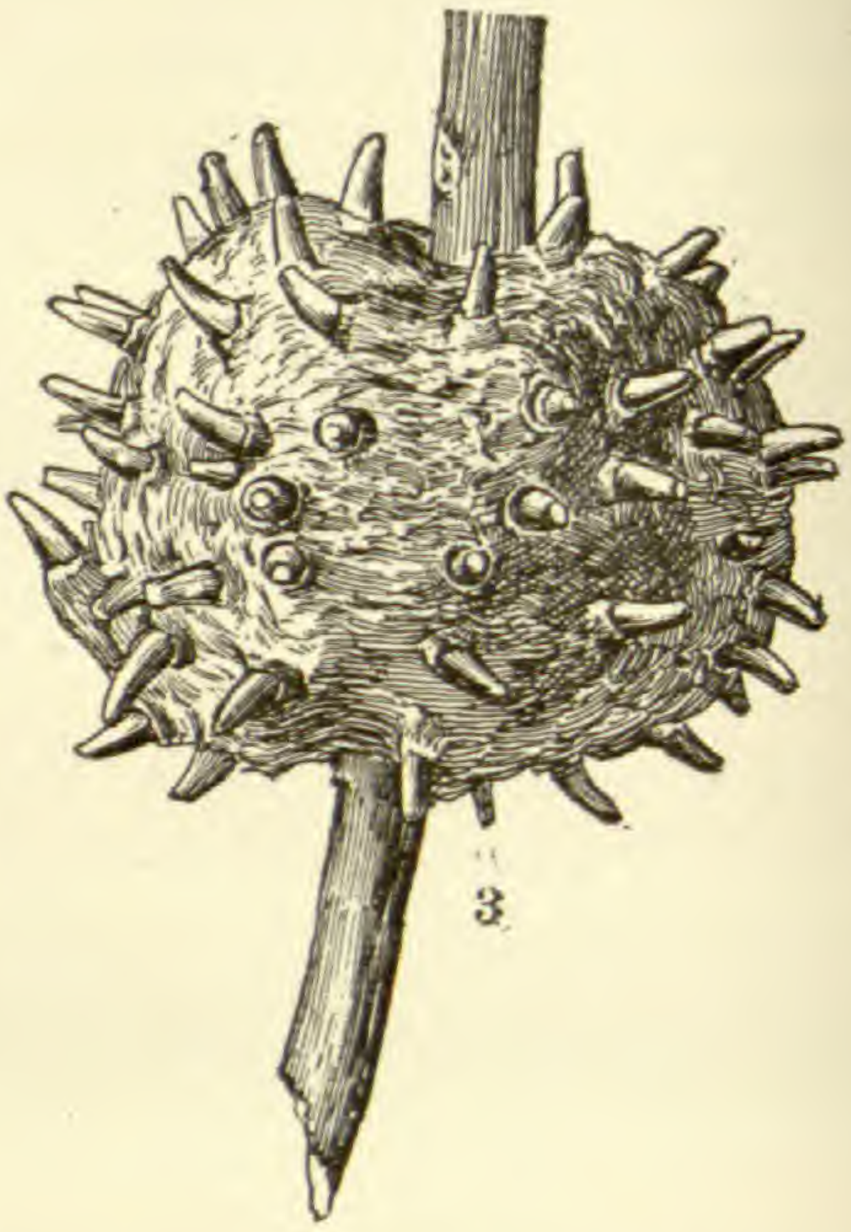

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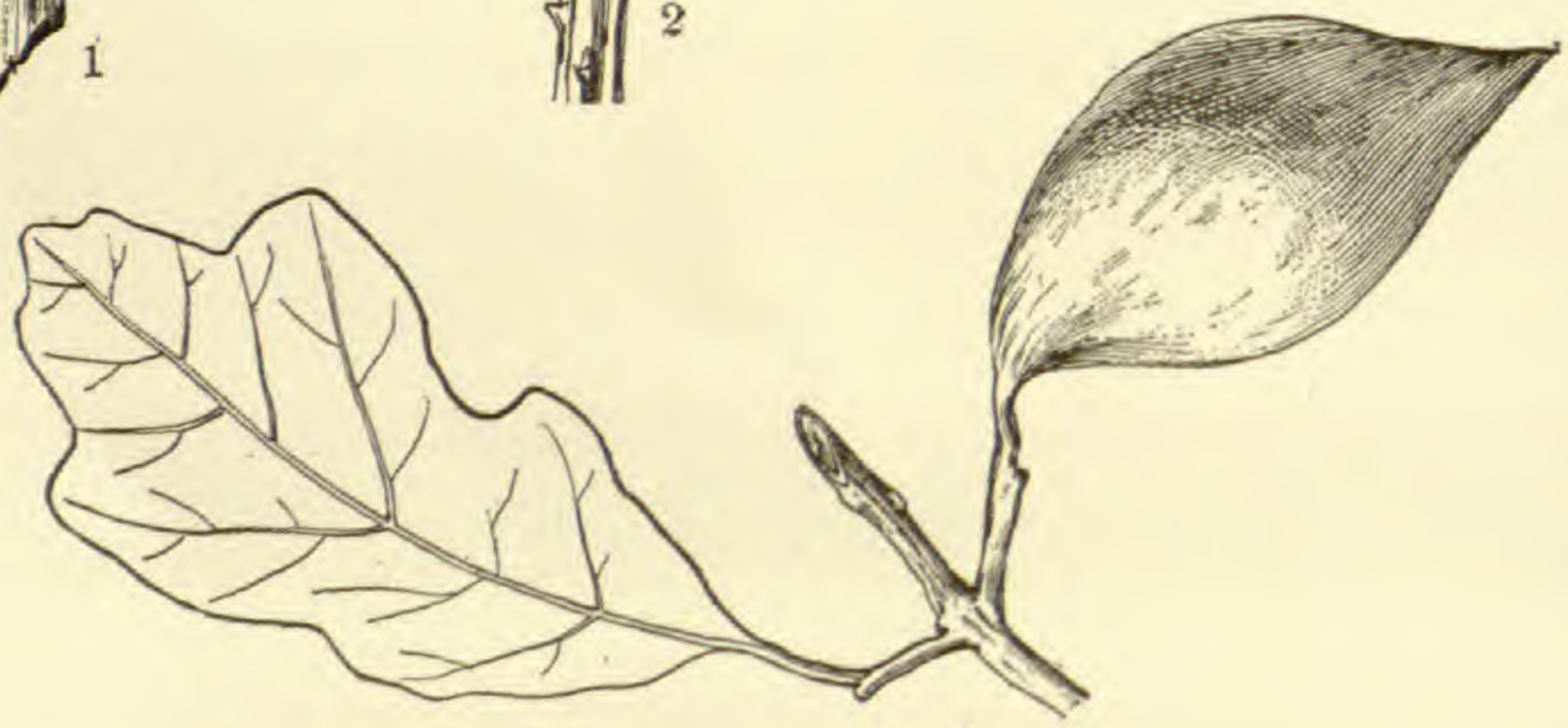


6

5

4

1. *Diastrophus cuscutæformis* O. S.
2. *Diastrophus nebulosus* O. S.
3. *Andricus cornigerus* O. S.
4. *Amphibolips confluentus* HARR.
5. *Amphibolips inanis* O. S.
6. *Amphibolips ilicifoliæ* BASS.

This multiplication of the entoblastic cells is not equal on all sides, however, but is most frequent on the dorsal side of the invagination; so that the ectoblast becomes invaginated itself at this point and pushing the entoblast before it finally forms the roof of the cavity, while the sides and floor are lined by entoblast. At the same time the margin grows backward and the gastrula mouth gradually closes. In this invagination, then we have two distinct processes: first, the invagination of the entoblastic cells from which the gut is formed, (it is a palingenetic process—the gastrulation); second, the invagination of the dorsal ectoblastic cells; this is to be regarded as a cœnogenetic process, that has nothing to go with gastrulation, but is preparatory to the formation of the chorda and the mesoblast.

Lwoff was unable to find the pole cells of the mesoblast described by Hatschek, and it is interesting to note that more recent observations by E. B. Wilson have had the same result. Lwoff points out, moreover, that even if these cells did exist they could have no connection with the mesoblastic bands; the latter are upon the opposite side from the position assigned to the former.

The multiplication of the cells in the medullary plate causes it to fold inward along the median, and it pushes before it the dorsal wall of the archenteron, leaving a mesoblastic fold on each side. The mesoblast is purely passive in its evagination. The inner half of each fold is composed of ectoblast cells from the roof of the gastrula cavity, and the outer half of entoblast from the side.

The lumen disappears in each mesoblastic segment after it has been constricted off from the general fold. Afterward the true mesoblastic cavity, which is to become the body-cavity, is formed by the separation of the cells in the process of their growth. The body-cavity, therefore, is not a true enterocoel.

The chorda is formed from what is left of the ectoblast in the gastrula cavity, aided, perhaps, by the entoblast at the anterior end. The chordal plate becomes folded outward, and the two sides of the fold are pushed together by the entoblastic cells that at this stage are multiplying rapidly to form the dorsal wall of the gut.

R. P. B.

Epigenesis.—In an interesting review of the history of Evolution versus Epigenesis, Prof. C. Hertwig[3] contributes a few experiments upon the eggs of Triton, to those of Chabry, Fiedler, Driesch and others all tending to overthrow the position occupied by Roux and

[3]Entwichlungs-Theorieen, Berlin, 1892.

Watase regarding the pre-formation and early localization of embryonic organs. While Roux held that the frog's egg is a mosaic in which definite regions must become certain organs, the following experiment of O. Hertwig seems to show that this is unlikely in the related form, the Triton.

When the egg of *Triton palmatus and T. cristatus* taken in May and June 1892 was dividing into two cells, a delicate silk thread was passed around it and drawn together so as to gently squeeze the two first cells somewhat apart. This made the egg somewhat dumb-bell shaped.

Each cell divided and finally an embryo with chorda, somites and nerve tube was formed. As the embryo was not formed so as to lie with its left on one of the hemispheroid parts of the egg and its right upon the other, we may conclude that the first cleavage did not divide the Triton egg so as to separate its right-forming from its left-forming material. The right and left halves are not separated by the first cleavage. In fact in one case the thread separated the head from the tail region.

It is only, the author thinks, by understanding the multiplication of the egg as an organism and the gradual interaction of the numerous cells of any stage that we can arrive at a true conception of the epigenesis-like formation of an embryo.

Form and Chemical Composition.—Curt Hebst[4] of Zurich has published a series of experiments made at Naples and at Triest in the endeavor to determine if the form of organic structures is dependent upon their chemical composition. To this end the eggs of sea urchins, (three species were tried), were reared in sea water to which definite, small amounts of certain salts were added. The salts used were LI Cl, Li Br, LiI, Li NO_3, Li_2 SO_4, Na Br, NaI, Na_2 SO_4, Na NO_3, K Cl, KBr, KI, K NO_3, K_2, SO_4, RhCl, CsCl, Mg SO_4 and Ca Cl_2; the results obtained were certain peculiar forms of larvæ, and the explanation adopted for the results was that the salts acted osmotically, not by altering the chemical constitution of the eggs.

Before speaking of the character of the larvæ reared under these abnormal conditions we will first note a few incidental results sometimes seen. One is that in a number of eggs, two blastulæ were seen inside the egg membrane so that separate twins had been formed from one egg. Again it was sometimes observed that only part of the cleavage cells formed the blastula, the rest remaining as an irregular mass within the

[4]Zeit. f. wiss. zool. 55, Dec., 1892.

same egg membrane. These facts favor the views of Driesch as to the equality of the cleavage cells in the echinoderm. Another peculiar result sometimes followed the addition of salts, namely, the production of twin gastrulæ or plutei (without processes) or even of multiple larvæ all to be regarded in these cases as due to *fusion*. The author entertains no doubt, that by some change in the character of the ectoderm cells the larvæ first adhere and then fuse till there are formed complete twins with two separate mouths, ani and (incomplete) skeletal systems, though but a single body space.

Coming to the main results of the experiments, we find that two peculiar larval forms, the *potassium larvæ and the lithium larvæ* may be formed instead of the normal larvæ when salts of potassium or of lithium are added to sea water.

The potassium larva is simply a pluteus with its normal digestive tract and cilia but without the characteristic pluteus processes or arms and with little or no skeleton. As an example of the amount of material necessary to effect this result may be cited one experiment in which eggs fertilized in normal sea water were put into 860 ccm. sea-water diluted by 140 cm. of 3.7% KNO_3 solution. The larvæ lived for fourteen days but had scarcely any or no skeleton and no arms.

The absence of the skeleton is regarded as the chief thing determining the absence of the pluteus arms; these, it is believed, naturally growing as they are constantly stimulated by the growing skeleton. The cells to form the skeleton may be properly arranged, but do not secrete the lime salts to form the skeleton.

This kind of larva may be formed by other salts than those containing potassium. The lithium larva, however, is formed only by salts containing lithium.

This latter form may be described as two vesicles attached to one another by a hollow stalk. One vesicle has a thicker wall and finer cilia on its outside, the other a thin wall and fewer, longer cilia on its outside. This larva is actually formed by the elongation of a normal blastula followed by a partial abstriction into two vesicular portions.

It is regarded, however, as having the morphological value of a gastrula which has grown in an evaginated form so that the thicker walled vesicle represents the entoderm and the other the ectoderm.

One experiment taken at random will serve to illustrate the amount of salts used; to 1950 ccm. sea-water 50 cm. 3.7% LI Cl solution were added; the characteristic double vesicle larva were formed, but all died on the eighth day.

Most interesting differences obtain amongst the various salts of lithium in the strength of their action. If the eggs of the same sea urchin are treated simultaneously with the various salts we find that at a given time the larvæ were not all equally far advanced, equal amounts of the some salts acting sooner than others in producing the lithium larva, and larger amounts of some salts being necessary to produce the same results as smaller amounts of other salts of lithium.

From a table of such experiment the author concludes that Li Cl, Li NO_3, Li Br, and LiI are less and less active in this order which is also the order of increasing molecular weights. Thus in these experiments where the same per centage of salts was always used the heavy molecules were less numerous and less active; the action of these salts in producing the lithium larva diminishes with the number of molecules used. This rule, however, finds an exception in $Li_2 SO_4$.

In Na Cl, Na NO_3, Na Br, and Na I as well as in K Cl, K NO_3, K Br and KI we find again the same rule; the larger number of molecules being most efficient in forming the so-called potassium larvæ, and so on down to the heaviest. The results hold only for salts of the same metal.

Now since it is known from the work of H. De Vries and others that osmotic pressure is associated with the number of molecules in a given volume, increasing with diminishing molecular weight we find so close a similarity between the effects of salt upon larvæ and their osmotic action, that we may conclude, the author thinks, that these effects are due to their osmotic action.

Thus the potassium larva is to be regarded as the result of disturbing those chemical processes which would have normally formed a lime skeleton, and this disturbance is by the removal of water osmotically. Again the lithium larva may be regarded as due to some peculiar impermeability of sea urchin larval cells toward salt of lithium; this produces strong osmotic pressure. The pressure is not regarded as working in a gross mechanical way, but rather as a stimulus that causes the larval cells to grow in an abnormal way.

Though this explanation leaves no room for chemical changes as a source of change of form in these echinoderm experiments, yet the author is inclined to think that in some cases, as in the formation of galls, chemical changes of the protoplasm may cause the changed form that results.

The application of this study in experimental embryology is that the normal course of ontogeny is dependent upon the conditions of osmotic pressure within and without the body.

ENTOMOLOGY.[1]

The Pear-Tree Psylla.—During the last two or three seasons many pear orchards in Connecticut, New York and other States have suffered severely by the attacks of a small jumping plant louse of the family Psyllidæ. This insect is supposed to have been imported from Europe early in the present century, having been first noticed in Connecticut. It now occurs throughout many of the Northeastern United States, and as far west as the Mississippi Valley.

In a recent discussion of this insect in Bulletin 44 of the Cornell University Experiment Station, Mr. Mark V. Slingerland records one of the most notable pieces of entomological work done since the establishment of the stations. After an introductory paragraph indicating the recent losses due to the pest the author considers its past history in America; its place in zoological classification; the indications of its presence; the appearance of the immature and mature insect; its life history in detail, and the methods of preventing its ravages, all of which is followed by a series of technical descriptions and a full bibliography. One of the interesting points brought out is that the species is dimorphic, the summer form having been described as one species, and the winter form as another. Concerning this the author writes:

"This difference between the summer and the winter adults is common among the *Psyllidæ*, and has before led to their being described as different species. It seems not to have been suspected that these insects were truly dimorphic or appeared in two distinct forms during the year. The general impression seems to have been that the adults appearing in the fall were at first the same as the summer form; and that as winter approached these adults gradually assumed the characteristics of the hibernating form. However, frequent observations upon *Psylla pyricola* in the field during August and September, 1892, have shown that from eggs lain about August 20th by typical summer adults, there hatched nymphs which showed no variations from the typical summer nymphs and from these nymphs there emerged about September 25th the distinct hibernating form *simulans*. The hibernating forms feed until the leaves fall and then seek their hiding places in which to pass the winter. None have been seen to copulate in the fall. But very few summer forms were seen after September 20th.

[1]Edited by Clarence M. Weed, Hanover, N. H.

Thus in our Pear-tree Psylla we have a case of true dimorphism. The summer form is the typical *Psylla pyricola,* and may be designated when necessary to refer to this form alone as *Psylla pyricola pyricola;* while the hibernating form should be known as *Psylla pyricola simulans.*"

Experiments showed that the immature stages of the Psylla were easily destroyed by spraying with kerosene emulsion. We are indebted to Mr. Slingerland for the use of the engravings on the accompanying plate, showing the stages and structure of the insect. Fig. 1 represents the adult insect; fig. 2, its head and antenna greatly magnified; 3, the abdomen of the male; 4, the abdomen of the female; 5, the wings; 6, the full-grown nymph, and 7, the egg.

Insects of Southern Alaska.—An important contribution to our knowledge of the coleopterous fauna of Southern Alaska has recently been made by Mr. H. F. Wickham,[2] who has published some of the results of a collecting trip made during the summer of 1891. The points visited were Fort Wrangel, mainland near Wrangel Island, Yes Bay, Loring; Hunter's Bay and Port Chester in Alaska, and the Stikine River Valley and Glenora in British Columbia. From his studies Mr. Wickham concludes (1) "That the fauna of Southern Alaska is less closely related to our alpine, northern inland or northeast coast faunæ than is that of the Stikine Canyon or of Glenora. (2) That the Stikine Canyon fauna is more closely allied to that of the north and east than is that of the coast, and about the same as is that of Glenora. (3) That the chief relations of all three are in the direction of Lake Superior. With larger lists this affinity might turn to the Rocky Mountains, especially in the case of Glenora."

Notes on Ohio and Other Phalangiidæ.—A recent study of a large collection of harvest-spiders (*Phalangiidæ*) from all parts of Ohio shows that the State is unusually rich in these interesting Arachnids. The following species occurred in the collection:

1. *Liobunum vittatum* (Say) Weed.
2. *Liobunum vittatum dorsatum* (Say) Weed.
3. *Liobunum nigripalpis* (Wood) Weed.
4. *Liobunum nigripes* Weed.
5. *Liobunum politum* Weed.
6. *Liobunum longipes* Weed.

[2]Entomology of Southern Alaska, Bull. Nat. Hist. Labrt. Iowa State Univ., V. ii, pp. 202–233.

7. *Liobunum ventricosum* (Wood) Weed.
8. *Liobunum bicolor* (Wood) Weed.
9. *Liobonum* (?) *calcar* (Wood) Weed.
10. *Liobunum maculosum* (Wood) Weed.
11. *Liobunum grande* (Say) Weed.
12. *Liobunum grande* var. *simile* Weed.
13. *Mitopus pictus* (Wood) Weed.
14. *Mitopus ohioensis* Weed.
15. *Phalangium cinereum* Wood.

An examination of more than fifty specimens of a harvest-spider in various stages of development taken along the banks of the Maumee River in Henry County, leads to the conclusion that the form from Illinois described some years ago as *Liobunum elegans* is an immature stage of the male of *L. bicolor*. A reexamination of the type specimen of *Mitopus ohioensis* after it has been in alcohol more than four years shows that it was apparently just ready to moult when captured. This gives rise to the suspicion that this is an immature form of *M. pictus*, the pink coloring possibly being due to the peculiar conditions of the moulting period.

The study and measurement of a considerable number of specimens of *Liobunum ventricosum* from many States shows that this species increases in size to the southward in a way similar to that of *L. vittatum*. The southern form is evidently sufficiently distinct for a subspecific name, and as the form now standing as *Forbesium hyemale* is pretty certainly an immature stage of it, the subspecies may well take its name and be known as *L. ventricosum hyemale*.

Illustrated papers on both these subjects are ready for the printer, and will appear in the near future.

Professor C. H. Tyler Townsend, of the New Mexico Agricultural College, recently sent me specimens of an undescribed species of Liobunum taken at Las Cruçes. It may be called *L. townsendii*. Its description is as follows:

Male.—Body 5 mm. long, 3.7 mm. wide; palpi, 5 mm. long. Legs, first, 43 mm.; second, 80 mm.; third, 45 mm.; fourth, 59 mm. General color of dorsum brown, approaching raw umber, with indistinct darker blotches, but no central marking. Ventrum light grayish brown. Palpi similar in color to ventrum, with dorsal surface of patella and of tip of femur darker brown. General color of legs raw umber, with whitish rings near articulations and blackish ones at articulations. Dorsum minutely tuberculate; articulation of the three posterior segments very distinct. Eye eminence rather high, nearly

square as seen from above; canaliculate; smooth except for two sparse rows of spinose hairs. Palpi rather long, slender, with no projecting angles; clothed with rather short hairs and a few minute spinose tubercles; claw slightly pectinate near base. Mandibles normal; light brown with tips of claws black. Femora angular. Second legs much more slender than others.

Female.—Body 7 mm. long, 5 mm. wide; palpi 4.5 mm. long. Legs, first, 35 mm.; second, 61 mm.; third, 37 mm.; fourth, 46 mm. Differs from the male chiefly by its larger body and shorter legs.

Described from three specimens (1 ♂ 2 ♀).—CLARENCE M. WEED.

Gall-Producing Insects.—Mr. Wm. Beutenmüller, of the American Museum of Natural History, publishes[3] a useful Catalogue of Gall-producing Insects found within fifty miles of New York City. Eighty-eight species are enumerated, the family distribution of which is: Cynipidæ, 40; Tenthredinidæ, 2; Cecidomyidæ, 32; Tripetidæ, 2; Psyllidæ, 5; Aphididæ, 6; Acaroidea, 1. The next to the last family is called Aphidæ instead of the more correct Aphididæ. "The vegetable deformations called galls," writes Mr. Beutenmüller, are produced by insects. Generally an egg is inserted in a bud, a leaf, a root, or some other part of the plant, and the presence of this foreign body among the vegetable cells causes an abnormal growth of a definite shape. The variety of galls in respect to texture and substance is very great. Every species of gall-producing insects attacks its own particular plant, and a particular part of that plant, and produces a gall of a definite and uniform structure." The two plates accompanying (due to the courtesy of the author) show a variety of common galls. Plate (III) represents those made by the minute two-winged flies of the genus Cadomyia; and (IV) those made by the four-winged flies of the family Cynipidæ.

Recent Publications.—Mr. Henry G. Hubbard publishes[4] an extended description of the larva of *Amphizoa lecontei*, illustrated by an admirable plate. He extends Schiödte's table of the larval characters of the principal families of adephagous coleoptera.

Through the cooperation of the Massachusetts Society for Promoting Agriculture, the Hatch Experiment Station of the Agricultural College has issued an edition of 45,000 copies of a bulletin concerning canker-worms, tent caterpillars, fall web-worms and tussock moths

[3]Bull. Am. Mus. Nat. Hist., V. iv, Art. xv.

[4]Proc. Ent. Soc. Wash., ii, pp. 341–346.

written by Professor C. H. Fernald. A special attempt is being made to induce the people of the State to suppress these pests. The author states that "There has been such culpable negligence on the part of many of our people with regard to the tent caterpillar that there can be no doubt that some legislation is needed to compel the negligent to destroy this pest on all the trees on their own land, and thus prevent it from extending to the trees in the surrounding orchards. Provision should be made for the destruction of tent caterpillars on all public lands as well as in the forests, and village improvement societies should urge such action in town meetings as shall make it the duty of the superintendent of roads to destroy all tent caterpillars on the trees and shrubs along the sides of the roads."

Mr. S. H. Scudder's Monograph of the Orthopteran Genus Hippiscus which has been running through *Psyche* for some time has been issued as a reprint. The thirty-eight species are grouped under the subgenera Hippiscus, Stichippus, and Xanthippus.

Two interesting papers on the Butterflies and Crickets of Indiana have been published by Mr. W. S. Blatchley, of the Terre Haute High School. The former is extracted from the 17th Report on the Geology and Natural History of Indiana, and the latter from the Proceedings of the Indiana Academy of Science, 1891.

Mr. Wm. Beutenmüller records in the Bulletin of the American Museum of Natural History (v. IV, Art. XIII) an important List of Types of Lepidoptera in the Edwards Collection of Insects. This collection (made by the late Henry Edwards) "consists of about 250,000 specimens and about 25,000 species, representing all the orders and gathered in various parts of the globe. It is especially rich in Australian species and in North American species from the Pacific Coast. The present list enumerates 465 types of species.

The department of entomology of the University of Kansas has recently published a bulletin of 126 pages concerning "Common Injurious Insects of Kansas," prepared by Vernon L. Kellogg. The paper is well illustrated and will prove valuable to Kansas farmers.

PSYCHOLOGY.

The Sense of Taste in a Sea-Anemone.—It is a well known fact that sea-anemones possess a faculty which enables them to recognize food. This sense has been recently studied by M. Nagel of the Zoological Station at Naples. The following is one of his experiments. A small piece of sardine was gently pushed toward the tentacles of a sea-anemone; the morsel was first touched, then seized, then swallowed. A small ball of blotting-paper, similar in appearance, saturated with sea-water was next offered, but it was not taken. The paper was then saturated with the juice of the fish, when it was seized with the same avidity as the bit of sardine, but often it was rejected after the lapse of a few moments.

When the blotting-paper is impregnated with quinine the tentacles recoil. The quinine does not affect the external surface of the body, except the part situated between the tentacles and the mouth. If food is placed in the mouth, or near the open mouth, the animal does not notice it, but will only take it when the tentacles have touched it. The sense of taste, then, is localized in the tentacles, which serve as organs of touch; and also appreciate changes of temperature. (Revue Scientifique, Dec. 1892.)

M. Vaillant on the Feeding of Snakes.—In a paper read before the *Academie des Sciences de Paris*, M. Léon Vaillant made the following interesting remarks concerning the alimentation of Snakes. These remarks were the result of a series of observations of a large Anaconda from South America, *Eunectes murinus*, one of the Boidae, about 6 meters long, which, contrary to the usual habits of this species accepted food very soon after its arrival at the menagerie of the Reptiles of the Museum, and has continued to eat with regularity up to the present time. In fact, since its entrance into the Jardin des Plantes, August 8, 1885, until the end of the year 1891, this serpent has eaten 34 times, or about 5 times a year. Its food has generally been small or young goats; three times it took a hare and once a goose. The intervals between the times of feeding have varied from 23 days to 204 days; this last interval occurred but once. The snake decided for itself the time for feeding, manifesting its desire by increased activity, and by other signs.

As to quantity of food, in order to avoid all accidents which might result from indigestion, the Anaconda was given animals of moderate size; the largest it has swallowed is a kid of about 12 kilograms weight; which represents one sixth the weight of the snake. There is no doubt, however, that in a wild state, a snake of its size could swallow animals three or four times as large.

M. Vaillant adds, in this connection, the following fact which shows the stretching capacity of certain snakes. In the menagerie of the museum, a viper from France, (*Pelias berus*) had to be put in the same cage with a horned viper, (*Cerastes.*) As the individuals, although they belonged to different species, were about the same size, it was supposed that they would live peaceably together. It was a mistake. During the following night the *Cerastes* swallowed the *Pelias berus*, and in order to accommodate himself to his huge prey, his body was distended so that the scales which touch each other laterally, and even lap in its normal state were now so spread apart that between the longitudinal rows, a bare space equal in size to the scales was left. Digestion went on regularly, however, and the *Cerastes* did not appear to suffer.

The author also remarked that snakes in general do not accept indifferently all sorts of food, but appear to exercise a choice. It is often difficult to induce a snake to take food for the first time, but once this is accomplished, it accepts more readily succeeding proffers. A *Pelophilus madagascariensis* has been known to refuse a variety of food for 22 months, when it ate a starling, then a few other small birds and finally some rats, which are still fed to him without any difficulty, although previously they had been offered to him in vain.

M. Vaillant also remarks that the residue of digestion are evacuated at a single time after each feeding, at the end of a certain number of days. However, it often happens that the fæces contain the residue of a former meal. (Revue Scientific, aont, 1892.)

ARCHEOLOGY AND ETHNOLOGY.[1]

International Congress of Americanists.—It is proposed in this department to make a series of sketches of some of the International Congresses held in Europe. Two of these Congresses, to wit, that of "Criminal Anthropology," of Brussels, and that of the "Americanists," at Huelva, voted to hold a special meeting in the United States during the Summer of 1893; both, presumably, to be at Chicago. The increased interest thus to be engendered justifies this publication.

The First International Congress of Americanists.—On the 25th of August, 1874, the Sociétè Geographique Française held a meeting in the City of Paris, and formulated a Constitution, which should serve as a foundation for a new Society, to be called the Congrès Internationale des Americanistes.

The object was to contribute to the progress of Ethnographic, Linguistic, Historic studies relative to North and South America, and especially those of antiquity. The Historic or Proto-Historic portion would naturally be directed to the time of the discovery by Christopher Columbus.

Committees were appointed, officers and their duties provided, requisites of membership laid down, all in the shortest and simplest manner possible, and it finally provided that the First Congress should be held at the City of Nancy, on the 19th of July, 1875, and to continue four days.

The First Congress was entirely successful, and demonstrated the good judgment of its founders.

Twenty-eight countries were represented. Professor Henry, Secretary of the Smithsonian Institution, and Hon. Robert T. Winthrop, General Clary and Professor Henry W. Haynes, of Boston, were delegates from the United States; although it does not appear that the two former were present.

The report of the Treasurer showed 1572 subscriptions at 12 francs each, with total receipts of 23,106 francs. The meetings were held in the Ducal Palace, at Nancy, under Government patronage and protection; the city was put in gala costume, the palace and streets were draped with the flags of all nations, and there were the usual excursions, receptions, fêtes, concluding with the official banquet.

[1]This department is edited by Dr. Thomas Wilson, of the U. S. National Museum.

There was an Exposition of American Antiquities, principally from the collections of the Archeologists of two countries; the most extensive being that of a most esteemed friend, M. E. Boban, of Paris and Mexico.

The papers read and the subjects discussed are here given to show the scope of the organization.

Discovery of America before the time of Columbus, by M. Benedict Grondals, 7 pages; Discovery of the New World, by M. E. Beauvois, 52 pages; The Pheniciens in America, by Gaffarel, 48 pages; Buddhism in America, by M. Foucaux and M. De Rosny, with discussion, 12 pages; Fou-Sang, by Lucien Adam, 18 pages; Atlantis, by M. Chill y Naranjo, 3 pages; The Dighton Rock, by M. G. Gravier, 26 pages; A Dream of Christopher Columbus, by M. Castaigne, 23 pages; Inscription on the Grave Creek Tablet, by M. Levy Bing, 17 pages; America and the Portuguese, by M. Luciano Cordiero, with discussion by Professor Haynes, 97 pages; The Arctic and Antarctic Regions, by M. Daa; The Esquimaux, by R. P. Petitot; The Indians of the United States, by M. De Semallè, 9 pages; The Ancient Races of Peru, by M. John Campbell, 19 pages; Columbian Skulls, by M. Paul Broca, 16 pages; The Aborigines of Haiti, by Madiou; The Tradition of the White Man, by Madier De Montjau; An Iroquois Manuscript, by Leon De Rosny; The Mound Builders, by M. Joly; The Indians of French Guiana, by M. Dupont; The Caribs, by M. Ballet; The Origin of America, by Baron de Bretton; The Indians of Peru, by M. Ber; Le Maguey, by M. Gordron; The Guano of Peru, by M. Ridel; Language of the Cheyenne Indians and the Quichua, by Lucien Adam, 7 pages; Les Déné-Dindjies, by R. T. Petitot, 24 pages, and An Iroquois Manuscript; The Relation of Words, by Lucien Adam, 6 pages; Comparison between the Basque Language and Indian Languages of America, by M. Julien Vinson, 14 pages; Deciphering the Maya Language, by Leon De Rosny, 5 pages; Central America, by M. Blaise, 2 pages; The Society of Quakers, by M. Magnin; The Crees and the Chippeways by Lucien Adam, 59 pages; Anthropology in the Antilles, by M. Cornilliac, 22 pages; Traditions of the Greenlanders, by M. Rink and Valdemar Schmidt, 9 pages; The falsity of the Hebrew inscription found on a stone at Newark, Ohio, by M. Henry Harrisse, 7 pages; America in Antiquity, by Francis A. Allen, 47 pages; Asiatic Emigration to the New America, by R. P. Petitot, 11 pages; Ancient Mexican Stirrups, by Eugene Boban, 3 pages; Archeologic Analogies, by M. Morey, 7 pages; Prehistoric Canada, by M. Le Metayer-Masselin, 8 pages; The Museum of St. Petersburg, by M. Schoebel, 3

pages; Ancient American Music, by Oscar Comettant, 27 pages; Alphabet of one of the Ancient Languages in the interior of South America, by M. Pacheco-Zegarra, 28 pages; Memoire on the numeration of the Maya Language, Leon De Rosny, 20 pages.

THE SECOND INTERNATIONAL CONGRESS OF AMERICANISTS was held at Luxembourg, from the 10th to the 14th of September, 1877. There were 1047 subscriptions, and the total receipts, including contributions, amounted to 18,338 francs. Twenty-seven countries were represented.

The titles of the papers presented and addresses delivered are as follows:—

The Ancient Pueblos, by Edwin A. Barber, 17 pages; The Mound Builders, by Mr. Robert S. Robertson, 26 pages; The Chinese in California, by M. Emile Guimet, 9 pages; Osteologic Evidence furnished by the Ancient Mounds of Michigan, by Mr. Henry Gillman, 15 pages; The Origin of Civilization in the New World, by Mr. F. A. Allen, 20 pages, with the Protestation, by M. L'abbe Hengesh, 4 pages; The Mound Builders, by Mr. S. D. Peet, 17 pages; To What Race Belonged the Mound Builders? by Judge M. F. Force, 25 pages; The Origin of the Language, Mythology and Civilization of America, found in the Old World, by Mr. Hyde Clarke, 14 pages; The History of America and its Discovery, by Mr. De Hellwald, 4 pages; The European Colonies in Markland and l'Escociland, in the XVI and XVII Centuries, by M. E. Beauvois, 61 pages; A Comparison between the Civil Legislation of the Mexicans under the Aztec Emperor, and of the Peruvians during the epoch of the Incas, by Sr. J. F. Nodal; The Route of the Mississippi, by M. Gabriel Gravier, 75 pages; Points or Marks in the Chronology of the History of the Mound Builders, by M. Stronck, 13 pages; The Migration of the Nahuas, by J. H. Becker, 26 pages; Address of Mr. Da Silva Paranhos and his criticism of the work of M. le Doctor Couto deMacalhaes, entitled "O Selvagem" or the Savage, being an investigation into the Antiquity of Man in South America, and especially in Brazil; Americus Vespucci, by Dr. Schoetter, 3 pages; Theories on Ka-kwaks, and their destruction by the Senecas, by Abbe Schmidt; Conquest of the Ancient Chilleans by the Peruvians in the times of the Incas, by M. H. Savary, 2 pages; Pay-Tuma, by Abbe Schmidt, 6 pages; Prehistoric Synchronism, by M. Anatole Bamps, 29 pages; The Discovery of Brazil by the French, by M. P. Gaffarel, 37 pages; Memoirs of Brazil, by M. Burtin; the voyage of Verrazzano, by M. Desimoni; The Ethnographic distribution of Nations and Lan-

guages in Mexico, by M. V. A. Malte-Brun, 36 pages; The Language Atacameña, by M. Moore, 22 pages; The Manuscript of M. Platzmann; The Indian Languages of America compared with the Ural-altaischen Languages, by Forchhammer, 19 pages; Is the Quichua an Aryian language? Being a critical examination of the works of Don V. F. Lopez; The Aryenne Races in Peru, by M. V. Henry, 83 pages; An inscribed tablet, by M. J. Gass, 2 pages; The Engraved tablet of Rockford, Illinois, and its evident fraudulent character, by N. Moody; A grammatical examination and comparison of 16 American Languages, by M. Lucien Adam, 83 pages; Principles of the Cree Language, by M. R. P. Remas, 10 pages; The Age of Stone, at the exposition of Philadelphia, 5 pages, by Emile Guimet; The National Library of Rio Janeiro, by Ferdinand Denis, 8 pages; American Antiquities in the Royal Netherland Museum at Leyden, by M. Leemans, 20 pages; A chapter in American Archæology, 16 pages, by C. Schoebel; A rock-shelter in Pennsylvania, by Mr. S. S. Haldemann, 8 pages; A primitive habitation of the Esquimaux, by M. H. Rink, 14 pages; The antiquity of Man in America attested by the Silex. The evidence upon which this paper relies to prove its proposition, is the similarity of the flint implements of America with those of Europe, by Jean Engling; The collection of M. Emile de Ville, Belgium Consul at Quito, and its proposed deposition or gift to the city of Brussels and its deposition in that Museum; Antiquities of Greenland, by M. Valdemar Schmidt, 3 pages.

The Third International Congress of Americanists was held at Brussels, from the 23d to the 28th of September, 1879.

The number of Nations represented was about the same at the two previous Congresses; while the number in attendance, and the papers read and addresses made were greater. The proceedings were reported in two large volumes containing together 825 pages, with an atlas of plates.

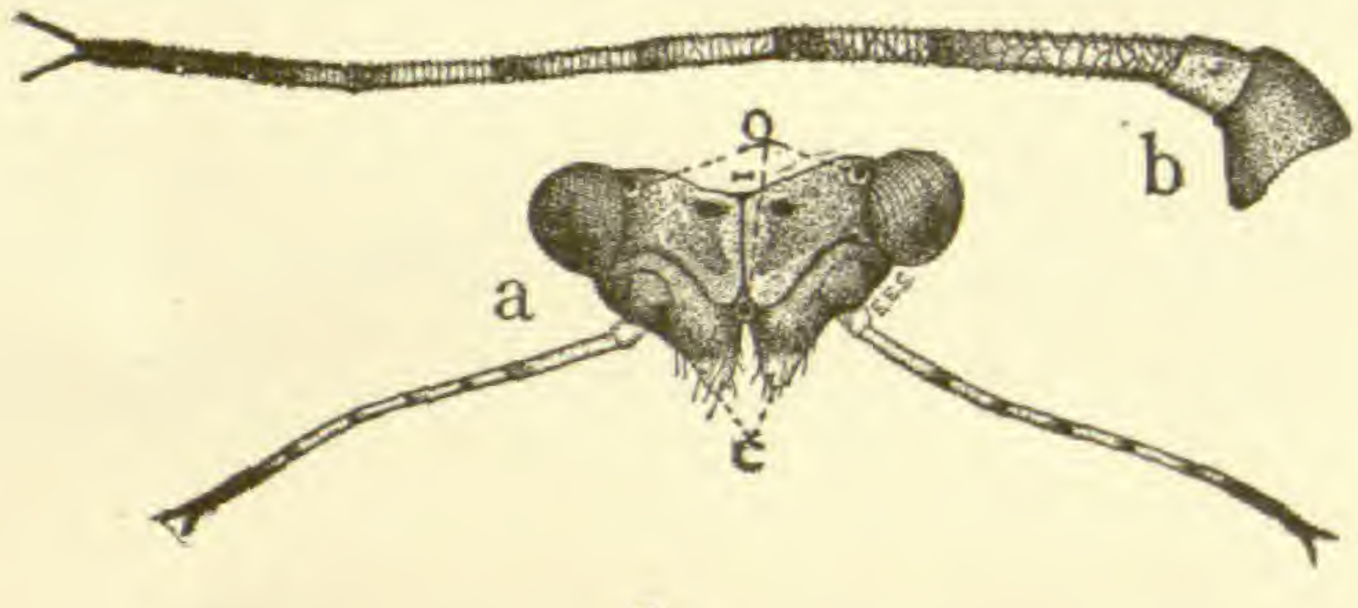
The following papers were read and addresses delivered:—

Pre-Columbian Historic Documents from Mexico and Anahuac, by M. Andre de Bellecombe, 13 pages; The Calpullis of Mexico, their administration, origin and communistic principles, by Mr. Ad. F. Bandelier, 3 pages; The Norambégue, with the proof of its Scandinavian origin furnished by the language, institution and belief of the Aborigines of Acadia, by M. Eugene Beauvois, 38 pages; The exploration of the Amazon by the Franciscans of Peru, by P. Servais Dirks, 31 pages; Progress of American Cartographie during the XVI Century, by Rev. F. B. De Costa, 8 pages; The same (Continued) by

M. Gabriel Gravier and by Lieut. Col. Adan, 89 pages; An unknown chart, the first one made by Louis Joliet in 1674, after his exploration of the Mississippi with Father Marquette in 1673, by M. Gabriel Gravieri with explanations by M. Lucien Adam, 38 pages; Observations on the earlier letters of Americus Vespucius, by Judge M. F. Force, 36 pages; On the influence of orography on the march of civilization in America and Europe, by Dr. Charles Barrois, 4 pages; Printing and Bookmaking in Spanish America, from the XVI to the XVII Century, by Vicente G. Quesada, 68 pages; The antiquity of different Canadian States, by M. Burtin, 3 pages; Verraxxano, discoverer of certain regions in North America, by Cornelio Desimoni, of Genoa, 67 pages; The Carib Language, and the differences between it as spoken by men and women, L. Adam; Peruvian Ceramics in the Society of Americanists at Nancy, by M. Jules Renauld, 20 pages; Christianity and the White Man in America before its discovery by Christopher Columbus, by Abbe Schmitz, 15 pages; The White Man and the Cross in America, by M. Peterkin, 20 pages; The White Man and the Cross in Peru before the Discovery by Columbus, by D. Marcos Jiminez de la Espada, 28 pages; Collection of M. Guesde, of Port-au-Prince, specially the Carib stone hatchet, 3 pages; American Antiquities recently acquired by the Royal Netherland Museum of Antiquities at Leyden, by Dr. Leemans, 3 pages.

Antiquities of Greenland, by Valdemar Schmidt, 6 pages; The last discoveries in the Mounds of America, by Rev. J. Gass, with a letter from M. Francis A. Allen, 26 pages; Effigy Mounds in America compared with those of the same kind in Europe and Asia, by Dr. Phéne, 7 pages; The probable destination of the Inca-Chunca, by Jean Van Volxem; Antiquities from the Equator at the Royal Museum at Brussels, by Anatole Bamps, 96 pages; The antiquities from the valley of San Augustine, United States of Columbia, by M. Jose Maria Gutierrez de Alba, 5 pages; The discourse of Dr. Virchow; The influence of American surroundings upon the White Race, by M. Grattan, 8 pages; Existence of Man in North America during the Glacial Period, by M. Sidney Skertchly, 4 pages; The reefs of St. Paul and the question of Atlantis, by Abbe Renard, 22 pages; The last of the Mexican Races in the United States; by M. Edwin A. Barber, 6 pages; The highest antiquity of Man in America, by M. Florentine Ameghino. This paper has reference to the man during the tertiary period in Brazil, 52 pages; Cosmogonye Algique, by Count de Charencey, 28 pages; Origin of the Primitive Indians of South America; by Mme. Marcella J. Wilkins, 8 pages; A critical examination and comparison of fourteen

PLATE V.



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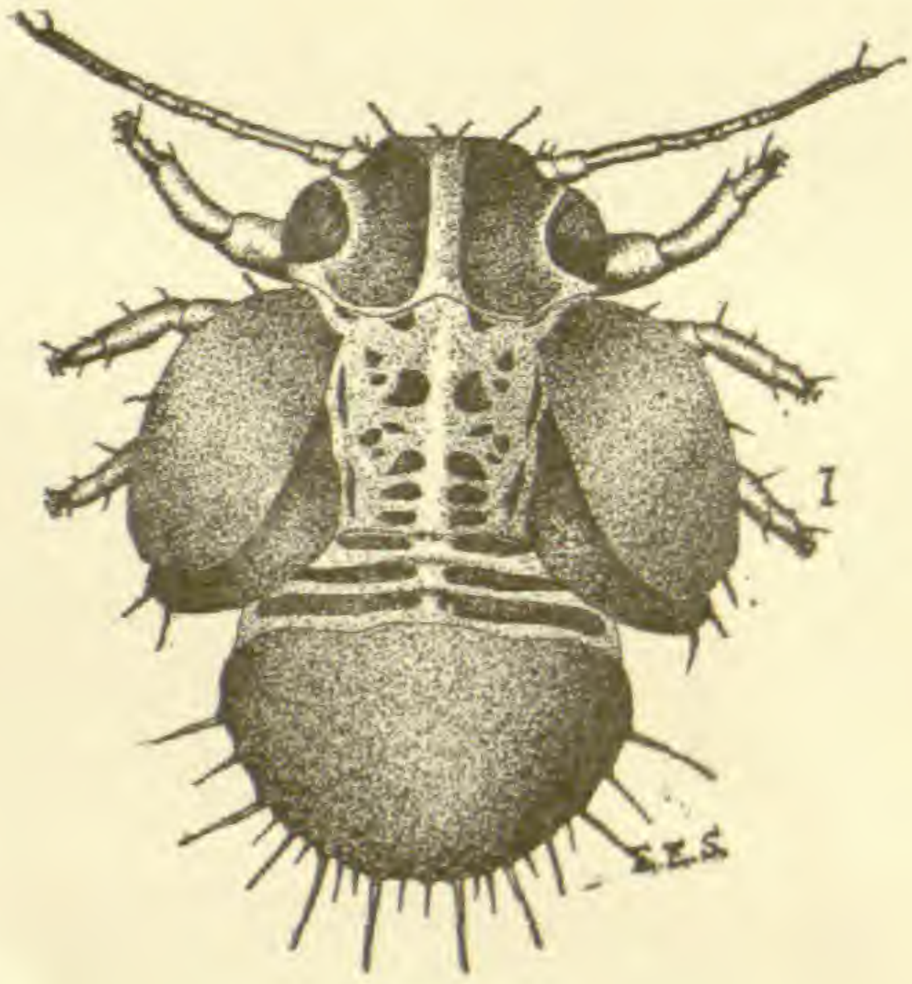

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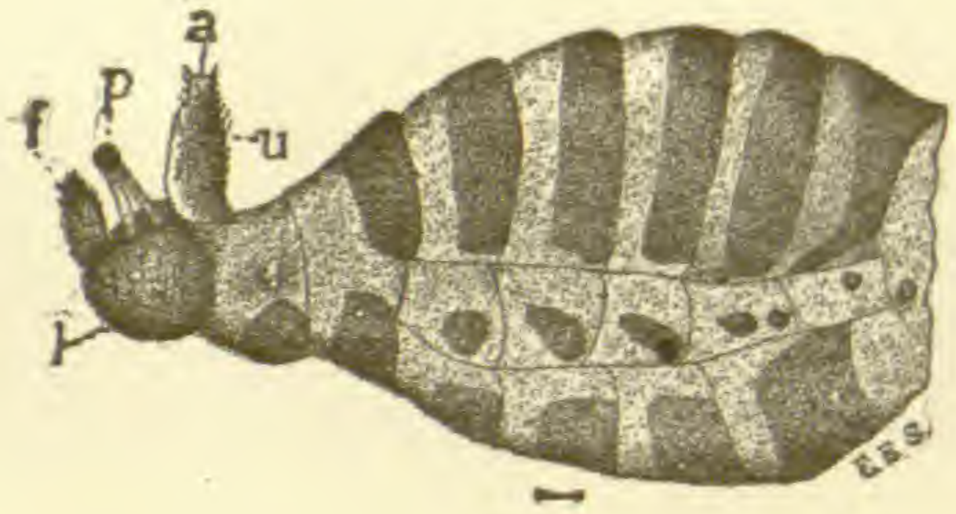

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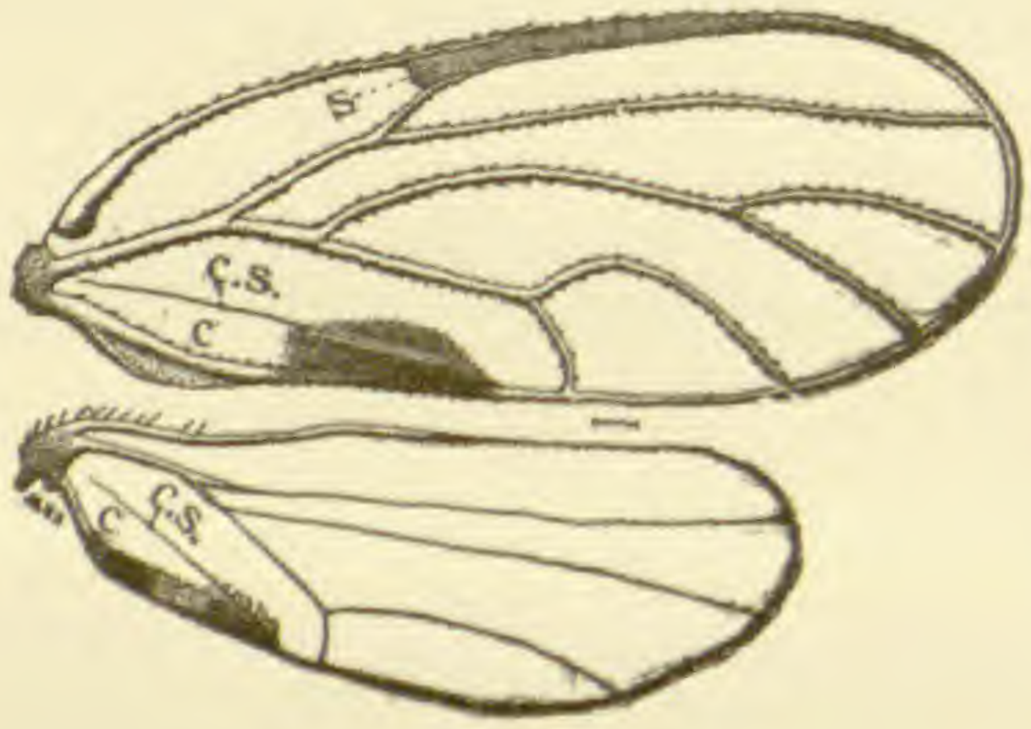

5.

The Pear Tree Psylla.

American Languages, by M. Lucien Adam, 61 pages; Grammar of the Moskito Language, by Edward Grunewald, and Dictionary of the same, Moskito and German; Inscribed Stones purporting to be in Hebrew, from Licking County, Ohio, by M. Charles Whittlesey; A comparative grammar of three languages of Greenland, by Victor Henry; A comparison between the Aymara of the Quichua and the dialect of Quito, by Jose Fernandez Nodal; Principles of Language and Othomie, by Professor de Harlez, 45 pages; The Affiliation of American languages, by M. John Campbell; A Communication on the Idol of Guaqui, by M. Marcos Jiminez de la Espada; Philologic Notes, by M. P. Vegreville, 39 pages; The Mexican Calendar, by Manuel Orozcoy Berra; Ancient inscriptions in the Argentine Republic, by Florentine Ameghino, 27 pages; Prehistoric Clocks in South America; The language Maskoki and its dialects, by M. Albert S. Gatschet, 16 pages; The deciphering of certain Maya characters, by the Count de Charency.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society of Naturalists.—This body met at Princeton, N. J., in J. C. Green Science Hall of Princeton College, on December 28–9, 1892. Professor Osborn, of Columbia College, N. Y., was President, and Professor T. H. Morgan, of Bryn Mawr College, Pa., was Secretary. On the afternoon of Dec. 28th, President Patton, of Princeton College, gave an address of welcome. A committee was appointed to confer with the executive committees of the affiliated societies to bring about a union between the societies of Morphologists and Anatomists. Professor Sedgwick read a report by Professor S. F. Clark, on Science Teaching in Schools. Reports on Marine Biological Laboratories were presented by Dr. E. A. Andrews, of Johns Hopkins University on the Marine Station in Jamaica; Dr. D. Bashford Dean read a paper on the Marine Laboratories of Europe, which was handsomely illustrated; Professor C. O. Whitman read a paper on the Outlook of the Marine Laboratory at Woods Holl, Mass. Dr. Stiles read a report of progress in obtaining support for an American table at the Marine Laboratory at Naples. The Society adopted resolutions favoring the establishment and continuous support of a table at that Laboratory.

In the evening the Annual Dinner took place in University Hall After the address by the President, Professor Osborn, remarks were made by Professor Brewer, of Yale, Professor Cope, of Pennsylvania, Dr. Heitzman, of New York, Professor Minot, of Harvard, and others.

On Dec. 29th, the following members were elected: Howard Ayers, J. H. Bamhart, G. W. Calkins, T. M. Chapman, D. Bashford Dean, D. G. Elliot, B. D. Halsted, Ida A. Keller, Edwin Linton, T. B. Lotsy, J. I. Peck, H. S. Pratt, J. E. Reighard, Wm. E. Ritter, J. P. Smith, O. S. Strong, R. Thaxter, H. H. Wilder, Arthur Willey, J. L. Wortman.

Professor Libbey offered the following resolution, which was carried: That a committee be appointed to bring about an affiliation of the Physiological, Morphological, Anatomical and Geological Societies with this body.

New Haven was adopted as the next place of meeting. The following officers were elected for the ensuing year: President, Professor R. H. Chittendon, New Haven; Vice-Presidents, Professor G. Baur, Chicago, and Dr. Wm. H. Dall, Washington, and Professor Wm. Libbey, Princeton; Secretary, Professor T. H. Morgan, Bryn Mawr, Pa.;

Treasurer, Professor W. T. Sedgwick, Boston; Executive Committee, Professor W. G. Farlow, Cambridge; Professor J. A. Ryder, Philadelphia.

Special reports on the work of the preceding season were made by Professor W. Libbey, Jr., on the summer work of the U. S. Fish Commission schooner, Grampus; by Dr. J. L. Wortman on the Exhibitions of the American Museum of Natural History in New Mexico, Wyoming and Dakota; and by Professor E. D. Cope on the Paleontological Exploration of the Staked Plains of Texas by the Geological Survey of Texas.

On Dec. 29th the Annual Discussion took place. The question was, What were the former Areas and Relations of the American Continent as determined by Faunal and Floral Distributions? The discussion was opened by a paper from Professor W. B. Scott, of Princeton, on "Evidence from past and present Distribution of Mammalia." Professor J. A. Allen read a paper on the Evidence from the Distribution of Birds; and Dr. N. L. Britton on Evidence from the Distribution of Plants.

American Morphological Society.—The annual meeting was held at Princeton, N. J., Dec. 28–29, 1892. The following papers were read: Dr. E. B. Wilson, Columbia College, The cleavage of the ovum and the teloblasts of Amphioxus. Dr. C. W. Stiles, Department of Agriculture, Washington, The topographical anatomy in the family Tæniadæ. Dr. E. O. Jordan, University of Chicago, The maturation and Fertilization of the egg of the Newt. Professor E. D. Cope, Philadelphia, False Elbow Joints in Man and the Horse. Mr. Arthur Willey, Columbia College, On Acinetæ parasitic in the buccal tube of Diplosoma. Dr. C. B. Davenport, Harvard College, The development of the cerata of Eolis. Dr. H. B. Ward, University of Michigan, The host of Nectonema. Dr. C. O. Whitman, University of Chicago, The metamerism of Clepsine. Dr. W. B. Scott, Princeton College, The evolution of the premolars. Dr. H. A. Ayers, of the Lake Laboratory, Milwaukee, The ending of the auditory nerves in the hair-cells. Dr. E. A. Andrews, Johns Hopkins University, Notice of a new sort of Amphioxus. Professor A. E. Verrill, Yale College, Some New forms of Nemerteans. Dr. T. H. Morgan, Bryn Mawr College, Preliminary note on Balanoglossus. Professor B. Sharp, Academy of Natural Sciences, Philadelphia, Joint formation among the Invertebrata. Professor W. A. Locy, Lake Forest University, The formation of the

medullary grooves, and some other features of embryonic development in the Elasmobranchs.

The following gentlemen were elected officers for the current year: President, Dr. C. O. Whitman, University of Chicago; Vice-President, Dr. E. B. Wilson, Columbia College; Sec'y-Treas., Dr. J. Playfair McMurrich, University of Cincinnati. Members of the Executive Committee elected from the Society-at-large: Dr. T. H. Morgan, Bryn Mawr College; Dr. C. B. Davenport, Harvard College.

Association of American Anatomists.—Fifth annual session, Tuesday to Thursday, December 27 to 29, 1892, at Princeton, N. J. The officers for the year 1891-1892 were—President, Harrison Allen, M. D., Philadelphia; First Vice-President, Charles Heitzman, M. D., New York City; Second Vice-President, Theodore N. Gill, M. D., Washington, D. C.; Secretary and Treasurer, D. S. Lamb, M. D., Washington, D. C. Executive Committee: Thomas Dwight, M. D., Harvard University; E. C. Spitzka, M. D., New York City; Dr. F. H. Gerrish, Portland, Me., the President and Secretary, ex-officio. Committee on Anatomical Nomenclature: Harrison Allen, M. D., Philadelphia; Frank Baker, M. D., Washington; Thomas Dwight, M. D., Harvard University; Thomas B. Stowell, Ph. D., Potsdam, N. Y.; Burt G. Wilder, M. D., Cornell University, Secretary. Delegate to American Congress of Physicians and Surgeons, F. J. Shepherd, M. D., Montreal, Canada. Alternate, R. W. Shufeldt, M. D., Washington, D. C.

Tuesday, December 27, the following business was transacted: 1, Opening of the session by the President; 2, Report of the Executive Committee; 3, Report of the Secretary and Treasurer; 4, Election of new members; 5, Report of the Committee on Anatomical Nomenclature; 6, amendment to Constitution, abolishing dues and substituting assessments; 7, Miscellaneous business.

Then followed the address of the President, Dr. Harrison Allen.

The following papers were read: 1. History of the development of bone tissue. Illustrated by microscopic slides. Dr. Carl Heitzmann, New York City; discussed by Professors Macloskie and Libbey. 2. Crania of the Cetacea (15 minutes), with specimens, Dr. Harrison Allen, University of Pennsylvania. 3. The human lower jaw (10 minutes), with specimens, Dr. Allen. The second and third discussed by Dr. Herrick and Professor Macloskie. 4. An anomalous human sternum, Dr. C. S. Lamb, Washington, D. C. Discussed by Dr. Dwight. 5. Observations on the psoas parvus and pyramidalis. A study on variation, Dr. Thomas Dwight, Harvard University. 6.

Significance of percentages in reversions in human anatomy, Professor H. F. Osborn, Columbia College, New York. Discussed by Professor Cope and Drs. Dwight and Lamb. 7. Series of thirty-five natural-size photographs of sections of human brain, with brief remarks, Dr. I. S. Haynes, University of New York. 8. Histogenesis in the brain, and its bearings on development and decline, Professor C. L. Herrick, University of Chicago. Discussed by Drs. Heitzmann and Piersol. 9. The metapore or foramen of Magendie, with photographs, Professor G. B. Wilder, Cornell University. Read by Mr. Clark. 10. Neuromerism and the cranial nerves of Ophidia, Professor Herrick. 11. The insula of the pig, with specimens, Tracy E. Clark, B. S., Clinton Liberal Institute, Fort Plain, N. Y. Discussed by Drs. Allen, Dwight and Spitzka. 12. The posterior surface of the liver; described by Vesalius; Dr. F. H. Gerrish, Bowdoin College, Maine. Discussed by Drs. Dwight, Heitzmann and Allen. 13. Embryos of bats, (with specimens), Dr. Allen. Discussed by Professors Cope and Minot. 14. Meckel's diverticulum, Dr. D. S. Lamb, Army Medical Museum, Washington. Discussed by Drs. Minot and Dwight. 15. Delimitation of abdominal regions, Dr. E. A. Balloch, Howard University, Washington. Read by the Secretary. 16. The need of agreement in the limits of the abdominal regions, Dr. Gerrish. Discussion of the last two papers together, by Dwight, Piersol, Kemp, Heitzmann and Lamb. 17. Physical characters of the Kootenay Indians, Mr. Alex. F. Chamberlain, Clark University, Worcester, Mass. 18. Discovery of an ossified thyroid cartilage, and a supposed rudimentary clavicle in an artiodactyl, with the specimen; Professor W. B. Scott, Princton, N. J. Discussed by Professor Cope and Dr. Allen. 19. Notes on diagrams of the spinal cord, Dr. J. T. Duncan, Toronto, Can. 20. Duration of motion of human spermatozoa, Dr. Geo. Piersol, University of Penna. Discussed by Drs. Spitzka and Heitzmann. 21. The innervation of the organ of Corti, Dr. Howard Ayers, Lake Laboratory, Milwaukee, Wis. Microscopical slides, with remarks.

New York Academy of Sciences.—Biological Section, Jan. 9.—The following papers were presented:—A. A. Julien, Suggestions in Microscopical Technique, including (*a*) a carrier of cover impressions (mycoderm blood) utilizing as clamps a coil of brass wire mounted in a phial. The same device with a platinum coil serves as a convenient staining phial for cover glass preparations; (*b*) a suggested medium for mounting delicately contractile protoplasmic objects; (*c*)

devices for avoiding inclusion of air bubbles in mounts; (*d*) balsam-paraffin as a ring varnish.

O. S. Strong: On the components of cranial nerves of Amphibia. In the seventh a dorsal root was shown to pass off into branches representing ophthalmicus superficialis, facialis and buccalis of fishes, and innervating the lateral sense organs of the head. In vagus, a root of similar internal origin passes into the R. laterales, innervating the lateral sense organs of the body. Another component of the facialis is the fasciculus communis of fishes. This passes off into the palatinus and mandibularis internus, innervating the mucous epithelium of the oral cavity; while in the glosso-pharyngeus and vagus, similar components divided from this fasciculus innervate in like manner portions of the alimentary canal and its appendages. The relation of the results to segmentation of head was discussed.

N. L. Britton: A Review of the N. A. species of *Lespedeza*, with comments on the eleven native species, shown to be divisible into two groups, (*a*) those producing both petalous and apetalous flowers, and (*b*) those in which no petalous flowers are developed. Of the two naturalized species, one in S. E. part of U. S., *L. striata* (Thunb.) H. and A., is a native of E. Asia, appearing (about 1845) in Georgia.

BASHFORD DEAN, *Rec. Secy. of Section.*

Proceedings of the New Mexico Society for the Advancement of Science.—Meeting of November 2, 1892, at La Cruçes.—(No. 1.) Professor Townsend read a paper entitled "A partial comparison of the insect fauna of the Grand Cañon with that of the San Francisco Mountain in Arizona." The paper discussed briefly the conditions which exert an influence on the vertical range of species, and then gave some exact data on the topographical features of the above region. Dr. Merriam's life-zones of the San Francisco Mountains were re-stated, and the following provisional zones were offered for the Grand Cañon (from top of south rim at Hance's, 7500 ft., to Colorado River, 2500 ft.):

Canadian or balsam fir zone (only on north or northeast exposure).

Neutral or pine zone (only on north or northeast exposure).

Piñon or cedar zone—6000 to 7500 ft. (top of south or southwest exposure).

Sub-desert zone—4500 to 6000 ft.

Gila zone—2500 to 4500 ft.

The insect fauna was considered in three sections—that peculiar to the cañon, that peculiar to the mountain, and that common to both. These divisions were compared with each other, and also with the fauna

of the surrounding region. Specimens of insects were exhibited, belonging to these three divisions of the fauna, and many photographs and views of the cañon region were shown.

(No 2.) "Exhaustion and renewal of soils," by Professor Arthur Goss. He first described soils chemically, and told where they obtain their various constituents. He next divided the productive existence of a soil into three periods—1. The pioneer period. 2. The period when soiling crops are necessary. 3. The fertilizer period. The desired thing in fertilizers is the element or compound which has been taken from the soil. The best way to find this is not by chemical analysis of the soil, but by judicious experimentation.

(No. 3.) Professor C. T. Hagerty read a paper entitled "Computation of the Comparative strength of Insects and the Higher Animals." He proved conclusively that the higher animals are much stronger than insects in proportion to their size, and readily accounted for the apparent superior strength of the latter. In the course of his remarks he referred to a computation on the comparative strength of the honey-bee and horse, made by Miall and Denny in a work entitled "The Cockroach" (page 82, edition of 1886), and pointed out an error in their computation. They state that the relative muscular force of the horse is more than fourteen times as great in comparison with that of the bee as it would be if the muscles of both animals were similar in kind and the proportions of the two similar in all respects, and he showed that according to their own method of solution, it would be 3.08 instead of 14. Quite a number of specimens of the insect fauna of Grand Cañon and the San Francisco Mountains of Arizona were exhibited by Professor Townsend, besides some photographs taken during the trip.

Dec. 1, 1892.—(No. 1.) Professor Townsend read a paper entitled "Notes on the occurrence of the puma (*Felis concolor* L.) in Southern New Mexico." The animal was reported on good authority as tolerably common in the Organ Mountains, and still more so farther east on the Peñasco River in Lincoln County. It has killed colts in Soledad Cañon (Organ Mts.). Measurements of some large skins are given, one of more than eleven feet being vouched for on good authority.

(No. 2.) Notes on the Ferns of the Organ Mountains, by Professor E. O. Wooton, following the distribution zones of ferns as advanced by Dr. Underwood in "Our Native Ferns and Their Allies" (pages 61–65, edition of 1888), he enumerated the various species and genera which had been collected on several trips to the mountains without any idea of such paper in view. Whole number of Genera collected, 7;

whole number of Species collected, 16. He then noticed the general characteristics to be: rigid stems, thick leaves, deeply-seated veins, fronds either very hairy, chappy, granulated, or with very thick epidermis. All of which characteristics were taken as being simply different ways of protecting themselves from the intense dryness of the climate.

(No. 3.) "Notes on the Mound Builders," by Professor J. P. Owen, was a paper concerning what is known of that ancient race. The professor showed, in several different ways, the difference between this race and the North American Indian found in possession of this continent at its discovery. He told of the migrations of this pre-historic race from the south and west to the central and northern states, and their probable return to the sections from whence they came. He led us to believe that these ancient peoples might have been connected with our Pueblo Indians, and were connected with the Aztec tribes of Mexico.

International Congress of Zoology.—The second meeting was held at Moscow, August, 1892. The fellowing papers were read:—

General Questions Concerning Biology:—Reply to questions proposed by Professor L. Cosmovici: 1. On a definite division of the animal kingdom into "phyla." 2. Natural basis of a system of the type of worms. 3. Uniformity in the terminology of the secretory organs of worms, J. von Kennel.—Observations on some points in Zoological Nomenclature, Ch. Girard.—On the importation and hybridization of reptiles and amphibians, J. de Bedriaga.

Special questions Concerning Biology:—Note on *Parapagurus pilosimanus*, a Pagurid from the abyss of the Atlantic Ocean, A. Milne Edwards and E. L. Bouvier.—Note on the fauna of the Black Sea, P. N. Bontchinsky.—On a fresh-water Thuricola, F. Vejdovsky.—Essay on the Classification of Animal variations according to their causes, A. Brandt.—The fauna of the eastern part of the Baltic Sea, and the problems for the next investigations in that fauna, Gr. Kojevnikov.—Geographical Distribution of the carnivora, Ch. Grévée.—The European and Circum-Mediterranean vipers, J. de Bedriaga.—*Chalcides symonyi* Steind., and *Molge luschiani* Steind., J. de Bedriaga.—Notes on the nests of insects made of clay, H. von Ihéring.—The Cetaceans of the Black Sea, living and fossil, J. van Beneden.—On the geographical distribution of the Cladocera, T. Richard.—On the Monodontophrya, a new species of the Opalinidæ, Fr. Vejdovsky.

Histology and Embryology:—Contributions to the theory of the mesoderm and of metamerism, N. Cholodovski.—Note on the forma-

tion of the germ of the peripheral nervous system, A. Plitzine.—Note on the development of the endothelium of the heart in the amphibians, V. Roudnev.—On the development of *Chrysopa perla*, Mme. O. Tichomirova.—On the segmentation of the egg, and the formation of the blastoderm of the Pseudoscorpionidæ, Fr. Vejdovsky.—On an embryonic organ of the Pseudoscorpionidæ, Fr. Vejdovsky.—Contribution to the history of the parasites of the Hymenoptera, N. Koulaguine.—The use of embryological researches for classification, A. Tichomiroff.

Physiology and Physiological Chemistry:—On the phosphorescence of animals in the Black Sea, P. Khvorostansky.

Morphology and Comparative Anatomy:—What is meant by "the water vascular system, the segmental organs, the excretory organs, and the nephridia, L. Cosmovici.—Presence or absence of an excretory apparatus in the genital organs of the Metazoa, H. von Ihering.—Note on metameric signification of the cranial nerves, P. Mitrophanov.—Position of the Strepsipteridæ in the system according to the data of post-embryonic development and of anatomy, N. Nassonov.—On the excretory organs of terrestrial arthropods, A. O. Kovalevsky.—On the origin and ancestry of the Arthropods, particularly the tracheated arthropods, N. Zograf.

Boston Society of Natural History.—January 18, 1893.—The following paper was read: Report on a study of Glacial sand-plains in Eastern Massachusetts, illustrated by lantern slides, by Professor W. M. Davis and students in geological field-work in Harvard University.

SAMUEL HENSHAW, *Secretary.*

SCIENTIFIC NEWS.

Recent Deaths.—HENRY TIBBOTS STAINTON.—Word comes from England of the death of this eminent Lepidopterist on December 2d, 1892, in his 71st year. For the past fifty years he has been one of the most active British entomologists. During this period he has been president of the Entomological Society of London, secretary and vice-president of the Linnean Society, and secretary of the Ray Society. One of the founders of the *Etomological Monthly Magazine,* he continued on the editorial staff from its beginning until his death. From this magazine we learn that he has published more than twenty-five volumes on natural history, besides frequent contributions to entomological periodicals. He studied chiefly the Micro-Lepidoptera, and was best known as a student of the Tineina. Two of his associates on the *Monthly Magazine,* Messrs J. W. Douglas and R. McLachlan, write: "Naturally diffident and unobstrusive in society, he yet pursued the objects that interested him, with ardor and perseverance, and his liberality in the cause of the advancement of entomological studies in Britain, which was always dear to him, and his unstinted aid in the identification of species, are too well known to require eulogy. From the first he restricted his researches to Lepidoptera, but he had sympathy with the students of all orders of insects, and of natural history generally. Possessed of an ample fortune, he used his means freely to assist any cause or person that he deemed to be deserving . . . In 1871 he was instrumental in founding the Zoological Record Association, for the purpose of continuing the Zoological Record, which had been relinquished by Er. Van Voorst, and largely through his liberality this indispensable publication appeared regularly until 1886, when it was taken up by the Zoological Society of London."

FREDERICK AUGUSTUS GENTH.—The death of Frederick Augustus Genth occurred at his residence, No. 3937 Locust street, Philadelphia, and ended, at the age of seventy-three, the career of a chemist and mineralogist whose reputation was not confined to one hemisphere, but was co-extensive with the world of scientific investigation. Professor Genth was born in Waechtersbach, Hesse-Cassel, on May 17, 1820. After attending the Gymnasium, in Hanau, he studied at the University of Heidelberg, under Liebig; at Giessen, and finally under Bunsen, at

Marburg, where he received the degree of Ph. D. in 1846. For three years he acted as assistant to Professor Bunsen, and soon afterward came to the United States, where he has since resided.

In 1872 he was called to the chair of chemistry and mineralogy in the University of Pennsylvania, which place he held up to within a few years ago. He had also held the office of chemist to the Geological Survey of Pennsylvania, and also to the Board of Agriculture of this State. Professor Genth was a member of many scientific societies in the United States, and was elected in 1872 to membership to the National Academy of Sciences. He had no superior in this country as an analytical chemist, and he greatly enriched the literature of chemistry with his very many and careful analyses of minerals. His name is associated with the ammonia cobalt bases, which he discovered in 1846, and, in joint authorship with Dr. Wolcott Gibbs, he contributed to the "Smithsonian Contributions to Knowledge," a monograph on "Researches on the Ammonia Cobalt Bases" (Washington, 1856).

Professor Genth was the author of nearly one hundred separate papers on subjects in chemistry and mineralogy, and published *Tabellarische ubersicht der Uichtigsten Reactionen welche Basen in Salzen zeigen* (Marburg, 1845); also the same in relation to "Acids" (1845); his "Minerals of North Carolina," being appendix "C" of the "Report on the Geology of North Carolina" (Raleigh, 1875). He also was the author of "First and Second Preliminary Reports on the Mineralogy of Pennsylvania" (Harrisburg, 1875–6) and "Minerals and Mineral Localities of North Carolina" (Raleigh, 1881).

Nikolai Ivanovitch Koksharoff, the well-known Russian mineralogist, died at St. Petersburg, January 2, 1893. During his early years he lectured on geology and physical geography, but later on devoted himself to the description of Russian minerals of which he discovered, and described many new ones. His chief works are embodied in eleven large quarto volumes of Beiträge zur Mineralogie Russlands, illustrated with numerous plates. The twelfth volume was in type when he died. He was a member of the St. Petersburg Academy of Sciences, and many of the scientific bodies of Western Europe elected him corresponding or honorary member.

—The address delivered by Professor Virchow on his assumption of the office of Rector of the University of Berlin, has been issued by the

German publisher, August Hirschwald, of that city, under the title "Lernen und Forschen."

Unofficial information has been received by Professor G. Brown Goode, of the National Museum, and member of the United States Commission to the Madrid Exposition, that awards have been made to the following exhibitors from this country:—

Gold medals—Smithsonian Institution, Bureau of Ethnology, National Museum, University of Pennsylvania, William Ellery Curtis, of Washington; the Hemenway Expedition, Dr. J. Walter Fewkes, of Cambridge.

Silver Medals—United States Geological Survey, the Numismatic and Antiquarian Society of Philadelphia, the Philadelphia Academy of Natural Sciences, the Peabody Museum of Archeology, Cambridge; The United States Mint, the United States Navy, The Army Medical Museum, Dr. D. G. Brinton and Mr. Stewart Culin, of Philadelphia; Professor O. T. Mason, Professor Thomas Wilson, Mr. W. H. Holmes and Mr. Walter Hough, of Washington; Mrs. Zelia Nuttall, of Cambridge.

Bronze Medals—Fish Commission, Department of Agriculture; Indian School at Carlisle, Pa.; Sons of the American Revolution, Dr. James C. Welling and Mrs. Tillie E. Stevenson, of Washington; Dr. Cyrus Adler, of New York; Mr. Warren K. Moorehead, of Xenia, O.

The gold medals, it is understood, are very handsome, with an intrinsic value of $150 apiece. Final action by the jury is not known, and others may be honored.

At the annual meeting of Bowdoin College Alumni held at Boston, Jan. 25th, Professor Robinson of the chemical department of Bowdoin, announced that Mr. Edward F. Searles, whose wife, the widow of Mark Hopkins, left him millions, had promised to erect the finest and best equipped building for the study of the sciences that could be had in this country. He stated that Mr. Searles had placed no limit on the cost.

Dr. Osaun has been appointed Geologist on the Geological Survey of Texas, and will take charge at once of the petrographic work of the Survey. Dr. Osaun is well qualified for the position, having been for many years first assistant to Professor Rosenbusch, in Heidelberg, and, later, extraordinary professor of mineralogy and petrography in that University.

Dr. Karl Spruner von Merz, the author of "Historisch Geographischer Hand Atlas," died August 24th, 1892, at the age of 89. His great work, commenced in 1837, was not completed until 1852. Spruner was also the author of two school atlases of historical geography.

The University of Cape Town has been admitted to affiliation with the University of Cambridge. This is the second of the Colonial Universities thus affiliated, the other being that of New Zealand.

According to the Anatomischer Anzeiger, the Biological station at Plön, under the direction of Dr. Otto Zaccharias, has accomplished successful work during the past Summer. Of the species of animals occurring in the Lake of Plön, there have been determined 20 fishes, 40 crustacea, 69 worms, 14 mollusca, and 74 protozoa. Of greatest interest is the discovery in fresh water of many organisms that have hitherto been supposed to occur only in the sea; and among these more especially may be noted certain genera of diatoms, rhizopods and worms. An illustrated report on results is soon to be published.

—Dr. R. von Wetlstein has been appointed Professor of Botany in the University of Prague, Bohemia.

—Mr. E. E. Prince, M. A., Professor of Zoology in St. Munigo's College, Glasgow, has been appointed Commissioner and General Inspector of Fisheries in Canada.

The Indiana Academy of Sciences has issued its Proceedings for 1891, in the shape of a pamphlet of 176 pages. It contains not only the proceedings of that year, but also a list of all papers read before the Academy since its organization in 1885. The Academy has 121 active, 11 non-resident and 1 honorary members. Copies of the Proceedings may be had of the secretary, Amos W. Butler, Brookville, Indiana.

Professor Bohumil Shimek has gone to Nicaragua to collect in the interests of the State University of Iowa. He will pay especial attention to the invertebrata and the cryptogamous plants.

Bulletin No. 40, of the U. S. National Museum, contains the fourth of the bibliographies of American Naturalists, that of George N. Lawrence by L. S. Foster, 121 titles are enumerated. A good steel portrait accompanies the Bulletin.

NEW YORK, Feb. 3.—A broad smile illumined the folio face of Caliph, the hippopotamus at the Zoo this afternoon. In the tank adjoining his a baby had arrived at exactly 12.15 P. M., and Miss Murphy, his mate, was its happy mother. Director Smith and his keepers knew Tuesday that something was in the air, for Miss Murphy was restless and excited. She is a nervous animal at all times, but Thursday she paced her cage all day, and Thursday night did not lie down once. The warning came just in time, and a thick straw bedding was given her, and the partition separating her from Fatima was put up. The latter has the empty tank and the mother has the landing.

After the youngster came, Mr. Smith said the first thing it did was to walk about shaking its tiny ears and giving little grunts. Murphy followed wherever it went, and would allow no one to approach within the railing, and so he didn't attempt it. Caliph meanwhile found a peek-hole in the boards, and viewed his progeny with a great deal of interest. He refused to go into his tank, and last night slept within touch of the mother and baby.

The baby weighs about thirty pounds, being very small. Its color is pink—a salmon hue—and its legs are so short as to be almost imperceptible at first sight. It is lively and runs about a great deal, much to the mother's discomfort. It is a peculiarly shaped animal. It might be said that it has no shape at all. It is about eighteen inches long, has no tail, ears that can hardly be seen and mouth no larger than a pint cup. The mother guards it with a great deal of care. It is her third born. Four years ago one was born which weighed sixty-three pounds. It died. Fatima came next, having been born October 4, 1890. Murphy is 8 years old and cost $5000. She weighs between 3000 and 4000 pounds. Caliph was brought from the Cincinnati Zoo and cost $5000. He weighs 7000 pounds. To-night Murphy and her baby were doing nicely.—*Late paper.*

Table of Contents of the North American Review for February, 1893.—How to Revise the Tariff, by the Hon. Wm. M. Springer, Chairman of the Ways and Means Committee; Recollections of the Panama Canal Congress, Rear-Admiral Ammen, U. S. N.; Changes in the Church of England, The Dean of St. Paul's; Criminal Law in France, Madame Adam; Boons and Banes of Free Coinage, I. "In the Interest of Shylock," by the Hon. R. P. Bland, Chairman of the Committee on Free Coinage, Etc., II. A Warning to Savings Bank Depositors, by John Harsen Rhoades, President of the Green-

wich Savings Bank, N. Y., III. A Depositor's Point of View, by a Depositor in a Savings Bank; Wild Stag Hunting in Devon and Somerset, The Countess of Malmesbury; Government Aid to the Nicaragua Canal, Senator John T. Morgan; Shall Our Laws be Codified? Frederic R. Coudert; Needed Reforms in the Army, General John Gibbon, U. S. A; Why Immigration Should Not be Suspended, Senator H. C. Hansbrough; The Hope of a Home, Erastus Wiman; Europe at the World's Fair, I. The British Section, by Sir Henry Trueman Wood, Secretary to the British Commission, II. The French Section, by Theodore Stanton, Commissioner Resident in Paris; Notes and Comments, Mistakes—but Not of Moses, Charles W. Trickett; Science and the Woman's Question, Lydia Lvovna Pimenoff; From Renan's Point of View, Arthur Reed Kimball; The American Common Schools, Rev. James A. King.

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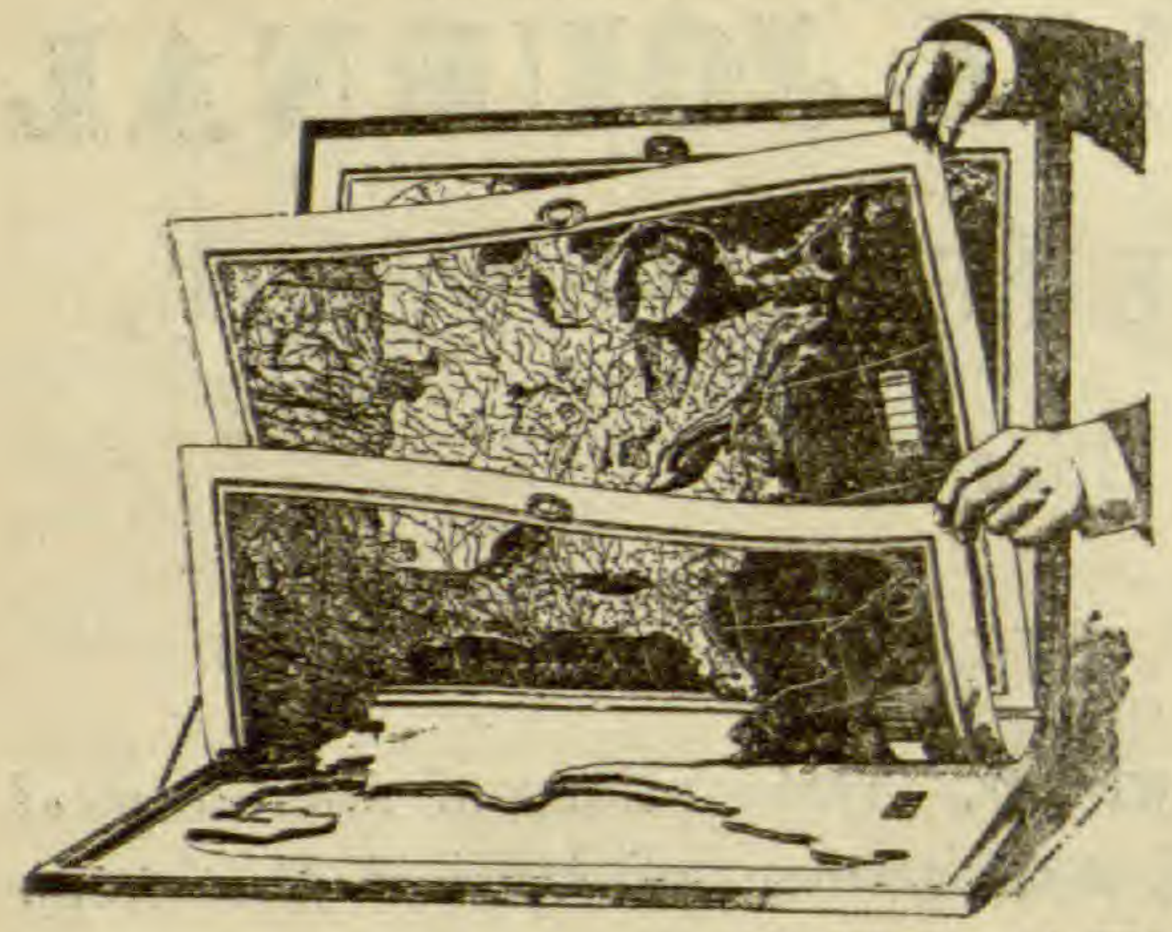

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PLATE IX.

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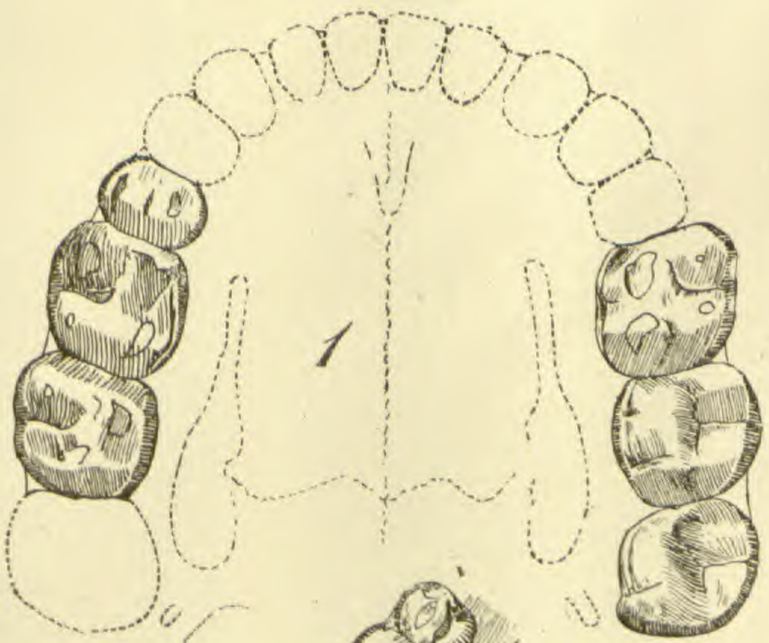

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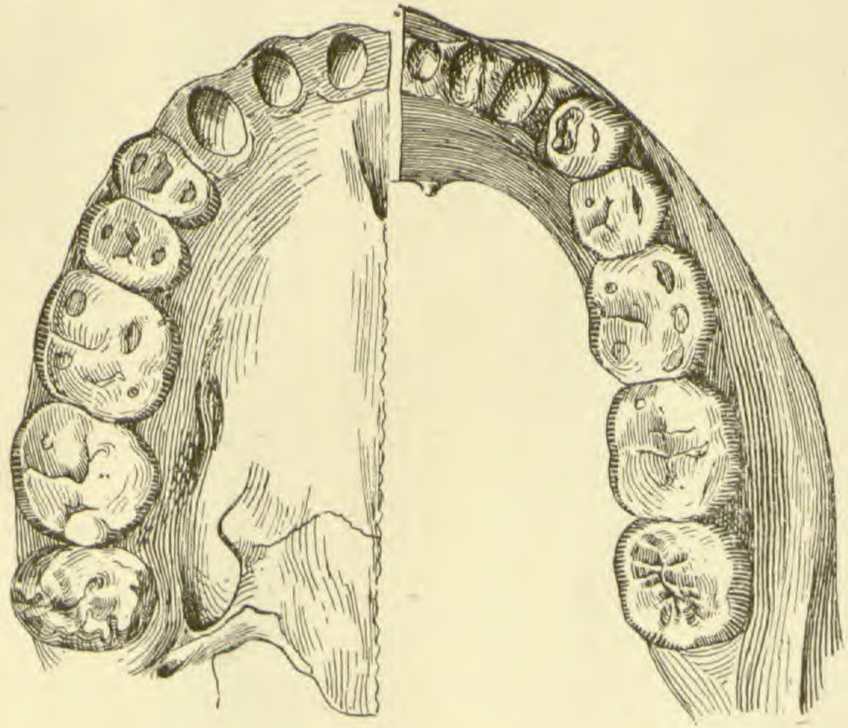

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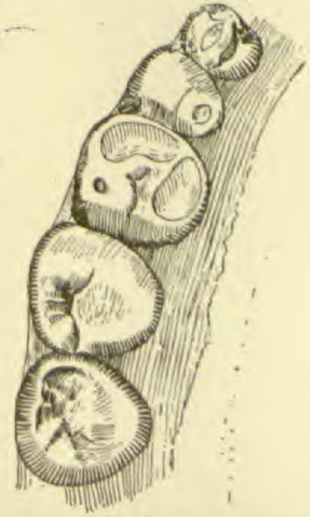

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1–2. *Man and Woman of Spy.* 3. *Maori.* 4. *Tahitian.* 5–6. *Fan.* 7. *Esquimaux.*

THE
AMERICAN NATURALIST

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THE GENEALOGY OF MAN.

By E. D. COPE.

The ancestry of man is a question to be solved by paleontology. Within the last twenty years, important progress has been made in our knowledge of the phylogeny of the mammalia, and some points have been gained which throw considerable light on the more immediate predecessors of man. These additions to knowledge have been made in the fields of both simian and human paleontology, and they have naturally received attention from archeologists as well as paleontologists. The question must be approached from the side of anatomy primarily, although aid from any other source is essential. Philology can, of course, give us no assistance, since the first man can have left no trace of his language. It is a fact that in some quarters, archeologists who are not anatomists, seem to underrate the value of anatomy in the premises, and are inclined to dispute the existence of men of very primitive or simian physical characteristics. But archeology, apart from anatomy, is a poor guide in the field of human ancestry.

Nothing is better known than that some races of men present a larger proportion of simian characteristics than others. Thus these approximations are fewest in the Indo-European race, and are rather more evident in the Mongolian. In the Polynesian, Negro, and Bushmen, they are most numerous, and in about equal but differently distributed proportions. Confining

our attention to the skeleton, it is known that almost every part of it is the seat of variations of greater or less significance.

Much importance attaches to the dentition. Many years ago, Owen[1] called attention to the fact that in the dark races the roots of the last superior molar are distinct from each other, while in the Indo-Europeans they are known to be more or less fused together. These now well-known characteristics of human dentition constitute one of the examples of transition from a simian to a human type. I have pointed out a corresponding modification in the structure of the crown of the superior true molars, viz: the transition from a quadritubercular to a tritubercular structure in passing from the lower to the higher races. As this point has some interesting implications in the earlier phylogeny of man, and as its value has been disputed, I give it a little attention.

The facts of the case are as follows: I have demonstrated[2] the fact that all forms of dentition exhibited by the Eutherian Mammals have been derived from a primitive tritubercular type. Professor Osborn says that he expects to be able to do the same for the Multituberculate (? Prototherian) dentition. I have also shown that man exhibits a tendency to revert from his primitive quadritubercular molar to this tritubercular type.[3] These facts are now common knowledge among paleontologists, although Dr. Brinton states in one of his late works that the latter proposition has been "refuted" by Dr. Harrison Allen and Professor Virchow. As to the significance of these facts, I have expressed the view that this acquisition of a tritubercular molar is a reversion to the lemurine type. This conclusion is necessary because the lemurs are the last of the families in the line of the ancestry of man which present this dentition. The monkeys and anthropoid apes are all quadritubercular, except a few limited collateral branches of the former, which still retain the lemurine type. There are also a few collateral types of lemurs which have acquired one

[1] Odontography, 1840-5, p. 454.

[2] Proceeds. Amer. Philosoph. Soc., Dec. 1883; Origin of the Fittest, 1887, pp. 245, 347, 359.

[3] Amer. Journal of Morphology, II, 1888, p. 7.

or more quadritubercular molars, but they are not typical. In many tritubercular mammals, a precocious form or two can be found, which has acquired the fourth tubercle. But the further back we go in time, the fewer they become, until, in the Puerco fauna, of eighty-two species of Eutherian Mammals, but four have true quadritubercular superior molars.

I take this opportunity of saying, however, that reversion is not necessarily a result of heredity. It may be simply a retrogression on a line of advance already laid down. What influence lemurine heredity may have had in the case of man, it is not easy to know. But it must be borne in mind that various forms of degeneracy of molar teeth are possible other than the resumption of the tritubercular type, yet the normal reduction generally presented, is just this lemurine and primitive Eutherian condition. The simplicity of the elements involved, has something, but not everything, to do with this reversion.

Dr. Paul Topinard has made an investigation[4] of the characters of the crowns of the molars in man, and has reached general conclusions identical with my own. He remarks (p. 665), "It is demonstrated, in conclusion, that the teeth of man are, at present, in process of transformation, and that in some future which is remote, the inferior molars shall certainly be quadricuspid, and the superior molars tricuspid. It will be curious to have the statistics as to prehistoric man; unfortunately, their crania are rare, and their molars generally much worn." In the details of his examination, there are some divergencies from my results. Thus he finds the quadritubercular second and third superior molar relatively of more frequent occurrence in Europeans than I did. But the absence of Europeo-Americans from his tables reduces the percentage of trituberculars in the Indo-Europeans. He makes no report of Esquimaux. Had he observed this type, he would have found a higher per cent. of tritubercular upper molars than in any race that he has recorded. He confirms my conclusion as to the high percentage of quadritubercular superior molars in the Malays, Polynesians and Melanesians.

[4] L'Anthropologie, 1892, p. 641 (Nov., Dec.).

The relation of this fact to phylogeny is to confirm Hæckel's hypothesis of the lemurine ancestry of man. I have advanced the further hypothesis that the Anthropomorpha (which include man and the anthropoid apes) have been derived directly from the lemurs, without passing through the monkeys proper. This close association of man with the apes, is based on various considerations. One of them is that the skeleton of the anthropoid apes more nearly resembles that of man in the most important respects than it does that of the monkeys. This is especially true of the vertebral column, where the anapophyses are wanting in the Anthropomorpha (insignificant rudiments remaining on one or two vertebræ, as pointed out by Mivart), while they are well developed in the monkeys and lemurs. The frequent presence of the tritubercular molar in man disposes of the superior claim of the monkeys over the lemurs to the position of ancestor. Another significant fact pointing in the same direction is the existence of large-brained lemurs with a very anthropoid dentition (Anaptomorphidae) in our Eocene beds. This resemblance is very remarkable, much exceeding that lately observed by Ameghino in certain extinct forms of monkeys in Patagonia, which appear to be ancestors of the existing South American monkeys (Cebidae), and possibly of the Old World monkeys also. The superior molars of Anaptomorphus are tritubercular, while the premolars, canines, and incisors are essentially anthropomorphous, and rather human than simian. Anaptomorphus is probably at the same time the ancestor of the Malaysian lemurine genus Tarsius, and M. Topinard remarks that Tarsius has as good claims to be regarded as ancestral to Homo as Anaptomorphus. But M. Topinard must be aware that in the existing genus the character of the canine and incisive dentition is very unlike that of the Anaptomorphus and Homo. It is specialized in a different direction. The dentition of Anaptomorphus being so generalized as compared with Tarsius, I suspect that its skeleton will be found to present corresponding characters. Of course, if it be found hereafter to have the foot structure of Tarsius (which I do not

anticipate), it must be removed from the line of ancestry of the Anthropomorpha.

It must be further observed that the ancestral line of the Anthropomorpha cannot be traced through any existing type of Lemuridae, but through the extinct forms of the Eocene period.[5] This is on account of the peculiar specialization of the inferior canines, which are incisor-like, and because of the peculiar character of the incisors themselves, in the modern lemurs in the restricted sense. But we have numerous lemurine types of the Eocene of both America and Europe which satisfy the conditions exactly, so far as the dentition is concerned. These are mostly referable to the family Adapidae.

Unfortunately, we do not know the entire skeletons of these Eocene lemurs, but as far as we have them (genera Tomitherium and Adapis), they are monkey-like. But we have what is almost as useful, the skeleton of their Eocene and Puerco ancestors, the Condylarthra. I long since pointed out that the latter order (not the genus Phenacodus, as Lydekker has represented me as saying), must be the ancestors of the lemurs, basing my views expressly on the general structure of Phenacodus, Periptychus and Meniscotherium. The structure of the ungual phalanges of Periptychus is very significant, and even more so is that in Meniscotherium, as recently shown by Marsh, who adopts (without credit) my hypothesis of lemurine affinities of the Condylarthra (which he renames the Mesodactyla). From Condylarthra back to Creodonta is an easy transition, and I have always assumed that the Creodonta were derived from generalized Polyprotodont Marsupialia. This view has been entirely confirmed by the recent discoveries of Ameghino in Patagonia, where he has found forms whose remains may be referred with equal propriety to the one group or the other. M. Topinard has been rather hasty in reaching the marsupial ancestry in supposing that Phenacodus belongs to that order. All the evidence shows that Phenacodus is a generalized ungulate placental.

To return to the more immediate ancestry of man. M. Topinard believes that I hold the opinion that the Hominidae

[5] On the Primitive Types of the Orders of the Mammalia Educabilia, 1873, p. 8.

descended directly from the lemurs without the intervention of the Simiidae. I have, on the contrary, expressed[6], and now maintain as a working hypothesis, that the Anthropomorpha were descended from the Eocene Lemuroids. In my system[7] the Anthropomorpha includes the two families Hominidae and Simiidae. The sole difference between these families is seen in the structure of the posterior foot; the Simiidae having the hallux opposable, while in the Hominidae the hallux is not opposable. This is not a strong character, since it depends on a slight difference in the form of the entocuneiform bone. In some vertebrates, as the tree frogs, the same and similar characters (genus Phyllomedusa) are not regarded as of family value. It is then highly probable that Homo is descended from some form of the Anthropomorpha now extinct, and probably unknown at present, although we do not yet know all the characters of some extinct supposed Simiidae, of which fragments only remain to us. It cannot now be determined whether man and the Simiidae were both descended from a genus with opposable hallux, or without opposable hallux, or whether from a genus presenting an intermediate character in this respect. This genus was, in any case, distinct from either of the two existing genera of Simiidae, Simia and Hylobates, since these present varied combinations of anthropoid resemblances and differences, of generic and specific value.

Professor Virchow has recently[8] thrown down the guage to the evolutionary anthropologists by asserting that "scientific anthropology begins with living races," adding "that the first step in the construction of the doctrine of transformism will be the explanation of the way the human races have been formed," etc. These two assertions are inconsistent, since the only way of solving the latter problem will be by the discovery of the ancestral races, which are extinct. The ad captandum remarks of the learned professor as to deriving an Aryan from

[6] American Naturalist, 1885, p. 467.

[7] Origin of the Fittest, 1887, p. 346, from American Naturalist, 1885, p. 346, where the classification of the Taxeopoda should be in a foot-note; loc. cit., 1889, October.

[8] Popular Science Monthly, Jan. 1893, p. 373, translated.

a Negro, etc., remind one of the criticisms directed at the doctrine of evolution when it was first presented to the public, as to a horse never producing a cow, etc. It is well known to Professor Virchow that human races present greater or less approximations to the simian type in various respects. Such are the flat coössified nasal bones of the Bushmen; the quadritubercular molars of the Polynesians; the flat ilia and prognathous jaws of the Negro; the flat shin-bones of various races; the divergent hallux of some aborigines of farther India, etc. But that no nearer approximation to the simian type than these has been discovered in any race will surprise most students of the subject. Professor Virchow does not satisfactorily explain the significance of the Cannstadt and Neanderthal skulls, and in his address he ignores the important and well authenticated discovery of the man and woman of Spy. To these ancient people I will now devote some space, describing more especially the dentition so far as it has been preserved.

What had been long suspected is now established, through the discovery and descriptions of MM. Lohest and Fraipont of

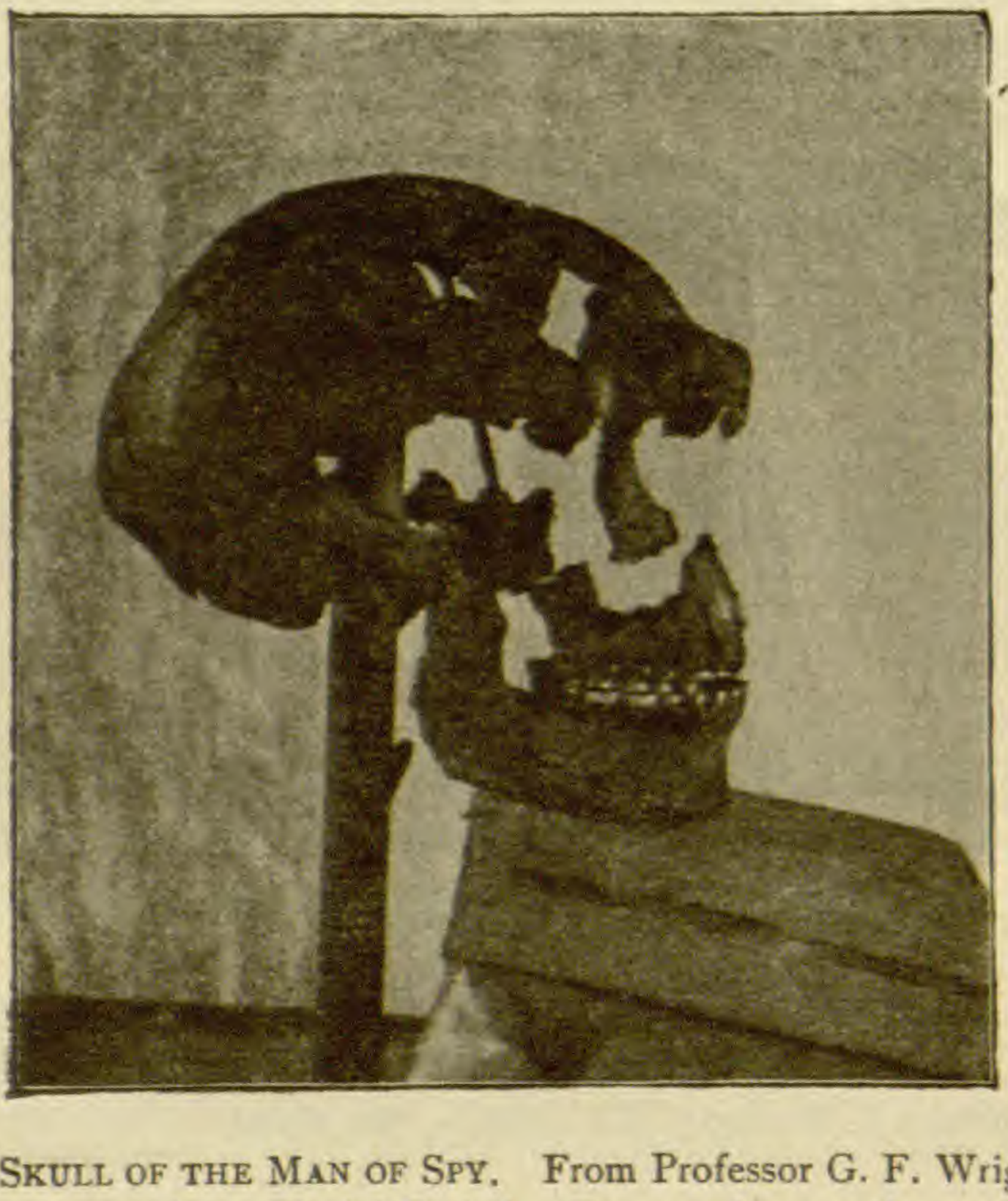

FIG. 1—SKULL OF THE MAN OF SPY. From Professor G. F. Wright's Man and the Glacial Period. From a photograph.

Liége, viz.: that there dwelt in Europe during paleolithic times, a race of men which possessed a greater number of simioid characteristics than any which has been discovered elsewhere. The important discovery in the grotto of Spy, of two skeletons, almost complete, served to unify knowledge of this race, which had previously rested on isolated fragments only. These skeletons proved what had been previously only surmised, that the skeleton of Neanderthal, the lower jaw of Naulette, and the crania of Cannstadt, belong to one and the same race. The simian characters of these parts of the skeleton are well known. These are the enormous superciliary ridges and glabella; the retreating frontal region; the thickness of the cranial wall; the massive mandibular ramus with rudimentary chin, and the large size of the posterior molars. MM. Fraipont and Lohest have added other very important characters to these, viz: the tibia shorter than in any other known human race; the sigmoid flexure of the femur; the divergent curvature of the bones of the fore-arm, and a very peculiar form of the posterior face of the mandibular symphysis. Of these characters MM.

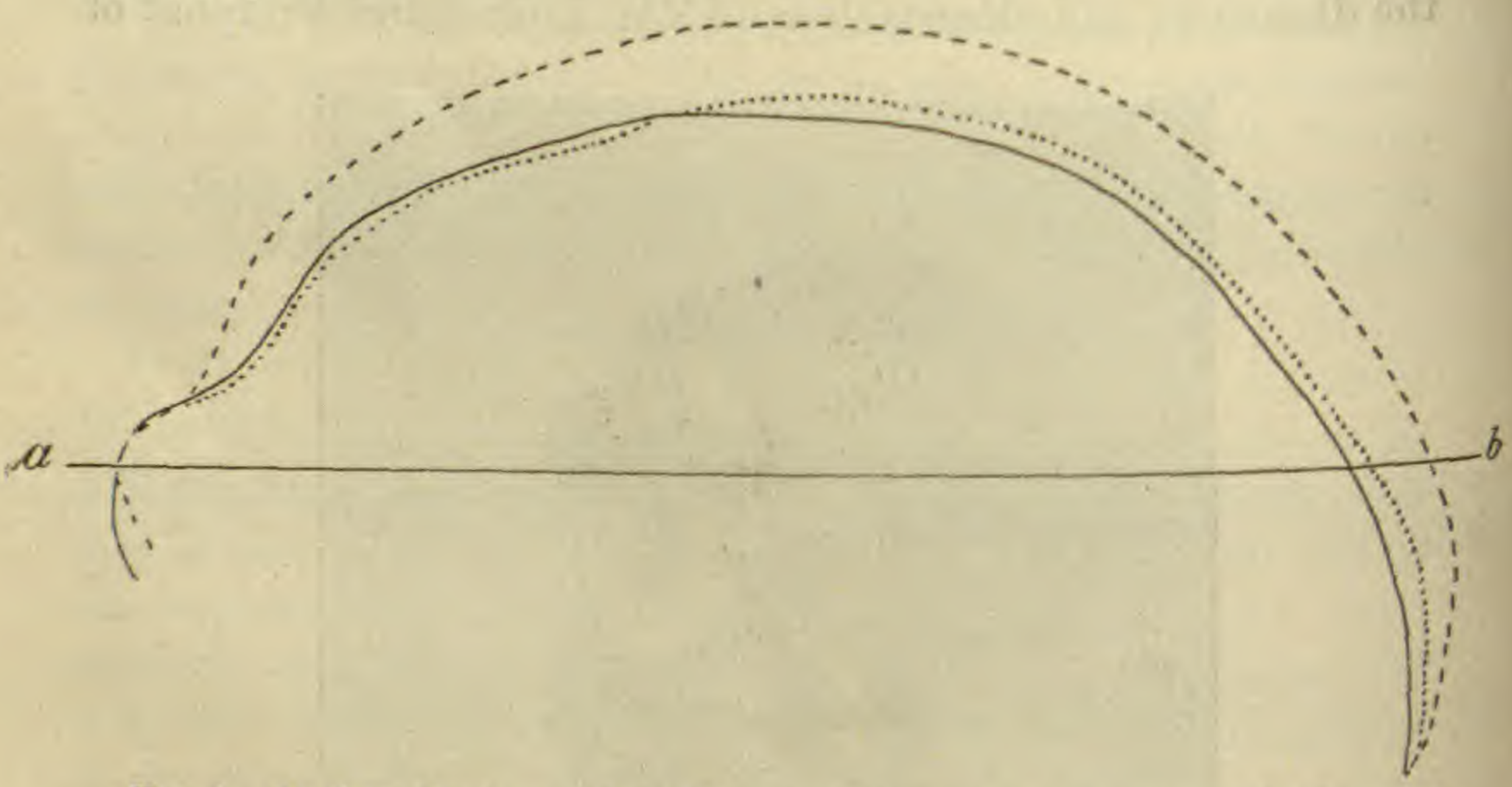

FIG. 2.—Outlines of calvaria of the Neanderthal man in solid line; of the Spy man no. 1 in dots; and of the Spy man No. 2 in broken line. From Fraipont and Lohest.

Fraipont and Lohest write as follows:[9]

I.—The prominent superciliary crests, which are characteristic of the Cannstadt race. No existing race presents such a

[9] Archives Belges de Biologie, VII, 1886, p. 731, Gand.

development, neither the Papuans, Australians, nor Negroes of any race. But we find the superciliary crests and underlying sinuses identical in adult female orangs and chimpanzees and young male gorillas. In the female chimpanzees the crests are almost inferior in size to those of the man of Spy.

II.—The retreating forehead of the two crania of Spy, is not found in any existing human race, while it is typical of that of Cannstadt. It is characteristic of female orangs and gorillas and of the young males of both species, and of adult males and female chimpanzees. It appears in existing men in rare and isolated cases.

III.—The prominent transverse superior semicircular crest of the occipital bone is found in existing races among the Fellahs of Africa and the Nigritos. It is characteristic of the Cannstadt skulls, and presents exactly the same characters as the young male and female orang and gorilla, and young male and adult female of the chimpanzee.

IV.—No human race presents the characters of the lower jaw exhibited by those of Spy, Naulette and Shipka. In this part of their osteology the anthropoids depart widely from man, the most conspicuous point in the latter being the presence of a chin. Accordingly, the angle formed by the anterior face of

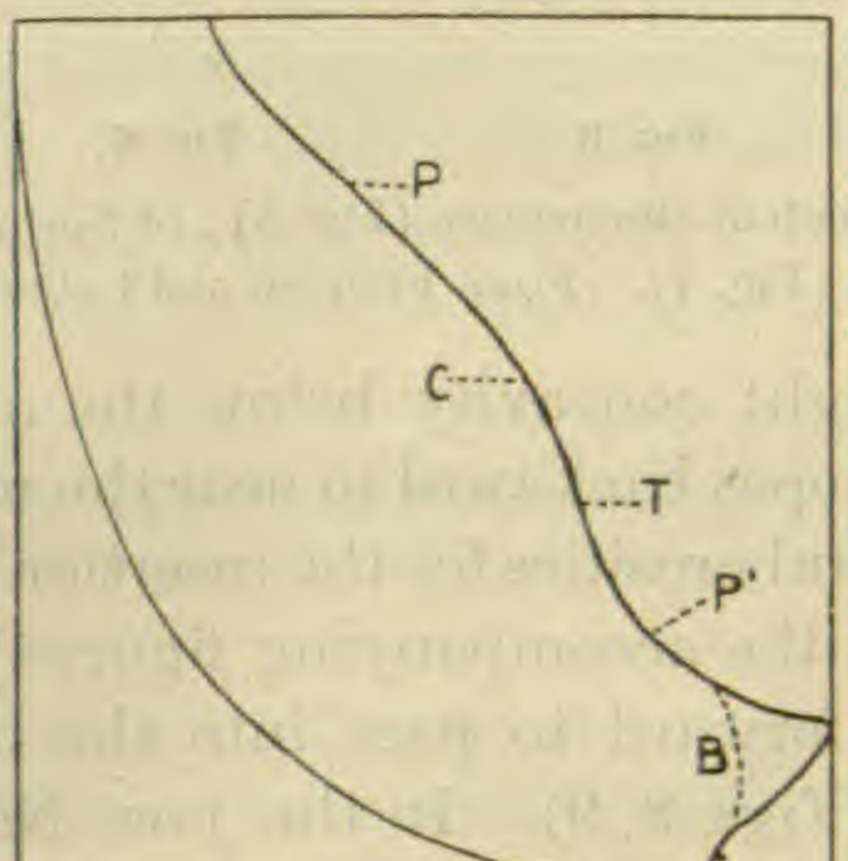

FIG. 3.

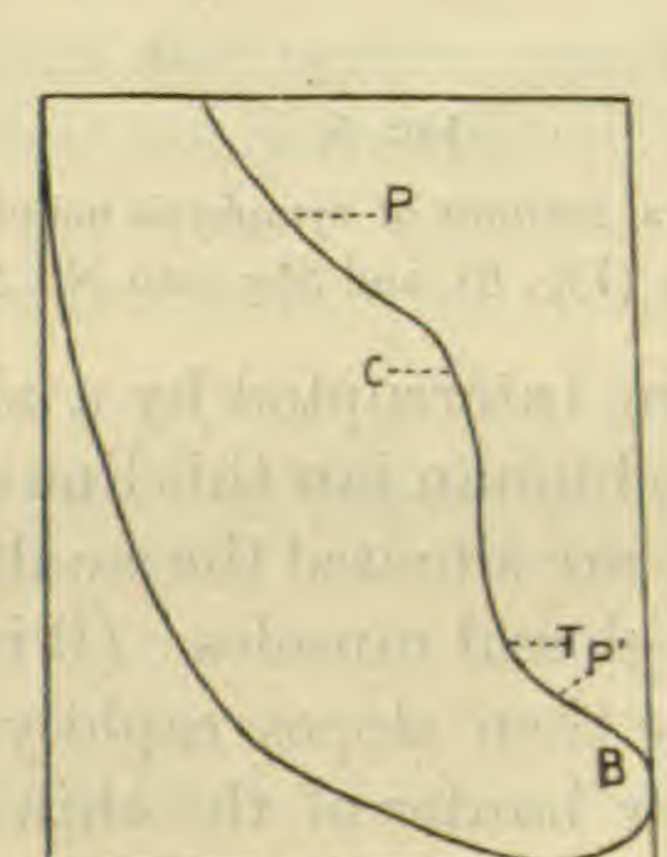

FIG. 4.

Vertical sections of symphysis mandibuli of gorilla (Fig. 3), and orang (Fig. 4).
From Fraipont and Lohest.

the symphysis with the inferior border of the horizontal ramus, is less than a right angle in man, and much more than a right angle in the anthropoids. According to Topinard, this angle in fifteen Parisians is 71°.4; in fifteen African Negroes, 82°.2; in fifteen Neocaledonians, 83°.9; in the jaw of Naulette, 94°. In the best preserved jaw of Spy, the angle is 107°, if measured from the inferior symphysial border, or 90° if measured from the inferior border of the ramus. There is no chin in the jaw of the Cannstadt race, and the large angle approaches without nearly equaling that of the anthropoids. But the posterior face of the symphysis presents the most remarkable peculiarity. In the symphysis of the apes (Figs. 3, 4, 5) the posterior border is a continuous slope from the alveolar border to the inferior

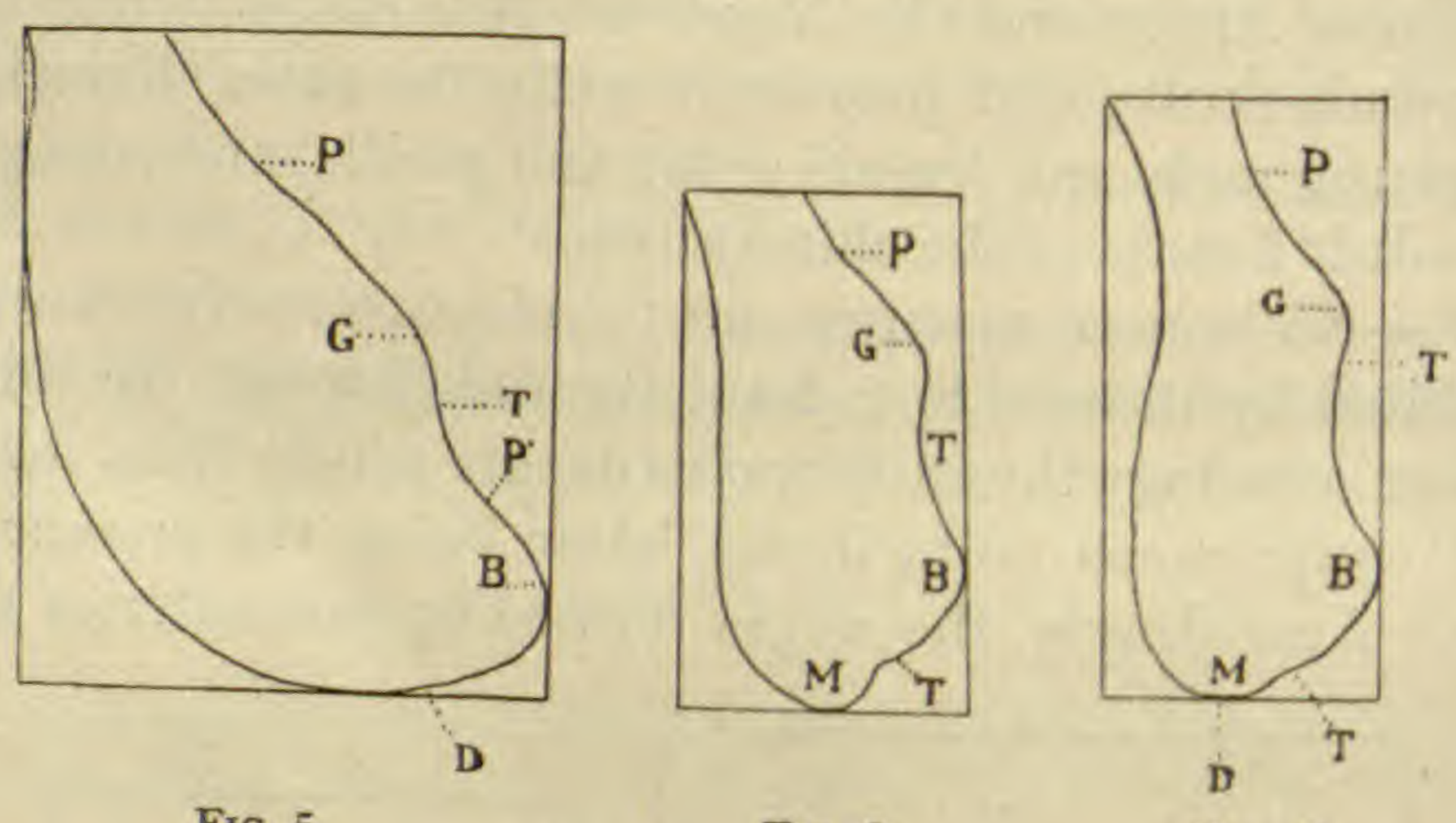

FIG. 5. FIG. 6. FIG. 7.

Vertical sections of symphysis mandibuli of chimpanzee (Fig. 5); of Spy man No. 1 (Fig. 6), and Spy man No. 2. (Fig. 7). From Fraipont and Lohest.

margin, interrupted by a slight concavity below the middle. In the human jaw this line slopes backward to near the middle, where are situated the small tuberosities for the insertion of the genio-glossal muscles. (B in the accompanying figures.) The surface then slopes rapidly forward to pass into the narrow inferior border of the chin (Figs. 8, 9). In the jaws Naulette and Spy, the structure is exactly intermediate between the two, and quite different from both. It commences above with a posterior slope similar to that of the apes, exhibiting what is called by Topinard, internal prognathism, as it appears in the lower human races. The surface then descends abruptly, form-

ing a vertical concavity, which is bounded a considerable distance below by another protuberance, the insertion of the genio-glossal muscles. This concavity is not present in the human symphysis, while it is less developed in the simian. The surface then slopes forward, as in the human symphysis, but this portion is shorter than in human jaws generally. It is represented by a convex face in the simian jaw. This character taken in connection with the others cited, goes a long way toward justifying the separation of the Cannstadt race as a distant species, as has been done by some author under the name of *Homo neanderthalensis* (Figs. 6, 7).

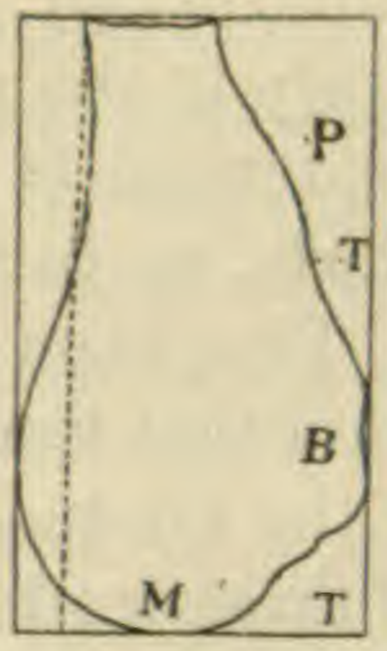

FIG. 8.

FIG. 9.

Sections of symphysis mandibuli of modern Liegois (Fig. 8), and of an ancient Parisian (Fig. 9). From Fraipont and Lohest.

V.—The curvature of the ulna and radius, which produces a wide interosseous space, is not found in any human race, but is common to the apes. On the contrary, the shortness of these bones is entirely human.

VI.—The anterior convexity of the femur, with its round section, is only found among living races among the Nigritos of the Philippine Islands. It is seen in a less degree in femora of neolithic men, and occasional instances are seen among existing Europeans. It is the normal condition in the apes.

VII.—The tibia is shorter in its relation to the femur than in any human race, and is more robust than in most of them. This character, with the oval section, while not identical with what is seen in the apes, forms an approximation to it.

VIII.—The condyles of the femur are not only wider than in human races generally, but they are more produced posteriorly. The portion habitually resting on the head of the tibia

is so far posterior as to throw the femur backward when in place. This requires that in order to maintain equilibrium, the head and body must have been thrown forward. This relation of the femur and tibia is what we find in the apes, and it is highly probable that the man of Spy presented a somewhat similar figure when walking. That is, the knees were bent and the body thrown forward. In the best preserved leg, the knee was also slightly bent inward. The femur had, however, the superior length generally characteristic of man, though this, it is well known, is a variable character.

MM. Fraipont and Lohest have pointed out the general characters of the dentition of the man of Spy. They show that the molars increase in size posteriorly to the same extent that they do in the apes, which is the reverse of what is usual in man, where they diminish posteriorly, or, in a few lower races (Australians, etc.), remain equal. They show that the superior molars are all quadritubercular, and that the internal root is distinct in all of them. Through the kindness of M. Lohest, I received casts and photographs of these teeth, and I give here figures the former (Plate IX), which are more satisfactory than those in the memoir from which I have already quoted so fully, where, indeed, the grinding faces are not represented at all. I also make some remarks which they suggest, on some details not noticed by MM. Fraipont and Lohest.

The casts of the teeth of the man are those of P. m. $\frac{2}{1\ 2}$ and M. $\frac{1\ 2\ 3}{1\ 2}$ of one side, and of M. $\frac{1\ 2\ 3}{1\ 2}$ of the other side. Those of the woman are alveoli of I. $\frac{2}{1}$ and C. $\frac{1}{1}$, and the entire teeth of P. m. $\frac{1\ 2}{1\ 2}$ and M. $\frac{1\ 2\ 3}{1\ 2}$ all of one, the right, side. The crowns of the man's teeth are moderately worn, so that their composition can be studied, while those of the woman are more worn, so that the composition is somewhat obscure. Comprehensively, it may be stated that the true molars are fully quadritubercular, as in the lowest known races of men, and that the hypocone is in the anterior molars, as large as the protocone, while it is always smaller in man when present. In the female the last superior molar has a well-developed internal root, which diverges widely from the posterior external, even more widely than in a chimpanzee in my possession. This arrangement is

even more simian than that seen in Australian and Maori dentitions in my collection. The last molar of the male is stated to have similar structure, but the roots cannot be clearly seen in the plaster cast. These two characters then place the man of Spy in the lowest category, just as would be naturally expected in the presence of the other simian characters already referred to. The dentition is inferior to that of the neolithic man of France,[10] where the last molar at least is tritubercular.

Some other peculiarities of these dental series may be now referred to. In the female dentition, where alone the canine alveoli remain, the size of the latter tooth and that of the premolar is large, relatively, to that of the true molars. The canine is not remarkably large, but exceeded by a little, that commonly seen in Polynesians and Australians, where it is largest among human races. The premolars exceed a little the proportions seen in the same races, approximating but not quite equaling the relative dimensions seen in the chimpanzee. The roots are relatively more robust in the transverse direction than in human dentitions generally. The first and second molars of the female are of equal transverse diameters, while the third is a little wider transversely and quite as wide anteroposteriorly. This large dimension for the third molar exceeds anything I have observed in human dentitions except in the case of a single Australian in my collection, surpassing a little that of the chimpanzee, and reminding one of some of the gibbons (Hylobates), where, however, the crown is subcircular in outline. In the male the transverse diameter of the third molar is a little smaller than that of the other molars, but the tooth is larger than is usual in man, and equals in its dimensions that of the chimpanzee.

A peculiarity which is pronounced in the male, and observable in the first molar only of the female, is the prolonged posterior convexity of the grinding surface. This is unlike anything I have seen in human molars, and resembles the character of the orang[11] more than that of any other quadrumane known to me. This appearance is increased by a contrac-

[10] Cope loc. cit., p. 17.

[11] Owen Odontography, p. 444.

tion of the grinding surface posteriorly, by the convergence of the internal and external borders, a peculiarity apparently unique to the man of Spy. The forward overlap of inferior molars on the superior is much greater than usual in the male. This contraction of the posterior part of the external border is equally marked in the female, but the posterior border is not so convex. It results from the peculiar form of the external borders of the crowns of the true molars in both sexes, that they form an echelon arrangement. This does not seem to be an adaptation to an oblique outline of the maxillary arch, which is broadly rounded as in the Australians and Polynesians.

Summarizing the above observations, I would say that in the quadritubercular molars, with distinct and divergent roots, the man of Spy takes the lowest position among the subspecies of man. Second, that in the relative proportions of the premolars and molars with each other and among themselves, he possesses some characters lower than any of the known races of man, and approximates near to the apes. Third, that in the echelon arrangement of the external wall of the molars, he presents a peculiarity more strongly pronounced than either man or apes, and whose true significance can not now be determined. It occurs in the abnormal V-shaped maxillary arch of existing men, but the arch in the man of Spy has not this character, but is fully rounded, and as it occurs in both sexes, it is not probably an abnormality.

In conclusion, it may be observed that we have in the *Homo neanderthalensis* a greater number of simian characteristics than exist in any of the known races of the *Homo sapiens*, although, so far as known, he belongs to the genus Homo. The posterior foot, so far as preserved, indicates this to be the case. The foot-character, which distinguishes the genera Homo and and Simia still remains. There is still, to use the language of Fraipont and Lohest, "an abyss" between the man of Spy and the highest ape; though, from a zoological point of view, it is not a wide one.

The flints which were discovered in the stratum of cave deposit containing the human remains, are of the paleolithic type known as Mousterien in France, which are of later origin

than the Chelléen or older paleolithic. The older paleolithic man is not yet known. It is interesting to observe that these flints (Mousterien) are of the same form as the obsidian implements which I collected at Fossil Lake, in Oregon, with the bones of extinct llamas, horses, elephants, sloth, etc. The animals which accompanied the man of Spy are, *Cœlodonta antiquitatis* (wooly rhinoceros), *Equus caballus, Cervus elaphus, Cervus tarandus, Bos primigenius, Elephas primigenius, Ursus spelæus, Meles taxus, Hyaena spelæa;* five extinct and four existing species.

As the evidence now stands, the most primitive and simian of human races inhabited Europe. No trace of the *Homo neanderthalensis* has been found in any other region of the earth. As, however, paleolithic implements are found in all continents, we may anticipate that this or some similar species of man will be discovered there also. An equally probable conclusion is that, taking into consideration the characters of the Neolithic man, the Europeans originated in Europe, and that some of us are the direct descendants of the *Homo neanderthalensis.*

EXPLANATION OF PLATE.

Dentition of the man and woman of Spy, natural size; taken from casts.

Fig. 1. Superior molars of the man from below.

Fig. 2. Do. of the woman from below; 2a do. last posterior molar from behind.

Fig. 3. Maori, last superior molar from behind.

Fig. 4. Do. of Tahitian from below; *a* do. from behind, showing fused roots.

Fig. 5. Superior dentition of a Fan from West Africa, from the collection of the University of Pennsylvania; *a* last superior molar.

Fig. 6. Inferior dentition of Fan of Fig. 5.

Fig. 7. Esquimaux, superior molars; from cranium in Army Med. Museum, Washington, D. C.

THE PROBABLE PHYSIOGNOMY OF THE CRETACEOUS PLANT POPULATION.

By Conway MacMillan.

The sudden appearance of metaspermic plants in the rocks of the Cretaceous period has occasioned much discussion, and has always proved to be a *crux* to the writers on evolutional philosophy. Even in the latest work of authority on general evolutionary topics—*Darwin, and after Darwin*, by Romanes, the old and vague statements—concerning "probable breaks in the records," and possible remarkable accelerations of what are usually very slow processes,—may be found again, and have the air of being all that can yet be said with much show of reason from the evolutional point of view. The various opponents of Darwinism, and of evolution in its broader sense, have ever appealed to the sudden emergence of Cretaceous metaspermic plants as an unanswerable argument against the different development-hypotheses. There is not space here even to cite the numerous works in which the unexplained and sudden appearance of Cretaceous metaspermic plants has been adduced in condemnation of the various evolutionary hypotheses. All students who have kept pace with the controversial biological literature of the last thirty years, will readily recall the important part that the Cretaceous plants have played in the anti-evolution polemic.

In view of what has been stated above, the intent of this paper will be recognized as a sufficiently ambitious one, when it is stated to be an effort to show two facts, as developed by the study of modern plant-formations and the evidence of the fossils; first, that the appearance of Cretaceous metaspermic plants is proved, *by the fossils*, not to have been sudden, but gradual, and consequently, in Cretaceous time, the general preponderance of plant-population was strongly coniferous, fern and cycadean; and second, that the conditions of Cretaceous time were such that the new and scattered metaspermic plants were placed under circumstances similar to those in

which to-day variation is most rapid and plasticity is greatest for each species and even for every individual.

The attempt to show that the high preponderance of metaspermic remains in the Cretaceous rocks is a sufficient proof of the high preponderance of pines, cycads, ferns and club-mosses in the Cretaceous forests is paradoxical enough to excite grave suspicions of the method by which such a result is reached, but the writer hopes to show that the absurdity of the statement is solely a superficial one, and that it is really capable of a defence both from experiment, observation and legitimate deduction. I have already presented in my recent work on the plants of the Minnesota valley the skeleton of the argument,[1] but desire here to amplify and extend the discussion, somewhat, to more fully cover the ground. If the conclusions that I have drawn are legitimate, and my knowledge of the literature of the subject sufficient to uphold my belief that certain new laws are determined, both of plant-distribution to-day and paleontological interpretation, it will be clear that the argument is an important one, and should be examined for what it may prove to be worth.

In the first place let us examine some of the observed facts of plant-distribution to-day. It is apparent that while species themselves are generally limited in some more or less definite manner and occupy a more or less considerable area of the earth's crust, there are several degrees of aggregation in which species play a subordinate part. We note the coniferous forest as distinct from the hardwood forest, the prairie knoll from the prairie swale, the mountain-side herbage and shrubbery from the herbage and shrubbery of the valley. The presence of these different zonal groups at different attitudes and latitudes was first pointed out in the modern way, by von Humboldt.[2] Since his time, the various groups of species, conditioned in some definite manner and, under climatic influences, acquiring characteristic habits or habitats, have been studied

[1]Metaspermæ of the Minnesota Valley, p. 602 (1892).

[2]Essai sur la Geographie des Plantes, suivi d'un Tableau Physique des Regions Equinoctiales.

De Distributione Geographica Plantarum, secundum cœli Temperium et altitudinem montium, Prolegomena.

somewhat in detail. The great works of DeCandolle[3], Grisebach[4], Engler[5], Drude[6], and the numerous special brochures of these and of many other writers on geographical botany, have pointed out with much distinctness the existence of plant-formations. These formations are of different degrees. In the United States there are, in the eastern portion, two very distinct formations that belong to the highest division—namely, the forest and the prairie. These two great formations, in the broadest sense, are scarcely anywhere in contact with each other, but are separated by what may be a very narrow strip of plants imperfectly developed in either forest or prairie. The region occupied by such a transitional strip of plants I have named in the work cited above, a *tension-line.* Wherever two formations of different sorts, such as hardwood forest and coniferous forest, meadow and hillside-grassland, or any other two, come together, there is such a tension-line developed along the line of contact.

The character of the tension-line between formations has received as yet very little study, and it is not possible to speak of it as exactly as one would wish. My own observations are confined to the tension-lines between forest and prairie in the Minnesota valley, a region of special study for the past two years. Certain interesting facts have been deduced. These may be noted as follows:

The plants of the tension-line consist of such species as are sparsely developed in the more central areas of the two adjacent formations, or in some cases of species very poorly developed in the solid parts of the two formations.

The number of individuals of the first group is generally greater over a given area along the tension-line than in the solid portions of the formations.

[3]Gèographie Botanique Raisonnèe, on exposition des Faits Principaux et des Lois concernant la Distribution Geographique des Plantes de l'epoque actuelle. Tom. I, II (1855).

[4]La Vègètation du Globe, d'apres sa Disposition suivant les Climats, esquisse d'une Geographie Comparèe des Plantes, trad. par P. de Tchihatchef. Tom. I, II. (1877).

[5]Versuch einer Entwickelungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode. Th. I, II. (1879).

[6]Handbuch der Pflanzengeographie. (1890).

There is a tendency for plants of a higher phylogenetic type to accumulate in the tension-line area than characterizes either of the adjacent formations. Thus in the border of the wood and prairie one finds Asters, Helianthi, Solidagos, predominant over the lower Archichlamydeae or Monocotyledones.

There is a transition from typically prairie groups of grasses to the typical tension-line groups of species, and similarly from the typically forest groups of trees, in the hardwood belt.

The tension line is characterized by a greater comparative richness of species and luxuriance of individuals, in the matter of number, than the average of the adjacent formations.

The tension-line is not a fixed, but a moving line, and usually one formation or the other is in a condition of encroachment while its adjacent formation is in a condition of retreat.

The movement of the tension-line is felt some distance from the contact line of the two formations, so that, if forest is encroaching upon prairie, the characteristic composites of the tension-line are thrust out farther into the prairie.

From the interior regions of both adjacent formations plants "work out" into the tension-line area. Such plants are generally the imperfectly established.

The last point lends itself very easily to direct experiment. If a field of some well established perennial plant, as for instance, blue-grass (*Poa pratensis*) be selected, and several sunflower seeds, or thistle seeds, be planted in the center of it, it will happen that one or two plants of the composite species may reach maturity, and will then distribute seed outward in every direction. In three years time the composites will probably be ejected to the periphery of the field, and will have gained there a considerable foothold, while in the center of the field they will have gained but a slight foothold, and perhaps will not have retained what they had given them at first. A strong formation thus ejects to its periphery the plants that not in harmony with it, still strive to establish themselves. In the work cited above, I have termed this "the law of the ejection of the weaker." It may be seen operating in any wood or field, and is, I believe, one of the most important factors in the

origin and modification of metaspermic species—although not generally recognized. It will be observed that while this ejection is purely biological, it nevertheless bears comparison with certain physical phenomena as when, for example, the water contained between the pores of adjacent solids is squeezed to the surface of the mass, and is thus ejected from its original, more central position.

It appears from the preceding analysis of conditions certainly existing and verifiable, that two adjacent formations do not actually come in contact, but are separated by the thicker or thinner band of tension-line species. It further appears that the tension-line group is made up of, and constantly replenished by plants ejected from the interiors of both formations, and reaching the tension-line as it were, to use a metaphor from chemical science, "in the nascent condition." This explains, or at least suggests the explanation of what otherwise would be difficult, viz., the large comparative number of species in the tension-line area, and the fact that higher types are aggregated there rather than in the solid portions of adjacent formations. For not only is the tension-area populated from the interiors of the adjacent formations, and thus comes to have a diversified group of inhabitants injected into it, but these inhabitants are likely to be the new forms, not in perfect harmony with the general mass of the formation in which they originated—and therefore they are ejected. Furthermore plants reach the tension-area "on the move"—their variations already begun and accentuated, it may be, by the forced journey to the periphery of the parent formation. Therefore both the actual numbers of species in the tension-area being great, and these species being derived from widely different habitat and environment conditions, together with the high degree of plasticity acquired in the ejection and after establishment in the tension-area, it becomes evident that it is precisely at such a contact-region between two formations that conditions are highly favorable for specific and generic and even ordinal variations to set in. Thus the increased number of species in the tension-area is seen to be in part the cause, and in part the

result, of the high variability that is experimentally noted in such an area.

From the above, the explanation of the various peculiarities of the tension-line will readily be derived. Under the law of the struggle for existence, it will be seen that this struggle may be between individual and individual, individual and formation, and formation and formation. All three phases are developed at the tension-line and since the causes of evolution are working at their highest along this area, it happens that the results are numerically most apparent. The three phases of the struggle are not elsewhere so vividly brought to one's notice, for at least the third will be wanting or felt but indirectly. It appears, as a result of the examination, that the character of the tension-line, as made out by observation, is capable of illumination by experiment and of explanation by the general and well-known laws of evolution.

It is now my intention to show that the metaspermic plant-population of the Cretaceous, and especially of the Upper Cretaceous was a tension-line population. If this be possible, we shall expect that population to manifest tension-line characteristics.

In the first place it is necessary to gain some comprehension of the Cretaceous geography. I shall concern myself here only with the Upper Cretaceous of America. At the time of the deposition of the Cretaceous clays and sandstones, the North American continent was much more restricted than now. It extended little south of Illinois, and was cut by a great Mediterranean Sea into an eastern, larger and shorter, and a western, smaller and longer continent. The Mediterranean Sea extended from the south to the extreme north, and was doubtless highly saline in character. The coasts of this sea were generally low—at least this is derived from the evidence of the flora, according to Lesquereaux—but, here and there, doubtless varied by some rocky promontory or headland. The shores were marked by frequent bays and estuaries, and the rivers which flowed into the Cretaceous oceans were probably tide-streams to a marked degree. The general character of the country was low or morassic, but this was certainly broken

by high uplifts, usually far inland. The coast-line of the ocean was therefore, so far as may be determined up to the present time, a generally low area, where vast stretches of sands or mud-flats were shifted about by the surf and by the inflowing waters of tributary streams. It is these sandy beaches and mud-flats that persist to-day as the Cretaceous rocks, bearing their countless imprints of archaic plants.

Considering next, for a moment, the character of the plant remains from the Cretaceous, we find that in the Lower Cretaceous, as studied by Fontaine, there are numerous ancient fern and cycadean types. These become less prominent in the Upper Cretaceous, so that in 1874, when, under the researches of Heer and Lesquereaux, already 130 species were described from the Dakota group, of these only five are ferns or cryptogamous plants, one doubtfully cycadean, six coniferous, two monocotyledonous, and the rest Dicotyledons—principally in the Archichlamydeæ, with only a very few (*Bicornes*, *Leguminosæ*, *Ebenaceæ*, etc.) referable to the Metachlamydeæ. The presence of the older types of cycads, conifers and ferns is important to be noted, for it is possible that the sole reason for their not appearing in countless numbers is the fact that they were cut off from the sandy-beaches and mud-flats by a thin but well-nigh continuous tension-line group of new and struggling Metaspermæ.

The study of shore-lines of modern seas is essential to the further working out of the hypothesis in process of development in this paper. The writer is not aware that observations have been made with the considerations in view that would make them useful either for support or objection. His own studies of sea-shore areas are confined to the observation of Cape Cod, Massachusetts, during a single month. While there he found that the older plants are more numerous in the inner regions, and the newer more numerous nearer the coast. The coast-line then seems to be a tension-area. While there are many pines on the Cape, these, so far as I could discover, were generally distributed inland, reaching the border of the sea only on high promontories, and on low lands being generally separated from it by strips of herbage, low shrubbery and hard-

wood timber. Further study of the sea-shore is needed along this line. But, apart from the testimony of the limited observation, it appears demonstrable that the coast-line, simply because it was peripheral, thus terminating ejections, must have developed a tension-line group of plants in Cretaceous times. That this tension-line was a relatively narrow one is proved by the great preponderance of metaspermic remains. For if it had been a broad one, the competition between older ferns and cycads, and newer metaspermic plants would doubtless have been sufficient to have brought down to the coast in larger numbers the more inland types of plants.

The picture of the Cretaceous plant physiognomy which these considerations brings before our eyes is of a great solid inland forest of conifers, cycads, ferns, and *Calamites* (*?*), bounded by a thin peripheral line of metaspermic trees, shrubs and herbs. This peripheral line extended up both sides of all estuaries, streams and rivers, and thus shut off the older, luxuriant and dominant flora from proper representation in the rocks of the period, as they have come down to us. An occasional inland plant was carried down some river and buried in the sands or shales at its mouth, and sometimes when the shores were high the inland types came close to the sea, and in the *Sequoias, Cunninghamites, Abietites, Zamieites* and other genera of the Cretaceous rocks, we derive a hint of the inland and general character of the plant population. The very fact, therefore, of the high metaspermic preponderance in the fossils—since it shows metaspermic plants to have been uniformly the coast population, and hence the tension-line population, is an argument in favor of supposing that metaspermic plants were actually very much less predominant in the general flora then than they were in Tertiary or Recent time.

Together with this disposition of the oft-repeated declaration that the Cretaceous Metaspermæ appeared with inexplicable suddenness, it will be seen that the other difficulty of their rapid and inordinate multiplication of species and genera is solved—so far as such notes constitute a solution. The tension-line position, with its tremendous increase of urgency to modify, and its concomitant increase of individual plasticity,

explains the matter, so far as general explanations are of value. As the Metaspermæ began to fight their way back into the solid coniferous fern and cycadean forest, doubtless the same phenomena might have been noticed that are apparent to-day. The examination of a region where hardwood forest is encroaching upon coniferous is especially suggestive. The forerunners of the hardwood trees, various herbs and shrubs, insinuate themselves up the rivers and tributaries, closely followed by the trees themselves. In this way the coniferous plants and their numerous allies, the various heaths, cornels, club-mosses, etc., are isolated into phalanxes of smaller and smaller size. At last they become entirely surrounded by the invading types, and at the first opportunity are exterminated altogether. Without question similar scenes might have been noticed in the ancient Cretaceous forest when the tension-line group of plants waxed strong and began the backward march carried on through Tertiary time and resulting in the domination to-day of archichlamydeous trees in the extra-tropical forest regions, while metachlamydeous plants are in their turn characteristic of the tension-lines.

To summarize, in conclusion, what is at best a disconnected and imperfect attempt to contribute somewhat toward the analysis of a very difficult group of problems. A study of modern plant formations reveals the presence of tension-line areas in which higher types of plants may become aggregated, and where the general tendencies are toward a high degree of individual and specific variability. Such tension-lines are peripheral in position, and may be of different degrees of organization as they lie around formations of greater or less degree of integration. Newer types of plants are particularly likely to be forced into the tension-line habitat, under the law of the ejection of the weaker. Both observation and experiment show this. Such tension-lines doubtless characterized the Cretaceous formations as well as those of to-day. In them the weaker, because newer, types were aggregated, and in this way the littoral regions of the Cretaceous oceans came in all cases to be densely metaspermic in the character of their plant-population. The generally low elevation of the coasts

contributed to this condition. The older types of plants, making up the bulk of the forest, were isolated from the shores and from the banks of streams, except very far inland. Consequently their remains are preserved only under exceptional conditions. That the metaspermic plants occupied the tension-line position indicates the preponderance of older types in the great inland stretches of country. The rapid appearance of new metaspermic types during the Cretaceous—and probably too in Jurassic time—was a result of the tension-line position into which they had been forced. The high development of the arboreal habit may be referred to similar causes.

The picture thus brought before the eyes differs much from the usual reconstructions of Cretaceous landscapes, but may be, nevertheless, a closer approximation to the truth. A final word may be added in regard to the conditions of the Triassic and even of earlier time. In those ages we may imagine the metaspermic types developing in the ancient forests of cycads —or even of *Lepidodendrons* and *Annularias*—and beginning their forced marches to the peripheral regions of the solid, archaic formations of their birth. Thus for century upon century they may have existed, and fail to appear in the fossils, because of their internal position in the formations. But when, after their long struggle for food and light and soil for support, they emerge upon the periphery of their parent formations we find them already arborescent or arboreal, and soon almost universal upon littoral areas. They then first come into a position where preservation in the rocks is possible.

AN EXTREME CASE OF PARASITISM.[1]

By Robert Hessler, A. B., M. D.

There is a small family of minute animals belonging to one of the sub-divisions of the arthropods which is of especial interest on account of the parasitic habits of many of its members. One of these, *Sarcoptes scabiei* De G., is parasitic on the genus Homo.

Historical.—It seems that the Jewish physicians dwelling among the Moors of Spain, in the 12th century, knew something about these animals and their causative relation to the affliction known as the itch. The discovery of the microscope early in the 17th century (1619) led to many investigations, some of which had reference to the itch mites. The first good description of the mite bears the date of 1687, and was written by Bonomo to Redi, at Florence. After this, various observers saw the insect, but frequently it was confounded with other mites, especially the cheese mite. Linnæus in his Systema Naturæ, 1734, had a very imperfect idea of it.[2]

In the century following the first appearance of the Systema Naturæ, the mites, as causes of the itch, were frequently the subject of heated discussions among medical men. The identity of the human itch mite was better known to naturalists than to physicians.[3] For instance, in a large treatise on skin diseases by P. Rayer, originally published in Paris in 1835, the author, in describing the causes of the itch, says: "Causes —Scabies is one of the most universally disseminated contagious diseases known; the most momentary contact of the fluid secreted by its vesicles is enough to communicate the infection; it is observed in every climate during every season of the year, attacking all ages and persons in every rank of life, without discrimination. It is most commonly observed, however, among the poor and wretched," etc. Further on he

[1] Read before the Indiana Academy of Science, December 28, 1892.

[2] Hebra, "Diseases of the Skin," 1868. P. 168–180.

[3] Hebra, "Diseases of the Skin," 1868. P. 180–181.

says: "Several authors of modern times have reported that they have discovered an apterous insect, almost invisible to the naked eye, within the vesicles of scabies, which they have described under the name of acarus scabiei," etc. The author does not state whether he believes this.[4]

The labors of many observers in 1834 and 1836 firmly established the true nature of the itch or scabies. In 1845 and 1846 the minute anatomy of the insect was thoroughly studied and described.[5] The mite *Sarcoptes scabiei*, as the cause of the itch, was established beyond all doubt.

In recent medical works, I find there is little uniformity in regard to the systematic classification of this animal and its generic and specific names. The latter are variously given, the most popular seems to be *Acarus scabiei.* Frequently, all the different names are given. A recent treatise has it thus: "The acarus scabiei, sarcoptes scabiei, or sarcoptes hominis, commonly called the itch mite."[6] Authorities for names are never given. The accounts of the animal are often very brief and unsatisfactory. The size of the mites is variously given. According to some it is "very minute, almost microscopic;" according to others, "the size of a pin head." The pictures or figures of the mite differ greatly. In one work consulted—a standard text-book by the way—an entirely different mite is figured.[7] From the great numbers of mites which I had for comparison, I may say, without going into invidious distinctions, that the best figures I have seen are those in Taylor's "Atlas of Skin Diseases." Dr. Piffard's atlas contains an excellent photo-micrograph of the female acarus.

The itch mite is now universally called by entomologists Sarcoptes scabiei De Geer. The names Acarus scabiei and Sarcoptes hominis, given in many medical works should be dropped. Acarus and acari as synonyms for mite and mites are, of course, allowable.

The best description of the mite I have seen is Hebra's. It runs: "Body oval, tortoise-shaped, with indentations in the

[4] Reyer, "Diseases of the Skin" (John Bell), 1845. P. 135–136.

[5] Hebra, "Diseases of the Skin." P. 187–489.

[6] Shoemaker, "Diseases of the Skin," 1892. P. 700.

[7] Frey, "Microscope and Microscopical Technology," Cutter, 1880. P. 562.

lateral margins. Skin provided with shallow, undulating, transverse furrows. Dorsal surface covered with numerous small and large appendages of a clavate or conical form, or resembling scales, and with spines resting on papillary elevations. Head apparently distinct from the trunk, with four pairs of jaws, and two strong, three-jointed palpi, placed near the jaws, and of the same length. Legs eight in number, five jointed; the first and second pairs provided with pedunculated suckers—the peduncles of the same length as the legs themselves, and having no joints; the third and fourth pairs in the female terminating in long bristles. In the male, the first, second, and fourth pairs of legs are all provided with suckers, the third pair alone having bristles; the epimera of the first pair united. Larva presenting six legs—the first and second pair with suckers, the third pair terminating in long bristles." In regard to size, Hebra says: "The adult acarus varies in size. On an average, its length is 0.45 mm.; its breadth, at the fourth ring of the thorax, 0.35 mm. The male is considerably smaller than the female. In length it measures 0.23 mm.; in breadth, 0.19 mm. The eggs of the itch mite are of an ovid form, and are 0.16 mm. long, 0.11 mm. broad." It is, perhaps, unnecessary to say that the size of the animal is entirely out of proportion to the commotion it occasions when its presence becomes known.

The presence of the mite on the human body is characterized by certain appearances and symptoms known as 'scabies' or 'itch'. Scabies comes from scabere, to scratch. "The name of 'scabies' is, at the present day, used to designate the numerous appearances produced on the skin by the presence of acari which dwell within it, and which, in obtaining food for themselves, and in propagating their species, give rise to a continual irritation of its component tissues. The morbid appearances themselves resemble, in many respects, those caused by other irritants, but, taken as a whole, they nevertheless present certain peculiarities, which justify our making of them a distinct form of disease" Hebra.[8]

"Though the (*Sarcoptes scabiei*) is the essential cause of scabies, it must be remembered that eruptions almost, if not wholly

[8] Hebra, "Diseases of the Skin." P. 192.

identical, are produced by other species of the Sarcoptes derived from horses, dogs, cats, camels, sheep and rabbits."[9] Such cases are, however, rare.

It is, perhaps, unnecessary to add that the mite is never found in the body, only upon it, never in the organs or in the blood.

The human itch mite is perhaps coeval with man. It has certainly always existed as far back as written history goes.

Hebra, for good reasons, believes that many of the afflictions of the Israelites, as mentioned in the Old Testament, were nothing other than the itch.[10] Aggravated forms no doubt frequently occurred. Geologically speaking, the mites, as a group, are of recent appearance (Garman).[11]

The itch is, at the present time, becoming one of the rarer afflictions of mankind—like all filth diseases, it is gradually disappearing.

(In his Atlas of Skin Diseases (p. 319), Doctor R. W. Taylor says: "Until a few years ago, scabies was a rather uncommon disease *in this country*, but it has been noticed that in the various large cities and in some small communities, there has been of late, a remarkable increase in its prevalence." *Italics mine.*

In a recent letter to the writer, he expresses the belief that this is mainly due to the influx of Russian and Polish immigrants.

Cases are seldom seen outside of the slums of large cities; but it sometimes happens that if a case occur, say in a small town where none had appeared for years, perhaps half of the population becomes affected before its true nature is known, and appropriate remedies are applied. Vigorous medical treatment soon blots out an epidemic.

In an ordinary, acute or epidemic case of itch, the number of mites is quite small, probably not exceeding one hundred adult animals.

[9] Taylor, "Atlas of Skin Diseases." P. 327.

[10] Hebra, "Diseases of the Skin." P. 164–166.

[11] "Insect Life." Vol. IV., P. 182.

Recently I met with an extreme and rare case of the itch,[12] brought about by the presence in the skin of an immense number of itch mites. It shows to what extent parasitism will go under favorable conditions. The first detailed description of this rare form of itch was made by Hebra, of Vienna, in 1852, and who gave it the name of Scabies norvegica, or Norway itch, because the case was from Norway. Since then, other cases have been seen at various times and in different places, still, it is so rare that modern treatises on skin diseases do not describe it. Taylor's large "Atlas of Skin Diseases," devotes just two lines to it, as follows: "European writers, particularly of previous decades, have described a severe form of encrusted eczematous scabies, which they call Scabies norvegica, or Norway itch. It is not seen in this country."[13]

DESCRIPTION OF THE CASE.

The host of the mites was a middle-aged white man; he was partly paralyzed, and hence comparatively helpless. At the time of his admission to the City Hospital, his entire body was covered with thick, yellowish-white, leathery scales, the largest measuring over one inch in diameter, and over one-tenth inch in thickness. He was literally covered with scales like a fish.

On rubbing the body slightly, a large quantity of these scales fell off; rubbing more briskly removed an additional quantity, but with the production of small bleeding places (these scales were not crusts or scabs, they were epithelial proliferations). At a few places on the body crusts were found, mainly where the skin was bent, as at the joints. On account of the bleeding, no vigorous mechanical treatment was used at any time; the scales were gently rubbed off. A handful could be gathered daily. Despite this great alteration of the skin, the general health remained good. Taken in its entirety, the case was a puzzling one.

In a search for the cause of this eruption, and as an aid to the determination of the disease, some of the scales were sec-

[12] The case was described from a medical standpoint in the *Indiana Medical Journal* for November, 1892, by Dr. Brayton and myself.

[13] Taylor, "Atlas of Skin Diseases." P. 327.

tioned. Itch mites were found in abundance, and the nature of the disease was soon established.

In order to study the case more thoroughly, a number of the scales were prepared by usual histological method. The scales were fixed and hardened by immersion in alcohol, stained in picrocarmine, finally imbedded in paraffin, sectioned, affixed to slides with clove-oil collodion, and mounted in series. The shrinkage in passing through this process was very slight. The differential staining in this case was peculiar: the epithelium stained red, the mites yellow; the eggs remained unstained, that is, white; the fæces appeared dark brown or black. In staining sections of normal skin with picrocarmine, the outer or horny layer stains a bright yellow, the underlying protoplasmic layers stain more or less deeply red. In the present case the epithelium is peculiar in that well-stained sections show very little yellow; this indicates that the component cells are still protoplasmic, and have not cornified.

The activity going on in the columnar layer to replace this constant and enormous loss of cells must have been great. Apparently a vicious circle was established; the presence of the mites irritating the skin—the skin, to protect or rid itself from the parasites, pushed out a large number of new cells. These succulent cells, however, furnished a good nidus for the mites. The mites increased, causing increased irritation of the skin, and this caused an increased proliferation of cells. Thus the case went on, until it assumed this extreme form.

I may here say, that under appropriate anti-parasitic treatment at the hospital, the mites were soon exterminated. The cause of the irritation once removed, the skin gradually regained its normal character.

Number of Mites.—In order to obtain an idea of the number of mites present on the host, that is, at the time the mites were present in greatest numbers, several scales were cut to measure one-half by one-eighth inch, sectioned and mounted serially. It will be readily understood that in such a procedure the mites were cut in various planes and directions; sometimes the head would be seen in one section, the body in one or two other sections, and the tail in still another. Many of the smaller embryos and eggs appeared entire.

Anyone who has attempted to get numerical results from serial sections, will understand the difficulty of obtaining approximately correct figures. In the present case, two counts were made in each of three series of sections, and the mean of these counts was taken as an approximately correct number. Here are the figures:

Eggs and egg cases, 380.
Mites in all stages of development, 109.

Assuming that the above figures are approximately correct, we can make a little calculation: Multiplying the above numbers by 16, gives the number for one square inch; again multiplying by 144, gives the number for one square foot.

The average amount of epithelial covering on an adult human being, is said to be about 16 square feet. To be on the safe side, we will say that only half of the body was covered with scales, therefore, multiplying our last figures by eight, gives the number of eggs and egg-cases and mites on the host at the time of greatest abundance. Here are the figures in round numbers:

Egg cases and eggs, 7,000,000.
Mites, 2,000,000.

Since the reading of this paper, I tried to determine the proportion of eggs which are empty, that is, hatched. It seems that from one-half to three-fourths are empty shells.

As to the number of *living mites* in the shed scales. This is a difficult question. I am inclined to believe that only a small proportion were alive at the time the scales became detached.

Indianapolis Ind.

ON THE RELATIONSHIPS AND DISTRIBUTION OF THE NORTH AMERICAN UNIONIDAE, WITH NOTES ON THE WEST COAST SPECIES.

By Chas. T. Simpson.

For some years past, it has been generally acknowledged by students of the Unionidæ that a more natural system of classification was needed for that family than any that has hitherto been offered.

The genera or sub-genera of Rafinesque, Swainson, Agassiz and Conrad are of little value, for while certain typical species may be fairly referred to their divisions, in many others the characters fade out, or so blend together that it is impossible to place them, and sub-generic lines cannot be drawn with any degree of accuracy. Lea's arrangement, in which he divided the genera into two great groups, characterized by the presence or absence of a dorsal wing on the shell, and then into smaller divisions based on sculpture and form, was, like the Linnæan classification in botany, almost entirely artificial, consequently in many cases it brought together side by side forms not at all nearly related, and in others it widely separated those having close affinities, or even sometimes individuals of the same species.

I believe that the best and simplest system that can be adopted at the present, at least, is to place those species, which by the characters of the shell, by what we know of those of the animal, and by the facts of geographical distribution are most nearly related, in groups, each founded on and taking its name from some common, characteristic, and widely distributed form. Thus *Unio gibbosus*, which is nearly everywhere found throughout the Mississippi drainage area, is well known to every collector who has only a few species of Unios, and, with its elliptic oval and sometimes arcuate outline, thick epidermis, heavy cardinal and solid club-shaped lateral teeth, fairly typifies an assemblage of forms found from Canada to Central America, and from the Missouri river to Florida. *Unio liga-*

mentinus represents another section, *Unio complanatus* another, *Margaritana margaritifera* a fourth, *Anodonta ovata* a fifth, and so on.[1]

This plan of grouping by relationships is not a new one, having been adopted by R. Ellsworth Call, Wm. A. Marsh, and other students of the Unionidæ in the arrangement of their collections, and even Mr. Lea acknowledged some such affinities, though he did not put his ideas into practice.

It is found that a common assemblage of Unionidæ inhabits the entire Mississippi drainage basin, and that a considerable number of the species have a distribution covering the greater part of this area, as well as the whole of Texas, and even parts of eastern Mexico.

Those streams which fall into the Atlantic are peopled by an entirely different set of forms, the Appalachian chain seeming to act as a sharp barrier between the two regions. Many of the Mississippi Valley species have spread into Michigan, a few into Canada, into streams in New York that flow into the Atlantic, and two or three of these are met with in the Red River of the North, and the waters about Hudson Bay; while below the southern end of the mountain range, there is another mingling of groups.[2]

There are some forms which, apparently, may be with equal propriety assigned to either of two or three groups, but, in such cases, the location of the species with regard to drainage often gives us a key as to its relationship. There is a group of oval, rather smooth, compressed Unios, which may be fairly typified by *U. favosus*, which is found in the rivers from North Carolina to Alabama, several members of which very strongly

[1] With such an arrangement, I believe that the North American Unios would fall into something like forty quite natural assemblages, whose group characters agree fairly well with their distribution so far as drainage areas are concerned. There would be some half dozen sections of *Margaritana*, and ten or a dozen of *Anodonta*.

[2] In many cases, the Unionidæ seem to have had no difficulty in migrating across the country from river to river; an example of this being the Mississippi Valley species which now inhabit all the rivers of Texas, and some of those of Eastern Mexico; while on the other hand species of South America extend up into Central America. The embryos, in some cases, may be carried by aquatic birds in the manner elsewhere mentioned in this paper; in others, they probably migrate across overflowed regions near the sea, in time of floods.

resemble some of those of the Clavus Group, but the species of the latter assemblage are confined, with one or two exceptions, to the streams of the Mississippi Basin, while those of the former belong entirely in waters falling into the Atlantic or the Gulf. Another small group of rounded or oval inflated forms typified by *U. irrasus* likewise approaches in a few of its members some of the species of the *clavus* Group, but it is confined, so far as my knowledge goes, to the waters of the Gulf drainage; the Etowah, Coosa, Chattahoochee, and a few neighboring streams, and not a specimen has, I believe, ever come from Tennessee or the rivers emptying into the Atlantic, though several of them rise near the Chattahoochee.

In Mexico and Central America, a totally different Unio fauna is found. Some of the Anodons extend into South America, and others belong to groups that have their metropolis on that Continent, while at the North there is a greater or less mingling of the species with those of the Mississippi Valley.

I have been greatly puzzled to account for the origin and relations of the few species found on the Pacific slope of North America. Two Unios, one Margaritana, and some half dozen Anodons, are all that have been hitherto credited to this immense region. Of the latter, *Anodonta wahlametensis*, *A. nuttalliana*, *A. oregonensis*, and *A. californiensis*, are believed by Dr. Stearns[3] and other competent conchologists to be merely variations of one species, although they often differ greatly in forms and general appearance. *A. wahlametensis* is provided with a wide dorsal wing, which gradually fades out through the other forms in the order I have given them, to *A. californiensis*, which is nearly or quite destitute of this appendage. This very abundant species is found from the Rocky Mountains on the east—in all the waters draining into the Pacific—to the coast, and from British Columbia on the north, well into Mexico on the south. Six shells in the collection of the United States National Museum (Mus. No. 117951), which were identified by Dr. Stearns as *Anodonta californiensis*, were collected by Mr. Duges in the Province of Oajacay.

[3] See paper on the History and Distribution of the Fresh Water Mussels, and Identity of Certain Alleged Species, by R. E. C. Stearns, Proc. Cal. Acad. Sci., Nov. 20th, 1882.

To the northward, this seems to be replaced by *Anodonta kennerlyi*, a species closely resembling some of the varieties of *A. cygnea* of Europe, and in Alaska another nearly related form, *A. youkonensis* of Lea, is met with. The latter is an absolute synonym of *A. herculea* Midd., of which specimens are in our collection, obtained in Kamschatka by Dr. Dall. I had noticed the resemblance of all these forms to that of the well known, abundant, variable, and widely distributed *Anodonta cygnea* and its variety *anatina*, and on hunting up the distribution of that species, I have been able to trace it through Northern Asia into Eastern Siberia. Any one who will carefully examine an extensive series of *Anodonta cygnea, anatina, herculea, youkonensis, kennerlyi, wahlametensis, nuttalliana, oregonensis*, and *californiensis*, cannot, I think, fail to notice their remarkable resemblance in many essential points: the peculiar and usually exact rounding of the anterior end of the shell, the flattening of the umbonal region, which, in good specimens, is generally overlaid with hair-like, greenish, radiating, wavy lines, and the singular cutaway in the posterior slope, all indicate close relationship, and the fact that they have sprung from a common origin.

I should unhesitatingly place these forms in a natural group, typified by *Anodonta cygnea*. Dr. Stearns, in the paper to which I have already alluded, believes that *Anodonta wahlametensis, nuttalliana, oregonensis*, and *californiensis*, are but variations of the European *A. cygnea*, and that *A. fluviatilis* of the Atlantic drainage is probably but another form of this protean species.

While I was formerly inclined to this view, a more careful and thorough examination of large quantities of material has induced me to somewhat modify my opinions. Though the *nuttalliana* and its variations are very close to *cygnea*, I do not, at present, feel justified in uniting them specifically, and I regard the *A. fluviatilis* as the type of a rather nearly related group, having a distribution from Canada to Florida, in the streams which fall into the Atlantic. The shells of this section are generally more inflated than those which belong with *cygnea;* they are not flattened at the umbonal region, and are more full on the dorsal slope.

If I am right in this view of the case, it is probable that the group of *Anodonta cygnea* is confined in North America to the Pacific slope, and that its connection with the rest of the species in the Old World was made over a land passage between Asia and North America. Dr. Theodore Gill informs me that the boreal fresh-water fishes of the Old World and those of the western slope of our continent have a similar distribution to the *cygnea* group of Anodons as I have outlined it.

One of the most remarkable of the Unionidæ, *Anodonta angulata*, is an inhabitant of the waters of Oregon, Washington, and California. The anterior end of this species in ordinary specimens is much narrowed; the posterior is wide and inflated, and, running from the beaks to the posterior ventral regions is an extraordinarily developed sharp-edged ridge or keel. Nothing in the least resembling this peculiar form has hitherto been found. But the National Museum possesses specimens in which the anterior end is wider, and the keel is far less developed, and others in which it is almost entirely wanting, and that indefatigable collector, Mr. Henry Hemphill, has sent me a photograph of a specimen in his collection which has no vestige of a ridge, but is furnished with a slight groove running down the posterior slope. Recently, Messrs Mearns and Holzner, of the International Boundary Commission, have sent to the National Museum a large number of specimens of what is apparently a new species of Anodonta, from San Bernardino Ranch, Arizona, which, externally, very much resembles some of the varieties of *Unio complanatus*, but has a very different texture, and, on comparing these shells with Mr. Hemphill's photograph, and the more compressed specimens of *A. angulata*, I was convinced at once that they group together. They have the same outline, the same beak sculpture, and, when viewed from the dorsal or ventral region, have a much greater diameter through the posterior area than elsewhere, and nearly all exhibit the slight groove I have mentioned.

The type of *Unio oregonensis* was presented to Mr. Lea by Mr. C. M. Wheatley, and the former mentions that the latter reserved a specimen for his own collection. Lea's shell is said to come from the Columbia River, and is in rather bad condi-

tion, as it is dead and somewhat eroded. I have very carefully examined it, and after comparing it with everything that I could think might be related to it, I have come to the conclusion that it is a form of the protean *Unio luteolus.*

This is the most abundant, widely distributed, and variable Unio in the world, being found almost everywhere throughout the 1,200,000 square miles of the Mississippi drainage basin, through Texas, and probably into Mexico, in New York in some of the streams that flow into the Atlantic, and northward in the vicinity of Hudson Bay, and probably throughout the British possessions east of the Rocky Mountains. I have traced it up the Missouri River to near its source, and when it is taken into consideration that the Marias, a tributary of this stream, heads within a few miles of Flathead Lake on Clarkes River, a branch of the Columbia, and that the embryos of Unios are provided with hooks by which they can attach themselves to the feet or feathers of aquatic birds, it is very easy to see how this species might have been carried from the waters of one drainage system to those of another. *Margaritana margaritifera,* which inhabits Europe, Northern Asia, and the Pacific slope of North America, is also found in the upper Missouri. Two specimens of *Unio luteolus* in the Museum collection, from the North Shore of Lake Superior, are almost exactly like Lea's type of *U. oregonensis.*

So far as I am aware, nothing is stated of *Unio famelicus,* the other Pacific slope species, save that Gould received his type from Dr. Pickering, and that it is said to have come from Walla Walla, Oregon. The type is in the National Museum, *and is undoubtedly a young Unio ellipticus* Spix, from Brazil, a species belonging to an extensive South American group, characterized by having oblong, compressed, sulcate shells, which are often granulated on the ridges. Any one familiar with Unios would know at once on carefully examining the type, that it came either from South America, or some part of the Southern Hemisphere of the Old World, a fact which is made evident by its form, its peculiar greenish olive epidermis, the strong growth lines, and, most of all, the compressed, parallel, cardinal teeth of the right valve. It is perfectly safe to say that the locality given is an error, and that this species was never found in the United States.

EDITORIALS.

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

—STATISTICS as to the publication of original books by the four leading nations of readers have recently appeared. America and Great Britain have published during the last decade between four and five thousand books each. In America the proportion of fiction was considerably larger than in Great Britain. In Germany the number of books published in the same time was over ten thousand, with a smaller absolute number of works of fiction than in Great Britain. The figures for France fall between those of Great Britain and Germany.

In view of the fact that America exceeds in population each of the countries named, and includes in this population a greater number of readers, these statistics are not pleasing to our national pride. Great Britain, with a much smaller population, is our superior in the quality of books produced, and yet falls far behind Germany.

There are several reasons for this state of affairs. One is the absence of compulsory education, which exists in an effective condition in Germany. Another, and probably more efficient cause, is the fact that our publishers think it necessary to bring out books of value in an expensive style, so that they are out of the reach of students generally. The same cause probably conduces to the depression in the publishing business in Great Britain. If American students could purchase scientific and other serious books at as low rates as can be done in Germany, the general standard of intelligence would be greatly elevated. If American publishers would get out cheap editions of such literature they would greatly profit by it. The extravagant style in which popular scientific books are published in this country is an anachronism. There is no nobility here whose attention it is necessary to gain for material reasons, nor is social position the object for which the scientist is supposed to be striving. Hence the absurdity of clothing science in a garb which can attract a small class only, while it makes her inaccessible to the mass of mankind. The supposition that people will not buy solid literature is negatived by the experience of Germany. If American publishers will not publish cheap works of this class we shall become dependent on foreign countries, whose books will soon become accessible to us by the removal of the oppressive tax on intelligence, known as the protective tariff.

—We have received the first number of the New Journal of Geology published by the geological faculty of the University of Chicago, and printed by the press of the University. It is edited by six members of the United States Geological Survey, together with twelve associate editors, of whom five are Americans, and one resides in each of the following countries, viz.: Canada, Great Britain, Germany, France, Austria, Norway, and Sweden. The articles of the number are by Messrs Geikie, Holmes, Williams, Chamberlin and Salisbury, and are all of much interest. Editorials, Reviews, Abstracts, and Acknowledgments follow. The beginning of this new journal is auspicious, but it remains with the future to determine whether it can be continued on its present basis. On the face of it the proposition is broad, but the basis is narrow. The names of the associate editors indicate cosmopolitan aspirations, but "the immediate editorship," we are told in the announcement, "will rest with the geological faculty of the University of Chicago," who are all members or ex-members of the U. S. Geological Survey. The leading article is by a foreigner, but this is appropriate in a city which has legal holidays in honor of William of Germany and Saint Patrick. We will observe with interest whether such a constitution can stand the test of time, or whether it will meet the difficulties which befel the image of the prophetic vision, in which the geological order was reversed, since the head was of archean gold, but whose feet were of glacial clay. Not but that the precious metal may be found in the superficial stratum in this instance; but placer deposits in glacial drift are not as permanent as those of greater geologic age. We have an excellent geological magazine, the American Geologist, which is not identified with any institution or institutions, and whose editorial corps is not interested in supporting geological literature in other countries. While, therefore, we welcome all additions to scientific periodical literature, it is always with a reservation which requires that they shall be viable infants, endowed with a good constitution.

—A movement is on foot in New Zealand to secure an island not far from the coast as a preserve for the native animals and plants of that country. In view of the extreme importance to biological science of the preservation of the remarkable types of this ancient flora and fauna, and in view of the other fact that many of its representatives have become extinct within recent times, and others are disappearing, we sincerely hope that this effort will be successful. If there is any doubt about it, a concerted effort should be made by the scientific men of all countries to secure favorable action from the colonial legislature.

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RECENT LITERATURE.

The Woodland of the Southwest, by Chas. F. Lummis.[1] —For those readers who have read but a few books of travel on the Southwest, this snug little volume will be quite a revelation. The contents of the twenty-two chapters scarcely contain anything that has been written or sketched before, except a few pages on the Moqui Snake dance and Indian superstitions. The thoroughness of his familiarity with Pueblo customs and folklore is only equalled by the graphic qualities of his style. In looking about the "strange corners" which the author describes, we are first attracted by a prairie-dog hunt, with the Navajo Indians put in scene to fill their larder. White people of the Southwest never think of killing this rodent for food, because it is so difficult to attain with a rifle ball; but these natives utilize abundant downpours of rain to conduct the floods into their tunnels and afterward haul up their dead bodies for a feast. To get rid of the prairie-dog plague, people have proposed to kill them with poisoned apple-quarters. The belief in witchcraft is as potent among the whites and Indians of New Mexico as it ever was during the middle ages. Manslaughter is committed for any act arousing even the suspicion of witchery, and the fact that one-half of the Isleta people are wizards and witches speaks loud enough. The "Finishing an Indian Boy" shows principles of education in full force now, which our Northern Indians began to drop as early as one century ago. In the chapter "The American Sahara" the wide waste is delineated in colors none too sharp or cruel. Lieut. Wheeler is mentioned by mistake as its earliest explorer instead of Lieut. Whipple. The marvelous wealth of objects presented in Lummis's volume will attract ever and again the class of readers and tourists which seeks instruction rather than pleasure in books of travel, and they will hold it dear as a publication of really scientific value, standing far above most of the productions of our present sensation-loving period of literature.

"The Wanderings of Cochiti" is another very interesting sketch from our "Wonderland" on the upper Rio Grande. It is printed in the "Century Magazine," January, 1893, and describes and also pictures in photographic reproductions the people, customs, history and scenery of Cochiti, one of the Quéres Pueblos of Northern New Mex-

[1]Some strange corners of our country, the Woodland of the Southwest, p. 270. 12 mo., richly illustrated. New York, The Century Co., 1892.

ico, and the celebrated gorge of Tyú-on-yi with its rock carvings in the vicinity of that pueblo. The scene of Bandelier's archæologic novel, "The Delight-Makers," is placed in that locality.

Macmillan's Metasperma of the Minnesota Valley.[2]— In this thick, handsomely printed book, in which excellent paper and an equally excellent selection of type are manifest, we have a notable departure from the usual "report" issued from a State printing office. So unlike the State or Government reports is this volume that one has to turn to the imprint to satisfy himself that it is actually the work of the State printer. If this model is followed in the future by other State printers then indeed is this book a noble pioneer in a much needed reform in State book making.

Turning to the more important part of the book, namely its contents, we find that the author also has broken away from the traditional form and style of State reports, and has given to the botanical world a useful book. He first of all chose an area with natural boundaries, instead of one arbitrarily set off for political and not scientific purposes. In his choice of the Minnesota Valley the author seems to have been fortunate in having to deal with an area of more than usual interest, but it is likely that if in other States natural areas were studied, similar interesting features would be discovered.

The list of plants includes 1174 species and varieties, a large number when one remembers that the area covers but 16,000 square miles, and the only plants enumerated are the Metaspermæ (Angiospermæ).

These species are found in prairies and woodlands, in "meadows, marshes, swamps and bogs." There is, however, a considerable preponderance of the rolling prairies. The soils are not much varied, and the difference in altitude is little more than 1300 feet from the lowest point at Fort Snelling (688 ft.), to the highest hills in the eastern part of North Dakota (2000 ft.).

The author aims to trace the history of the flora of this valley. To him it is not enough to tell what plants occupy the territory; he seeks to show how they came to do so, from whence they came, and why they came. Accordingly we have a series of discussions such as we rarely (if ever) have had in books dealing with local floras. Thus one finds such headings as these: "The Dynamic Relations of Plants,"

[2]Geological and Natural History Survey of Minnesota. Conway Macmillan, State Botanist. *The Metaspermæ of the Minnesota Valley*, a list of the higher seed-producing plants indigenous to the Drainage Basin of the Minnesota River, by Conway Macmillan. Reports of the Survey, Botanical Series, i, Dec. 29, 1892, Minneapolis, Minnesota, pp. xiii, 826. Large octavo.

"General Features of Plant Distribution," "The General Factors in Floral Differences," "Pressures and Tensions," "Outlines of Metaspermic History in the Northern Hemisphere," etc.

Enough has been said to indicate that this work is an unusual one. It is impossible to give a summary of its many interesting chapters. Perhaps the conclusion which the author reaches that while the region is geographically central in the continent, the flora is "preponderantly southeastern," sums up the results of the work as well as any which could be given.

It remains to speak somewhat more as to the list itself. In the first place it is ultra-modern in nomenclature and arrangement. Engler & Prantl's work, "Die Natürlichen Pflanzenfamilien," is followed in the sequence of the families, so that one finds the simple Monocotyledons first (*not* the grasses, and sedges, however), and following the well-known succession of families, reaching the culmination of the Dicotyledons in the Compositæ. The manuscript of the book went to the printer four months before the Rochester meeting of botanists last year, hence it does not conform in all respects to the present rules as to nomenclature. Thus the initial date adopted for the genera is 1737, instead of 1753, and now and then one finds a specific name identical with that of the genus to which it belongs. In the preface, which bears date of Dec. 24, 1892, the author records his hearty acquiescence with the action of the botanists at Rochester, and suggests the changes which must be made in order to bring the nomenclature in the book into harmony with the present code.

A very valuable feature of the work is the fulness of citations of synonyms, with dates. Thus one finds:

LACINIARIA Hill, Syst. Veg. iv, 49 (1762).
Psilosanthus Neck. Elem. (1790).
Liatris Schreb. Gen. Pl. 572 (1791).
Calostelma Don, Sweet. Brit. Fl. Gard., 2, 184 (1838).

The following may serve to show the treatment of species:

LACINIARIA SQUARROSA (Linn.) Hill. Syst. Veg. iv, 49 (1762).
Serratula squarrosa Linn. Spec. 88 (1753).
Pteronia caroliniana Walt. Fl. Gar. 292 (1788).
Liatris squarrosa Willd. Spec. III, 1065 (1802).

Then follow many references to descriptions or lists giving localities, followed by statements as to its general and particular distribution, etc.

The book will be read with interest by all advanced botanists, and it is to be hoped that it will serve as a model for future plant lists.

CHARLES E. BESSEY.

Ridgway on the Anatomy of the Humming-Birds and Swifts.—A Rejoinder.—What I say here has reference to Mr. Ridgway's reply to my review of his "popular monograph of the Humming-Birds," which review appeared in the October NATURALIST, and his reply in the December following issue of that journal (1892, p. 1040).

In that reply Mr. Ridgway remarks that his description of the humming-bird's tongue "is substantially a condensation of MacGillivray's"[3] (in Audubon's Birds of America, Vol. iv, pp. 197, 198), and that his "knowledge of the subject is based chiefly upon it." Now one of the errors I pointed out in Mr. Ridgway's "Humming-Birds" was that he claimed the tongue in those birds was "hollow," and yet he now states that his account is a condensation of Macgillivray's lucid description. Let me contrast the statement of the two authors, thus:

MACGILLIVRAY.	RIDGWAY.
In the tongue of the humming-bird "there are, it is true, two cylindrical tubes, but they gradually taper away toward the points, and instead of being pervious, form two sheaths for the two terminal parts or shafts of the glosso-hyal portion of the tongue, which run nearly to the tip." (Aud. Birds of Amer., Vol. iv, p. 198).	In the humming-birds "The tongue is slender and very extensile, like that of the woodpeckers. * * * * * Instead, however, of its being as in the woodpeckers, solid and tipped with a barbed, horny point, it is hollow." (The Humming-Birds, p. 290).

These sentences, *in either case*, are completed by their respective authors in their calling attention to the bifurcated condition of the extremity of the tongue, and, as that is not the point in question, I purposely omitted it.

Farther on in his reply Mr. Ridgway remarks that his knowledge of the structure of the humming-birds is to some extent based upon the "later dissections of thirteen species," made by Mr. F. A. Lucas, "instead of one, as in the case of Dr. Shufeldt's 'extensive dissections.'" If my friend will again allow me to invite his attention to the literature of the subject, I would call it to my memoir published in

[3]If Mr. Ridgway will permit one who has long been familiar with the works of "the Scotch anatomist," I would "kindly invite" his attention to the fact that that careful dissector of birds spelled his name Macgillivray, and *not* MacGillivray, as Mr. Ridgway always writes it.—R. W. S.

the *Linnean Society's Journal*, Vol. xx (London), pp. 303, 304, where he will find that I had the following material for my "extensive dissections," namely, spirit specimens of *Cœligena clemenciæ, Trochilus colubris, T. alexandri, T. anna, T. platycercus, T. rufus, T. calliope* and *Iache latirostris*—in all 3 genera, 8 species, and 62 specimens. When this material was presented by me to the collections of the U. S. National Museum, Mr. Lucas remarked that it was the largest and best collection of spirit specimens of North American humming-birds ever donated to the institution by one individual. It naturally seems to me that the further Mr. Ridgway goes into this subject the greater is the display of his ignorance of the literature of it. Now when I charge a writer with being ignorant of the literature of a subject I take the pains, as I have done above, to point out wherein his ignorance lies, and do not resort to the remarkable method adopted by Mr. Ridgway—thus, and alluding in his reply to myself, he continues: "Apparently he is not familiar with the literature of the subject, for, if he were posted, he would know that leading authorities on avian comparative anatomy are overwhelmingly if not unanimously against his side of the question." Rather remarkable logic—especially to be immediately followed up in the very next sentence by, "I would therefore suggest that he consult Fürbringer, Parker, Garrod and Gadow, and thus learn regarding the matter which he handles with so much assurance. Even a careful perusal of Huxley (whom, by some strange hallucination, he imagines his abettor), may also prove instructive to him (p. 1040)." To this I would simply reply that in so far as Professor Fürbringer is concerned, I can say that, thanks to his generosity, I am the fortunate possessor, not only of many of his works upon comparative avian anatomy, but also his two massive and superb volumes so familiar to us all, and while I can thank him for his numerous and courteous references to my memoirs in that great work, I must dissent from his views in the matter of the taxonomy, of the Cypseli and Trochili. Apparently Professor Fürbringer had not seen my Linnean memoir, which was defended for me by Professor Parker before the London Linnean Society a number of years ago. There is a reason for that, however, as both works appeared early in 1888.[4]

[4]Shufeldt, R. W., Studies of the Macrochires, morphological and otherwise, with the view of indicating their relationships and defining their several positions in the System. Linn. Soc. Jour.—Zool., Vol. xx, pp. 299–394, Pls. xvii–xxiv (Communicated by W. K. Parker, F. R. S., F. L. S., 19th Jan., 1888). When I spoke of my extensive dissections this was the work I had reference to, and not to the brief note in *Forest and Stream*, as Mr. Ridgway seems to think. It stands to-day as the most extensive paper on the *entire structure* of the Humming-birds ever published by a single individual.

As for Professor Parker, I can say that I had the honor of being one of his constant correspondents for a number of years, and I have from him *several hundred* letters. A year or so before his lamented death it was his intention to supplement my work upon the "Macrochires," and I had sent him some material to that end. I have letters to show from him that he practically agreed with me in the taxonomy of the swifts, swallows and humming-birds, and he proposed to figure one of the latter "as big as a Cochin-China cock!" It is to the loss of the science of systematic ornithology that he never lived to accomplish it. Next as to Garrod. My library contains a copy of his "Collected Scientific Papers," a work I have had occasion to refer to almost daily since its appearance. He was disposed to classify birds upon altogether too few characters; there is no evidence whatever in his work that he ever critically compared the *entire structure* of a humming-bird with that of a swift; he notes simply the fact that "the tensor patagii brevis (in the Cypselidæ and Trochilidæ) and the pterylosis are characteristic, as is the sternum," but he failed to point out how widely they differed morphologically (p. 222). I dissent altogether from his views not only upon his taxonomy of the Cypseli and Trochili, but also from much else that he has left us upon the classification of birds. I must ask Mr. Ridgway for the title of any work from the pen of Professor Gadow wherein I may find a critical comparison of the *entire structure* of a swift and a humming-bird. I know of none, though I *do* know, as do many others interested in the classification of birds, that at the present time Dr. Gadow is hard at work upon probably what will prove one of the best *practical* schemes for the taxonomy of the class, and it will shortly appear. He has already done me the great honor in inviting me to submit my own views to him on the subject, and in a valuable letter I have just received from that able taxonomer I find that he is prepared to admit that the goatsuckers no longer should be retained in the same group with the forms they have usually been associated with heretofore, and he says, "I shall reconsider the position of the Caprimulgidæ and elevate them perhaps on account of Steatornis as Caprimulgi, thus making the difference from Cypselidæ and Trochilidæ more marked, although I shall not go so far as Fürbringer has done." Mr. William Brewster, of Cambridge, the distinguished American ornithologist, and one of the Committee responsible for the "Check-List" of the American Ornithologist's Union, and the classification therein set forth, having read my contribution to *The Ibis* (January, 1893) on Swifts and Humming-birds, writes me under date of February 13, 1893: "It

is comforting to find that there are now, among scientific men of distinction, champions of the belief of my boyhood days that a swift is merely a peculiar kind of swallow."

Now as to my "strange hallucination" in the matter of Professor Huxley's views upon the classification of the Swifts, Swallows, and Humming-birds. I have a well-worn copy of his famous P. Z. S. memoir of 1867—one of the most remarkable contributions ever written upon the classification of birds—and, I may add, a *perfect monumental beacon*, warning comparative avian anatomists for all time in their attempts to classify birds, against trusting to any single set of characters. In his "Cypselomorphæ" Huxley placed only the Swifts, Humming-birds and Goatsuckers (pp. 468, 469). It was done upon only too few characters, and mainly based upon the osteological ones seen at the base of the skull. But Huxley believed the vomer of a Humming-bird was "truncated at the anterior end," an error which both Parker and myself independently pointed out for him. But a quarter of a century is a long time in comparative anatomy (1867-1892), and if Professor Huxley has kept up with the literature of the subject he may hold entirely different views at the present writing. This would appear to be the more probable, as his misgivings were sufficiently strong as to have him write in his 1867 memoir that "In their cranial characters the Swifts are far more closely allied with the Swallows than with any of the Desmognathous birds, the Swift presenting but a very slight modification of the true Passerine type exhibited by the Swallow (*loc. cit.* p. 456). May I ask Mr. Ridgway what he thinks Professor Huxley meant when he wrote that sentence? And does he believe that to-day Professor Huxley would retain the Caprimulgi with the Humming-birds and Swifts together in one group and consider it to be a natural one?

One word more and I have done for the present. In the case of doubtful affinity among birds, as with all other forms, there is but one true way of getting at a solution, and that is to critically weigh and compare *everything* that is known about the one group with *evergthing* that is known about the other, before finally deciding. Now I challenge Mr. Ridgway to take any species of North American Humming-bird and any species of North American Swift, and arrange in two columns in a comparative way all that is known about either species, paleontologically, biologically, morphologically, or otherwise, and then upon summing up give any real reason why the Trochili and the Cypseli should be considered to constitute by themselves a natural group of birds. I have very serious doubts as to his ability to do this. If he

ever undertake such a task, he must bear one thing well in mind, and that he must not do not do it with the view of "exploding" any one's "peculiar notions," but rather with the view of getting at the truth of the matter. Then, too, do not condemn another's views simply because "leading authorities on avian anatomy are overwhelmingly if not unanimously against his side of the question (p. 1040)." That has been the case with a great many anatomists in the world's history, and even I can remember when the "leading authorities" overwhelmingly if not unanimously believed that *Chamæa* was a *Wren;* but the present writer in his published account[5] based upon his "extensive dissections" claimed it was most nearly related to the Bush-Tits (of the genus *Psaltriparus*), to which opinion the "leading authorities," who have reviewed my work, are now rapidly coming. But no doubt Mr. Ridgway remembers something of this; he most assuredly does if he is familiar with the literature we have upon the subject.

R. W. Shufeldt.

Animal Coloration.[6]—This volume has grown out of materials collected by Mr. Beddard for the Davis lectures delivered at the Zoological Garden of London in 1890. It contains the latest information as to the phenomena of coloration exhibited by animals, together with the most important theories upon the subject, including those of Dr. Eisig and M. Stolzmann, which had not previously found their way into works of a popular character. Mr. Beddard groups his facts under the following heads: Coloration Affected by Environment; Protective Coloration; Warning Coloration; Protective Mimicry; Sexual Coloration.

In summarizing the facts concerning Protective Mimicry, the author concludes that the theory of Natural Selection alone does not satisfactorily explain the remarkable resemblances included under that caption.

The chapter on Sexual Coloration calls attention to some objections to Darwin's theory of sexual selection, and gives briefly a sketch of the views of Mr. Stolzmann and those of Mr. Wallace.

Mr. Beddard's objections to the use to which the theory of Natural Selection has been put by various naturalists, and especially by Messrs

[5] "On the Position of Chamæa in the System." The Jour. of Morph., Vol. iii, No. 3, pp. 475–502, figs. 1–8.

[6] Animal Coloration, an Account of the Principal Facts and Theories Relating to the Colors and Markings of Animals, by Frank E. Beddard, M. A. Oxon., F. R. S. E., with four colored plates and wood cuts in the text. London, Swan, Sonnenschein & Co.; New York, Macmillan & Co., 1892.

Wallace and Poulton, are well taken. While he is far from denying the efficacy of that process, he does not trace to it the origin of characters, and he presents various instances where the latter seem to have been the consequence of the direct action of physical causes. His investigations are especially valuable because they cover a field which has been especially cultivated by the advocates of the exclusive efficiency of natural selection, and he thus throws new light on the class of facts where the evidence for natural selection is strongest. For this reason the work will well repay perusal, as it serves as a corrective to thought which has, in the opinion of many, gone to an extreme in one direction.

FIG. 1. The Stoat in winter pelage, or Ermine.

The author cites the following remarkable example of the direct effect of physical causes in producing changes of coloration:

"That the yellow color of canaries can be altered to an orange red by mixing cayenne pepper with their food has been known for a long time. This curious fact was first discovered in England, as was also the fact that the different races of canaries vary in their susceptibility to the action of the pepper; some kinds are more, others are less affected, while one race is absolutely without any power of having its coloration altered by these means. The color change is produced by feeding the newly hatched young with the pepper conveyed in their food or the old birds while sitting upon the nest are furnished with food containing the cayenne, which they in turn feed their offspring. The color change can, in fact, be only brought about in very young

birds whose feathers are not completely matured; it is quite impossible to produce any alteration upon the full grown canary. Clearly, therefore, here is an instance of the direct effect of food upon color. An interesting paper upon the subject, which has also furnished me with the facts already mentioned,[2] and it will be of interest to give some account of the author's (Dr. Sauermann's) experiments for reasons that will appear. Cayenne pepper, of course, is a composite substance, from which a number of distinct chemical substances can be extracted; the red color is caused by a pigment termed capsicin, which can be separated from the pepper; and it might easily be supposed that the change from yellow to red in the feathers of the canary was simply caused by a transference of the pigment, as in the cases mentioned on p. 127; but Dr. Sauermann shows that it is not so. Yellow colored canaries were not in the very slightest degree affected by the pigment alone; but, curiously enough, parti-colored birds did react—the brown parts of the feathers became distinctly lighter in hue. It is a fatty substance (triolein) which appears to convey the pigment and produce thus a changing of the color from yellow to red; and further experiments were made with other birds, showing that it is not only canaries which are influenced by their food in this way. Some white fowls, belonging to a special breed, showed traces of yellow among the feathers after feeding with cayenne; but in this case these were not racial, but individual differences in susceptibility, for all the specimens of birds experimented with did not react to the stimulus.

"A similar series of experiments was made with some other colors; it was found with carmine that the yellow color was destroyed and the birds became white. This unexpected effect is explained by the fact that a mixture of violet and yellow produces white. The fact that the fatty constituent, triolein, plays the chief part in the coloring of the feathers may perhaps help to explain the very singular fact that the Amazon parrots change from green to yellow when fed upon the fat of certain fishes.

"With regard to the white fowls referred to, the experiments made by Dr. Sauermann were particularly interesting. The interest lies in the fact that the pigment was not absorbed equally by all the feathers; only special tracts were affected; the breast feathers, for instance, became red, while the head remained white. It is therefore quite credible that in a state of nature partial alteration of color may be produced by a change of diet."

[2]Archiv. Anatomie und Physiol., 1889. Physiol., Abtheil., 543.

In a chapter relating to protective resemblances will be found an account of several examples of animals which have apparently acquired a resemblance to their surroundings by the transference of pigment to their bodies in their food.

The list of illustrations comprises four very attractive colored plates and thirty-six wood cuts, each of which repay study.

We reproduce three of these; one that represents color harmony

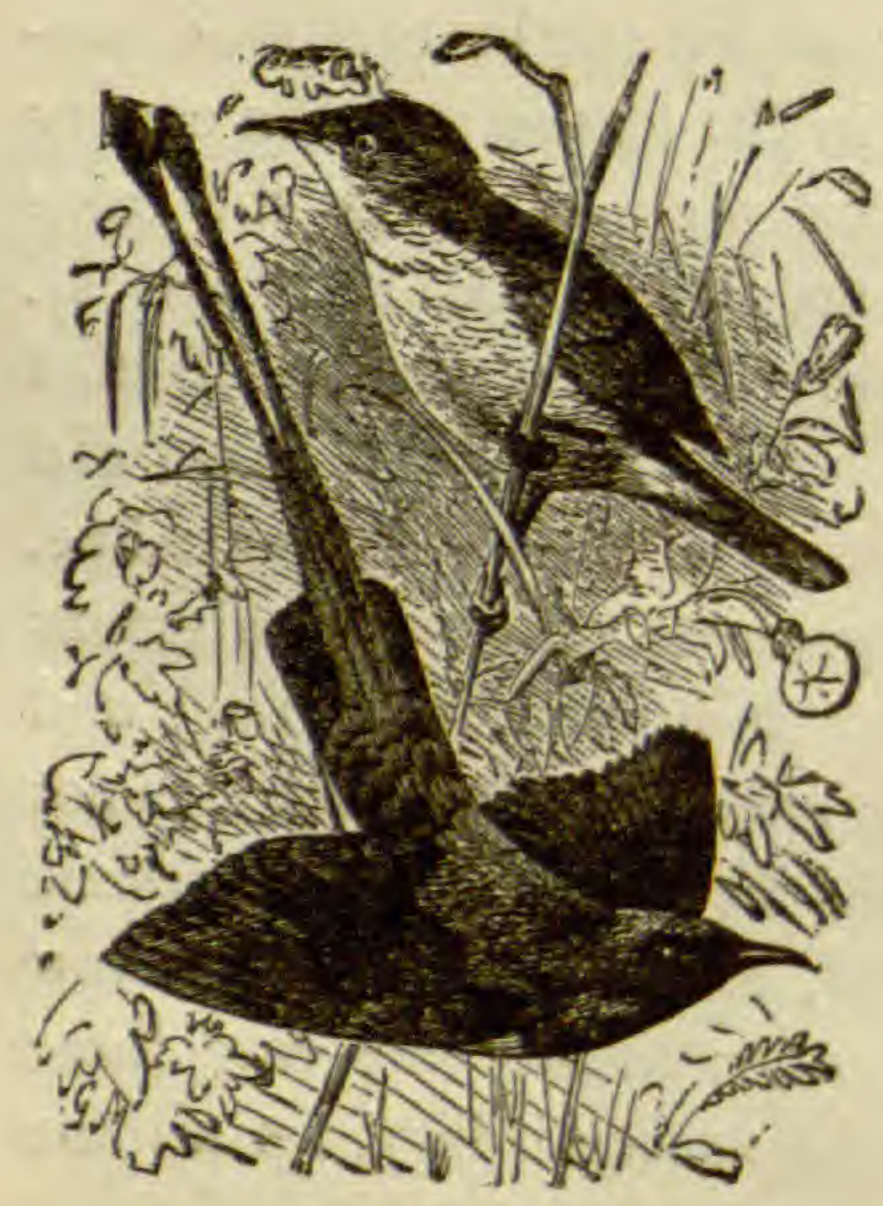


FIG. 2.

The Polytmus humming bird; lower figure the male; the upper the female.

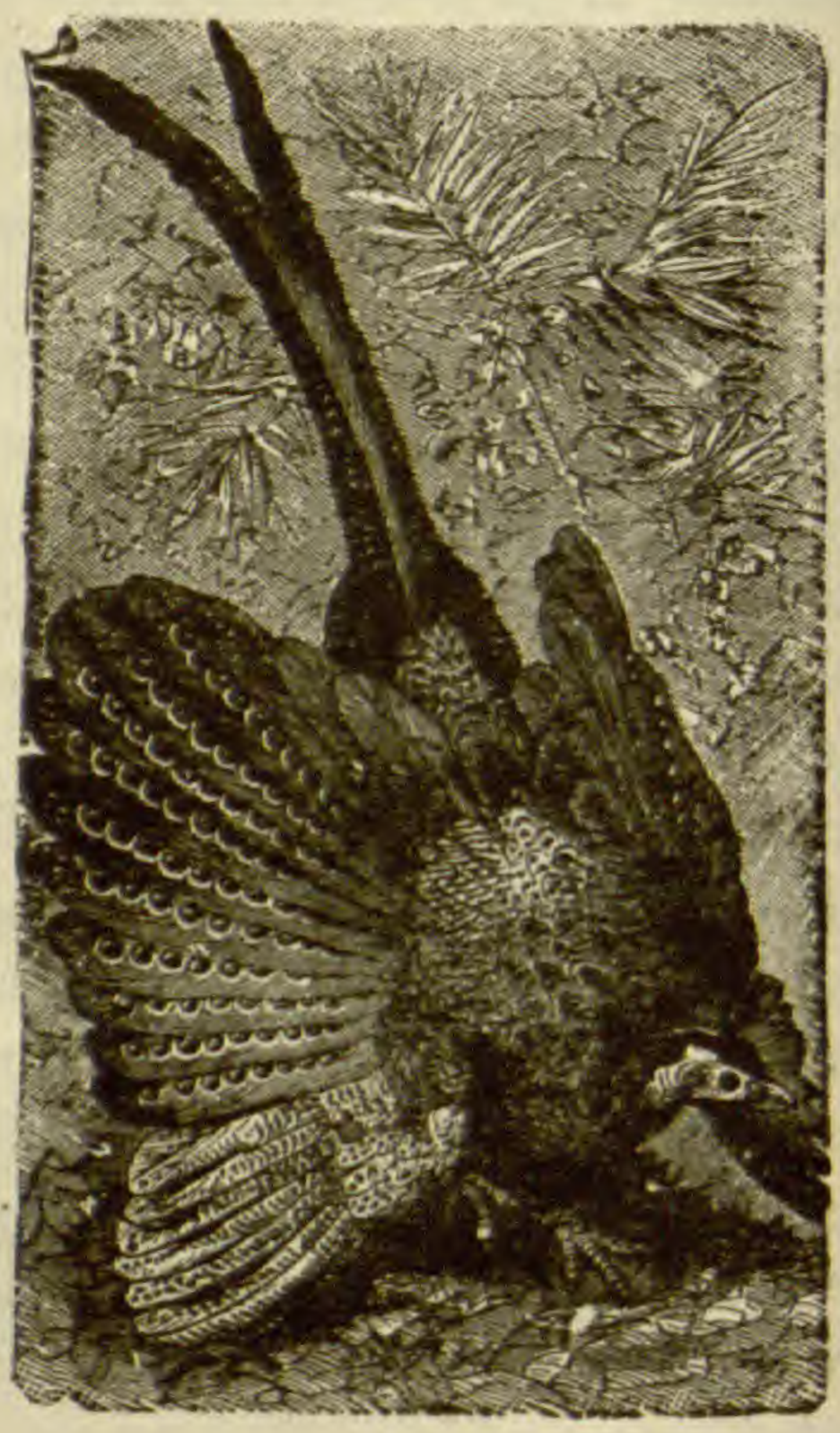


FIG. 3.

The male argus pheasant.

with the environment in the winter pelage of the stoats; and two showing similar feather developments in the tails of the Polytmus humming bird and of the Argus pheasant, in America and Asia respectively.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Currents of the North Atlantic.—Prince Albert, of Monaco, has recently published a chart of the currents of the North Atlantic, entirely based upon the results of a series of experiments he has been conducting since 1885. In that year he launched 160 floats at intervals, along a line of 170 miles, in the direction of N. 14° W. from a point 110 miles northwest from Cowo, one of the Azores. The following year 510 floats were launched, nearly in the meridian 17° 40′ west of Greenwich, between 42° 34′ and 50° N. latitude. In 1887, 931 floats were launched along a line extending from the Azores to the Grand Banks, of Newfoundland. During the same year, a group of floats was launched between two other points in the North Atlantic, between the Azores and Newfoundland.

Of the floats thus launched, 227 were sent back to the experimenter with detailed information as to the place and date of finding. These several histories gave indications of the direction and speed of the currents which floated them. The internal edge of the great vortex performs a revolution with a very short radius round a point south-west of the Azores, and not very distant from them. The cycle described by objects drawn into the vortex is renewed indefinitely, except in the case where they escape by an offshoot into the Arctic regions.

The mean velocity for the region comprised between the Azores, Ireland, and Norway is 3.97 nautical miles in 24 hours; between the Azores, France, Portugal, and the Canaries it is 5.18 nautical miles in 24 hours. From the Canaries to the West Indies, the Bahamas, and even to Bermuda, it attains 10.11 nautical miles in 24 hours. In the eastern portion of the arc, which extends from Bermuda to the Azores, it falls again to 6.42 nautical miles in 24 hours. The mean velocity is 4.48 nautical miles in 24 hours. (Proceeds. Roy. Geog. Soc., Sept., 1892.)

Fins of Palæaspis Americana.—Mr. Claypole has recently published the description of certain objects which he believes to be the fins of *Palæaspis americana*. This fossil Mr. Claypole at first supposed to be a spine, but upon examination it was found to be mar-

gined with a flat fringe around the pointed end and the rounded conical parts were filled with matrix; this central spine-like portion is covered with a layer of the same tissue as that of which the shield is composed; the fringe around the conical central portion is distinctly striate in a direction approximately parallel to its axis. These points of resemblance to a Crossopterygian fin, together with the fact that one of the specimens was found so close to the side of the dorsal shield as to irresistibly suggest a connection, have decided Mr. Claypole to add the character of a fin to his amended definition of *Palæaspis americana.* (Quart. Journ. Geol. Sur. 1892.)

New Reptiles from the Elgin Sandstone.—We have already noticed the reptilian remains from the Elgin Sandstone, which are in the condition of hollow moulds, the bones themselves having entirely disappeared. Casts of these moulds have been made of gutta-percha, which upon examination prove to be models of eight distinct skeletons, of seven species of remarkable reptiles new to science. Professor E. T. Newton, to whom the casts were sent for identification, refers 5 of them to the genus *Gordonia*; *G. traquairi* (2), *G. huxleyana*, *G. duffiana* and *G. juddiana*. In *Gordonia*, as in *Dicynodon*, the maxilla is directed downward and forward to end in a small tusk. The former is distinguished from the latter by the presence of two post-temporal fossæ on each side of the occiput, by the small size of the maxillary tusk, and by the slight ossification of the vertebral centra. A second generic form, *Geikia elginensis* is nearly allied to *Lystrosaurus* Cope, but is distinguished by its shorter muzzle and the entire absence of teeth. The maxilla is produced into a tooth-like prominence, which occupies a similar position to the tusks of *Gordonia.* For the remaining species, Mr. Newton proposes the name *Elginia mirabilis.* The exterior of the skull is covered in by bony plates, the only apertures being the pair of nostrils, the orbits, and the pineal fossa. Horns and spines, varying from ¼ inch to 3 inches in length are found upon nearly every bone of the exterior. This feature reminds one of the living lizards *Moloch* and *Phrynosoma.* With the exception of a smaller number of teeth, the dentition is a repetition on a large scale of *Iguana.* This peculiar skull seems to show affinities with both Stegocephali and Lacertilians, and is unlike any living or fossil form; its nearest, though distant ally apparently being the *Pariasaurus* from the Karoo beds of South Africa. (Nature, Dec., 1892.)

Fossil Reptiles from the Parana.—In the Boletin of the Academia Nacional de Ciencias of Cordova (Argentina), Mr. Juan B.

Ambrosetti describes three new species of fossil reptiles from the Oligocene of the Parana. He also descrbies more fully three other species already named by Bravard, Burmeister, and Scalabrini. The entire number are referred to five genera, of which four are reported to be new. The descriptions of species are quite full, but the new genera are not described at all, so that they have, so far, no scientific standing. One of them is said to be near to Tupinambis ("Podinema"), and the others are crocodiles. Three of them are regarded as near to the gavials, and are an interesting addition to the South American fauna, if this statement is confirmed. But the author is not yet fully competent for the task he has undertaken. He writes of the "Ameividæ," meaning Teidæ, and imagines that Rhamphostoma was proposed by Burmeister in the Annals of the Museum of Buenos Ayres! His knowledge of classic composition is indicated by his construction of the abortion Oxysdonsaurus, of which an American grammar school boy would not have been guilty. He should have written Oxyodontosaurus, a very awkward name at best. As the genus is not defined, however, nobody is under obligation to adopt it.—E. D. C.

On the Systematic Position of the genus Protogonodon.—The collection of fossil mammalia in the American Museum from the Puerco formation contains among the numerous specimens a few upper teeth, and a number of lower jaws belonging to the genus *Protogonodon*, Scott[1] (– *Mioclænus* Cope, in part). I consider the material referable to the genus *Protogonodon* as the most important in this collection, as it enables me to probably settle the question as to its phylogentic position in the system.

Professor Cope's type of *Protogonodon* is a lower jaw with teeth. In his description[2] of this specimen, he considered it as probably closely related to the Condylarthra, but as he was not familiar with the upper molars, he placed it in the rather indefinite genus *Mioclænus*. Later Professor Scott[3] in his valuable paper on the Creodonta removed the *M. pentacus* from *Mioclænus*, and established the genus *Protogonodon* for its reception. Professor Scott places this genus among the Condylarthra, and probably in the family *Phenacodontidæ*.

The series of upper molars in the collection which I refer to Protogonodon were not found associated with lower teeth, so that their reference to this genus is not absolutely certain. However, as the lower

[1]Proc. Philad. Academy, 1892, p. 322.

[2]Synopsis of the Vertebrate fauna of the Puerco series, 1888.

[3]Op. cit.

true molars of *Protogonodon* are of the sextubercular type, I believe they should be associated with a superior molar which is tritubercular. These upper molars consist of three principal cones with well developed intermediate tubercles; the external cones differ considerably in form from those of the Creodonta (*Sarcothraustes*), but the general form of the upper true molars in *Protogonodon* closely resembles that of the Creodonts.

Another character of the teeth of *Protogonodon* which differentiates it from the Perissodactyle line is the character of the inferior premolars. The last tooth of this series is much simpler in structure than in *Protogonia*, and closely resembles that of *Pantolestes*. It consists of a simple cone with a slightly enlarged heel. In *Protogonia puercensis* on the other hand, a well marked deuterocone is present, and this tooth is nearly as complex as it is in *Phenacodus*.

I believe from these characters of the teeth, and also from the fact that the lower jaw is elongated and slender, as in the genus *Pantolestes*, that *Protogonodon* should be placed near the latter genus, and may stand in ancestral relation to it.

Unfortunately the foot structure of *Protogonodon* is totally unknown, so until that is discovered we cannot decide its affinity with certainty.

It is of great interest to note, if my supposition be correct, that in the genus *Protogonodon* we are dealing with an ancestral Artiodactyle, and that already as far down as the lowermost Eocene (Puerco) the main types of the Ungulata were differentiated. It will not then be necessary to resort as Schlosser has done to derive the Artiodactyla from any of the known Periptychidæ, but that the Perissodactyla were represented by *Protogonia*,[4] the Artiodactyla by at least *Protogonodon* and perhaps other genera, as suggested by Professor Scott. Lastly as Professor Cope has shown the *Amblypoda* were already evolved and represented by the genus *Pantolambda*.

Whether or not these Ungulate stems were in all cases distinct from the Condylarthra, remains for future research to prove; but at least one of them, the Amblypoda, was differentiated. In the case of Protogonodon the structure of its teeth shows that it was fairly well on the Artiodactyle line, but the discovery of its foot structure will demonstrate whether or not it had passed the Condylarthrous stage.

I believe that among the Puerco Condylarthra that *Protogonia* was a persistent type, and nearly all of the Periptychidæ with the possible

[4]Professor Cope informs me by letter that the name *Protogonia* is preoccupied, and he proposes as a substitute the name *Euprotogonia*.

exception of *Mioclænus turgidus* died out and left no descendants.—CHAS. EARLE.

American Museum of Natural History, New York.

The Brown Coal and Lignite of Texas.[5]—Mr. E. T. Dumble's comprehensive report on the fossil fuel supply of Texas has been issued as a separate publication by the Geological Survey of that State. In the course of his investigations, Mr. Dumble found it necessary to visit the mines and factories of Austria and Germany, where by personal observation he ascertained the character, use, and value of lignites, together with the best methods of utilizing this fossil wealth. His report is complete, both from a geological and an economic standpoint. Geologically, he describes the origin, formation, physical and chemical character, and the occurrence of the brown coal. Incidentally a classification of the Texas brown coals is given. As an economist, Mr. Dumble suggests the particular uses to which the varieties of brown coal may be put, discusses the valuable products that may be obtained from it, and gives in detail the most approved methods of making it into artificial fuel by brignetting. In a word, Mr. Dumble has demonstrated that in her brown coals and lignite, Texas has an abundant and cheap fuel supply.

The text is illustrated with a number of cuts of machinery, and an excellent map.

Extinct Fauna of Mauritius.—At the meeting of the Zoological Society, of London, Nov. 1, 1892, a communication was read from Sir Edward Newton and Dr. Gadow, describing a collection of bones of the dodo and other extinct birds of Mauritius, recovered from the Mare aux Songes in that island by the exertions of Mr. Theodore Sauzier. The collection contained examples of the atlas, metacarpals, prepelvic vertebræ and complete pubic bones of the dodo, which have heretofore been wanting, as well as additional bones of Lophopsittacus, Aphanapteryx and other forms previously known to have inhabited that island. Besides these there were bones of other birds, the existence of which was not before suspected, and these were described as belonging to the genera Strix, Astur, Butorides, Plotus, Sarcidiornis, and Anas.

[5]Report of the Brown Coal and Lignite of Texas. Character, Formation, Occurrence and Fuel Uses. By E. T. Dumble, F. G. S. A., State Geologist.

MINERALOGY AND PETROGRAPHY.[1]

Description of the New Rock Type, Malchite.—The new rock, malchite, referred[2] to a few months ago as the granitic dyke form of diorite, is now described in some detail by its discoverer, Osann.[3] It forms dykes cutting granite in the Odenwald, Germany. In a dense groundmass are rare phenocrysts of dark mica, pale green plagioclase and quartz. The mica is biotite and the plagioclase labradorite. In addition to these the microscope reveals the presence of idiomorphic green hornblende, allanite and sphene. The groundmass in which these lie strongly resembles that of some tinguaites, with hornblende and quartz in place of aegerine and nepheline. It consists of a fine granular aggregate of feldspar and quartz, the latter with occasional idiomorphic contours, and prisms of hornblende imbedded in the aggregate, the prisms often arranged in flowage lines. An analysis of a fresh specimen of the rock yielded:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	SO_4	P_2O_5	Total
63.18	17.03	.24	6.37	.92	4.17	4.44	2.91	.52	.19	.23	=100.20

The Petrography of Hokkaido, Japan.—In a general geological sketch of Hokkaido, (Jezo or Yesso), Japan, Jimbo[4] declares that the island consists largely of paleozoic beds, probably underlain by amphibolites and various other schists, and cut by granite, diorite, gabbro, peridotite, and serpentine. In the lower portion of the paleozoic the beds consist largely of pyroxenites, with traces of radiolarian remains, phyllites, quartz-schists, limestone, and serpentine. The pyroxenites are aggregates of light colored augite, quartz and feldspar, in which the augite is often more or less changed to epidote and glaucophane. Where the granite cuts the clastics the clay slate is changed by contact action to a biotitic clay slate, to hornfels and to mica schist, with the latter nearest the eruptive. Tourmaline occurs in the schist and cordierite in this rock and in the mica slate. An amphibolite in the contact belt is supposed to be an altered tufa. Schistose granites, diorites and gabbro are phases of the corresponding

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

[2]AMERICAN NATURALIST, May, 1892, p. 422.

[3]Mitth. Gross. Bad. geol., Landesanst ii, p. 380.

[4]General Geological sketch of Hokkaido, with special reference to the petrography. Satporo, Hokkaido, Japan, 1892.

massive rocks associated with the contact products. Diabases occur as sheets in the unaltered paleozoic beds, and serpentines derived from gabbros and from dunites are met with cutting these at various localities. In addition to paleozoic there are also tertiary rocks on the island, and these are cut by their own systems of dykes and bosses, and are interbedded with characteristic sheets of lava, and layers of tufas. The tertiary volcanic rocks are pyroxene and hornblende andesites, propylites and rhyolites. The pyroxene andesites contain both orthorhombic and monoclinic pyroxenes and occasionally some olivine. They have also a glassy base which sometimes becomes so abundant as to resemble pumice. The hornblende andesite is strongly porphyritic with large phenocrysts of hornblende. The rhyolites are both compact and glassy, in which latter case they are vesicular.

Two Peculiar Rocks from Siberia.—Two very remarkable rocks are described by von Chrustschoff[5] from Taimyr-Land, Siberia. One is an ophitic aggregate of anorthoclase and nosean, containing as accessories sanidine, plagioclase, amphibole, biotite, melanite, magnetite, sphene, zircon and glass. The anorthoclase is in long, narrow crystals of the following composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Total
64.59	19.84	2.24	1.26	.63	3.53	7.88	=99.97

Corresponding to Or_2, Ab_6, An_1. The feldspar is usually idiomorphic with respect to the nosean, whose period of formation was between that of the biotite and that of the hornblende. The nosean is in very large quantity. Its density is 2.266 and composition:

SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	CaO	H_2O	Cl	SO_3	Total
37.83	26.59	.38	22.40	1.63	.54	.87	1.66	8.68	= 99.98

The zircon is of the trachytic type, and is the only accessory of any importance. The author calls the rock taimyrite. The second rock is composed of anorthoclase, sanidine, biotite, and amphibole as essential components, and the other minerals mentioned above in connection with taimyrite as accessories, except that sodalite here replaces nosean. The zircon is of the granitic type, and the rock possesses the granitic texture.

[5]Bull. d. l'Acad. Imp. des Sciences St. Petersb. Mél. Geol. et Paleont., i, p. 153.

An Ottrelite Bearing Conglomerate in Vermont.—It is not uncommon to find ottrelite forming 25% of the schistose groundmass of the conglomerate[6] at the base of the Lower Cambrian, near Rutland, Vermont. The same mineral occurs along shear planes in a blue quartzite and constitutes 40% of a massive bed of the conglomerate. In the last named rock the ottrelite is in rudely circular areas, lying in a dark colored quartz. The areas consist usually of radiating plates of the mineral, disposed in a single plane. Its commonest inclusions are quartz and feldspar, while sericite often forms the centers of the radiating bundles. In the latter case the ottrelite is oriented in parallel position with the mica. Other inclusions within the ottrelite besides those above mentioned are crystals of zircon and rutile, flakes of graphite and plates of ilmenite. In other cases the ottrelite is in plates including large areas of the groundmass of the rock, which is a granulated mixture of quartz and albite (?) in about equal proportions, a large quantity of sericite, and some biotite. In this groundmass associated with rutile are crystals and plates of anatase. No traces of its original clastic structure remain in the rock, though its conglomeratic character is beyond dispute.

Lithophysæ in the Rocche-Rosse.—In parts of the Rocche-Rosse lava stream of Monte Pelato, Lipari, are spherulites with lithophysal characteristics. In some specimens examined by Cole and Butler[7] the spherulitic growth originated about the walls of steam vesicles, and progressed outward into the rock; in other cases they grew inward until they have completely filled the space that was formerly vacant. The importance of the paper lies in the fact that it acknowledges the correctness of many of Idding's views with respect to the formation of lithophysæ, and contradicts the view that regards all hollow lithophysæ as the result of the decomposition of spherulites.

The Composition of the Dune Sands of the Netherlands.—A very elaborate paper by Retgers[8] on the constitution of sand composing the dunes on the west coast of Holland at Sheveningen, near the Hague, contains a large amount of information concerning the character of sands and the method of determining the nature of their constituents. The author carefully fractioned large quantities of the dune sand by the ordinary methods of fractional precipitation in

[6]C. L. Whittle, Amer. Jour. Sci., Oct., 1892, p. 270.
[7]Quart. Jour. Geol. Soc., xlviii, 1892, p. 438.
[8]Recueil des Travaux Chimiques des Pays-Bas., xi, 1892, p. 169.

the usual heavy liquids and by means of the molten substances suggested by himself[9] for this purpose a few years ago, thus obtaining mixtures of mineral grains of about the same density. These then were studied carefully by comparison of their indices of refraction, by immersing them in liquids of known optical densities, until one was found in which the grains became almost invisible. The index of refraction of these is nearly that of the liquid, consequently their nature is thus approximately determined. Microchemical tests and the ease with which cleavage laminæ were produced, served to distinguish accurately between minerals having nearly the same refractive index. The principal minerals identified by the author are orthoclase, quartz, microline, plagioclase, cordierite, calcite, apatite, amphibole, tourmaline, pyroxene, epidote, sphene, sillimanite, olivine, garnet, staurolite, disthene, corundum, spinel, rutile, zircon, magnetite and ilmenite. The surprising discoveries are those of cordierite, calcite and olivine, and of glaucophane among the amphiboles. The proportions of the various minerals present according to specific gravity was 2.5% between 2.5 and 2.6; 85% between 2.6 and 2.7; 7.5% between 2.7 and 3. ; 1.5% between 3 and 3.3; 1% between 3.3 and 3.6; 2.4% between 3.6 and 4.2; .1% between 4.2 and 5.2. The sands are supposed to have come mainly from the rocks of archean terraces.

Quartz-Gabbro in Maryland.—In the Baltimore gabbro area, according to Grant,[10] are quartz gabbros consisting of bytownnite, quartz, hypersthene, secondary hornblende, and a few accessories. The quartz is limpid, and is almost free from inclusions, except for lines of small liquid cavities that traverse the grains, as is usual in granitic quartz. Diallage, which is so common in the normal gabbro of the region, is entirely absent from the quartz-bearing phases, which thus becomes a quartz norite.

Minerals from the Diamond Fields of Brazil.—Hussak[11] describes the characteristics of crystals of brookite, cassiterite and xenotime from the diamond region of Dattas, Minas Geraes, Brazil. On *brookite* from the sands of Diamantina was found the new pyramid, $\frac{1}{2}P\breve{2}$. The *cassiterite* is from Manquinho, near São Paulo. It occurs in a rubellite-bearing lepidolite granite. The *xenotime* accompanies the brookite in the sands of Dattas. On one doubly terminated crys-

[9]Cf., AMER. NATURALIST, 1890, p. 175.

[10]Johns Hopkins Univ. Circ. No. 103.

[11]Min. u. Petrog., Mitth. xii, p. 455.

tal were found the two new pyramids $\frac{4}{7}$P and $\frac{1}{5}$P. The axial ratio of these crystals is 1 : .61775. The author has also made a crystallographic examination of the *monazite* occurring so abundantly in the Brazilian granites and gneisses. The crystals of this substance are always tabular parallel to $\infty P\bar{\infty}$. They contain the same forms as do the Ilmengebirge crystals, but are never twinned. Upon washing a portion of sand from Bohia a 3 mm. long crystal of *euclase* was obtained whose density is 3.1. It is very rich in planes, being possessed of not less than three prisms, six clinodomes and three negative pyramids, beside the clinopinacoid.

Mineralogical Notes.—*Christianite* crystals are reported by Gonnard[12] as lining geode cavities in the basalts of dykes at Queyrières and Fay le Froid, Haute Loire, France. In the latter case the christianite groups enclose many crystals of augite. The trachyte of Montcharet, occurring as a dyke in granite, is cut by fissures whose walls are lined by *chabasite.*[13] The cubic faces of *galena* crystals implanted in druses of quartz at Pontgibaud are roughened by little cavities whose walls have the positions of octahedral planes. The phenomenon is regarded by Gonnard[14] as the result of corrosion. The same author mentions the existence of large crystals of *beryl* in the granites of Droiturier, near La Palisse, Allier, *psilomelane* in mammillary forms at Croix Moraud, Mt. Doré, and cubic pseudomorphs of *quartz* after some unknown mineral, probably fluorite, in the vicinity of d'Aubenas, Ardèche.

Three specimens of *melilite* from Mt. Somma, with densities of 2.917, 2.932 and 2.945 respectively, were powdered, purified, and analyzed by Bodländer[15] with this result:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total
41.34	10.37	4.29	33.84	5.79	1.13	3.45	.08 =	100.29

The author combats the view of Vogt that melilite is an isomorphous mixture of the gehlenite and akermanite molecules. He thinks that the negative variety is an admixture of $R''SiO_3$ and the aluminate R'''_2O_4R'', while the positive variety is a compound of the same silicate with the aluminate $R_2'''O_6R_3''$. Intermediate varieties are isomorphous mixtures of these.

[12]Bull. Soc. Franç d. Min., 1892, xv, p. 28.
[13]Ib., p. 31.
[14]Ib., p. 34.
[15]Neues. Jahrb. f. Min., etc., 1893, i, p. 15.

Moses[16] records the analysis of a granular *nickel arsenide* associated with native silver and siderite in a mine 18 miles west of Silver City, N. Mex. The silver is imbedded in arborescent forms in the brittle gray nickel ore, and this in turn is in a gangue of siderite. The analysis made on impure substance gave:

SiO_2	Pb	Ag	As	Ni	Co	Fe	Total
4.56	tr.	8.38	67.37	11.12	5.13	2.64	= 99.20

Regarding the SiO_2 and Ag as impurities the composition takes a form that may be represented by RAs_3 in which R = $\frac{4}{7}$ Ni $\frac{2}{7}$ Co and $\frac{1}{7}$ Fe, corresponding to a *nickel skutterudite.*

On crystals of topaz from the Province of Omi and from the tin mines of Yenagari Mino, Japan, Matthew[17] finds four pyramids, seven prisms, one of which, $\infty \breve{P}\frac{11}{4}$, is new, the three pinacoids, three brachydomes and two macrodomes.

Optical Anomalies.—After an exceedingly careful examination of many sections of appophyllite crystals and a comparison of the phenomena they present with those presented by combinations of thin biaxial plates placed one upon the other, Klein[18] concludes that the mineral in its geometrically tetragonal crystals is an intimate mixture of optically positive and optically negative triclinic lamellæ. The positive constituent seems to differ from the negative element in containing no crystal water, since upon heating the positive component appears to increase in quantity. Negative appophyllite becomes positive upon loss of $4\frac{1}{2}$ molecules of crystal water. The investigation is a beautiful piece of accurate optical work.

In a reply to Mallard's[19] remarks on the black garnet pyrenaite Brauns[20] states that the structure described by the first mentioned anthor is exactly what should be expected of a dodecahedral substance under strain, and that the peculiarities of this garnet's optical properties may be easily explained on the Klein-Brauns theory of strain.

Upon soaking in oil sections of zeolites that have been rendered cloudy by loss of water, they again become sufficiently transparent for the study of their optical properties. Rinne[21] has taken advantage of

[16]School of Mines Quart., xiv, No. i, p. 49.
[17]Ib., xiv, No. 1, p. 53.
[18]Neues. Jahrb. f. Min., etc., 1892, II, p. 165.
[19]AMERICAN NATURALIST, Oct., 1892, p. 849.
[20]Neues. Jahrb. f. Min., etc., 1892, I, p. 217.
[21]Ref. Neues. Jahrb. f. Min., etc., 1892, II, p. 237.

this phenomenon and has carefully examined a number of the members of the group with a view to learning something of the changes effected in them by the loss of water. *Natrolite* appears monoclinic under these conditions, *scolecite* orthorhombic, *stilbite* orthorhombic, and each of the other zeolites affords a corresponding meta-zeolite. The optical anomalies often observed in these minerals is thought to be undoubtedly due to partial loss of water.

Isomorphism.—After a long mathematical discussion of the theory of the structure of isomorphous mixtures and upon comparison of the results of investigations upon the optical properties of mixed crystals, Poeckel[22] concludes that we have not yet sufficient data to decide as to whether Mallard's lamellæ theory of the constitution of these bodies is correct or not.

By the use of the method[23] in which colored and colorless crystals of supposed isomorphous substances are allowed to form under the microscope Retgers[24] has proven that the alkaline ferrates are isomorphous with the corresponding sulphates, selenates, molybdates and tungstates, that the potassium tellurates and osmiates are isodimorphous, and that the rutheniate of this metal is isomorphous with its uranate.

The arguments for and against the view as to the isomorphism of calcite and dolomite are given respectively by Brauns and Retgers[25] in a recent letter to the Neues, Jahrbuch. The discussion is too involved to warrant an intelligible abstract in these notes.

Etched Figures.—The matrix of the African diamonds is capable of resorbing[26] *diamonds*, producing on their faces irregular, long, and hemispherical hollows, associated with which are little spheres and grains of black carbonaceous substance, supposed to be a compound of iron and carbon.

Hofer[27] describes corrosian forms on the *calcites* of Steierdorf, Banat, and of Rauris and Salzburg, and ascribes the hexoctahedral faces $^{2}_{5}{}^{4}O2$ on the *fluorite* of Sarnthal, Tyrol, to corrosive processes.

[22]Neues. Jahrb. f. Min., etc., B. B., viii, 1892, p. 117.

[23]American Naturalist, June, 1892, p. 517.

[24]Zeits. f. Physik. Chem., x, 5, 1892, p. 529.

[25]Neues. Jahrb. f. Min., etc., 1892, II, p. 210.

[26]Ber. deutsch. chem. Ges., 1892, p. 2470.

[27]Min. u. Petrog., Mitth. xii, p. 487.

Microchemical Reactions.—The methods of testing for traces of ammonia under the microscope, and of precipitating metals with H_2S are described in a few words by Streng.[28]

Directions for the detection of the following minerals in small particles are given by Lemberg:[29] *Scapolite, hauyne, sodalite, eudialite, lazurite, sulphur, olivenite, celestite and melilite.*

Miscellaneous.—Under the title "Rapid Qualitative Examination of Mineral Substances," Moses and Wells[30] publish a scheme for the detection of minerals. The blowpipe method is used with the metallic minerals, but in the silicate group a mixture of the dry and wet methods is made use of. From a hasty reading of the scheme it seems to be a practicable and convenient one.

[28]Neues. Jahrb., 1893, I, p. 49.

[29]Zeits. d. deutsch. geol. Ges., 1892, p. 224.

[30]School of Mines Quart., Nov., 1892, p. 25.

ZOOLOGY.

The German Zoological Society.—The annual report of this society for 1892 is out, and contains among others the following papers: The opening address by the President, Professor F. E. Schultze, described the zoological department of the University of Berlin, where the meeting was held, giving also a sketch of its history. Professor H. E. Ziegler spoke upon the embryonal anlage of the blood in the vertebrates. At first the blood is a clear serum in which no corpuscles appear. Later they are present. Various ideas have been advanced as to their origin. Ziegler vigorously discusses the view which assigns them to the entoderm and decides that they are without doubt mesodermal in origin. Dr. L. Plate described the anatomy and affinities of the Onchidiidæ. These forms belong to the Asiatic region, and are amphibious, living equally well in or out of the salt water. To separate the genera the author uses the relative width of the foot and of that suprapedal region to which he gives the name of hyponotum. The group is of great interest from the fact that though usually regarded as Opisthobranchs they must be considered as near the ancestral Pulmonate. Plate, however, thinks that they have crossed the line and are true Pulmonates, but that their Nudibranch characters are such as cannot be explained except upon the hypothesis of descent from that group. Dr. Thiele, in discussing the phylogeny of the byssus apparatus of the Lamellibranchs, thinks that it must be traced back to some such type as the adhesive glands of Haliotis, and does not agree with Pelseneer in regarding the byssal glands of the Nuculidæ as the most primitive. The fact that either in young or in adult the byssus occurs in most Acephals, is proof to Thiele that the gland must be traced back to the ancestral mollusc. Von Nathusius discussed the form and color of the hair as a basis of classification of the Equidæ. Dr. Korschelt presented a paper on the differentiation of the germ-layers in the Cephalopods with especial reference to the formation of the alimentary canal and the nervous system. According to Bobretzky both the midgut and the nervous system are of mesodermal origin, while several other authors think that the whole alimentary canal is formed by ectodermal inpushings (stomo- and proctodeum). Korschelt finds[1] that at an early date an epithelial layer arises just above the yolk in the anal region. It is distinctly separated

[1]The full paper with illustrations appears in the Leuckart Festschrift.

from the ectoderm by the mesoderm. Later it becomes elevated from the yolk, forming a small cavity open to the yolk, the future mesenteron. This layer is regarded by Korschelt as entoderm, and has been regarded by several authors as the proctodeal inpushing. He also finds the nervous system to be, as might have been expected, ectodermal. Dr. Burckhardt described the central nervous system of the Dipnoi. He has subjected the brain to sections, and by study of these has been able to elucidate points not before understood. He concludes that in its brain Protopterus is not an Amphibian, but that it is in this respect a problematic organism between the fishes (Elasmobranchs) and Amphibia, whose exact position will first be solved when the ontogeny is studied. Professor R. Hertwig had a review of recent work upon canjugation and fertilization, and Dr. H. H. Field a paper on the Metamerism of the Kidney of Amphiuma, already noticed in our pages. The last paper was a view of the idea of instinct, by Professor H. E. Ziegler.

Eyes of Polychætes.—Dr. E. A. Andrews has an extended article[2] on this subject. He has studied a large series of genera, some both as young and adult, and among the conclusions at which he arrives are the following: The eye is an epidermal organ consisting of a pigmented cup containing a refracting mass, which at the orifice of the cup comes in contact with the cuticle. The wall of the cup consists of a single layer of cells forming the retina, each retinal element containing pigment, and being produced internally into a nerve process, externally into a clear rod. This, as will be seen, is a different conception of the annelid eye from either that of Carrière or that of Graber, but one which approaches most nearly to that of the former author.

Arachnida.—Mr. B. I. Pocock discusses[3] the external anatomy of the members of the group Arachnida (*s. s.*), and concludes that the members must be arranged in two sub-classes, Ctenophora, with the single order Scorpiones, and Lipoctena, containing the superorders Caulogastra (Pedipalpi and Araneæ) Mycetophora (Solifugæ), and Holostomata (Pseudoscorpiones, Opiliones, Acari).

F. Purcell, after studying the anatomy and development of the eyes of *Liobunum hemisphæricum*, concludes[4] that contrary to the com-

[2]Jour. Morph., vii, 169, 1892.

[3]Ann. and Mag. Nat. Hist., VI, xi, p. 1, 1893.

[4]Zool. Anz., xv, 1892.

monly accepted ideas, these organs in the Phalangids are to be regarded as compound, and further that they are inverse eyes homologous with the anterior middle eyes of spiders and the middle eyes of the scorpions.

The Fishes of the Pacific Coast of America North of Cerros Islands.—An important paper recently published is an enumeration of the fishes occurring on the Pacific coast of America north of Cerros Island, and to a depth of 150 fathoms by C. H. and R. S. Eigenmann. The authors have placed the dividing line between the littoral and the bathybial faunas of this region at 150 fathoms, because all of the genera so far recorded from this depth have representatives in the shallower water. The few littoral genera which have representatives in deeper water are added as footnotes. Cerros Island is a natural boundary to this region, since south of it few of the characteristic genera of this region are found. The author's observations show that the old division, at Point Conception, of the northern and southern California fauna is incorrect, and that, in reality, no definite boundaries can be assigned for a northern and southern fauna.

The California fauna is distinct from that of Alaska, although four of the species found at San Diego are found in Alaska. The California Fauna is characterized by the abundance of species of Sebastodes, of Cottidæ, and of Embiotocidæ. The last are entirely absent from Alaska, and only a few species of Sebastodes are found there. The boundary between these two regions lies somewhere between Sitka and Puget Sound.

The relative number of species at the principal localities is as follows:

	Species.
The whole of Alaska	108
Puget Sound	107
San Francisco	156
Monterey	148
Santa Barbara	117
San Pedro	82
San Diego, including Cortes Banks	168

There are known from the entire region 382 species, belonging to 228 genera. Of these 116 genera, or more than half, are also found in the Atlantic Ocean, and 32 species are found both in the Atlantic and in the Pacific.

The genera having species in both oceans practically all belong to one of three classes: 1st, Tropical genera; 2d, Arctic genera; 3d, Pelagic and other genera (Ann. N. Y. Acad. Sci., vi, 1892).

On the Mechanical Genesis of the Scales of Fishes.—Mr. J. A. Ryder has advanced a theory that the genesis and arrangement of the scales of fishes is due to the movements of the fishes in swimming. The scales originate in a continuous subepidermal matrix which may be regarded as a basement membrane. Such a matrix is found to actually exist in some forms at an early stage, just beneath the epidermis; in other forms it exists in the larval stages, and in the young of many types of fishes it is coextensive with the whole epidermal layer just at the time when the scales are forming.

In the Clupeoids and Cyprinoids it is found that the myocommata, or sheets of connective tissue intervening between successive somites are attached firmly to the deeper layers of the skin. This construction, together with the peculiar arrangement of the muscle plates at the time the scales begin to form, conditions the further growth of the scale matrix. The ordinary movements of the fish in swimming throw the whole integument into definitely circumscribed areolæ, of which the central portions are in a quiescent state, while the margins are wrinkled or folded as a result of the current action of the lateral muscles of the body.

In each of the circumscribed areolæ a scale develops; the continuity of its development with its fellows across the margins of the areola is prevented by the flexures to which the dermis is there subjected.

The author shows that the imbrication as well as the arrangement of the scales is determined by the action of the segmentally arranged muscles of the body.

Special types of squamation, as those of the eel and the sturgeon, confirm the author's views. In cases where the scales are very fine, that is, several oblique rows corresponding to each somite, the principle holds good, since the rows still conform to the lines of tension of the linear attachment of the myocommata to the integuments.

From the hypothesis and the evidence presented, Mr. Ryder draws the following important conclusion:

1. "The scales of fishes bear a segmental relation to the remaining hard and soft parts, and are either repeated consecutively and in oblique rows corresponding to the number of segments, or they may be repeated in rows as multiples of the somites, or segmental reduction may occur, which may affect the arrangement of the scales so as to

reduce the number of rows below the number of somites indicated by the other soft and hard parts.

2. "The peculiar manner of interdigitation of the muscular somites as indicated by the sigmoid outline of the myocommata, as seen from their outer faces, and the oblique direction of the membranes separating the muscular cones, has developed a mode of insertion of the myocommata upon the corium which has thrown the integument into rhombic areolæ during muscular contraction. These areolæ are in line in three directions, and the folds separating them, particularly at their posterior borders, are inflected in such a manner by muscular tensions, due to the arrangement of muscular cones, as to induce the condition of imbrication so characteristic of the squamation of many fishes."—(Proceeds. Phila. Acad., Part II, 1892.)

The Systematic Position of the Kiwi.—In a paper on the History of the Kiwi, Professor T. Jeffery Parker gives the following conclusion as to the systematic position of this species:

"On the whole it will be seen that the study of the development of the kiwi tends to lessen the gulf between it and ordinary birds, and to show that its ancestors probably possessed many of the more important and distinctive features which characterize the Carinatæ of to-day. The facts clearly indicate that the founder of the Apterygian house had interrupted plumage, functional wings, an ordinary avian tail, a keeled sternum, a double-headed quadrate, lateral optic lobes, and a pecten in the eye; in other words, that the ancestors of the genus were typical flying birds and not bird-like reptiles.

"Of the eight characters enumerated above as separating the Ratitæ from the Carinatæ it will be noticed that the first five are directly connected with the power of flight. We should expect to find such adaptive characters in purely cursorial birds whether they arose from a common stock or sprang separately from early flying birds, and as a matter of fact they occur to a greater or less extent in such flightless birds as the Dodo, Weka, Notornis, etc., which we know have no genetic connection with one another, but have independently acquired the characteristics of flightlessness. I think, therefore, that the possession of the characters referred to by the whole of the Ratitæ is no argument for their common origin.

"The peculiarity of the quadrate has been shown to be a secondary matter, and we have left only the characters of the base of the skull. These certainly form an excellent diagnostic character by which the whole of the Ratitæ are separated from the majority of the Carinatæ,

but even here the distinction is not absolute, for the Tinamous approach in many respects more nearly to the Ratitæ than to the rest of the Carinatæ. Still it seems probable that the various genera of Ratitæ must have diverged from the main line of descent at a comparatively early period, though perhaps not earlier than some of the existing orders of Carinatæ. The Penguins, for instance, are far more reptilian in their vertebral column and less typical in the structure of their wings than the Ratitæ. The Ostrich, however, shows the unique and very reptilian character of two claws on the wing, and the very general presence of wing-claws in the group is a distinctly primitive character.

"Leaving the skull, in which the whole group shows primitive characters, and the wing and related parts, in which the resemblances between the genera are largely adaptive, we find the range of variation in the Ratitæ to be very great indeed. Two genera (Apteryx and Dinornis) have a normal four-toed foot; in three others (Cassowary, Emu and Rhea) the hind toe or hallux has disappeared; while in another (Ostrich) only two toes are left. The pelvis of the kiwi and moa is of the simplest avian type, both pubis and ischia being free; in the cassowary and emu the ischium unites with the ilium; in the rhea the ischiæ unite with one another above the intestines—a unique arrangement; in the ostrich the pubes unite to form a symphysis as in most of the higher vertebrates. The feathers have an aftershaft in the emu, cassowary, and moa, none in the ostrich, rhea, or kiwi. In no order of carinate birds do we find such a wide range of variation as this, and when we add to the characters enumerated the extraordinarily aberrant skull and the structure of the egg shell of the Apteryx, the total atrophy of the wings in Dinornis, and even of the shoulder-girdle in some species of the genus, and the striking differences between the sterna, the shoulder-girdle and the wings of the various genera, we are forced to the conclusion that the existing or lately extinct cursorial birds now known to us are divisible into five well-marked orders, each the equivalent of an entire order of Carinatæ. Of these one order contains the ostrich alone, another the rheas, a third the emu and the cassowaries, a fourth the moas, and a fifth the kiwis.

"As to the relation of the kiwi to the other genera it has been shown to be most nearly allied, as far as its skeleton is concerned, to the moa, differing from it, however, in many important respects. It must certainly have been isolated at a very distant period, and as far as we can see, some of its more striking peculiarities are distinctly correlated to its method of feeding. Most nocturnal animals have large eyes suited

for taking the utmost advantage of the semi-darkness, but the kiwi, finding its prey by scent alone, has developed an extraordinarily perfect olfactory sense, while at the same time, having no need to keep watch against beasts of prey, its eyes have diminished in size and efficiency to a degree elsewhere unknown in the bird class."—(New Zealand Jour. Sci., March, 1891.)

Mammals from the Galapagos Islands.—The mammals collected by Dr. Baur on the Salisbury Expedition to the Galapagos Islands were sent to Mr. J. A. Allen for identification. The collection numbers 12 specimens, representing 4 species, of which 2 prove to be introduced species of *Mus.* The other species are both new, one a bat, *Atalapha brachyotis*, the other a mouse, *Oryzomys baurii*, closely related to *O. galapagœnsis.* The only other species of mammals thus far reported from the Galapagos Islands are two species of Eared Seals, *Otaria jubata* (Forst.) and *Arctocephalus australis* (Zimm.), which were obtained by the Hassler Expedition. The list of known indigenous species thus numbers only five.—(Bull. Am. Mus. Nat. Hist., Vol. iv.)

EMBRYOLOGY.[1]

Echinoderm Eggs.—Karl Fiedler[2] endeavored to corroborate the work of Roux by experiments made at Naples upon the eggs of three species of sea urchin. At first the method used was that of Roux, piercing the egg with a needle. It was found necessary, however, to use a lancet shaped needle made by hammering out and sharpening the tip of a common needle. Later the method of shaking employed by the Hertwigs and by Boveri was, for the first time, adopted in separating the cleavage cells.

The use of the needle under the microscope was attended with a great many difficulties, increased by the large mortality amongst the few individuals that could be successfully operated upon. After the egg membrane is quickly cut the cells may be individually punctured and destroyed. Such embryos can be kept only in large vessels with algæ.

By this means it was possible to pierce a cell so that some of the contents ran out without destroying its power of cleaving, providing the nucleus remained; but in other cases where the nucleus escaped, even with but little protoplasm, the cell died. In the cases where cleavage continued the diminished cell gave rise to small progeny; thus in the four cell stage two cells were much smaller than the others; in the sixteen cell stage two of the four polar micromeres were plainly smaller than the others; in the blastula one half was less convex than the other; but later the difference seems to have been equalized.

When cells are separated by shaking, the remaining ones may change their shape, becoming more spherical where no longer in contact with other cells, but they retain their normal position much as if the other cells had not been removed. Thus when one of the first two cleavage cells was destroyed there resulted an eight celled stage that was half the normal sixteen celled stage, having half the normal number, four, of micromeres at one pole and the other cells likewise arranged as if the sixteen celled stage had been cut into two. The same was true of the half-twenty-eight cell stage. Such half embryos can be formed either by destruction of one of the first two cells or by destruction of two of the first four. The same result is produced by destroying any two of the first four cells, whether they are sister cells or first cousins.

[1]This department is edited by E. A. Andrews, Johns Hopkins University.

[2]Entwicklungsmechanische Studien. Festschrift für Nägeli, Zurich, 1891.

The first four cells are thus all alike in their possibilities as well as in appearance; not so the first eight cells, though they all look alike.

When the eight cells are separated into groups of four these give rise to quite different sets, some with eight large, others six large and two little cells, others four large and four small cells. Thus the development of the eight cell stage is largely a process of "self differentiation" of these cells and not due to the mere interaction of the cells of the group.

By destroying one of the first two cleavage cells half-blastulas even, perhaps, half-gastrulas were reared in a few cases from the single remaining cleavage cell. The half-blastulas were obtained both after piercing and removing one cell and by killing it by shaking, which left it still inside the intact membrane.

The half-blastulas showed a tendency to close in as spheres, but died first.

One interesting case suggesting Roux's "postgeneration" was seen, but lost. It consisted of a half blastula lying against a second solid hemisphere covered over by a layer of cells continuous with the half-blastula.

Electricity and Cleavage.—Wilhelm Roux,[3] seeking to determine if electrical phenomena are involved in the process of karyokinetic cell division, subjected frogs' eggs to the action of a current from three Bunsen cells. In these experiments, made in 1885[4], the eggs were placed in a glass tube surrounded by the coiled wire conveying the current.

The result was negative. In the present paper the author describes the results obtained by the use of an alternating current of 100 volts or less, used for lighting the Anatomical Institute at Innsbruck. Here again, the result as far as any connection of cleavage or cell division and the electric current is concerned, was entirely negative. When the current was not strong enough to kill the eggs they divided in the glass tube without any reference to the presence and direction of the current. The same is found to be true of the maximum continuous as well as of the alternating current.

The alternating current is also found to have no directive effect upon the entering sperm or the fusing pronuclei, factors which Roux regards as determining the first cleavage plane. The electric current has, however, a marked effect upon the egg, visible as a change in color at

[3]Bresl. ärzt. Zeitschrift, 1885, No. 6.

[4]Sitzb. Akad. Wiss. Wien., Jan., 1892.

each pole as contrasted with the equator, where such a contraction takes place that at first one might regard the equatorial belt as a cleavage furrow. These changes involve the death of the egg, and are merely a "morphological" polarization produced by the passing current and localized by its direction irrespective of any axial or polar differentiation within the egg itself.

However interesting and valuable the long series of experiments recorded in the two hundred pages of this memoir may be to the physicist and to the biologist, they have for the embryologist of the present day too little direct bearing to make it worth while reviewing them at length.

It should be mentioned, however, that the most diverse objects, frogs' eggs, gall bladders, embryos, hearts, hydras, tritons, lizard and fish embryos, chick and mammal embryos, as well as inorganic substances, such as mercury, copper, lead, etc., exhibit visible differentiation of polar and equatorial areas dependent upon the direction of passing currents. Yet this is not true of even all organic bodies experimented with.

Membranes of the Sea Urchin Egg.—Curt Herbst[5] repeated the experiment of the Hertwigs, and used in addition to chloroform, clove oil, creosote, xylol, toluol and benzole.

Eggs of the sea urchin shaken in water that had been mixed with small quantities of any one of these substances form an artificial egg-membrane just like that normally formed after the entrance of a sperm in fertilization.

This membrane, the author holds, is made by the hardening of the preexistent hyalin outer layer of the egg.

The subsequent separation of the membrane from the surface of the egg is probably due to the secretion of some jelly-like substance. The egg does not shrink away from the membrane at all.

The sperm has no direct part in the formation of the membrane, but merely acts as a stimulus to the egg. If the membrane is removed from a fertilized egg (by shaking) the presence of more sperms does not cause the formation of a new membrane. If, however, some of the above substances are used, a second membrane is formed. Two membranes, one inside the other, may be formed from eggs having one membrane, or even from those having the first membrane removed. The cause of this membrane formation is to be sought for in the egg itself.

[5]Biol. Centralblatt, Jan., 1893.

Experiments on Cleavage.[6]—Dr. Jacques Loeb, of the University of Chicago, has made a most valuable addition to our knowledge of the cleaving ovum. His experiments were simply the exposure of the eggs of sea urchins (*Arbacia*) to water containing more or less than the normal amount of sodium chloride.

The general result is stated as follows: "If we reduce the irritability of the protoplasm of the egg by reducing the amount of water contained in it, the nucleus can segment without segmentation of the protoplasm. If we increase again later the amount of water, and consequently the irritability of such an egg, the protoplasm at once divides into about as many cleavage cells as there are nuclei pre-formed. The segmentation of the protoplasm in the egg, and probably in every cell, is only the effect of a stimulus exercised as a rule by the nuclei."

The following illustration of the character of the experiment is presented by the author: Eggs taken a few minutes after impregnation were divided into four lots, one put into normal sea water, one into that concentrated by adding 2 g. Na Cl per 100 ccm., the other two into sea water concentrated by addition of 1.3 g. NaC and 1 g. Na Cl per 100 ccm. in each case.

When the eggs in normal sea water had arrived at the two celled stage none of the others had as yet begun to cleave. In the least concentrated solution the cleavage soon followed and in the more concentrated solution it followed about an hour later, but in the most concentrated solution no cleavage took place. Concentrations greater than 2 g. per 100 ccm. produced plasmolysis. The form of the cells indicates the amount of water and the intracellular pressure; thus in normal water the first two cells are nearly hemispheres, but in concentrated solutions the cells approach more and more toward a spherical shape.

Other experiments bring out the interesting point that the effect of salt is not to destroy but to suspend the cleavage phenomena. When the eggs are put back into normal water after staying some time, but not as long as twelve hours, in concentrated water, the suspended cleavage begins and goes on much as in a normally situated egg. The longer the eggs have been in the concentrated water the more numerous are the cleavage cells formed all at once when the egg is returned to normal water. An interval of about twenty minutes in the normal water must elapse before the sudden appearance of the retarded cleavage cells occurs.

[6]Journal of Morphology, vii, 1892.

The behavior of the nuclei of the eggs in concentrated sea water was observed somewhat in live eggs and in certain stained eggs which Dr. Conklin prepared for the author. It seems that the nuclei increase in numbers in the salted sea water when there are no cleavage furrows visible on the outside of the egg, but this increase is not always accompanied by a normal separation.

In the light of the conceptions of Fol and O. and R. Hertwig regarding the effects of polyspermy in producing a cleavage into many simultaneously formed cells it might have been urged that Dr. Loeb's results were due to polyspermy.

Granting, however, that the increase in nuclei takes place while the eggs are in the salted sea water such facts as the effect of this water in paralyzing the spermatozoa, as observed by the author, show that the spermatozoa cannot be connected with these peculiar cleavage phenomena.

Regarding the method of action of the salt used in these experiments we must premise that the author in previous work upon hydroids came to the conclusion that growth and regeneration in animals and plants is a function of the amount of water contained in the cells. The application of this to the present case is in the idea that increasing the concentration of the liquid about a cell decreases its irritability by removing water from it; the effect is the same quantitatively and qualitatively as would be produced by lowering the temperature.

The normal source of the stimulus which the abstraction of water is supposed to render no longer efficient to produce cleavage is considered to be the nucleus. The nature of this stimulus is unknown, but some facts lead toward the assumption that it may be a chemical one.

On the other hand the protoplasm has some influence upon the nucleus; possibly the intracellular pressure determining the form of the cell also fixes the direction of the nucleus, which will then be less defined in a mass without cell walls.

ENTOMOLOGY.[1]

Termitophilous Insects.—E. Wasman has lately described[2] a number of new termitophilous insects, erecting for part of them the genus Termitobia and has summarized our present knowledge of the guests of termites. He says that very little is known concerning the guests of the termites as compared with those of ants, largely because the former are chiefly confined to the tropical and sub-tropical regions and also because the investigation of their nests is more difficult. But in spite of this more than fifty species of termitophilous animals are known. Of these forty belong to the Coleoptera, two to Orthoptera, one to Heteroptera, one to Lepidoptera, two or three to Thysanura, one to the mites (Acaroidea), one to the Arachnida, and one is a Nematode. Of the beetles one is a species of Glyptus with its larva, and thirty-nine are Staphylinidæ. The author refers to the investigations of Mr. E. A. Schwarz in North America.[3]

Notes on the Mouth Parts and Thorax of Insects and Chilopods.—The difference between the mouth parts of true insects and Chilopods are usually mentioned in text-books. But when one believes that insects must have come from some form similar to living Chilopods, it becomes a matter of interest to see what is the homology between the various parts of the mouth. As it is usually stated, Chilopods have one pair of mandibles, two pairs of maxillæ, and a pair of maxillipeds; insects a pair of mandibles, one pair of maxillæ, and a labium. The mandibles are of similar structure in both groups. In Chilopods the first pair of maxillæ are two-lobed; the second pair of maxillæ, or first pair of legs (as it is sometimes called), is, in structure, like a pair of legs; the maxillipeds are a modified pair of legs, large and powerful, used for seizing the prey. The dorsal scuta of the segment to which the maxillipeds belong is frequently not wholly united to the head, but is plainly visible (*Lithobius*).

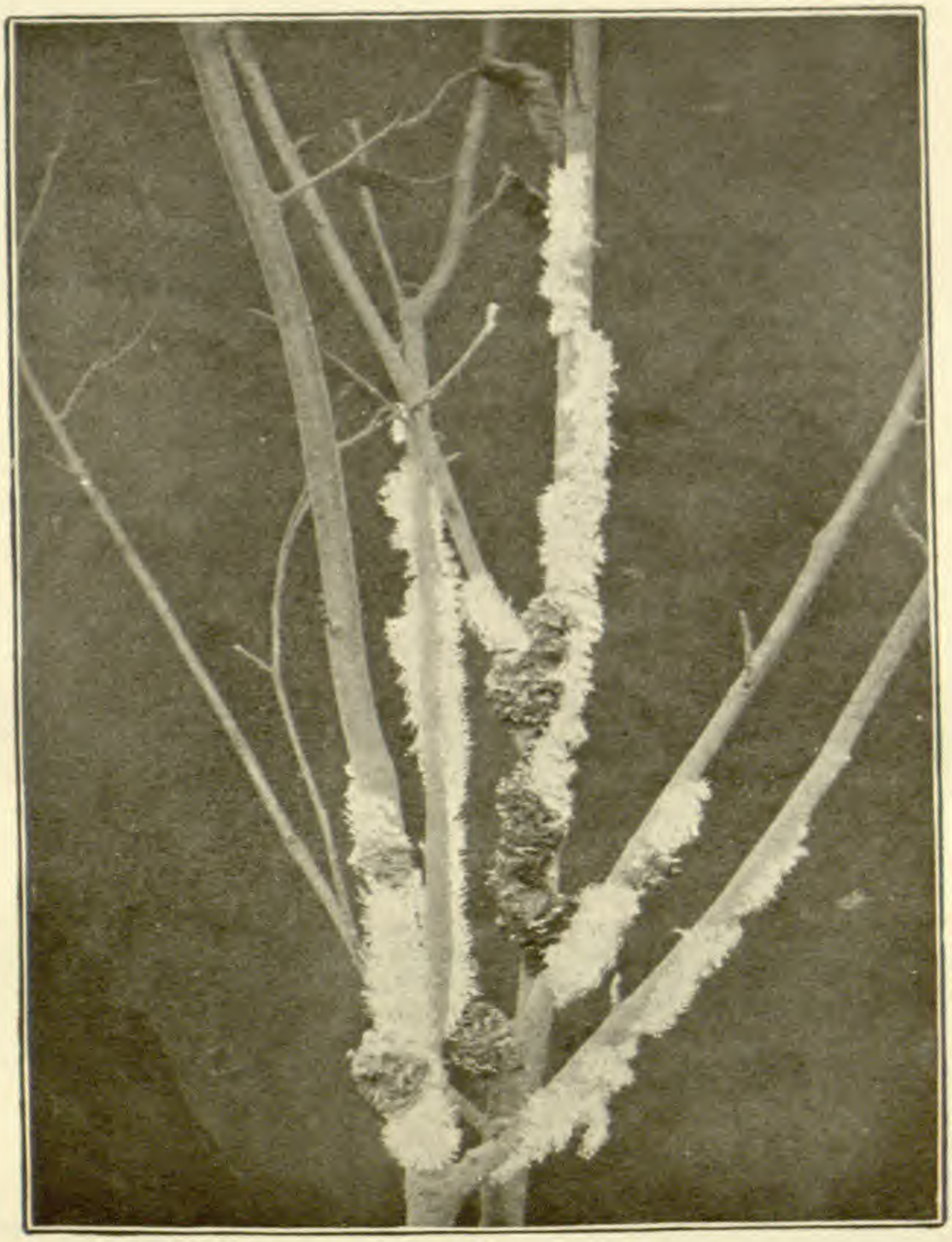
We here see what is well-known among the higher Crustacea; the tendency to the cephalization of thoracic segments in order that their appendages may function as mouth parts. If such is the case, what

[1]Edited by Clarence M. Weed, Hanover, N. H.

[2]Neues Termitophilen, mit einer Uebersicht über den Termitengäste. Verhandl. Zoologisch botanish Gesellsch. in Wien, xli, 647.

[3]Proc. Ent. Soc. Wash., i, 161.

PLATE X.



The Woolly Alder Aphis.

has become of the second maxillæ and the maxillipeds? The maxilla of insects is composed of three portions, the palpus, the galea, and the lacinia with the basal joints. If now we look at a Perlid larva (the lowest winged insect) the secret lies revealed; the basal joints of the maxillipeds have united to form the sub-mentum, the remaining joints by their pressure have united to the basal joints of the maxillæ. Yet in the Perlid larva the union is not complete and one can plainly see that the palpiger is not articulated to the stipes, but has basal joints which are concealed by the stipes and the two parts of the cardo. So that the maxillæ of insects is equal to the first maxillæ of Chilopods plus the maxillipeds. The labium of insects appears to be the same as the second maxillæ of Chilopods, the mentum being the united basal joints.

I would also call attention to the steady tendency observable in Chilopods toward the union of certain thoracic segments. In the lower Chilopods (Geophilus) the segments are all of about equal size, and each one bears a spiracle. A little higher, in Scolopocryptops, we see that there are two kinds of segments, the large with spiracles, the small without them. Segments 2, 4 and 6 are small, the 7th and 8th both large, after that every other one is small. In Lithobius the process is continued still further, the small being smaller, the large larger. In Scutigera (the highest Chilopod) the dorsal scutæ of the small segments become united to the larger ones, so that seen from above, the first scuta (prothorax) covers one pair of legs, the second scuta (mesothorax) covers two pairs, the third scuta (metathorax) covers two pairs, and the fourth scuta covering three pairs of legs. Therefore I conceive that the mesothorax and metathorax of insects are each composed of two segments. This would appear quite probable if one but look at a grasshopper; but there exists greater proof. Machilis (a common Thysanuran) has on each abdominal segment a pair of small appendages, which have been recognized as representing legs, but the meso- and metathorax also bear these appendages beside the normal legs; hence if these appendages represent legs the meso- and metathorax of Machilis must be compound segments. It is possible that each abdominal segment is compound, but I hardly think this probable, since the first abdominal segment of insects, which is very small, appears to represent the small sixth segment of Scutigera. If this theory of the insect thorax be true, the thorax consists of five segments, segments one, three, and five bearing legs, segments two and four bearing wings.

Nathan Banks, Sea Cliff, N. J.

The Woolly Alder Aphis.—In the current report of the New Hampshire Experiment Station observations are recorded by Clarence M. Weed which show that in autumn large numbers of the young of this species (*Schizoneura tessellata* Fitch) are born by the parthenogenetic females. These young descend the alder shrubs to the surface of the ground, where they congregate, under various sorts of shelter, in enormous numbers. They remain there throughout the winter, and in spring those which have not been washed away or otherwise destroyed climb up the trunk to the limbs, where they fix themselves on the lower surface of the bark and grow rapidly into other parthenogenetic females. No males, females, or eggs have been found. This insect has been very abundant in New England during recent years; the appearance of an infested branch is shown in the accompanying plate.

Further Note on the Tineid Case-worm from the Grand Canyon—In my description of the seed-like lepidopterous case-worm from the Grand Canyon in the February, 1893, number of THE NATURALIST, pp. 166–169, figs. 2 and 3, it should be mentioned that the hair line in fig. 2 shows *twice* the natural size of the larva. Fig. 2 was intended to be reduced one-half, and was so indicated on the margin of the original drawing. The hair line was made twice the length of the larva, so that when the whole was reduced one-half it would represent the natural size, stated in the description as $2\frac{3}{5}$ mm.

It seems very certain that this larva is a tineid. It is well-known that these small larvæ often construct cases in which they live; and, as Dr. Packard states (Guide, p. 342), the larvæ of some of the smaller tineid genera (Antispila, Tinagma, etc.) are absolutely footless.

The narrow-leafed willow referred to in the description is *Salix longifolia* Muhl., while the round-leafed leguminous tree is *Cercis occidentalis* Torr. The elevation of that part of the canyon referred to as 2500 ft. below the rim is 5000 ft. above sea level.

C. H. TYLER TOWNSEND.

The Puparium of Blepharipeza.—*Blepharipeza* is a genus of Tachinidæ s. str., belonging in the subfamily *Hystriciinæ*, and thus closely allied to *Dejeania* and the other Tachinidæ that are characterized by the presence of dense and spiny macrochaetæ on the scutellum and abdomen. *Blepharipeza* may at once be recognized in this group by its hind tibiæ being thickly ciliate on their outer edge with more or less flattened bristles.

The following description is drawn from a puparium of *Blepharipeza adusta* Lev., from which emerged a ♀ specimen of the fly, both of which were sent to me by Mr. Harrison G. Dyar, who bred the fly from a larva of *Halisidota argentata.* It will serve to indicate the distinctive features of the puparium in this interesting genus. I do not know that any description has ever been published of the puparium in this group, except the very brief one of *Belvosia bifasciata* by Dr. Riley (Bull. 3, U. S. Ent. Com., p. 42). The latter indicates the puparium of *Belvosia* to be very different from that of *Blepharipeea* in the structure and situation of the anal stigmata or spiracles. This may serve to emphasize the distinctness of the two genera, which some authors have been prone to combine under the name *Belvosia.*

Description of Puparium.—Length, 10 mm.; greatest width and thickness, 5 mm. Color dark brown. Almost cylindrical, perfectly rounded at both ends, the anterior end a little less in diameter than the posterior, the transverse and dorso-ventral diameters of each segment equal. There appear to be 12 segments, including the capital and anal plates, but the segments are very ill-apparent on the posterior end, very plain anteriorly. A belt or zone of circular (longitudinal to the belt, transverse to the puparium) minute corrugations alternate with one having a rugose surface, there being 10 of the corrugated or fluted belts, and 10 of the rugose or punctured belts. The rugose belts are about one-half the width of the fluted belts, and there is apparently one of each to each segment of the puparium, not including the capital and anal plates. The anterior one-third of each segment is occupied by the rugose belt, and the posterior two-thirds by the fluted belt, these belts more or less clearly defining the segments. Mouth parts of larva showing on capital plate as a wrinkled protuberance consisting of 4 principal eminences, separated from each other by a wrinkle or fold of the integument. Each eminence is more or less minutely wrinkled, the wrinkles as well as the large folds radiating from the center of the protuberance. Anal stigmata showing an anal plate at center of posterior extremity of puparium, as a pair of organs, each marked by 3 short raised ridges, the two upper ones more or less parallel with each other, inclined outward above and at an angle of about 45 degrees with the lower one, which is not quite parallel with the transverse diameter of the puparium. These ridges are usually more or less slightly curved; when curved, it is always with the slight convexity outward from the center of the organ or stigma. The two stigmata occupy the same transverse plane of the puparium. What appears like an anal vent is situated exactly ventrally of the pair of

anal stigmata, forming with them the corners of an equilateral triangle, the vent representing the lower or exactly inferiorly directed angle. This vent consists of a circular raised portion of the integument, rugose in appearance, of about the same diameter as either stigma, and with a little circular pit-like depression on top. Exactly ventrad of this vent is a smaller, more irregularly shaped tubercle, apparently situated on the tenth segment. It is hardly more than three times as much removed from the anal vent as that is from either stigma, measuring from center to center.

The puparium is furnished inside with a fine, white, silken, membranous lining.—C. H. Tyler Townsend, Las Cruçes, New Mexico.

MICROSCOPY.[1]

The Solution of the Dust Problem in Microscopy.—The statement of the dust problem is this: Given a stock of cleaned micro-slips and cover-glasses, to keep them clean and ready for use at any moment, without the necessity of brushing or wiping them. The following solution is the result of a laboratory study of the problem, and is now announced after having received the approval of leading microscopists.

The objects to be accomplished are:—

1st, To secure a dust-proof magazine for storing the cleaned micro-slips and cover-glasses in separate compartments for the different sizes of squares, circles, and oblongs.

2d, To provide simple mechanical appliances for removing a single slip or cover without exposing those remaining in the case.

3d, To provide an automatic device for warning the operator of the approaching exhaustion of his stock of any of the shapes of covers and of slips, thus avoiding the necessity of opening the case except to replenish stock.

4th, To provide against the breaking or disarrangement of the covers iu case of the accidental overturning of the case.

5th, Incidentally to provide a mounting table with guides for centering the objects and cover-glasses, the whole apparatus being so constructed that the glasses are not touched by the fingers, and only once by the forceps until the slide is completed and labeled.

The Dust-proof Slip and Cover-glass Case[2] fully meets these requirements.

Plate VI is a front view of the case which is 4½ inches square on the base and 6 inches high. The slips and mounting table are contained in the lower half and the cover-glasses in the upper portion. The mounting table is shown in position for work, and the concentric lines for guidance in properly centering the objects and covers are seen on the celluloid slip. Four dust-excluders are hinged to the front of the grooved table, and two of them are shown opened so as to expose the slots through which the cover-glasses pass out upon the grooved table. The milled head of the roller which pushes the cover-glasses out of the slots is shown at the side of the case. A screw stop is inserted in the front of the case above each slot.

[1]Ed. by C. O. Whitman, University of Chicago.

[2]Patent applied for.

The case is fitted for 3 inch by 1 inch glass slips of any thickness, and has a capacity of six to twelve dozen. It has four compartments for the cover-glasses of the sizes $\frac{1}{2}$ inch, $\frac{5}{8}$ inch, $\frac{3}{4}$ inch, $\frac{7}{8}$ inch, or 12mm, to 24mm., either circles or squares or oblongs of the above widths, and any lengths up to $2\frac{3}{4}$ inches. The screw stops regulate the depth of the slots for either No. 1, 2 or 3 thickness of cover-glasses.

Plate VII is a vertical section from front to back, showing the plan of the case. The section of the lower half is made in the median plane, that of the upper half in the plane of a screw stop. Through the base (b) projects the stop (s) into a narrow groove in the mounting table (mt) which slides in and out between the base and the floor (f) of the stock compartments (sc′). The service compartment (sc) is deepened by a shallow cavity cut into the upper surface of the mounting table, and in the bottom of this cavity is fitted a sheet of celluloid bearing a series of concentric lines. The slips (ss) are stacked in the service compartment, the lowest slip filling the shallow cavity in the mounting table as shown at (ss′). A warning slip of paper (ws) is folded around the front edge of the top slip. The loose partitions (p) running in grooves in the sides of the case can be removed after sliding back the cover (c). In the base (f″) of the cover-glass case is the groove (r′) for the roller (r) which is made of brass and covered with chamois. To the front of the base is hinged the brass dust-excluder (de) whose lining of silk plush protects the grooved table (t) and the slot (sl) from dust. The dust-excluder also prevents the delivery of a cover glass by the roller except when the slot is opened. Into the slot projects the point of the screw-stop (st) which is so adjusted as to permit the passage into the slot and out upon the grooved table of only one cover-glass at a time. Above the roller are stacked the cover-glasses (cg). Near the top of the stack is placed the warning disk (w) and upon the top cover-glass rests the loosely-fitting follower (cf) which prevents displacement and breaking of the covers, if the case is accidentally overturned. The adjustable partition (ap) may be moved backward or forward to fit any length of cover-glass from $\frac{1}{2}$ inch to $2\frac{3}{4}$ inches. The cover (c′) is so constructed as to exclude dust.

Plate VIII is a front view of a form of the case as made for one size cover-glass, either circles or squares, and of either $\frac{5}{8}$in., $\frac{3}{4}$in., or $\frac{7}{8}$in. diameter. The open dust excluder is hinged above the slot at the sides of the case. The engraving does not show the groove in the table in front of the slot. A slip is shown in position in the mounting table. One of the lateral grooves in the mounting table is not represented.

The plan in general, is the same as in the complete form illustrated in Plates VI and VII.

Method of operation.

Thoroughly dust the inside of the case and partly, or completely, fill the compartments with clean slips and cover-glasses of the proper sizes and place the warnings in position. The apparatus is then ready for immediate use, or at any time during successive weeks or months until the stock of slips and covers is exhausted.

The slips are withdrawn from the case singly by pulling forward the mounting table, and from this they are removed, either before or after an object is mounted, by inserting a finger into the notches cut into the sides of the table. The mounting table is automatically reloaded on being pushed back into the case. The warning slip having been withdrawn, the service compartment is again filled by removing the sliding cover which carries with it the cover-glass case, withdrawing a loose partition and sliding the cleaned slips from a stock compartment into the service compartment.

Whenever a cover-glass is needed, the dust-excluder in front of the proper slot is opened by a touch of the finger, the milled wheel is rotated and the chamois covered roller pushes the bottom cover-glass through the slot and out upon the grooved table, where it is readily grasped by the forceps. This action is positive because the friction between chamois and glass is greater than between two clean glass surfaces. The table being grooved, only the extreme margins of the cover-glass touch it. A touch of the finger closes the dust-excluder.

It will be noted (a) that the slips and covers are doubly protected from atmospheric impurities by the dust-proof case and the constant contact of clean glass surfaces with each other; and (b) that in the process of removal for use they do not come in contact with any surface from which they receive dust. They come out as clean as when, weeks or months before, they were put into the case. Thus the dust problem is solved.—A. H. Cole, A. M., University of Chicago.

Cooling Paraffine.—To those who have experienced the inconvenience and difficulty connected with the preparation of good paraffine sections in the Tropics or even in the Tropical Summers of other climates, the following simple device of Professor C. Gracomini[1] may be a welcome suggestion.

[1]Arch. Ital. de Biolegie, IX, 1888, p. 380.

A small rubber tube, a meter or so long is connected with a vessel of ice-water partly stopped at the other end so that a slow stream passes through it. This tube is wrapped around the paraffine block upon the microtome and cools it off so that thin sections can be cut.

If in winter the paraffine is too hard, the same device with warm water may be resorted to.

PLATE VI.

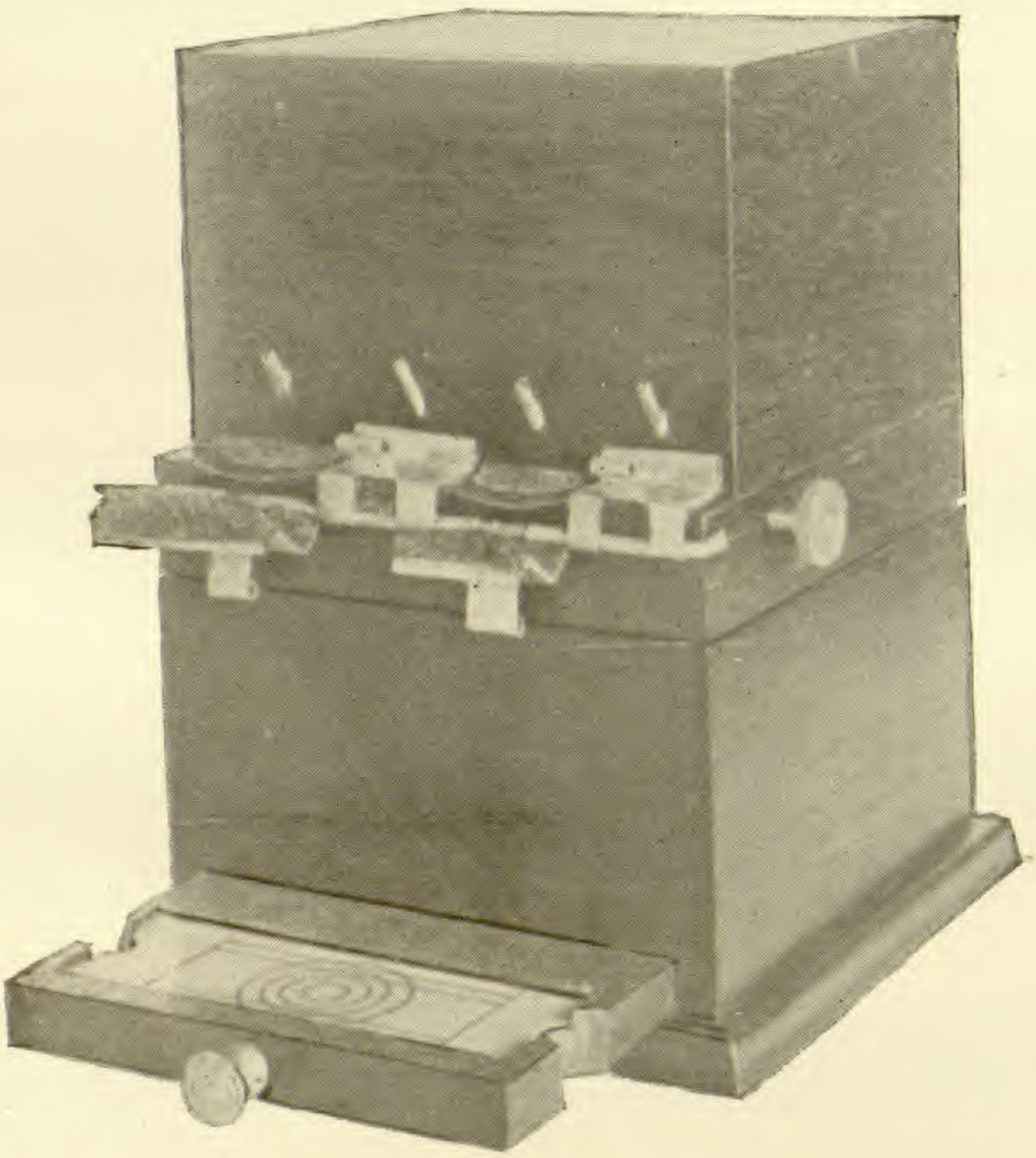


PLATE VII.

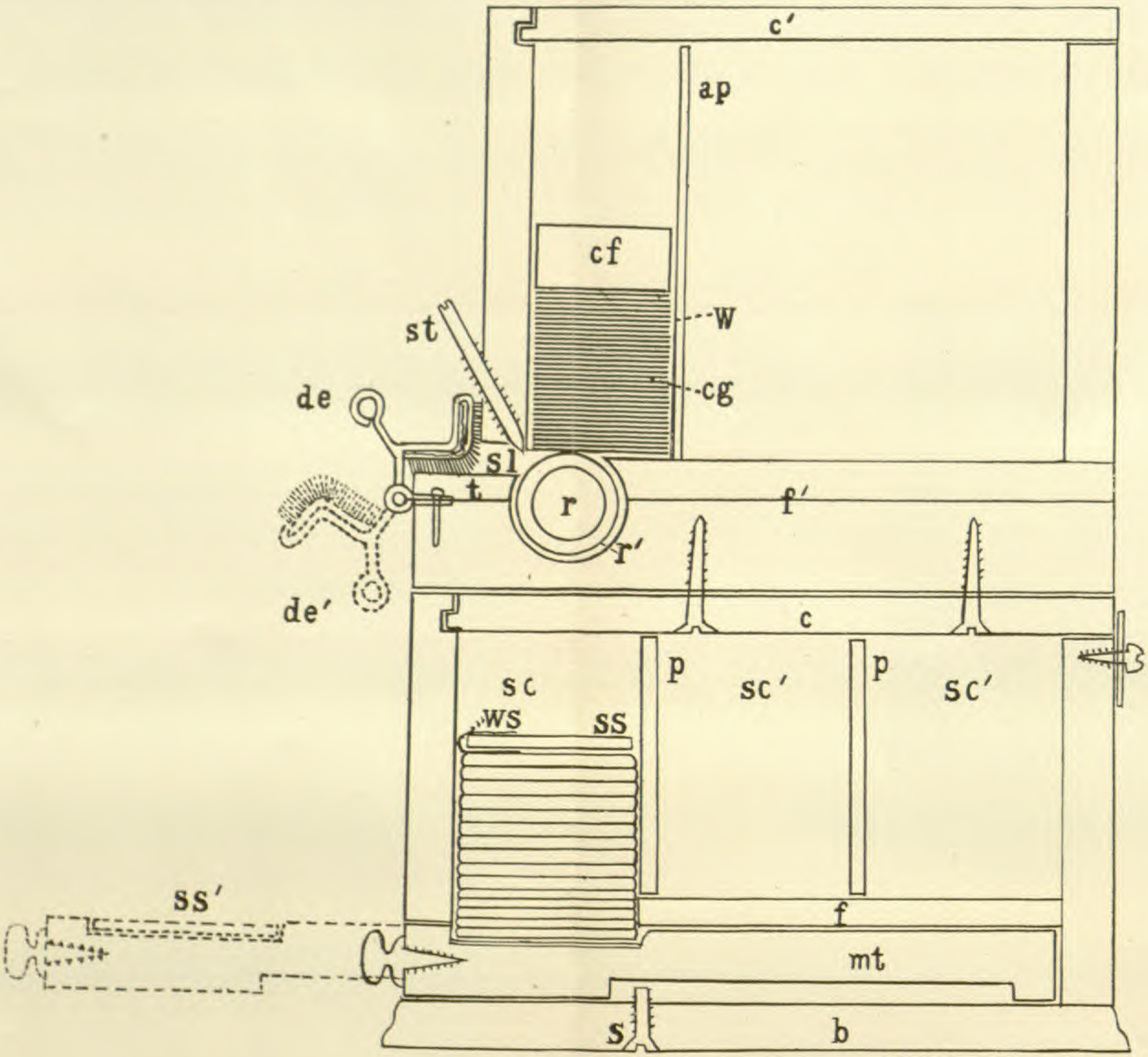
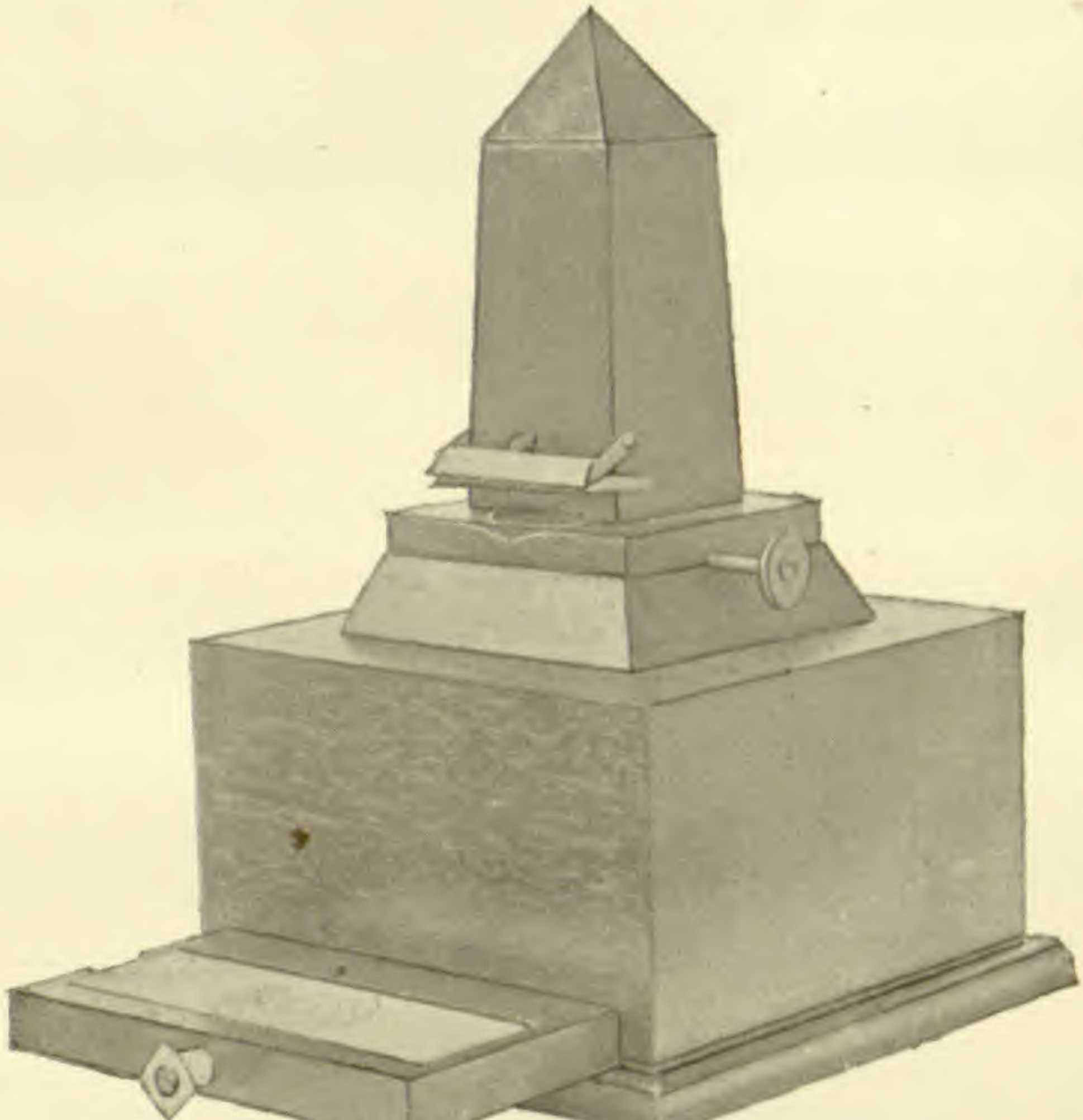


PLATE VIII.



PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, February 1.—The following papers were read: Mr. H. L. Harris, A new instance of the capture of streams; Professor W. T. Sedgwick, The natural history of disease.

February 15.—The following papers were read: Professor Henry W. Haynes, More evidence of cannibalism among the Indians of New England; Dr. R. T. Jackson, Notes on the development of palms; Dr. S. J. Mixter, A Massachusetts beaver dam.

March 1.—The following papers were read: Prof. E. S. Morse, A curious Aino toy; Dr. C. Willard Hayes and Mr. M. R. Campbell, The structural features (geomorphology) of the southern Appalachians. Maps and diagrams were shown and a discussion followed, Professor Davis, Mr. Upham and others participating.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Meeting of Biological Section, Feb. 13, 1893. A paper on the Functions of the Internal Ear was presented by Dr. F. S. Lee, based upon a study of dog-fish. The results of experiments were given showing that the semicircular canals are sensory organs for dynamical (rotational) equilibrium, otolithic parts for statical (resting) equilibrium. Each canal appreciates movement in its own plane and by a definite functional combination of canals all possible rotational movements are radiated. This theory explains compensating movements of eyes, fins and trunk. The method of experiment was that of sectioning the branches of the acoustic nerve and stimulation (by rotational movements) of the living swimming fish.

In a paper by Bashford Dean on the Marine Laboratories of Europe a series of views was shown of the stations of Naples, Banyuls, Roscoff, Plymouth, Arcachon, the Helder, and St. Andrews.

H. F. Osborn described the foot of *Artionyx,* the new member of the order *Ancylopoda* Cope. It is distinguished from *Chalicotherium* by the artiodactyle character of ankle and pes.

BASHFORD DEAN, *Rec. Sec.*

The Biological Society of Washington.—The following communications were made: Mr. M. B. Waite, the Destruction of Lichens on Pear Trees; Mr. C. H. Townsend, The Propagation of the Atlantic Coast Oyster on the Pacific Coast; Mr. Charles Hallock, The Geographical Distribution of the Musk-Ox; Dr. C. Hart Merriam, The Four-toed Kangaroo Rats (with exhibition of specimens).

February 25.—Communications: Mr. Sheldon Jackson, The Introduction of Reindeer in Alaska; Mr. M. B. Waite, Variation in the Fruit of the Pear due to Difference of Pollen; Mr. E. M. Hasbrouck, On the Development of the Appendages of the Cedar Waxwing; Mr. F. A. Lucas, The Food of Humming-birds.

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Special Meeting, February 14.—The program consisted of a lecture, A Primitive Priesthood, by an Initiate. Illustrated by lantern slides by Frank Hamilton Cushing.—WESTON FLINT, *Secretary.*

SCIENTIFIC NEWS.

Errata in Mrs. Bodington's article "Legends of the Sumiro-Accadians of Chaldea" in THE AMERICAN NATURALIST for February, 1893, p. 105.

Page 105, Line 2 from bottom, for Bohu read Bahu. (N. B. Bohu in the last line is correct.)
Page 106, Line 4; for Herodach read Merodach.
Page 107, Lines 13, 18, 21, 25, 30, and 36; for Tzdubar, read Izdubar.
Page 107, Line 14; for Tshtar read Ishtar.
Page 108, Line 1; for Tzdubar read Izdubar.
Page 108, Lines 12 and 31; for Tshtar read Ishtar.
Page 209, Lines 5, 8, 12, 18, 24, 31 and 37; for Tshtar read Ishtar.
Page 110, Lines 4, 7 and 15; for Tshar read Ishtar.
In the January Number, 1893.
Page 14, Note 1; for Story of the Natives read Story of the Nations.

Dr. Henry Wheatland, of Salem, Mass., died February 27, 1893 aged 81 years. Dr. Wheatland graduated at Harvard in 1834, and

later at Harvard Medical College. While a student at college he received instruction in zoological studies from Nuttall, the ornithologist and botanist. Later he turned to anatomical work and then to the study of marine zoology. Under his instruction the late William Stimpson did his first dredging in Massachusetts Bay. For many years Dr. Wheatland has been President of the Essex Institute at Salem, Mass., and he has been trustee of both the Peabody Academy of Science at Salem, and the Peabody Museum of Archeology and Ethnology at Cambridge since their foundation. In later years his energies have been devoted to the study of local history. Personally, Dr. Wheatland was a delightful companion, and his stories of the older days of American Science were especially interesting.

Mr. A. Smith Woodward, of the British Museum, has gone to the Lebanon to explore the deposit of fossil fishes.

Professor R. Ellsworth Call is now instructor in Physics and Chemistry in the Manual Training High School, Louisville, Ky.

The Tacoma Academy of Sciences is endeavoring to have the name Mt. Tacoma adopted as the official title of what was formerly known as Mt. Ranier. If the Academy could have the name of the State of Washington changed to Tacoma it would be a great convenience. We have too many Washingtons already.

The Leuckart "Festschrift," the volume of the contributions of the former students of the celebrated Leipzig zoologist, brought together at his seventieth birthday, makes a splendid quarto volume illustrated by forty plates. Thirty-five pupils contributed to the memorial.

Richard Greeff, Professor of Zoology in Marburg, died August 30, in his sixty-fifth year.

J. G. Joessel, Professor of Anatomy in the University of Strasburg, died Dec. 4, 1892, in his 55th year.

Professor W. Pfitzner, of Strassburg, has been appointed to the position left vacant by the death of Professor Joessel. His assistants will be Drs. Mechnert and Heinrich Hoyer (of Würzburg).

Professor F. C. Noll, for many years editor of the "Zoologiscenh Garten," died in Frankfurt a. M. Jan. 14, 1892.

Dr. Jan Pieter van Wickevoort Crommelin, an ornithologist, died in Haarlem, Holland, Oct. 20, 1892.

Thomas John Moore, Curator of the Liverpool Museum, died Oct. 31, 1892.

Dr. Benjamin Vetter, Professor of Zoology in the Royal Polytechnicum of Dresden, and well-known as the translator of many works, died in the night between Jan. 1 and 2, 1893.

Professor H. Schaaffhausen, the anthropologist of Bonn, is dead in his 77th year.

Professor James Ellis Humphrey sailed Feb. 11th on a botanical collecting expedition to Jamaica, where he wishes especially to study the algae of the Caribbean Sea.

Mr. Samuel Henshaw is in charge of the entomological collection of the Museum of Comparative Zoology at Harvard.

The University of Minnesota is publishing a "Quarterly Bulletin." From the last issue (Jan. 30, '93) we gain the following: The herbarium of the University and of the State survey are merged together In the past three years 350 species of Minnesota fungi have been determined. In 1892 over 20,000 species of flowering plants were collected in the limits of the State, and the collections now contain about 900 species from the region. In the line of geology considerable work has been done in collecting lower Silurian fossils near the University; while the collections have received many additions from other States. In zoology considerable work is being done. The Museum has been fitted with cases, but the curator reports that the collections still leave much to be desired. Not half the birds of the State are represented, while the collections of fishes, reptiles, amphibia, etc., are largely in prospect. The labors of the zoological survey during the past summer were mostly in the neighborhood of Mille Lac, which was pretty thoroughly explored, and work is being carried on, so that a few years hence there will be one of the best local faunal collections for reference and comparison in the country. The University also proposes to establish a Biological station on the upper Mississippi to be open without fees to all who may wish to come. The location will be decided later. A laboratory for histology and embryology in the College of Medicine has been fitted up with equipment for elementary and advanced work.

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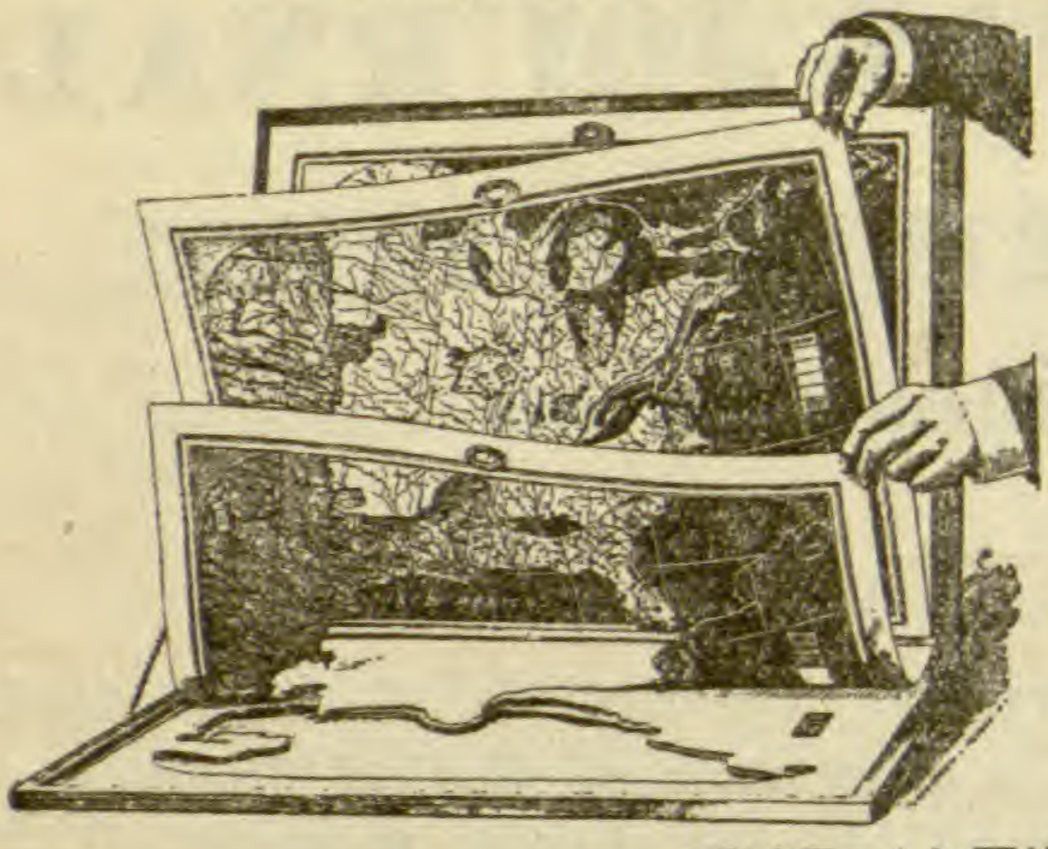

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The Microscope and Its Accessories. (Illustrated.) The Editor.
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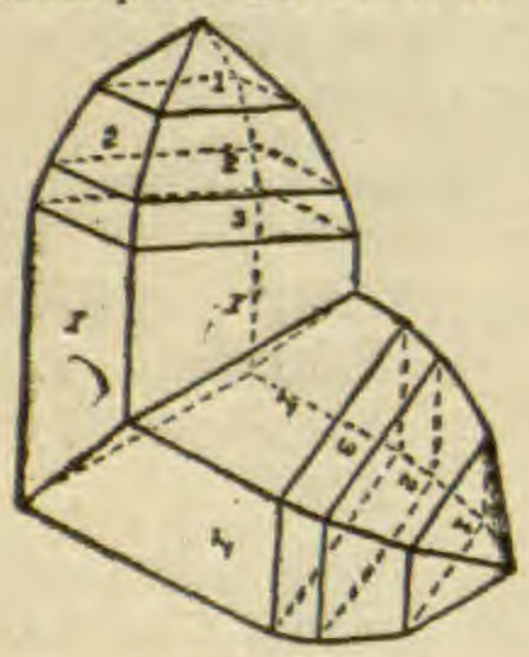

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THE
AMERICAN NATURALIST

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RECENT STUDIES OF CARNIVOROUS PLANTS.[1]

BY JARED G. SMITH.

N. Tischutkin published an article in 1889 in the *Berichte der Deutschen Botanischen Gesellschaft* on the cause of the digestion of albumen by the leaves of *Pinguicula vulgaris* L. in which he endeavors to show that the process of digestion is the result of the action of Bacteria. This is in opposition to the theory of Darwin and other authors that the digestion is analogous to the digestion by means of pepsin in the animal kingdom.

In an article in volume XII of the *Acta Horti Petropolitani* he further discusses the subject and concludes that the pepsin of the leaves of insectivorous plants is not a secretion of the plants themselves but is a by-product formed by the numerous species of Bacteria found in the digestive fluid.

In his former study Tischutkin performed over one hundred and fifty experiments, using extracts from the leaves of Pinguicula and small amounts of the secretions of the insect catching leaves. Into these extracts and secretions he put small cubes of coagulated egg albumen. In no case did there follow any peptonization of the egg albumen. These results impelled him to take up the further study of the relation of micro-organisms to the digestion of albuminous compounds by insectivorous plants, using other species and genera.

[1]Shaw School of Botany, St. Louis. Read before the Botanical Seminar of the University of Nebraska, Feb. 18, 1893.

Certain authors who have investigated the digestive process (among them Darwin, Gorup, Besanz, Reess and Will) have concluded that it is the result of pepsin secreted by the plants. Others, as C. Morren, see only a process of rotting and decay. Tischutkin in his former paper has reviewed the methods by which these various authors have arrived at their results. Morren placed on the leaves of *Drosera binata* Labill. different insects and cubes of coagulated egg albumen and observed that a few hours afterward the albumen became transparent, the angles were rounded off, and after a day or two the pieces entirely disappeared. Microscopic examination of the transparent fragments of albumen revealed the presence of bacteria, monads, and filaments of a mycelium which resembled the conjugating stage of some species of Mucorineæ. He concludes that while this dissolving of the albumen by some absorbent principle is possible, the intervention of pepsin is entirely problematic.

Schimper in the *Botanische Zeitung* for 1882 tells of some experiments which he made with *Sarracenia purpurea.* These are of great value because made on plants growing wild in Massachusetts. A part of the observations were made on insects caught by the plants, and a part by placing pieces of meat on the leaves. He found that on stopping up the mouths of the leaves at their time of opening and thus preventing the free entrance of bacteria the digestion took place no more rapidly than when the bits of meat were placed in pure water, and from this fact he concluded that pepsin was not present. He did not test the liquid by chemical means. He found great numbers of worms in many of the leaves and thinks that they may have something to do in rendering organic matter absorbable.

Hildebrandt in the *Botanische Zeitung* for 1870 tells of the experiments made on the leaves of *Dionæa muscipula* Ell. and on the cups of *Sarracenia, Cephalotus* and *Nepenthes.* He doubts very much whether the insects caught are of value to the plants. "My observations on *Dionæa muscipula* showed me that the long legged spiders which are caught in the leaves exert an injurious influence upon them. A slimy fluid

would be secreted, but after a short time the leaves would commence to die, if I had not removed the spider in time."

Aschman in 1875-6 in his work on insectivorous plants throws doubt on the presence of pepsin in the secretions of Nepenthes and Sarracenia, and believes that the digestive process is simply putrefaction.

Thus we see that many authors have expressed the opinion that the digestion of nitrogenous substances by the secretions of the leaves of insectivorous plants is due to disintegration through the action of the lower organisms rather than by active ferments produced by the plant itself.

Following this preliminary statement of the published data of the subject, Tischutkin takes up his own experiments and gives the results which he has obtained.

The objects which he kept in view while making these experiments were, first, to see whether the presence of lower organisms in the secretions was a constant occurrence; second, if uniformly present, could these organisms dissolve albumen; and, third, to compare the results obtained with other insectivorous plants with *Pinguicula vulgaris*. The plants used were *Pinguicula vulgaris*, *Drosera longifolia*, *D. rotundifolia*, *Dionæa muscipula* and *Nepenthes mastersii*. All of these plants, the last excepted, were cultivated under bell-jars to prevent the visits of insects. To procure the secretion he excited the glands by means of cubes of sterilized egg albumen. The leaves of the first three species responded once to the irritation, those of *Dionæa muscipula*, three times. The acid sap thus obtained was examined microscopically every 24 hours for five days. In every case great multitudes of bacteria were discovered, and frequently there were various moulds as well. The author considers this discovery of much importance, because Darwin had stated that the secretions possess antiseptic properties which prevent the rapid appearance of micro-organisms, and compared their action with that of the gastric juice in the higher animals, which, as is well known, destroys injurious and decay-producing lower organisms.

Gelatine cultures were made in the usual manner, using a drop of the secretion from Dionæa and Drosera 24 hours

after the commencement of the experiment. After the development of from nine to ten generations on Fleisch-Peptone-Gelatine, the different species of bacteria were transferred to test tubes which contained dilute acid peptone-free meat bouillon. Control experiments were made with test tubes containing sterilized water acidulated with dilute hydrochloric acid. Into each test tube was placed a small cube of sterilized egg albumen. In all of those test tubes in which the bacteria developed there followed a rapid solution of the egg albumen commencing at the surface of the cubes and invariably continuing to their centers until solution or peptonization was complete.

By these experiments the author proved that bacteria which possess the power of dissolving egg albumen are always present in the secretions of insectivorous plants.

The number of species that had this power were:

In *Pinguicula vulgaris*, 4 species.
In *Drosera longifolia*, 2 species.
In *Drosera rotundifolia*, 1 species.
In *Dionæa muscipula*, 2 species.
In *Nepenthes mastersii*, 2 species.

His next experiments were made using the leaves of Nepenthes, where comparatively large quantities of the fluid could be procured without special irritation. He examined fully developed pitchers of *Nepenthes mastersii* and *N. kennedyana*. The reaction of the secretion was neutral. The secretion contained neither peptone nor insects, and yet there were vast numbers of micro-organisms. The liquid from a leaf of each species was poured into two test tubes, one acidulated with dilute hydrochloric acid, the other without addition of acid. A small cube of coagulated egg albumen was placed in each test tube, and they were then placed in a thermostat at a temperature of 37.5° C. At the end of sixteen hours the egg albumen in the tubes to which hydrochloric acid had been added, had commenced to dissolve, but in the other two was unchanged. This experiment was made to satisfy himself concerning the truth of observations made by Gorup, Besanz and Will that the secretion of unirritated pitchers possessed the property

of peptonizing egg albumen only after it had passed from neutral to acid reaction. He further says that it is extremely improbable that this peptonizing principle is secreted by the glands of the Nepenthes pitchers, but that it is produced by certain micro-organisms present in the solution. Hence the digestion that takes place is not analogous to digestion of albuminoids in the stomach of man, because in the latter case the secretion of gastric juice follows as a result of direct irritation.

To demonstrate this more fully he repeated his experiments in a modified form, using a neutral secretion which contained no bacteria. For this purpose he selected two unopened cups of *Nepenthes coccinea* and *Nepenthes*——sp. ?——which were so far developed that the liquid was already present in considerable quantity. The leaves were separated from the plant and the petioles were attached to a ring stand so that the pitcher of the leaf was vertical. The outside of each pitcher was disinfected with a freshly prepared 1:1000 sublimate solution in water. After the water of the sublimate solution had partially evaporated, a small hole 3 mm. in diameter was cut in the wall of the pitcher with a pair of sterilized scissors. The secretion from each was then transferred by means of a sterilized pipette into two test tubes each containing two cubic centimeters of distilled water and a small cube of coagulated egg albumen. One of the test tubes was slightly acidulated with hydrochloric acid, the other remained neutral. The four test tubes were then placed in a thermostat at 37.5° C.

At the end of 48 hours there was no solution of the egg albumen, though a control experiment with a test tube containing pepsin gave positive results. Microscopic examination and gelatine cultures gave negative results. These experiments were repeated, using the remainder of the secretion diluted with a little pure glycerin, but the result was the same.

In these experiments the only question that could be raised was whether the pitchers from which the secretion was taken were not too young to contain pepsin. But if one remembers the experiments of Wunschmann in 1872, and also considers

that the cups were more than half filled, there can be little doubt on this ground.

To obviate this objection the experiment was repeated in another way. Two cups were taken, the one from *Nepenthes distillatoria* and the other from *N. hirsuta*, which were still closed but appeared to be just ready to open. Considerable secretion was present. The cups were not separated from the parent plants. The wall of the cup was sterilized with a sublimate solution which was washed away with sterilized water. Then a small V shaped opening was cut in the wall above the surface of the liquid. Through this opening in the wall of the cup a piece of sterilized egg albumen one centimeter long and one millimeter thick was introduced into the cup of *N. hirsuta* and a piece $\frac{1}{4}$ cm. long and 1 mm. thick, into that of *N. distillatoria*. The openings in the walls were then covered with pieces of court plaster, and these for protection from the moisture of the culture house were covered with varnish. After four days the cups opened. The pieces of egg albumen were unchanged, not even the corners being rounded off. Pepsin was not present in the secretion and bacteria only in very small numbers.

The secretion from each cup was then poured out into sterilized test tubes containing small pieces of white of egg, and they were set aside at a temperature of 20-22° C. The white of egg in the secretion from *N. distillatoria* was dissolved in four days, that in the secretion of *N. hirsuta* in five. At the same time enormous quantities of bacteria were developed.

After finishing these experiments the author noticed an article in the *Comptes Rendus* for 1890, by Dubois, who had experimented with the secretions of various Nepenthes species taken before the cups had opened. Dubois's results agree with those of Tischutkin. The secretion taken from the cups just as they were ready to open did not contain pepsin and did not affect the cubes of albumen. But after having been exposed to the air for some time, putrefaction commenced and the resultant liquid contained traces of pepsin. Dubois draws the following conclusions from his experiments.

1st. That the secretion of Nepenthes does not contain any pepsin and that Nepenthes is not an insectivorous plant.

2d. That the phenomenon of disintegration, called "digestion" by Hooker, was without doubt due to the presence of micro-organisms and not to the secretions of the plant itself.

The author finds that the results of his various experiments show that all the disintegration of nitrogenous substances by the leaves of insectivorous plants is *directly dependent* upon the presence of certain lower organisms, principally bacteria, in the secretions of the plants.

The secretion contains bacteria of many different species, micrococci and rod-shapes, and sometimes the mycelia of moulds or other fungi. It is evident that most of these organisms are carried into the cups by the air, though some may be washed in by rain drops or carried on the bodies of insects. The solution of albuminous compounds commences simultaneously with the development of great numbers of micro-organisms in the secretion.

The secretion of the leaves of insectivorous plants is not analogous to the gastric juice of the higher animals. It is only a medium in which bacteria may live and develop while they are breaking up nitrogenous organic insoluble compounds and preparing them for assimilation by the plant.

It will not be uninteresting to present a table showing the chemical composition of the secretion of various Nepenthes species. The calcium and magnesium are in composition with malic and citric acids.

Malic acid and a trace of citric acid	38.61%
Potassium chloride (Chlorkalium)	50.42
Sodium carbonate	6.36
Calcium	2.59
Magnesium	2.59
Organic matter—a trace	
	100.57.

There are no free acids in the liquid, though Dr. Turner in 1828 reported a trace of oxalic acid.

Without doubt these genera constitute a group entirely unique. They furnish great natural bacteriological laboratories in which the cultivation of microbes which are beneficial to the plant is carried on. It is in a certain sense a symbiosis between the lowest and the most highly organized plants. The higher organisms furnish a food supply for the use of the microbes in order that they may in turn be benefited by food stuffs which the lower organisms manufacture and furnish in convenient form. That the nitrogenous compounds set free by the dissolution of the egg albumen are really absorbed is shown by Darwin in his experiments.

On the ground of his experiments the author offers his conclusions as follows:

1st. The disintegration of albuminous compounds by the secretions of carnivorous plants is due to the growth of micro-organisms, principally bacteria.

2. Micro-organisms possessing the power of dissolving albuminous compounds always vegetate in the secretions of completely developed carnivorous plants.

3. The disintegration of the albumen does not commence at the moment of the secretion of the fluid, but only after micro-organisms have developed in sufficient numbers in the secretion.

4. The micro-organisms found on the leaves of carnivorous plants come principally from the air, though they may be derived from other sources.

5. The name "carnivorous" plants is to be understood in the sense that the plants only assimilate the products which the lower organisms have set free.

6. The rôle of the plant itself is only to furnish a medium in which certain micro-organisms may live and develop.

A NEW THEORY OF THE MECHANICAL EVOLUTION OF THE METAPODIAL KEELS OF DIPLARTHRA.

By J. L. Wortman, M. D.

In the last number of the Journal of Morphology, Mr. Austin Carey gives the results of his studies in the foot structure of the Ungulates. A fair statement of his main conclusions, or rather perhaps the pith and substance of his argument is to be found in the concluding sentence of his article which reads as follows: "That the lines of evolution have progressed with but few useless side variations seems to be the uniform testimony of paleontologists; but that race changes follow those produced in individual life, or that they are directly caused by their mechanical surroundings, I do not think has been satisfactorily shown."

It is not my intention to enter here into a criticism or general discussion of the points this author has raised in his argument, nor will I undertake to discuss at this time the broad question of the transmission of acquired characters. I do, however, wish to say a few words upon the question of the production of crests and keels upon the distal extremities of the metapodial bones. Upon this point Mr. Carey says, (p. 341) "The crests and grooves on the lower metacarpal ends in some forms, produced apparently in relation to the sesamoid bones, is one of the most marked examples of probable mechanical evolution." "But before such structures can be said to prove the inheritance of acquired characters, the question should be tested whether they are not produced somewhere in the history of each individual by the necessary interaction of parts." He further adds in a footnote that "The crests in certain highly specialized forms, like the horse and deer, reach round to the anterior face of the bone and apparently cannot thus be interpreted or assigned to any mechanical origin that is obvious."

With reference to Mr. Carey's first proposition that these metapodial crests are produced during the life of each individual by the necessary interaction of parts, it appears to me to be a very simple one indeed. If they are produced, by pressure during the lifetime of each individual, and are not inherited, then clearly we should find the crests absent in new born animals that had never walked, and in which the metapodials had not been subjected to any impact or pressure whatever. I have taken the trouble to examine a number of such examples in which the distal ends of the bones were entirely cartilaginous, and I find that the keels and grooves are as well developed as they are in the adult animal. I will cite one case in particular in which I happen to know the history completely. During the past winter, a young hippotamus was born in the Zoological Gardens in Central Park, and it was stated to have been a premature birth; the animal lived but twenty-four hours, and I was informed by the keeper that it never stood upon its feet. An examination of the feet shows that the distal ends of the metapodials are entirely cartilaginous, and in them the keels are as well prefigured in cartilage as they are performed in bone in the adult animal. I have also found the same to be true of newborn rabbits and guinea-pigs. In another case of a young buffalo calf preserved in the American Museum Collection, the distal keels of the metapodials are complete notwithstanding the fact that the epiphyses of all the bones are very imperfectly ossified. This evidence, it appears to me, effectually disposes of the question of the production of these structures during the lifetime of the individual. They are as truly inherited as is the number of digits or any other important organ in the animal economy.

Mr. Carey further states in his concluding remarks that "Plasticity of bone, using the word *plasticity* not in a physical sense merely, but to include absorption under pressure, will probably account for much structure in the foot and elsewhere, especially in connection with the joints and in the field of variation and correlation." Now just what Mr. Carey means by "absorption under pressure" is not clear to my mind. If he means a process similar to that of the absorption of the roots

of the temporary or milk teeth, then the term "under pressure" is especially inappropriate, since Tomes has shown[1] that this process is entirely independent of pressure of any kind whatever, but is in some way connected with the presence of "myeloid" or "giant" cells. The only other process of "absorption under pressure" with which I am acquainted, is a pathological one. In this case the pressure is sufficiently severe to cut off entirely, or seriously affect the supply of nutrition, thereby causing the death of the part and its subsequent removal by sloughing. This however may be very gradual, so gradual in fact, as to resemble a perfectly normal change, as is often seen in the pressure of an aneurismal sac upon a neigboring bone. It may be true that a process of this nature, having its origin in a strictly pathological cause, may have become normal. Indeed, Huxley has remarked[2] that it is not always easy to draw the line between pathological and normal changes. Upon the whole, however, it seems to me that before we can admit this principle of "absorption under pressure" as having played any important part in the modification of the skeleton, we must require further proof of its existence and its method of operation.

That living bone tissue is plastic, I should say *highly* plastic and that too in the ordinary physical sense, is so abundantly demonstrated upon every hand, that no further argument is necessary to establish the truth of this proposition. It is recognized and acted upon in everyday surgical practice, and the number of cases wherein entirely new joints have been formed in old dislocations, leaves nothing to be desired to complete the proof. The changes thus produced however, have all occurred within the lifetime of the individual and it yet remains to be proven that they are capable of transmission to succeeding generations.

With reference to the production of the metapodial keels or crests, Cope has explained it in the didactyle foot at follows[3]: "A similar cause produces a similar result in the development

[1]Dental Anatomy, p. 197.

[2]Address to the British Medical Association, London Lancet.

[3]The Artiodactyla, American Naturalist, March 1889, p. 115.

of the tongue and groove articulation between the metapodials and first phalanges. In alighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce upon each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle, and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth on alighting. The pinching of a keel by its groove takes place at all points in the length of the former, reached by the opposite sides of the extremities of the latter during flexion and extension. This keel becomes acute and prominent in the Boöidea and extends to the anterior face of the condyle. This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these two bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a median trochlear surface exists at the distal extremity of the first phalanx in all mammals. But a single flexor tendon crosses this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as is the case of the patella and the rotular groove of the femur."

In support of Cope's proposition, that the development of crests or keels upon the plantar or palmar aspect of the distal end of the metapodials, is due primarily to the presence of two sesamoids imbedded in the flexor tendons, I can add that in every case where these sesamoids are present, and pressure is exerted by the flexure of the phalanges upon the metapodials, the keels are developed, and conversely, that where the sesamoids are absent or are present without pressure, the keels are absent. The human foot and hand are

excellent examples of this. In the foot there are two sesamoids developed in the tendons of the *flexor brevis hallucis* as they pass over the end of the metatarsal of the great toe, to be attached to the phalanx. Now in the act of walking the greater part of the weight of the body falls upon this digit and as the heel is raised and the foot is brought into a more or less vertical position, these tendons are put upon the stretch and pressure results; in this metapodial, therefore, we find the keel present. In the other digits the sesamoids are absent and there is no keel developed. In the upper extremity there are sesamoids developed in the tendons of the *flexor brevis pollicis* at the metacarpo-phalangeal articulation, but owing to lack of pressure the keel is absent. Again in the Spider Monkey there are two sesamoids present in the tendons of the short flexors of the great toe and the keel is developed, while in the other digits there are no sesamoids and no keels. In other species of monkeys on the other hand such as the Macaques, the sesamoids are present and the keels are developed upon all the metapodials. These monkeys are said to be less arboreal in their habits, which would explain the difference in the matter of sesamoids and keels. Among the Marsupials there is no patella in the Vulpine Phalanger, and here we find that the rotular groove of the femur is very little developed. The hallux is without the sesamoids and there is no keel, notwithstanding the fact that there are both sesamoids and keels in the other metapodials. These cases could be multiplied indefinitely showing the same results. I have in fact failed to find a *single example of a metapodial*, in which sesamoids are present and pressure is exerted, *which does not show the presence of the primary keel.*

I will now consider Mr. Carey's other proposition viz: that the crests or keels in certain highly specialized forms reach around to the anterior face of the bone, and are not explainable by, nor cannot be assigned to any mechanical reason that is obvious. I must say that when I met with this problem several years ago, I was somewhat at a loss to understand how any mechanical explanation could possibly be applied to its Professor Cope's explanation of the extension of these keels in

the didactyle foot may possibly be the correct one, but I am inclined to doubt it seriously. It certainly cannot apply to the monodactyle foot since it is inconceivable that any "pinching" could occur in flexion and extension of the phalanges upon the metapodials; for the reason that there is no spreading such as he describes in the didactyle foot. It is moreover manifestly impossible that the sesamoids could have come into play to form the keel, because the amount of extension necessary to bring them into the proper position would be so great as to cause complete dislocation of the phalanx. How then can this extension of the keels be explained upon the basis of mechanics?

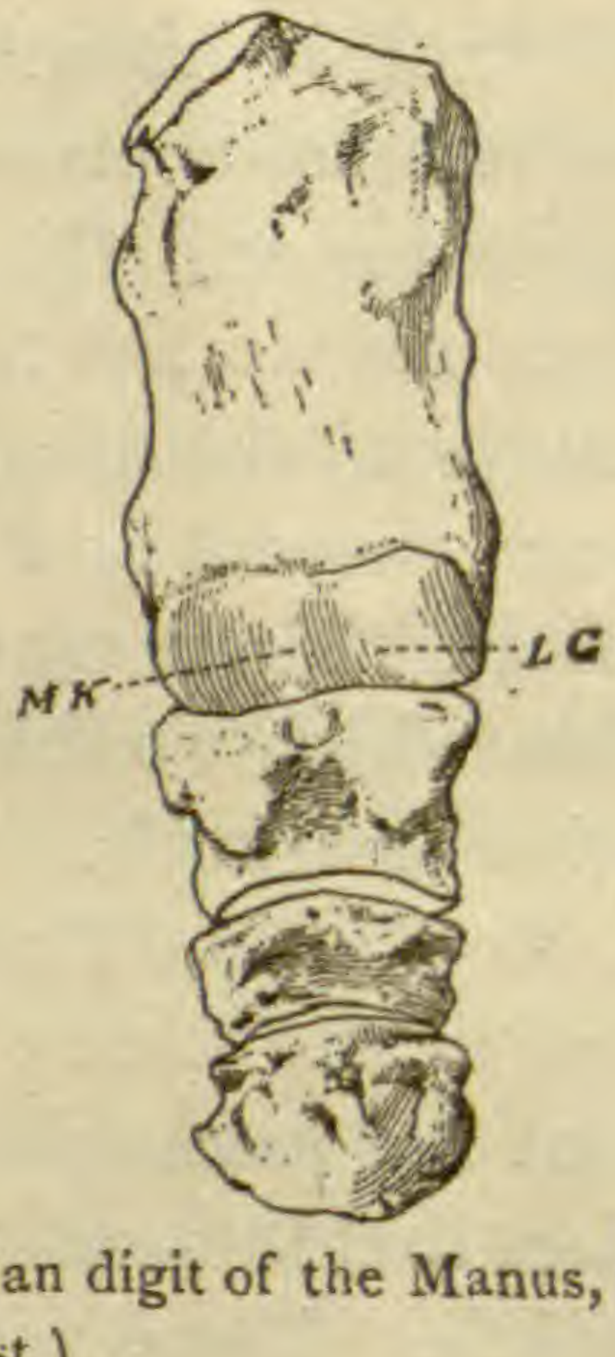

FIGURE 1.—*Coryphodon*, Median digit of the Manus, posterior view. (Coll. Am. Mus. Nat. Hist.)

In the first place it is necessary to call attention to the fact that at least three positions have been assumed in the various stages of the evolution of the ungulate foot, viz: a p l a n t i g r a d e or s u b p l a n t i g r a d e position, in which not only the phalanges but the metapodials are applied to the ground in walking, as in the hind feet of *Coryphodon* and all the earlier forms; second, a d i g i t i g r a d e position, in which only the phalanges are applied to the ground in walking, as in such forms as the tapir, rhinoceros and the earlier representatives of the horse series; and finally the u n g u l i g r a d e position in which the weight of the body is supported entirely upon the terminal or ungual phalanges. This position of the foot

belongs to the higher forms of both the odd and the even-toed ungulates. Now if we attempt to trace the history of the metapodial keels in the evolution of such a form as the horse, no one will deny, it seems to me, that we have here an unusually complete phylum represented, which clearly indicates the different stages in their development. In the earlier members of this series, such for example as *Hyracotherium*, the keels are confined to the plantar and palmar surfaces of the metapodials, and the animal was subdigitigrade. In such a form as *Mesohippus*, on the other hand, we pass from the digitigrade position of the foot to that of the unguligrade, wherein the weight of the body was supported upon the terminal phalanx or coffin bone. Just what induced this change is unknown, but it is more than probable that it was in some way connected with the reduction of the lateral toes.

We do not yet know with certainty the ancestors of the horse series beyond *Hyracotherium*, but there can be little doubt that the feet were pentadactyle and plantigrade. So far at least as the metapodials are concerned, we have such a condition in *Coryphodon*, in which the keels are but faintly indicated, and the two lateral grooves of which the primary keel forms the common median wall, are in the first stages of development. There is every reason to believe that this animal was plantigrade or subplantigrade in gait, and that the failure to develop the keels was due to the more equal distribution of the strain upon all the digits. This is true of the foot of the elephant in which we observe another structure which has certainly had much to do with the retardation of keel development viz: a very thick plantar pad. The possession of this pad not only tends to distribute the strain and equalize the pressure but at the same time limits the amount of flexion and extension of the phalanges. It is a fact worthy of especial note, and one which I will make use of later on, that in all these forms wherein the lateral grooves and keels are very little developed, the plantar border of the articular surface of the first phalanx is not at all notched. It is also to be noted that the feet are short and spreading.

With the assumption of the digitigrade position however, the plantar pad was reduced, the foot became more elongated, and the strain became more localized. In this position of the foot the weight of the body falls upon the phalanges, which are now bent at a considerable angle upon the metapodials, and an especial strain is produced by the flexor tendons where they pass over the distal ends of the metapodials. In a foot of this type therefore, do we find a considerable advance in the development of the median keel and lateral grooves of the metapodials? Those of the third digit are most advanced for the reason that the strain is more concentrated and localized

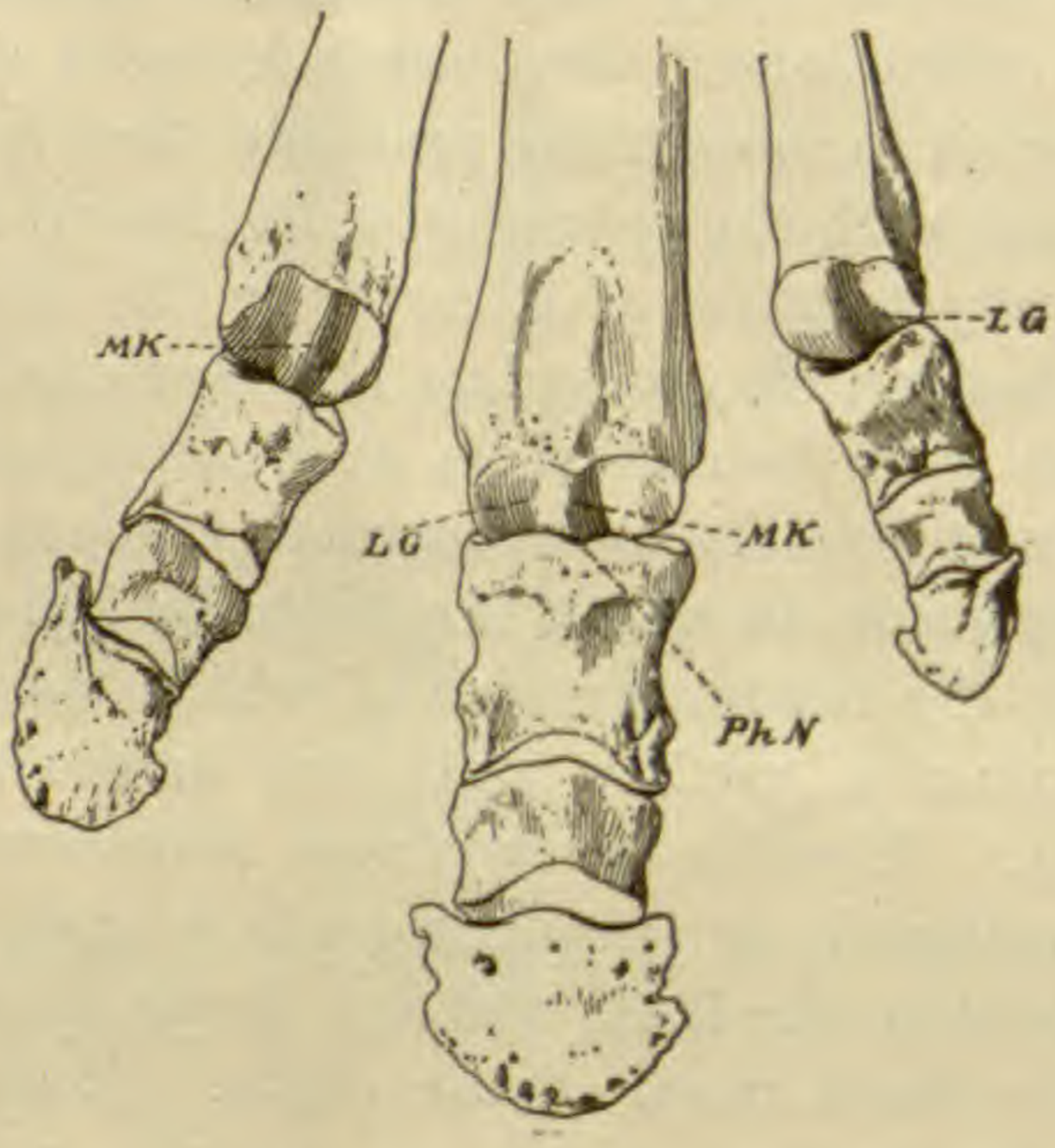

FIGURE 2.—Modern Tapir. Posterior or plantar surface of the hind foot.

at this point. In none of the metapodials however, do the lateral grooves and keel extend more than half-way around the articular ends, nor does the keel rise but little above the lateral boundaries of the grooves. This is well shown in such forms as the tapir, rhinoceros, *Hyracotherium* and nearly all the Eocene Perissodactyla. While the foot remained in the digitigrade position, the median keel of the metapodials made little or no impression upon the lower edge of the articular surface of the proximal phalanx, for the reason that the main flexure of the foot was between the first phalanges and the

metapodials, which would throw the keels so far back as to seldom come in contact with the proximal phalanx. In the middle toe or third digit, of the digitigrade foot however, the main flexure of this toe is momentarily transferred from the articulation between the metapodial and first phalanx to that between the second and third phalanges in the act of walking, and this straightening out of the first two phalanges, so as to bring them in a line with the long axis of the metapodial, has caused the keel to impinge upon the lower edge of the articular surface of the first phalanx which has become distinctly notched.

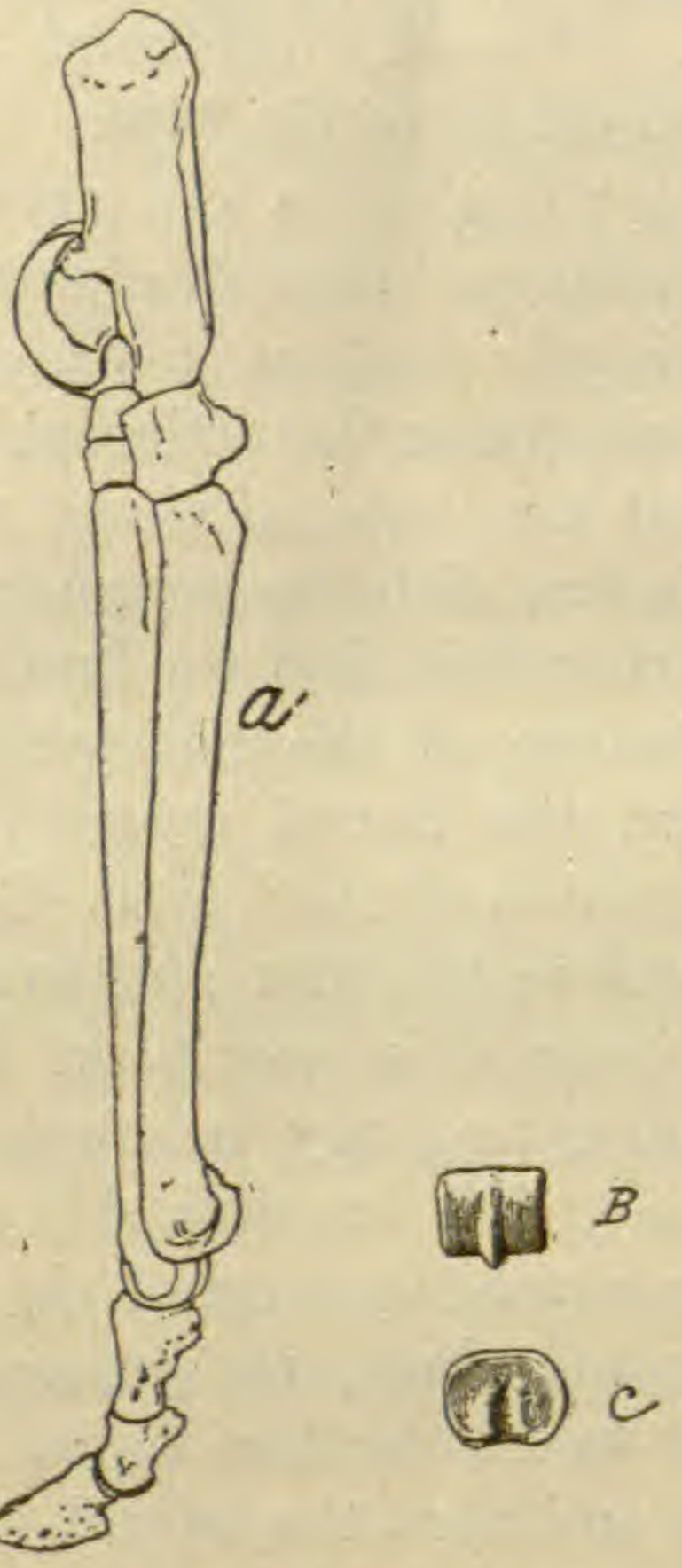

FIGURE 3.—*Mesohippus.* Outer view of the left hind foot. B, Distal surface of median metatarsal, C, Proximal surface of median first phalanx. (Collection Amer. Mus. Nat. Hist.)

It follows that in such forms as the tapir, rhinoceros, *Hyracotherium*, and in fact in all of the truly digitigrade Perissodactyla, the first phalanx of the median digit is always

slightly notched, while the first phalanges of the lateral digits are without the notch. This is an important fact, and in connection with what has just been said of *Coryphodon*, I think that it may be accepted as demonstrated, that the formation of this notch is due to the impact of the keel upon the lower border of the phalanx. Up to this stage therefore, we have the following conditions, viz: a comparatively low primary keel bounded upon either side by well marked lateral grooves whose outer borders are as much elevated as the keel. We also note that the grooves and keel extend but half-way around the end of the metapodial, and that the lower edge of the first phalanx in the middle toe is distinctly notched. This may be termed the digitigrade stage in the development of the keel.

In the next or unguligrade stage of this development, beginning with *Mesohippus*,[1] the foot changed from the digitigrade to the unguligrade position in which the main flexure of the foot was transferred to the articulation between the two last phalanges, and the two proximal phalanges came to occupy a position in line with the long axis of the metapodial. It is in this genus therefore, that we find the first distinctive evidence of an advance of the metapodial keel around the lower surface toward the dorsal aspect of the bone. While this advance or extension of the keel is slight, it is interesting to note that the notch in the first phalanx, which we see just beginning in the tapir, has now been transformed into a groove and extended nearly across the articular face of the bone. We are thus able to demonstrate that, in the further extension of the keel of the metapodial beyond that of the digitigrade stage, *the groove was formed in the phalanx first.* It is to be further noted that the keel has become prominent and that the lateral grooves of the metapodials are almost entirely obliterated, at least their outside walls have disappeared, leaving two nearly plain articular surfaces separated by a now prominent, or secondary median keel. Again, if the bones be placed in position,

[1]It is highly probable that the most incipient stages of this process are to be traced to forms somewhat older than this genus.

that is, if the first phalanx be articulated with the metapodial, it will been seen that when the phalanx is placed in a line with the metapodial or very nearly so, there is equal bearing upon all parts of the two articular surfaces of the bones; but if the phalanx is flexed even to a slight extent, then the bearing falls largely upon the keel for the metapodial surface and the shallow groove for the phalangeal surface. When I say flexed I mean bent in the direction of the plantar side of the foot.

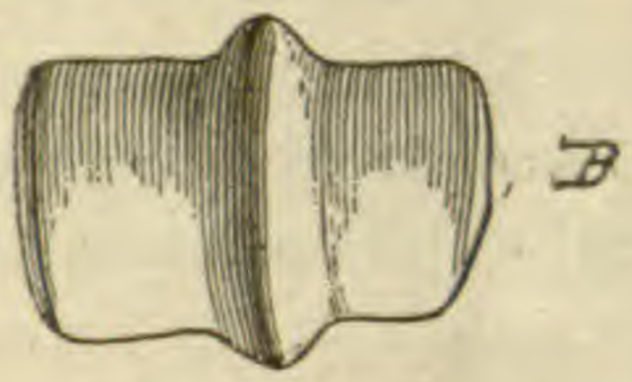

FIGURE 4.—Modern horse. Distal view of median metatarsal or cannon bone, showing complete keel.

How now can we apply these facts to the mechanical explanation of the further extension of the keel toward the dorsal side of the metapodials? When the foot assumed the unguligrade position permanently, we can understand, and have in fact already seen how the keel impinges upon and produces the notch in the phalanx. Any flexure of the phalanx upon the metapodial, under pressure would bring the keel to a more advanced position with reference to the phalangeal articulation, and would cause an extension of the notch in the phalanx so as to form a groove. That the phalanx is so flexed is evident to anyone who has ever studied carefully the movements of the foot of a horse in the act of pulling a heavy load up an inclined surface. Here the phalanx is seen to be greatly flexed when the foot strikes the ground and is therefore under great strain and pressure. I speak of it particularly in a horse pulling a load, because it is more noticeable in this case than in the unencumbered animal, but what is true of one is also true of the other. Now in an animal in which the keels and grooves were little or not at all advanced, such as was the case with the ancestor of the horse when he emerged from the digitigrade and assumed the unguligrade position of the foot, the flexure of the phalanx brought the keel forward and produced a groove in the phalanx. As the

phalanx went back to its more normal position, that is, in line with the long axis of the metapodial, there would then be a plane surface of bone lying immediately in front of the keel which would be opposed to a groove in the phalanx. An extension of the keel would necessarily follow as a result of moulding of this metapodial surface to fit the groove. Flexion, therefore, of the phalanx upon the metapodial under pressure, bringing the keel already formed to a more and more anterior position with reference to the articular surface of the phalanx, thus causing it to become grooved, and the subsequent moulding of the keel to fit this groove, I conceive to be the complete mechanical explanation of the production of this structure. The various stages in the forward extension of the keel is to be found in such series as *Hyracotherium*, *Epihippus*, *Mesohippus*, *Anchitherium*, *Hipparion* and *Equus*.

FIGURE 5.—Modern Tapir. Middle toe inside view, showing position of the phalanges upon the ground.

In the preceding discussion, only the possibility of the metapodial keels having been produced and extended forward by mechanical means, has been shown. I will now turn to the matter of the application of this reasoning to the somewhat broader question of the transmission of acquired characters, and see whether or not any argument can be adduced in support of the proposition that the development of these structures has been due *solely* to mechanical causes, and that they have in time been transmitted to succeeding generations. Upon this hypothesis it must be assumed that the changes took place first within the lifetime of the individual and that they finally came to be inherited. It must likewise be shown that wherever a groove or a keel has occurred, there must have been pressure, impact or strain, exerted at that particular point sufficient to accomplish the result. The only other pos-

sible explanation of these structures is upon the hypothesis of the accumulation of a number of spontaneous variations in this direction, entirely independently of any mechanical results acquired during the lifetime of the individual. According to this theory, all mechanical influence must of necessity, be rigidly excluded, for the reason that it is possible for it to have been exerted, or come into play only during the time that the foot was in use, and therefore, during the lifetime of the individual. If mechanical influence is admitted even to the slightest extent, then the whole proposition of the transmission of acquired characters is at once proven, and who can say how much is due to mechanics and how much to natural selection?

In the production of the completed keel and phalangeal groove, it must be shown by those who hold the theory of origin purely by natural selection that they are congenitally *correlated structures*, otherwise they must, according to the very nature of the case, have proven injurious to their possessor. In order for a keel to be useful it must be accompanied by a groove into which it is received. In other words it must be shown that any variation in the one *must have affected the other*. I shall now attempt to show that the keels and grooves are not congenitally correlated. It has been shown in the preceding pages, that the phalangeal notch which is the earliest and incipient stage of the phalangeal groove is *not* correlated with the keel. The evidence for this is to be seen in *Coryphodon*, *Elephas*, *Metamynodon*, *Titanotherium* and others in which the keel exists without any vestige of the phalangeal notch. Again, in the tapir and rhinoceros, the lateral metapodials are provided with distinct keels but the notch is absent. In the middle toe of many of the lower Perissodactyla, the keel is associated with the notch, but it was not until the foot assumed a position whereby it was possible for the keel to impinge upon the lower border of the phalanx that the notch appeared. It would indeed require a great stretch of the imagination to believe that the keel and notch were congenitally correlated structures in one toe and not in the others of

the same foot! In like manner it can be shown that neither the sesamoids, keels nor grooves of the metapodials are correlated structures, for we have seen that in the human thumb there are sesamoids present but no keels nor lateral grooves.

If upon the other hand we look at the problem from the standpoint here advocated of the mechanical explanation, or kinetogenesis, and we admit that the bone is plastic, then we are forced to conclude, it seems to me, that the lateral grooves and keels of the metapodials are the direct and unavoidable results of pressure exerted by the sesamoids. This is proven by the fact that wherever there are sesamoids present, and s t r o n g p r e s s u r e is exerted, there are developed lateral grooves and median keels, and that where the sesamoids are absent, or no pressure is exerted, there are no lateral grooves nor keels. As long as the foot remained in the digitigrade position the keel did not advance, and this is demonstrated by the fact that there is no animal of this gait that has a completed keel. Up to this point the lateral grooves and keel had a distinct function, viz: to serve as guides for the sesamoids, but when the change was made in the position of the foot to that of the unguligrade, the lateral grooves began to disappear and the keel, which we must regard in the light of a necessary accompaniment of these grooves, began to perform a new function. The excavation of the phalangeal notch, its extension into a groove, and the subsequent moulding of the metapodial surface into a secondary keel to fit the groove were just as much a mechanical necessity as was the original or primary formation of the lateral grooves and keel. The proof of this is to be found in the fact that in the further extension of the keel beyond the digitigrade stage, the phalangeal groove led the way. In the mechanical explanation therefore, we have every condition satisfied, while upon the theory of natural selection of favorable variations the explanation is vague, unsatisfactory and not in accord with the facts.

American Museum of Natural History, March 29th, 1893.

AMONG THE CLIFF-DWELLERS.

By Clement L. Webster.

In the *August* number of the *Naturalist*, for 1891, the writer in an article entitled "*Preliminary Notes on the Archeology of southwestern New Mexico,*" alluded to, for the first time, the most important discovery of a Cliff-dweller Mummy, made by him in a Cliff-dwelling of that region; and promised to, later on, give a more detailed account of the discovery.

The present sketch then may be considered as a partial redemption of the promise then made.

The Mogollon Mountains of southwestern New Mexico, are one of the most rugged and broken of the great Rocky Mountain system.

This region abounds in deep and vast cañons, sometimes so profound as to almost exclude the light of day. This region is also deeply cut and scored by the channels of the headwaters of the Rio Gila, known as the East, West and Middle branches.

At no other place in this great system of mountains, is there presented so abundant and diversified scenes of wild and romantic beauty.

A strange charm surrounds this region; and there is here presented a remarkably rich field for the study and investigations of the Archeologist.

For almost everywhere here in the natural caves, in, and at the base of the almost innumerable cliffs, are found the former abodes of the Cliff-dwellers. Some of these dwellings are solitary, and only large enough to accommodate one or two persons; while others occupy a series of large connected caves, where are sometimes found as many as twenty-five or thirty beautifully preserved rooms or dwellings. The writer spent some time in this region making explorations in these ancient ruins, sketching and drawing; and here obtained a large and exceedingly valuable collection of specimens.[1]

[1]See report alluded to in the August number of this journal, for 1891.

Extending out from the West branch of the Gila, about three and one half miles above its confluence with the main Gila, is one of the most beautiful, wild and romantic canyons possible to be found.

The average width of this canyon is perhaps thirty-five or forty feet, while towering cliffs rise perpendicularly on either side to a height of from two hundred to three hundred feet by estimate.

Through this wild glen there rushes, during the rainy season, a small stream of pure water, clear as crystal. The lower nearly one-half of these great cliffs is composed of a hard, dark colored basalt, upon which the elements have made but slight impression; and overlying them is a vast stratum of buff colored conglomerate, such as occupies such extensive areas in southwestern New Mexico, portions of Arizona and California.

Here the lower portion of this vast stratum of conglomerate has been worn away by the slow action of the elements, leaving a narrow projecting shelf of basalt extending along horizontally for some distance.

In the base of this conglomerate, nature has formed numerous large connected caves.

These caves the ancient Cliff-dwellers had taken possession of, and in them reared their strange dwellings.

Here may be seen upward of twenty-eight rooms, of different sizes, shapes and designs; which taken together form the most interesting group of these dwelling which the writer has ever seen.

As the object of this paper is mainly to deal with the discovery of the mummy already alluded to, a detailed description of these and other Cliff-dwellings, etc., will be deferred to a future report.

One of the questions regarding the Cliff-dwellers, is that pertaining to the dispositions made of the remains of their dead.

But very few facts have been obtained thus far, which shed much light upon this question.

There have been discoveries made, however, which demon-

PLATE XI.

FIG. 1.

FIG. 2.

Mummied child from a Cliff-dwelling.

strate that in the matter of disposing of the dead, departures from the general custom, whatever that may have been, were occasionally practiced. One of these exceptional cases was brought to light in the discovery of the mummy, which forms the subject of this paper.

This mummy was discovered in one of the rooms of the large collection of Cliff-dwellings just described; and had been carefully placed in an excavation made in the floor, on the side and slightly under the partition wall. The wall here, as well as elsewhere, rested upon the debris which had previously collected in the cave. Every portion of the body, including the nails, hair and teeth, were perfectly preserved.

The preservation of this body was due to the great dryness of the atmosphere of the country, and the chemical elements of the soil, etc., in which it was entombed. The mummy was small, being that of a child apparently about seven years of age; although inferior in size to that of a child of the same age with us.

It had been carefully and completely wrapped in two large pieces of coarsely woven cloth of different textures, made from the fibers of the "Spanish dagger"—which was used so extensively by the Cliff-dwellers for this and other purposes —and then again as carefully wrapped in a large and nicely woven mat of bear grass.

After this, it was bound with cords, onto a small and curiously shaped board of cottonwood; the cords crossing the body and passing through small circular holes made in each corner of the board.

The board had apparently been fashioned with a stone ax, and afterward finished by being rubbed with some instrument.

The hair on the head of the mummy was of a beautiful dark brown color, and of a soft and silky texture. The arms were drawn up near to the sides of the head, and hands clinched; and the legs also were somewhat drawn up.

This description is better illustrated by the plate Figs. 1, and 2, (copied from a photograph) which represent the back and front views of this mummy.

At the feet is shown a portion of the mat which formed the outer covering, and the board to which it was bound.

There existed on the wall of one of the rooms, located a few feet from where the mummy was discovered, many strange and interesting characters, or picture-writings, of these ancient people, painted in the provincial red color.

Close by where the mummy was found, was also discovered an ancient weaving-room, of the greatest interest. In this were found portions of the ancient loom, woven fabrics, etc.

Near the mummy were discovered long braids of human hair identical in all respects with that of the mummy, save that it was much longer and of a coarser texture. In other rooms of this Pueblo, were found great quantities of corn-cobs, husks, and kernels of corn; squash or pumpkin rinds, seeds and stems; gourds, sandals, wearing apparel, basket and other woven work, pottery, stone mills, weapons, utensils, etc., etc. Such a mass of evidence was secured, in connection with the discovery of the mummy, as to leave no doubt as to the genuineness of this relic. So far as the writer is aware, this is the only specimen of its kind of the Cliff-dwellers, ever discovered.

NEW DISCOVERIES OF FOSSIL MAMMALIA OF SOUTHERN PATAGONIA.

By Florentino Ameghino.[1]

I.

At this time, the most important discovery in South American paleontology is the presence of true monkeys in the Eocene of Patagonia. Certain paleontologists have expressed doubts as to the age of the remains. I believe that these doubts have no foundation from whatever point of view one approaches the subject.

From the geological standpoint, the latest researches of my brother, Carlos Ameghino, show that the marine formation, which I have named *Subpatagonian*, and the formation of sub-aerial or terrestrial origin that I have designated *Santacruzian* (the formation which contains the mammals in question), are conformable without a break. The characteristic fossil of Subpatagonian formation is *Ostrea bourgeoisii* (R. de C.). In the east, toward the Atlantic, the lower part of the Santacruzian formation, is found to be intersected with beds of *Ostrea bourgeoisii*, representing the upper part of the Subpatagonian with all the beds of the two formations resting upon each other conformably. In the west, toward the Andes, in the lower reaches of the Rio Sehuen, and in the vicinity of the lakes Viedrua and Saint-Martin, the marine beds of the Subpatagonian formation rest on the Dinosaurian beds of terrestrial origin, contemporary with the North American Laramie (Pehuenche formation); the transition from one formation to the other is almost imperceptible. Throughout this region no mammalian remains have been found in any formation more recent than the Santacruzian. It is then certain that the fossil monkeys belong to this formation. The *Homunculus* specimens have always been found in place, and in the lower Santacruzian beds. It is beyond a doubt that the fossil monkeys belong to the Santacruzian fauna.

[1] From the Revue Scientifique, Jan. 7, 1893.

It remains now to ascertain if the Santacruzian fauna is really Eocene, or if it belongs to a more recent epoch. The affinities of the lower part of this formation with the Dinosaur beds, the presence of Creodonts and Plagiaulacidae, the absence of the modern groups of Ungulates, seem to me to demonstrate plainly that we have to do here with a fauna which dates at least from the commencement of the Tertiary epoch, and which represents the development upon the spot of an autochthonic fauna dating from an anterior geological epoch. Another proof of its antiquity is that a large number of Laramie mammals from the United States described by Marsh, have their nearest allies in the Eocene of Patagonia.

On the other hand, some of the forms characteristic of the Puerco fauna of North America are found in beds much more recent (Lower Oligocene and Upper Eocene) of the Argentine Republic in the neighborhood of Paranà (*Periptychus* Cope). It must also be said that all the authors who have studied the conchological fauna of the rocks of Paranà (d'Orbigny, Darwin, Bravard, Doering, Philippi, etc.), have referred this fauna to the Upper Eocene or to the Lower Oligocene. But, between the Santacruzian fauna and the fossil fauna of the Paranà, there is, when we consider the development of forms, a considerable hiatus, almost an abyss, that can only be filled by the aid of a half-dozen intermediate faunas yet to be discovered. Moreover, the greater part of the types of the Santacruzian fauna, considered from the point of view of an evolutionist, represent forms less advanced than do the totality of similar forms found in other continents.

Thus all the evidences—geological, paleontological and evolutional—are in favor of the great age of the Santacruzian fauna. I place this fauna at the beginning of the Tertiary, and consider it to be contemporary with the fauna of the Puerco of North America. I believe that the more we seek to place this fauna at a later date, the harder it will be to explain the affinities it presents with the faunas of other continents.

Returning now to the fossil monkeys of this formation, I can say that my brother, in his last exploration, found some new specimens, among them, a skeleton, almost complete, of *Ho-*

munculus patagonicus, in the lowest bed of the Santacruzian formation. This skeleton is imbedded in a large block of stone, and, as yet, only a few bones have been exposed. The lower jaw has been taken out almost intact, with its entire dentition. This new specimen, the preservation of which leaves nothing to be desired, shows that the jaw is not so narrow nor so compressed as I have figured recently in drawing from a specimen whose symphysis was evidently distorted by pressure. In the new specimen now at hand, the distance between the internal posterior border and the second true molar on each side is 10 mm., 5. It thus results that the two dental series are more widely separated at the back, and that the whole jaw is much more elevated.

The exact dental formula is I $\frac{2}{2}$, C $\frac{1}{1}$, P M. $\frac{3}{3}$, M $\frac{3}{3}$. The first two true inferior molars are very nearly of the same size, but the third is smaller. The internal incisors are weaker than the external ones. The canine is a little more developed than in the first specimen, and is separated from the premolar by a small diastema. It is probable that the two specimens are respectively male and female. Unfortunately, the individual represented by the new specimen, was very old, so that one can no longer detect the details of the surface of the crown of the molars. The dental series measure, in a straight line, 31 millimeters. The femur is 11 centimeters, and the radius 95 millimeters long. The humerus has a large epitrochlear perforation, but it lacks the intercondylar foramen. Each of these bones, in form, are those of a man in miniature.

Among the other forms belonging to the Santacruzian formation, and which ought to be better known, I will select only the most important, beginning with the Ungulates which are exceedingly interesting.

II.

I have been able to reconstruct the foot of the Mesorhinidæ (the genera Mesorhinus, Theosodon, Pseudocoelosoma), which are the predecessors of the Macraucheniidæ. The genus Theosodon had five toes in front as well as behind; the three in the middle were well-developed, very similar to those of *Macrau-*

chenia, but the internal and external on each foot were very small.

The Homalodontheridæ also had five toes on each foot, but with them all the toes are well-developed. The feet are strong and robust, and it is worthy of note that the hoof-bearing phalanges are split up, and have the same shape as those of the Chalicotherium of Europe. The carpal and tarsal bones have the alternate arrangement. The legs are equally robust, and the humerus has an epitrochlear foramen. The bones of the feet and of the legs bear a singular resemblance to those of the Edentates, but there are also more characters of specialization altogether peculiar, without which they might be taken for the direct ancestors of the Edentates. The Homalodontheridæ are the ancestors of the more modern Chalicotheridæ of the Northern Hemisphere. It is a mistake to look for the stock of the Chalicotheridæ in the Meniscotheridæ. The latter represent a type allied to the Proterotheridæ, with which they ought to have a common ancestor as yet unknown.

The Proterotheridæ present us with peculiarities still more surprising. The discovery of the leg bones of the Thoatherium prove that it was a monodactyl like the horse. Moreover, in the *Thoatherium minusculum*, the reduction of the parts was still more advanced than in the horses; the posterior feet are very slender, provided with a single toe, the third, while the second and the fourth are represented only by vestiges of the metatarsals, much more atrophied than are the same bones in the horse. One sees, in this case, an example of parallel evolution very remarkable. A complete reduction of the bones of the foot among the ungulates has taken place in two different families, at two different epochs, a fact perhaps without precedent in the Vertebrate series.

It is, however, certain that there exists a certain ancestral relation between the Proterotheridæ and the Equidæ, for the latter have descended from a form approaching the Protereotherium, but with complete dentition. I have elsewhere stated that in Europe as in North America, one may be able to trace the genealogy of the horse beyond Anchitherium (Mesohippus included), and that one ought to separate definitely from the

ancestral line of the horses, the genera Palaeotherium and Hyracotherium, as well as the different types of the sub-order of Condylarthra. In my opinion, the horses originate from a group of Litopterna, from which sprang, at the same time, the Paleotheriidæ and the Hyracotheriidæ, and this ancestral type would be closely related to the Proterotheriidæ.

It would seem that I am right, for the splendid monograph of the genus Mesohippus, recently published by M. Scott, shows that the calcaneum of this genus still possessed a very small articular facet for the fibula, the last vestige of the litoptern organization, however, the shape of the astragalus, as a whole, is already like that of a Perissodactyl.

We now have evidence to warrant the statement that the horses are descended from a form allied to the Proterotheridæ, and which ought to differ from it above all by its orbits open behind, and its complete dentition, in a continuous series. This ancestral is, perhaps, the *Notohippus* or a kindred genus, but, be that as it may, it is undoubtedly in the Northern Hemisphere that the group of horses has acquired the characters which distinguish it at the present time.

The genus *Astrapotherium* is now known, not only by a skull almost entire, but by many of the bones of the skeleton. The skull, in its anterior part, agrees in a number of points with those of the Proboscidians, and could have carried a proboscis as fully developed as that of the elephants. The bones of the limbs also greatly resemble those of the elephants, and there is no doubt that this type represents the nearest relative of the Proboscidians discovered up to this time in the older formations. The genus *Astrapotherium* is certainly not the direct ancestor of the Proboscidians, but only a collateral branch of the trunk from which the latter have sprung. However, some of the other genera of the family of the Astrapotheridæ, Astrapodon for example, may well be considered the ancestor of the living Proboscidians.

In any case, the latter have acquired their characters upon some other continent, as it is certain that during the epoch of the formation of the fossiliferous beds of the Paranà, the Proboscidians had no representatives in our country. These ani-

mals did not make their appearance in the Argentine Republic until the end of the Miocene.

The new specimens of fossil rodents taken from the Santacruzian formation afford unexpected opportunities for comparison. The fossil Cercolabinæ of Patagonia are the ancestors of all the hystricomorphous rodents. The Stiromys have, while young, five superior molars on each side, but the next to the last premolar is soon lost. From the primitive Cercolabinæ are derived the Eocardiinæ, the Eryomyinæ, and the Echinomyinæ. The Eocardiinæ, in their turn, have given rise to the Caviidæ and to the Dasyproctinæ. The Octodontidæ, which now seem to be isolated, have come from certain forms of primitive Echinomyinæ. The discovery of complete skulls of the genus Scieromys, enables me to recognize in this genus the true origin of the Octodontidæ. There are still some intermediate forms wanting, but, no doubt, they will be found soon in the fossiliferous formation of the Paranà.

Not only are the Cercolabinæ of the Eocene of Patagonia the primitive source of all the Hystricomorpha, but they are also the ancestors of another group of rodents, the Myomorpha, which seem also, for the present at least, entirely isolated in that order. The origin of the rats is found in the genera Acaremys and Sciamys, from the lower Eocene of Patagonia. The Myomorphs are not derived from the Acaramyinæ, they having lost their premolars and undergone various modifications in the conformation of the skull. If fossil rats have not yet been found in the Paranà beds, it is on account of their fragile bones, but, in all probability, they will be found there some day.

I now know a part of the dentition of the animal that I have named Tidaeus—this name being preoccupied, I substitute for it, Mannodon. The *Mannodon trisulcatus* is the first genus of Plagiaulacidæ of Patagonia which has the inferior molars constructed on the same type as those of the Multituberculata. It is a genus closely related to Neoplagiaulax and Ptilodus.

Many of the types of the Plagiaulacidæ present a feature that is strange to be found among mammals. The Epanorthidæ, for example, have the inferior incisors beveled on their

internal border, and not on their upper face as is the case among rodents and all other known mammals which have chisel-like incisors the mandibular branches of the same animals have no symphyseal suture, the surface of the bone, at this point, being nearly as smooth as the rest of the jaw. It thus results that the two mandibular rami of the Epanorthidæ were susceptible of lateral movements, and the singular incisors could perform, up to a certain point, the function of horizontal pincers.

Also, although I am quite convinced that the Plagiaulacidæ and the allied fossil forms have been derived from the Didelphian Diprotodontia, the relation with the living Diprotodontia is not so close as I had thought. The discovery I made showing that the large furrowed tooth of the mandible of the Plagiaulacidæ is not the last premolar, as had been believed, but is the first true molar, separates the latter from the living Diprotodontidæ. This character justifies a sub-order in the Diprotodontia, to which can be given the name Plagiaulacoidea, a name which is as appropriate for the northern forms known as Multituberculata as it is for those of the Eocene of Patagonia.

The recent studies that I have made of the Microbiotheriidæ have confirmed me in my opinion that they represent the direct ancestors of the living Didelphyidæ. The latter have certainly originated in South America, and although their remains have not yet been found in the Paranà formations, they will be found there some day.

One of the fossil groups of Patagonia which presents the greatest interest is that of the primitive Carnivora, allied both to the Dasyuridæ and to the Creodonts. It seems to me impossible to find a line of demarcation between them. In studying the material in my possession, I arrive at the following conclusions: The Dasyuridæ are descended from the Microbiotheriidæ and are then modified into Creodonts; these, in their turn, are transformed into the more modern Carnivores. The dental formulæ of these primitive carnivora are varied—take, for example, the superior incisors, of which the Microbiotheridæ have five pairs like the Didelphydæ; the Dasyuridæ have

only four pairs, and the same number is found among other forms allied at once to the Dasyuridæ and to the Creodonts. The larger number of the Creodonts have only three pairs, and, in some genera, but two, and even a single pair. There are some specimens in which one can trace the evolution from the primitive formula. Thus, in the genus Amphiproviverra, the internal pair of superior incisors are entirely atrophied and useless, while the other three pairs are well-developed. This proves that it is the internal pair of upper incisors that is lost in the passage from the Dasyurian form to the creodont and carnivorous forms.

Perhaps the most remarkable specimen discovered during the last exploration is a skull almost entire of *Borhyæna tuberata*, an animal which has hitherto been known only by some insignificant fragments. It is certainly one of the most singular carnivores that is known. It must have been rather large since its skull is 205 millimeters long, and nearly 15 centimeters in transverse diameter at the level of the zygomatic arches. The upper arch of the skull is in an almost horizontal plane with the cerebral cavity excessively reduced, but the sagittal crest is very long and well-developed; the frontals have no postorbital apophyses, and the nasals are widened behind in an extraordinary manner; the anterior nasal opening has the characteristic form of placental Carnivora. The lachrymal canals open entirely inside of the orbits. The malar bone is prolonged behind to the glenoid cavity, of whose border it forms a part of the boundary as in the Marsupials. The palate has no palatine foramina. The upper incisors are reduced to two pairs, of which the internal one is atrophied. Between the canine and the external incisor on each side, is a large groove intended to accommodate the lower canine; this groove replaces the deep fossa which is found in the same place in Dasyurus and Amphiproviverra. These grooves and the contraction of the anterior part of the intermaxillary bone, followed by the reduction in the number of the incisors, gives the anterior part of the skull the appearance of a rodent. The canines, premolars, and molars, of each side, form a continuous series. There are seven molars, of which three are premolars

and four are back molars. The first have but a single cusp, but they have a posterior heel, well-developed in the last. The first three true molars increase regularly in size from the first to the third, and have the anterior internal cusp atrophied, which gives them a cutting form, especially noticeable in in the third. The fourth is much reduced, and occupies the same position as in the genera Thylacynus, Prothylacynus and Amphiproviverra. Perhaps Dynamictis, of which only the lower jaw is known, is a synonym for Borhyæna. In any case, the latter animal was a formidable Carnivore, as dangerous as our tigers, and which it is hard to classify. It may belong with the placental Carnivores, or among the marsupial flesh-eaters (Dasyures), or with the ambiguous forms known as Creodonts.

It would take too long to speak of the numerous fossil Edentates of the Santacruzian formation and of the many peculiarities they present. However, I cannot resist mentioning one of the greatest novelties of the new family of the Metopotheriidæ, which comprises the genera Metopotherium, Pelecyodon, and Zamicrus. In this group, each of the horizontal branches of the mandibula is formed of two distinct bony parts, one in front, the other behind. These two pieces are united by a suture which commences at the alveolar border, very nearly in the middle of the dental series, and is directed obliquely back and down, terminating in the lower border, almost just below the last tooth. This is evidently a character inherited from the reptiles. The same suture can be seen, but not quite so plainly, in the mandible of some of the Orthotheriidæ.

I remarked, in the beginning of this article, that I had found some forms characteristic of the Puerco of North America in the beds much more recent than those of the Santacruzian epoch. In fact, I have received from the Paranà, a fragment of a upper maxillary, which shows several tooth sockets and one tooth in place. The latter corresponds to a third premolar. It is impossible to separate this specimen generically from Periptychus (Cope). The tooth resembles perfectly the third upper premolar of *Periptychus rhabdodon* and shows the same grooves or wrinkles in the enamel which

distinguishes the North American species. However, the South American species (*Periptychus argentinus* Amegh.) is easily distinguished by its size—almost a third smaller—and by the insertion of the molar teeth which are closer together, forming a continuous series. This specimen was found in the Lower Oligocene or the Upper Eocene in the neighborhood of Paranà.

While I am speaking of the fossils of that region, I must add that the doubts which I had concerning the real nature of Ribodon are now set at rest. The new material at hand shows that *Ribodon limbatus* belongs to the Sirenia, and is one of the family of Halitheriidæ.

III.

I would like, in closing, to reply to the objections that have been made to my classification of the Tertiary beds of the Argentine Republic, and particularly to the assertion of Professor Steinmann, who maintains that the beds I have designated Miocene and Pliocene are only Plistocene (or Quaternary).

I have not the complete work of Professor Steinmann, and therefore will refer only to the extracts that he has published.[1]

I am more and more convinced that the Pampean formation is tertiary, and not quaternary. The Araucanian, of which Professor Steinmann speaks, is entirely distinct from the Pampean formation. The vast difference which exists between the Paranà fauna and that of Monte-Hermoso is easily explained by taking into account the fact that the first is Lower Oligocene or Upper Eocene of the old geologists, while Monte-Hermoso is Upper Miocene. Some day, when the Lower Miocene of Catamarca (an Araucanian bed) is explored, and the mammalian fauna of that formation is satisfactorily known, the great break that is now held to exist between the fauna of the Paranà and that of Monte-Hermoso will largely disappear.

I am astonished that any one can still speak of a glacial epoch and of traces of glacial action in connection with the Pampean, and still more so in regard to the pre-Pampean formations. The Araucanian bed is formed by the accumu-

[1]American Naturalist, 1891, p. 855.

lations of volcanic detritus. The Pehuelche is of fluviatile origin. Is it necessary to repeat for the hundredth time, that there is not the least vestige of glacial action in the Pampean formation?

It is impossible to name single fossil species from the Pampean formation which is characteristic of a colder climate than now prevails in the same country. On the contrary, not only does the mammalian fauna indicate a warmer climate than at present, but the fresh water conchological fauna also furnishes similar evidence. The many fossil plants of the Pampean formation are the same that are seen to-day in the province of Buenos-Ayres, or in the northern part of the Argentine Republic—not a single form belonging to a cold climate. I am almost certain that an examination of the marine shells of the same formation would lead to the same result. I am about to make a collection of them to send to M. von Jhering, whom I will request to study them from this point of view.

EDITORIALS.

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

—We have had occasion to refer in previous numbers of this journal to the difficulties under which the Geological Survey of Georgia has labored, by reason of the attempts of a political board to assume its direction. This board appears to consist of men ignorant of Geology, and who use the survey as an opportunity for giving places to their friends. The director of the Survey, Dr. J. W. Spencer, has not been permitted to direct, nor even to select his subordinates, so that chaos has been the natural result. Ignoring the fact that this state of affairs has been due to their own incompetency, the board has asked for the resignation of the director of the survey. This Dr. Spencer has very properly refused to furnish. In a letter to the Governor he presents a strong defense, which is an arraignment of the board of a convincing character. It is evident that the board should resign, rather than the director of the Geological Survey. If they will not resign, the board should be abolished. It appears that their misgovernment has not been confined to the Geological Survey, but that many of the educational interests of the State have suffered at their hands. If Governor Northen desires the acquisition of accurate information as to the material resources of Georgia, he can not do better than retain Dr. Spencer in his present position. If he regards the fair fame of Georgia, he will use what power he has to abolish the present board, and when a competent one is selected, it will permit the State Geologist to select his own assistants. That the Governor sees the question in its true light is evident from the fact that he has requested Dr. Spencer to continue his work and complete the report. It is to be hoped that the Governor's course will put an end to the interruptions and difficulties which have beset the survey for too long a time. Should it do so, he will have the warm commendation of the scientific interests of the entire country. Private interests, especially of mining districts, have often interfered with the comfort of honest geologists, as in the case of Professor Branner, of the Arkansas Survey; but their attacks have always resulted in the scientific vindication of the experts whose education and experience have enabled them to reach just conclusions.

—A ridiculous bill has been introduced into the Legislature of Pennsylvania with the following title and provisions, by Representative

Jno. H. Fow, of Philadelphia, "(No. 163) An Act to prohibit public exhibitions of physical or mental deformities in certain public places."

"SECTION 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same, that on and after the passage of this act, it shall be unlawful for any person to exhibit in any public hall, museum, theater or any other building, tent, booth, or public place, for a pecuniary consideration or reward, any insane, idiotic or deformed person or any imbecile, and whoever shall exhibit such mental or physical deformity, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be sentenced to pay a fine not exceeding one thousand dollars, or suffer imprisonment not exceeding six months or both, or either at the discretion of the Court."

If this bill becomes a law, it will require the closing of scientific exhibitions of abnormalities to students where a fee is charged, as well as the more popular exhibitions of a miscellaneous character. It will thus deprive the public of a real source of instruction, which is important from various points of view. It will deprive scientific men of the opportunity of examining many curious pathological specimens which the industry of the exhibitors brings together, and which would be otherwise generally inaccessible to them. The Alexis St. Martins, Siamese Twins, double monsters and other such specimens, which are most important for physiologic research, would no longer come to Philadelphia. It will also deprive many unfortunate persons of making a very good livelihood, who would otherwise become chargeable to their relatives or to the State. What good is to be attained by the passage of such a bill it is impossible to imagine.

—THE New York game protector, Mr. Willett Kidd, and the *Forest and Stream* periodical, are to be congratulated on the successful result of their endeavors to enforce the game protection law of the State against the restaurateur Delmonico, of New York City. For having in his possession eighteen woodcock killed out of season, Delmonico has been compelled to pay a fine of $25 apiece—total, $450.00. This result was only attained after persevering efforts, prolonged through many months. The delay was due to the culpable neglect of Prosecuting-Attorney Nicholl, of New York, who would have permitted the culprit to escape, had it not been for the interest of Judge McCarthy, who took up the case himself. We trust that the game and fish laws of all the States may be enforced as effectually, and a great deal more promptly.

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RECENT LITERATURE.

A Summary Description of the Geology of Pennsylvania. Vols. I and II.[1]—The results of the Geological Survey of Pennsylvania from its beginning, in June, 1874, to the close of its field work, June 1, 1890, have been summarized by Professor J. P. Lesley, in three octavo volumes of 700 to 800 pages each, of which Vols. I and II have just been issued, while Vol. III is promised in June, 1893. This summary is compiled from the reports published by the Board since 1875, with the corrections, and the additions that the accumulation of fresh facts make necessary. Vol. I describes the most ancient deposits: The Laurentian granites, gneisses and mica schists; the Cambrian gneisses, schists and limestones; the lower Silurian limestones and iron ores, roofing slates and mountain sandrocks; Formations II, III and IV, in the order of advancing time and superposition. The second volume describes the Upper Silurian red shales, limestones, and fossil iron-ore beds; the glass sand-quarry rocks; the black and gray shales, and the gray and red sandstones, with fish beds; Formations V, VI, VII, VIII and IX reaching to the top of the Catskill Mountain rocks, the upper limit of the Devonian system.

Each formation is discussed in detail. Its geographical distribution, thickness, lithological characters and fossil contents are carefully described, together with its relation to similar formations of neighboring states.

The question of sedimentary Archean rocks receives attention, and while discussing Archean rocks in general, Professor Lesley calls attention to the fact that the Huronian rocks of Canada are nowhere recognized along the Highland Belt from the Hudson to the Schuylkill. In the author's opinion, the term Huronian, "must be used simply as a proper and private name for a series of rocks exposed along that part of the northern boundary of the United States." In the paleozoic series, Professor Lesley does not clearly discriminate between the Cambrian and Ordovician limestones, including them all under the one head of No. II, as was done by the first geological survey. He leans toward the explanation given by Dr. Fraser of the structure of the Chester Valley, rather than those of Hall and Rogers.

The illustrations are numerous, many of them being photo-electro-

[1] A Summary Description of the Geology of Pennsylvania. Final Report ordered by Legislature, 1891. Vols. I and II. By J. P. Lesley, Director, Harrisburg, 1892.

type reductions of the drawings made by the assistant geologists. Page plates of fossils accompany the chapters of the several formations. These are half-sized reproductions of the figures of fossils given in Report P. 4, Dictionary of the Fossils of Pennsylvania and the surrounding States, published in 1889–1890.

The present report has been evidently written with an eye to the general rather than the scientific public. As a popular synopsis of the geology of Pennsylvania, it will have much utility. As a discussion of the more abstruse problems presented by the structure of the formations of the State, especially of the eastern region, it has less value.

The Earth's History,[2] by R. D. Roberts, is an attempt "to furnish a sketch of the methods and chief results of geological enquiry, such as a reader interested in the subject for its own sake would desire to obtain. It is not intended to be a text-book of Geology." Beginning with a brief history of geological thought, it takes up the earth-history and shows how geologists are enabled to trace the successive steps in the development of the earth's physiography, by reference to the records of the rocks as interpreted by means of the results of investigations into the processes at present active on and beneath its surface.

The central idea of the author is "to reconstruct, from ancient fragmentary remains, the old conditions that characterized the successive stages in the evolution of the land areas; to make out the life-history of the earth," and this idea has determined the method of treatment of the subject matter. The book is not crowded with geological facts, it is not a dry abridgment of some popular manual of geology, but it is exactly what its author intended it should be—an exposition of geological logic. Its style is simple and clear, its statements are accurate, and its various parts are well proportioned. In short, it is an excellent volume for collateral reading for college classes in geology, and a fine introduction to the geological methods for general students.—W. T. B.

Wright's Light,[3] although mainly a discussion of light phenomena that may be projected upon the screen by means of a lantern with the lime light, is nevertheless, an excellent volume for study by

[2] The Earth's History, an Introduction to Modern Geology, by R. D. Roberts, University Extension Manual. New York: Scribner's Sons, 1893. pp. 270, Pl. ix. Price, $1.50.

[3] Light, a course of Experimental Optics, chiefly with the Lantern. By Lewis Wright; 2d Ed. Macmillan & Co., pp. 301, Pl. 9, Figs. 207. Price, $3.25.

the students in the theory of light—natural and polarized. The value of the work to the student of polarized light lies in the fact that many experiments are described that aid one to gain a clear notion of double-refraction, of interference, and of the resolution of vibrations into two sets at right angles to each other, without compelling him to accept the conclusions of mathematical processes. Scattered between chapters dealing with the experimental data are others, in which these data are explained, and a few in which the theory of light vibrations is discussed, the whole forming a logical exposition of the modern theory of light.

Unfortunately for the reader, there are many clumsily-constructed sentences in nearly every chapter of the book, which need much close study before the meaning of their author can be discerned. This fact necessarily detracts from the delight with which the volume would otherwise be perused, but not so much so as would be the case were it not so compactly written. An immense amount of material is collected within its covers, and very little of this matter could well be spared by the student. A little more confidence might have been felt in the author's statements, as representative of the most modern views of light specialists, had he given some evidence of his acquaintance with the wonderful grating of Rutherford and Rowland, instead of mentioning only Noblet's gratings and Barton's buttons in his discussion in diffraction. The imperfections, however, are slight as compared with the abundant good qualities of the book.

The volume is well printed and splendidly illustrated with a wealth of cuts and nine lithographic plates, of which four are beautifully colored.

The student of light phenomena will find many of his difficulties in understanding the theory of his subject cleared away if he will carefully examine the experiments described by Mr. Wright, and thoroughly digest the accompanying explanations.—W. T. B.

General Notes.

GEOGRAPHY AND TRAVELS.

Africa.—IBEA, OR BRITISH EAST AFRICA.—Although the continent of Africa is now gay with the colors which distinguish the spheres of influence of the various European countries, and though it has now been crossed and re-crossed in almost every conceivable direction, there are still considerable areas about which very little is known. This is especially true of the regions adjoining and intervening between the great lakes of the Equator; those vast fresh-water areas dimly known to the ancients, but entirely lost to the moderns until the present generation. The politico-religious troubles in Uganda, which some endeavored to convert into reasons for the abandonment of that country by the British, have directed considerable attention toward that region, and Captain Lugard, whose name has been prominent in the recent troubles, has not been slow to furnish information. The British sphere of influence in this quarter is separated on the north from the Italian by the river Juba, while to the southwest a line drawn from the center of the east shore of Victoria Nyanza, to a point on the ocean near the island of Penba marks the edge of the German sphere. This line is however, bent northward around Kilima njaro, so that the whole of that snow-clad elevation is within the German sphere. At the Victoria Nyanza the Anglo-German boundary is deflected westward. Upon the west, the British protectorate is bounded by the Congo State. The territory of Uganda stretches along the north and northwest shores of the great lake, extending inland as far as Unyoro, which skirts to the southeast shores of the Albert Nyanza; eastward of Uganda toward the Albert-Edward Nyanza, lies the district of Ankoli. The whole of the British sphere in northeast Africa has received the name of "Ibea," formed from the initials of Imp. British East Africa Co., and, as this name is both short and pretty, it may be hoped that it will persist when the company itself is a thing of the past.

Captain Lugard's route to Uganda was from Mombasa to the little river Sabaki, to the south of Mount Kenia, which is entirely within the British sphere. According to him, the source from which the great Victoria Nyanza derives its supply of water is among the chief

geographical puzzles of Africa. All the rivers flowing into the lake are very small, and the broad Somerset Nile which flows out of its northern coast certainly carries away more than is received by their combined streams.

The greater part of the waters which fall upon the Uganda region seem to make their way either to Lake Rudolf or Lake Baringo, and we must therefore assume that Victoria Nyanza is fed by springs. The western shore of Lake Albert is faced by a lofty plateau, the waters of which flow, not to the Nile basin, but to the Ituri, a tributary of the Congo. The Senliki River, which, under various names, unites the Albert-Edward or Mwutanzige Lake with the Albert Nyanza, is relatively small where it issues from the former, and its considerable volume at its entrance into the latter is due to the affluents which flow from the western extremity of the snow-capped range of Ruwenzori. Though the eastern portion of this range drains directly into the Mwutanzige, the waters flowing from the western part are sufficient to convert the lower portion of the Senliki into a deep and rapid river. Adjoining the Victoria Nyanza on the northeast is the fertile district of Kavironda, where much grain is grown and where the natives, a good-natured and merry set, wear no clothing of any kind unless the tusks of wart-hog, horns and wings with which the warriors decorate their heads can be considered as clothing. Passing west from Kavirondo to Usoga, a district tributary to the Waganda, the character of the agriculture suddenly changes, the grain giving place to bananas, potatoes and cassava, though no marked difference of soil or aspect can be detected in the surface of the country. Moreover, the transit is from nudity to clothing, for every native of Usoga, like the Waganda, is dressed in the mbugu, an ample garment manufactured from fig-bark. The dress of both sexes is the same, but while the mbugu of Usoga is black, that of Uganda is brick-red. East of Kavirondo is an equatorial plateau seven to eight thousand feet above the sea, apparently well-suited for the residence of Europeans, and gradually sloping to the Kavirondo lowlands. In various parts of this plateau are still to be found remnants of the once powerful nation of the Gallas whose forces have been exhausted in the struggle with the Masai to the south and the Somals to the north. A curious feature of the districts of Uganda and Unyoro, according to Captain Lugard, is the scarcity of running water, and the occurrence of swamps in every depression. The average elevation of Uganda is 3,700 feet, while Unyoro, though not greatly dissimilar in general aspect is higher, and has loftier hills. The Waganda possess great natural aptitude, are clever carpenters

and smiths, and can be readily taught European methods of working. They are fond of music, have many rude musical instruments, and possess a currency of cowries. Mentally, they are certainly superior to the surrounding races. Uganda is divided into ten provinces, each of which has its chief, while over all is set a vizir. The system of land-tenure is very complex, and chieftainships are complicated. The northern part of Ankoli is thickly peopled, but the land has suffered terribly from the cattle-plague, which has reduced all the pastoral tribes of this region to a state bordering on starvation. Not only have millions of domestic cattle fallen before this dread disease, but the buffalo has been practically exterminated, while the eland and the smaller kinds of antelopes have suffered severely.

The Albert-Edward or Mwutanzige is really a double lake, for the long northeastern arm known as Ruvango is only connected with the larger body by a river not more than 500 yards across. This lake is abundantly supplied; the Mpanga alone brings down more water from Ruwenzori than is taken out by the Senliki.

During his circuit from the Victoria by the Albert-Edward to the Albert Nyanza and Wadelai, Captain Lugard picked up the Sudanese refugees left by Emin Pasha, and upon his return was accompanied by some 9000 people. He concluded his address before the Royal Geographical Society with a graphic picture of the present disordered state of the countries west and north of the Uganda, smitten by the cattle-plague, oppressed by a usurper named Kabarega, and only prevented from freely accepting protection, from the fear that all protectors, like Stanley, will depart and thus leave them a helpless prey to the vengeance of their oppressors.

Uganda is a region of rounded grass-clad knolls, while Unyoro is more rugged, often with fantastic piles of granite, and abounds in caves. The rivers of Uganda are large papyrus swamps with no current, and little open water. The hills are of red marl or shaly gravel. In past times Uganda had broad roads, often with culverts across water, and even now it would be easy to make a good road to the Albert Nyanza. More grain is grown in Unyoro than in Unganda. A survey for a projected railway from the coast to Victoria Nyanza has already been made for 350 miles.

There seem to be several small lakes in Buddu, a province of Uganda west of the Victoria Nyanza; in Koki, a tributary state east of Buddu, and in Ankoli, the eastern part of which has loftier hills and poorer soil than Buddu. One of these lakes, between Ankoli and Koki, is named Kashera. Iron seems to be abundant in these

districts. The natives of Ankoli are Wahuma, a fine race apparently with affinities to the Galla and Somali, but mingled with Bantu.

The Tana, a large river south of the Juba, has been navigated by Captain E. G. Dundas in the stern-wheel steamer *Kenia*, to within a short distance of the mountain of that name, which was afterward ascended to a height of 8,700 feet. The Tana has two mouths, the northern one, the Ozi, is not now important, but the entire district between it and the Tana mouth is alluvial. The lower portion of the river is almost meridianal, but close to the equator a broad westerly curve conducts to the congeries of affluents which descend from the forest covered slopes west of Mt. Kenia. The steamer could proceed as far as Hameyé, near the equator, at the start of the great bend. The peoples met with in the ascent were the Kalindi at the mouth, the Ngao, Omoina, Ndera, Guano, Ndura, Sabaki, Malululu, Malakote, Wasania, Korokoro, Wandorotu, Murdoi, Wathaka, Mumomi, Mbe, Kikoya and Muea near Mt. Kenia.

The smaller Sabaki river to the south of the Tana, also has its head-waters in the forest belt S. W. of Kenia. The existence of such a river as the Tana, navigable through more than three degrees of latitude, was until recently pratically unknown. A considerable fall about 18' south of the equator, and sixty feet high, terminates the navigable part of the stream.

It may be remembered that Mt. Kenia has been ascended by Count Teleki to a height of 15,350 feet, yet he estimated that there was still above him 3,500 feet to the highest summit. The forest reaches to 3,500 feet, bamboos to 10,500, after which the vegetation as far as the snow-line at 15,000 feet consists of mosses and the curious tree *Senecio johnstonii*. The slope toward the west is very gentle, but southward the mountain presents a serrated ridge four miles in length.

An expedition has started for the Juba River commanded by Lieutenant C. R. Villiers, and accompanied by J. W. Gregory of the British Museum.

Asia.—A Visit to Peik-Tu-Shan.—Mr. Carles has recently paid a visit to the singular white-topped and flat-topped mountain in Mantchuria, from which issue the sources of the three great rivers Tumen, Yalu and Sungari. This mountain, which has upon its summit a lake some twelve miles in circuit, at an elevation of 7,500 feet, had been previously been visited by Mr. Younghusband and his party, but Mr. Carles was moved to undertake the journey from Seul, the capital of Korea, by reading an account of it in a Chinese work.

This account, exaggerated though it was, giving to the mountain a height of five miles, and to the lake a proportionately expanded circumference, showed that there really existed a remarkable elevation. Chan-y-Peik, the "Ever White Mountain," is well-wooded to the top, and thus presents a contrast to the isolated Peik-tu-Shan or Old White Mountain the summit of which is bare, and white with pumice. It is the latter which encloses the lake.

The account of the journey, in the March issue of the Proceedings Royal Geological Society is full of interesting matter concerning the ways of the large-hatted Koreans, their threshing-floors of beaten clay, the pickled cabbages and turnips so dear to their palates, their dress and domestic animals, among which the black and hairy pig is conspicuous. The untidiness of a Korean village offers a marked contrast to the neatness of a Japanese one, but Mr. Carles gives the Korean rustics credit for a more thorough appreciation of natural beauty than is possessed by any other people. A Korean who has climbed a summit stops, not to complain of the toil, but to admire the landscape. Ham-Heung, the chief town of N. E. Korea, is a walled town with twenty-five to thirty thousand inhabitants.

THE KACHINS AND THE IRAWADI.—The recent expedition of the Indian Government among the hills of the rebellious Kachins, Chingpaws, or Singphos, who occupy much of northern Burma, toward the Chinese frontier, though they have added to our geographical knowledge of the upper waters of the Irawadi, have not solved the mystery of the Salwin. The upper Irawadi divides into two principal streams, the Mali Kha to the west, and the more easterly Nmai Kha. The course of the former has been mapped as a result of the Kachin expeditions, but little is really known of the latter, save that at its junction with the Mali Kha it is somewhat the larger.

The Kachins seem to be descended from the Karengs, and have for ages been subject to hereditary chiefs or Sawbwas; but of late years many villages have rebelled against these, driven them out or killed them, and these villages are now only governed by 'headmen' with little authority. This, together with the fact that the peaceful trading villages of the Shans and Chinese are each under the protection of a Kachin village, made it difficult to reduce the tribes to subjection. Among the Kachin tribes are the Kanong, Passu, Nankmong, Kamans and Khangs, these are said to be the wildest, and to be unclothed. The district is not one of lofty mountains, but of rugged hills two to three thousand feet in height, intersected by well-watered valleys. A

good deal of opium is grown, but not enough to fully supply this opium-consuming race. No reliable information can be obtained respecting the head-waters of the Nmai Kha. It is thought that the Phung Mai, east of Kanti and the Nmai Kha, may be the latter, while the Lu is the Salwin. All the water that falls upon the land up to within a few miles of the Lu drains to the Irawadi, which thus rapidly develops into a noble river, though it is doubtful whether any of its sources are farther north than 28° 30′.

East Asia Minor.—In these days of exploration of the unknown, some of the districts that have been longest known, and which fill large pages of the world's history, seem to be least visited. It is this which lends additional interest to D. G. Hogarth's account of his travels in Asia Minor—that land of many peoples and of many ruins which has for centuries been the stronghold of the Turkish power. Mr. Hogarth not only examined many ruined cities, but penetrated through several little known passes of the Taurus and Anti-Taurus. In the district between Lakes Egerdir and Beysheher there are no passes, but the Eurymedon cuts its way through a great gorge, and the population interests from its primitive and apparently indigenous character. The Pisidian city of Adada, now Kara Bavlo, perched high on its hill-top, is a most perfect specimen of an Anatolian city of Roman times. Not very distant are the ruins of Lystra and Derbe.

In a small island upon Lake Egerdir are the remnants of a small colony of Greeks, who in the twelfth century deliberately preferred Mohammedan to Byzantine rulers. The monastery of Koja Kalessi is a remarkable ruin, containing a church of the fourth or fifth century, restored in the reign of Justinian, and evidencing the power still possessed by heathen traditions in the entire absence of Christian symbolism from its sculpture. The city of Coropissus is a veritable Pompeii, the church probably of the seventh or eighth century, most of the ruins a little later. The east Taurus is richly wooded, and is traversed by the tremendous canyons of Samanti, Saros and Jihan, not passable even on foot. Several important passes occur farther east than the famous Cilician Gates. This district was the last refuge of the independent Armenians of Cilicia, and their robber towns, Hadjin and Zeitun, still exist. The half-troglodyte Kurds, nominally Mussulmans, but with pre-Mussulman customs, have penetrated to these parts. The Anti-Taurus, deserted since the eleventh century, is now inhabited only by the nomad Avshar and some Kurds, who found their way there about fifty years ago. The great Roman road to the Euphrates can

still be easily traced in the valley of the Saros, and has many milestones. Tne fortified tower of Maidan dates from the first or second century, when the Cilicians were lords of the Mediterranean. Among so-called Hittite monuments, one of the most important is the obelisk at Albistan. This the inhabitants refused to sell to some Germans, the Government heard of it, and took possession without payment. It has sixty-seven lines of inscription on all four sides.

Northeast Siberia.—The region of the Verkhoyansk and Stanovoi Mounts, in N. E. Asia, with the upper basins of the Kolyma, Indigirka and Lena, have been recently explored by M. Cherski. Proceeding up the Chandyga River, Cherski reached the heart of the Verkhoyansk, whose summits are below the snow-line. Then by way of the river Dyba, a tributary of the Tyra, he reached the valley of the Omekon, which stream the natives regard as the true head-waters of the Indigirka. The Uchagei-urach does not, as shown on the maps, empty into the Omekon. The Verkhoyansk was then crossed at its junction with the Stanovoi range, where the latter runs eastward. The region between the Indigirka and the Kolyma, covered by the bend of Stanovoi, is split into several subdivides, of which the expedition crossed three, and found the third to be the water parting between the Indigirka and Kolyma basins, the Moma flowing from one side, the Syrjanka, an affluent of the Kolyma, from the other. The valleys of this district are broad with gentle slopes, and without terraces, which are destroyed by the shifting courses of the rivers, the tendency of the latter being rather to fill up the valleys with rubbish than to deepen them. On the southern slopes magnificent poplars and willows flourish, and the meadows have a rich flora. Notwithstanding the high latitude, the temperature in June and July rose to 113 in the sun, though for fourteen days in August it sank below 32. The great longitudinal valleys seem to have possessed immense glaciers in the plistocene period; while the mountains are formed of Silurian and Jurassic folds.

Asiatic Notes.—The recent expedition of Lieutenant H. S. Walker, from Napeh in Upper Burma to Arakan, possesses considerable interest, were it only for the visit paid to Myohaung, the ancient capital of Arakan, now peopled only by some 2500 souls. The ancient magnificence of the place is attested by the great ruined walls, forming three squares one within the other, and by two gigantic pagodas, one

with eighty, and the other with ninety thousand images. This city was known to Ptolemy, who speaks of it as Triglyphon.

The outward route was through the An Pass, while the return route was eighty miles to the north. The former was found far the better for a railway, though beyond Dalet it was cut up by creeks, many of which, however, could be missed by hugging Myaintaung Hill. Lieutenant Walker speaks of the Arakanese as indolent and cowardly beyond measure.

W. M. Conway, with a party, started in February of the past year to explore the glacier regions of Baltistan and Karakoram, southeast of Pamir. News of his expedition has several times been received, but no full account has yet been given. He has been the first European to cross the Nashik pass; has explored the Hispar Glacier, a vast level sea of snow of 300 square miles, surrounded by a ring of giant peaks—the largest glacier outside of the polar circle; has ascended many lofty peaks, among which is one which he has named Pioneer Peak (over 23,000 feet) because it was found to precede the Golden Throne, some 2000 feet higher still.

A new map of Persia, compiled from a great number of general and divisional maps, may be found in the issue of the Proceedings Royal Geographical Society for February, 1892. It is on a scale of 600 miles to the inch, and includes Afghanistan and Beluchistan. The boundaries of the famous Persian desert, the Dasht-i-Kavir, with its two large salt-swamps, and the Kuh-i-Gugird, are clearly shown. The desert is shaped like a dumb-bell, and the largest salt-swamp is in the centre of the western portion.

Captain Bower and Dr. Thorold left Leh in June last year, crossed the widest part of Tibet, and passed a chain of salt-lakes, one of which, Bor-Ba-Tu, is probably the highest lake in the world, since it is situated 17,930 feet above sea-level. Their course lay from Ladak to Chiamdo, about 150 miles to the north of the route of Pundit Nain Singh. Though ordered back by the Tibetan authorities, they made their way through Tibet to west China.

Burma and Assam seem temptingly close upon the map, and are only separated by about a hundred miles of hill country, yet a satisfactory road from one to the other has not yet been found. The highest hills or mountains of the district range from but four to eight

thousand feet, but as they are clothed with dense forest and impenetrable jungle, with few inhabited or cultivated spots, the passage is very difficult. The political officer of Assam, Mr. Needham, after having had experience of one route, tried that by which in past times the Burmese armies used to find their way to conquer Assam. This leads across the Patkoi, among hills below 3000 feet in height, to Nongyong Lake, and then via the Loglai to the Singpho village of Ham Yung, thence to Ningbu, three short marches from Maingkhwan.

Australasia.—AUSTRALIAN EXPLORATION.—The news of Australian exploration is always tame and little varied, like the aspect of that "scrubby" interior. Dr. Lindsay and party crossed the space between the courses of Forrest and of Giles. They found the Queen Victoria spring on the latter course nearly dry, and the country seemed to have had no rain for two years. Various bushes were found, also a gum-tree forest which extended into S. Australia. From the roots of certain mallee trees, which the natives know by experience, they procure a quantity of pure water.

In South Australia the country between lakes Eyre and Amadeus has been explored, and seems to be rather more varied than most of the interior, as several ranges of hills, the Musgrave, Everard, Mann, etc., have been found, rising four to five thousand feet above the sea. The Musgrave hills are of red granite, which appears to predominate in the other ranges. Spinifex, a few pines, stunted gums and mulga, are the prevalent trees, but between the Musgrave and Mann ranges is a growth of large casuarinas.

In West Australia the country between Northam and Eucla has been traversed, and good ground has been found in a slightly undulating country. After the limestone was reached (31°, 10′ S., 124°, 30′ E.) the open forest and plains changed to grass and salt-bush plains, well adapted for pastoral purposes. Many holes were met with, probably leading to underground streams. The soil is mostly rich red loam, there are springs in many places, and water is near to the surface. White gum and gimlet-wood were the most conspicuous trees. The land seems rich in minerals. The natives seen were of much finer physique than those which frequent the towns.

NEW GUINEA.—Sir W. Macgregor continues his work of visiting the various tribes of British New Guinea with the aim of bringing them to acquiesce in the government and laws of Great Britain. Great progress has already been made in this matter, so that already some

villages which were built upon piles for security are now removed to dry land. The want of recognized hereditary chiefs among the natives present causes some difficulty, but the coast tribes have to a great extent accepted the change, and the inland tribes, who were for the most part driven inland by the coast residents, are commencing to come in. The area of the British portion is 86,000 square miles, and the population is probably 350,000. On their part the Germans are doing similar work. Between Pouro and Milne bays there is a ridge of lava and coral limestone, rising to 850 feet. The close relationship often supposed to exist between the flora of New Guinea and that of Australia seems scarcely borne out by the facts. Though Proteaceæ and Myrtaceæ abound in the savannahs of Fly River, yet the palms are numerous in species, and at least fifty indigenous plants are known.

Sir W. Macgregor has been specially engaged among the D'Entrecasteaux and Trobriand Islands. The latter are a little known group of small islets, with one language, and a population of some 15,000.

The most interesting discovery has been that of a number of atolls which have, since their formation, been elevated by a horizontal uplift. Kitava or Nowan has a surface of 5.6 square miles, and is now girt by a fringing reef: almost its whole circuit is surrounded by a low sloping margin about a quarter of a mile wide, covered with trees. This abuts against a steep coral wall three to four hundred feet in height, also covered with forest. Within this wall the land dips gently to a plateau fifty to a hundred feet below the edge of the wall, plainly the ancient lagoon. The soil in this interior plain is of a rich chocolate tint, and very fertile. All the natives reside in this protected area, which is drained by filtration through the porous coral rock. Kwaiwata is similar, but much smaller. Gawa is a still more perfect specimen, having a coral wall four hundred feet high, and so steep that it must be climbed by ladders, while the interior is a 100 feet lower. On approaching these islands from the sea they seem to be uninhabited, since the natives live in the saucer-like hollow. In Iwa the raised border has been worn away. A great portion of the south of Fergusson Island, one of the D'Entrecasteaux group, is occupied by the mountain mass of Edagwaba, 4-5000 feet high, composed of mica schist, and in the N. W. corner Kubioia rises to 3–4000 feet. The islets of Namu and Bagiagia are of coral, low and uninhabited. On each of the small Trobriand Islands there is a single village.

Polar Regions.—THE DANISH EXPEDITION.—Lieutenant Ryder of the Danish navy, contrived in spite of the floating ice which extended from three hundred to three hundred and fifty miles from Greenland, to enter Scoresby Sound last year, and to discover that it was really an extensive fjord with several branches. Hurry's Inlet, a branch toward the north, proved to be a fjord 28 miles long, with gneissic cliffs 3000 feet in height on the east, and westward the crags of Jameson's Land, 2500 feet high, seemingly composed largely of glacial moraine. Many Jurassic and Tertiary fossils were found on Jameson's Land, while at Cape Brewster, where the cliffs rose only from 300 to 500 feet, fossils of older date were found.

The southern shore of Scoresby Sound presents a lofty and unbroken granite wall sixty miles in length, the ground rising in the interior to 3000 feet. The widest inlet is named Hall's Inlet, and trends northwest. On its shores are *roches moutonnées* and striæ in abundance, but no ice. The inland ice is not met with until a distance of 176 miles from the sea is reached, it is found at the heads of the smaller bays and fjords, and all the fjords seem to reach it. The gneiss rises to 500 feet in the southwest, to 3000 in Milne's Land (west of Hall's Inlet) and to 6000 feet in the northern region explored—on the west it is covered with basalt. Animal life proved to be rich, especially on Jameson's Land, where reindeer occurred in wonderful numbers, while the musk-ox was found on Hurry's Inlet. No less than 150 species of flowering plants were gathered. No inhabitants were met with, but winter houses and graves were seen.

POLAR NOTES.—Several whalers have left Dundee for the Antarctic, in the hope of combining discovery with a good catch.

Dr. Drygalski, in connection with the Geographical Society of Berlin, has erected an observatory between the Great and Little Karajak glaciers, on Umanak Fjord, West Greenland.

Coal has been discovered in Spitzbergen by L. Cremer.

GEOLOGY AND PALEONTOLOGY.

The Western Lowland of Ecuador.—A paper by Dr. Th. Wolf, read at the Berlin Geographical Society, Dec. 3, 1892, gives the following account of the Western Lowland of Ecuador:—

Its superficial area is 25,950 square miles. As late as the end of the Neocene period the waves of the ocean washed the foot of the Western Cordillera of Ecuador. At the commencement of the Plistocene period a part of the northern half of the lowland appeared above the ocean while the southern half was covered over by an immense sandstone formation. The latter, containing here and there the bones of mastodons and horses, was, at a very recent period, subjected to upheaval, which gave to the country very nearly its present configuration.

The great low-lying plain east and west of the Gulf of Guayaquil as well as the smaller alluvial plains, are quite recent formations, true deltas. The highest points of the coast ridge attain an elevation of 2,300 feet in a chalk range between Guayaquil and the sea, and in the Cordillera of Chongon and Colonche. In the Neocene region there are summits of from 650 to 1000 feet. The Plistocene marine strata form a gently undulating country rising from 65 to 260 feet above sea-level, while the extensive plain of alluvium is quite level. The rivers which issue from the Western Cordillera, do not flow due west; but, in consequence of the chalk range which runs north and south, form two extensive river systems, Rio Guayas emptying into the Gulf of Guayaquil, and Rio Esmeralda, flowing without a delta into the sea at 1° N. latitude. (Geog. Journ. Feb., 1893).

Devonian Fossils from Manitoba.—During the summer season of 1888 and 1889, Mr. J. B. Tyrrell made a collection of the fossils of the Devonian rocks of the islands, shores and immediate vicinity of Lakes Manitoba and Winnipegosis. This collection forms the subject of a report by Mr. J. F. Whiteaves, published by the Geological Survey of Canada. According to the author, this collection is one of the most important that have been brought back by the Survey collectors for many years. The species represented are of unusual interest, not only on account of the number of new forms, but also as showing the close relations that exist, in so many respects, between the fauna of these rocks and that of the Devonian rocks of Europe.

Mr. Whiteaves' report comprises 105 pages of text illustrated by 15 full page plates. The classification followed, with few exceptions, is that adopted by Dr. Karl Zittel in his Handbuch der Paleontologie. (Contributions to Canadian Paleontology. Vol. I, Pt. IV, 1892).

Jura and Trias in Taylorville, California.—Professor Hyatt gives the following preliminary results of an examination of four different collections of intervebrate fossils from the Jura and Trias of the Taylorville region in California.

A general comparison of the Trias of Taylorville with that of Idaho and of the Star Peak range in the Humboldt region, Nevada, shows that the Idaho Trias has a well marked Triassic fauna, with fossil cephalopods recognized in Europe by Mojsisovics, Steinmann and Karpinsky, as belonging to the lower part of the Triassic system. This fauna appears to be more nearly the equivalent of that of the Werferner beds of the middle Buntersandstein of the German Trias than of any other.

The Trias of the Star Peak range contains an unmistakably younger fauna. The species show a parallelism with the Muschelkalk instead of the Saint Cassian stage, as has been supposed.

The Trias of Taylorville is quite as interesting as that of the other two localities, and it is suggestive that its age, as indicated by the fossils, is that of the Noric and Karnic series in the upper Trias.

The Lower, Middle and Upper Jura, are represented by characteristic fossils which can be closely compared with representative European species. No remarkable or entirely new types occur, such as have been found among the vertebrata of this continent.

On comparing the Taylorville with that of Aurora, Wyoming, and of the Black Hills, it is found that the latter were deposited in the same basin, the species being largely identical, and that they can be spoken of together as having characteristice of the fauna of the Callovian or Oxfordian in the upper Jura of Europe.

The supposed Callovian of Mount Jura has no species in common with those of Aurora or the Black Hills. This accords with the distinct fauna of the Bicknell sandstone and the Hinchman Tuff, and would go to show that there was no direct connection between the upper Jurassic faunas of the Rocky Mountain region.

The Oolite of the Rocky Mountain region is too little known to permit comparison. Dr. White has described a few fossils found by Dr. Peale near the lower cañon of the Yellowstone in Montana.

The lower Lias, having certain forms of undeniably European facies, occurs in western and southwestern Nevada, and perhaps in California east of the crests of the Sierra. These faunas are older than those found at Mount Jura.

It is obvious that the Jura occurs in widely separated patches, and that, so far as now known, Mount Jura exhibits a larger number of fragments of the series of the Jurassic system than any other locality in the United States. (Bull. Geol. Soc. Am., Vol. 3, 1892.)

The Post-Laramie Beds of Middle Park, Colorado.—Mr. Whitman Cross, in a paper read before the Colorado Scientific Society in October, 1892, points out the unconformities that exist between the Middle Park Beds of Colorado and the underlying recognized Laramie formations, and calls attention to the difference in lithological characters. A study of specimens collected at different points show that a large series of andesite rocks strongly resembling those that constitute the Denver conglomerates take part in this formation. The Lignitic beds also resemble those of the Denver beds. In regard to the fossil plants Mr. Cross finds that 12 out of 21 species from the Middle Park beds occur in the Denver beds. These facts, the author believes, justifies him in correlating the Middle Park beds with the Denver, and he agrees with Mr. R. T. Hill in assigning them to the Post-Laramie group.

It has been suggested by Mr. J. B. Hatcher,[1] that in view of the fact that at least two species of Agathaumas have been described from the Denver beds, that it would be well to take into account the evidence from the vertebrate fauna before settling definitely the age of the beds under discussion. (Proceeds Col. Sci. Soc. 1892).

Marine Pliocene Beds of the Carolinas.—The tables of the Molluscan fauna of the Waccamaw and Croatan Beds of the Carolinas recently published by Dr. Dall, establish the presence of genuine Pliocene beds in both the Carolinas. The Pliocene of Tuomey and Holmes is shown to be based on a confusion of species belonging to at least two horizons, and hence the classifications based upon the supposed characters of this non-existent fauna may now be consigned to oblivion. (Trans. Wagner Free Inst. 1892.)

Geological News.—General.—Mr. Ralph S. Tarr has called attention to the resemblance between the terraces now forming on the

[1]Amer. Journal Sci., Feb., 1893.

Colorada River in Texas, and the older ones of the Connecticut River. He suggests that the modes of formation may be identical. In the one case the floods and sentiment supply arise chiefly from the climatic accident of desiccation, while in the other they are the result of glacial accident. (Am. Journ. Sci. July, 1892.)

M. E. Ficheur has added an important fact to the knowledge of the geology of northern Africa. He finds that on the northern flank of the Atlas Mountains in Blidah (Algeria), and throughout the extent of the region occupied by the Chiffa schists, there is an anteclinal fold affecting the whole sedimentary series, a fold long drawn out and turned toward the north. This phenomenon appears to be the result of a lateral thrust from the north against the resisting mass of the Chiffa schists which formed, to all appearance, an island in the Cretaceous Sea. This folding took place after the Cartéirenne period, and very probably after the Helvétien stage, for these beds are seen to be disturbed at the end of this range on the slopes of the spur on the left side of the Harrach. M. Ficheur is of the opinion that the folding is limited to the Blidah range. (Revue Scientifique, Feb. 1893.)

Paleozoic.—In his notes on the Devonian formation of Manitoba, Mr. J. F. Whiteaves remarks that in Manitoba the Stringocephelus zone is remarkably clearly developed, and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. (Geol. Mag., Feb., 1893.)—Mr. Rollin Keyes calls attention to a well defined Kinderhook fauna intercalated in the Burlington limestone in northeastern Missouri. The fossils, chiefly molluscan, are found in a heavily bedded white encrinital limestone with a peculiar white chert in nodules and irregular bands. The forms are all species which characterize the Kinderkook of Burlington, Iowa. This seems to be an illustration of Barrande's celebrated "doctrine of colonies." (Am. Journ. Sci., Dec., 1892.)

Mesozoic.—According to Mr. H. W. Fairbanks the granitic rocks of southern California are not Archean. They are present as intrusions squeezed into rocks varying in age from the Jurassic to Paleozoic inclusive at the close of the Jurassic. (Geol. Mag., Feb., 1893.)—Mr. A. Smith Woodward reports the skeleton of a fish from the Oxford Clay of Wiltshire, England, which he "provisionally quotes as an immature example of *Ischyodus egertonii.*" The fossil tends to confirm the reference of *Ischyodus*-like fishes to the existing family of

Chimæridæ. (Ann. Mag. Nat. Hist., Jan., 1892.)——The fossil fragments of jaws and teeth described by Gervais under the name *Lepidosteus suessoniensis* have been referred by M. V. Lemoine to the genus *Champsosaurus* Cope. M. Dollo has recently published a critical comparison of Gervais' Lepidosteus with Champsosaurus to show that there is no point of resemblance between them, but that they present numerous and radical differences, and that Gervais' reference is correct. (Bull. Scien. de la France et de la Belgique, 1892.)

Cenozoic.—Señor Nogués, who has been exploring the Andesian volcanoes of Chillan, confirms the supposition of Pissis (*Geografia fiscia de la Republica de Chili*, 1875, Paris) concerning the existence of moraines of two distinct epochs, and therefore of glacial periods, one of them being anterior to the present volcanoes. This explains the orography of the region. (Geographical Journal, Feb. 1893.)——Mr. G. Cotteau, who is studying the fossil echinoderms of the Eocene of France, has recently described a number of new species belonging to the genera *Coptosoma* (Desor), *Liosoma* (Cotteau), *Micropeltis* (Pomel) *Circopeltis* (Pomel), and *Gagaria* (Duncan). The latter genus is represented in France by six new species belonging to the middle Eocene. (Revue Scien., Jan., 1893.)——Professor Cope recently exhibited to the Academy of Philadelphia a nearly entire mandible of the *Tetrabelodon shepardii* (*Mastodon shepardii* Leidy) from the Blanco (Pliocene) of Texas. He showed that it differs from the known species in the decurvation of the mandibular symphysis, which equals that of the corresponding part of the jaw of Dinotherium, but lacks the incurvature of that genus. He shows that the Mexican species formly referred to that species is distinct, and he proposed for it the name of *Mastodon oligobunis*.

BOTANY.

North American Fungi, Century XXIX.—Subscribers to Ellis & Everhart's North American Fungi were gratified recently by the receipt of the 29th volume of this great collection, with its neatly mounted and labelled specimens. It is one of the "miscellaneous" volumes, nearly all groups of the fungi being represented. Thus we find five Myxomycetes, among which is the new *Stemonitis virginiensis* Rex; the recently described *Peronospora echinospermi* Swingle; a dozen or so Uredineæ, some but recently described; *Erysiphe graminis* in fruit; many Pyrenomyceteæ, some Hymenomycetes, and a good many "imperfect fungi," the latter well represented by species of *Phyllosticta* and *Septoria*.—CHARLES E. BESSEY.

New York Fungi.—A new and interesting distribution of specimens of fungi has been undertaken by Mr. C. L. Spear, of Alcove, N. Y., under the title of "New York Fungi." It is designed particularly to illustrate the work of the well-known mycologist, Charles H. Peck, who, in the capacity of State botanist, has for so many years been engaged in the study of the fungi of New York. Century I contains the following species: *Amanita cæsaria* Scop., *A. phalloides* Fr., *A. muscaria* L., var. *alba* Pk., *A. vaginata* Bull., *Tricholoma album* Schæff., *Collybia radicata* Relh., *Mycena galericulata* Scop., *M. leaiana* Berk., *Omphalia campanella* Batsch., *Pleurotus sapidus* Kalchb., *Clitopilus cæspitosus* Pk., *Naucoria pruinatipes* Pk., *Hypholoma aggregata* Pk., *H. sublateritium* Schæff., *H. candolleanum*, Fr., *Coprinus picaceus* Fr., *C. micaceus* (Bull.) Fr., *C. plicatilis* (Curt.) Fr., *Lactarius deceptivus* Pk., *Cantharellus floccosus* Schw., *Marasmius oreades* (Bolt.) Fr., *M. rotula* (Scop.) Fr., *Panus stipticus* (Bull.) Fr., *Schizophyllum commune* Fr., *Lenzites betulina* (L.) Fr., *Boletinus pictus* Pk., *B. porosus* (Berk.) Pk., var. *opacus* Pk., *Boletus subluteus* Pk., *Polyporus perennis* (L.) Fr., *P. sulphureus* (Bull.) Fr., *P. fumosus* (Pers.) Fr., *P. adustus* (Willd.) Fr., *P. pubescens* (Schum.) Fr., *P. applanatus* (Pers.) Fr., *P. fomentarius* (L.) Fr., *P. conchatus* (Pers.) Fr., *P. hirsutus* (Wulf.) Fr., *P. pergamenus* Fr., *P. versicolor* (L.) Fr., *Dædalea confragosa* (Bolt.) Fr., *D. unicolor* (Bull.) Fr., *Gloeoporus conchoides* Mont., *Hydnum zonatum* Batsch., *H. graveolens* Delast., *H. coralloides* Scop., *Irpex paradoxus* (Schrad.) Fr., *Phlebia zonata* B. & C., *P. radiata* Fr., *Craterellus cornucopioides* (L.) Fr., *Thelephora schweinitzia* Pk.,

Stereum rugosum Pers., *S. acerinum* (Pers.) Fr., *Hymenochæte corrugata* (Fr.) Lev., *Corticium salicinum* Fr., *Cyphella tiliæ* (Pk.) Cke., *C. fulva* B. & Rav., *Clavaria botrytis* Pers., *C. formosa* Pers., *C. stricta* Pers., *C. fusiformis* Sow., *Spathularia flavida* Pers., *Guepinia spathularia* (S.) Fr., *Lycoperdon gemmatum* Batsch., *L. pyriforme* Schæff., *Scleroderma vulgare* Fr., *Phragmidium subcorticium* (Schrank.) Wint., *Puccinia peckiana* Howe, *P. graminis* Pers., *P. circææ* Pers., *P. pimpinellæ* (Strauss) Lk., *P. sorghi* Schw., *P. malvacearum* Mont., *P. mariæ-wilsoni* Clint., *P. fusca* (Relh.) Wint., *P. podophylli* Schw., *Uromyces junci* (Desm.) Tul., *U. polygoni* (Pers.) Fckl., *U. hyperici* (Schw.) M. A. Curt., *Ræstelia lacerata* (Sow.) Fr., *Æcidium clematidis* DC., *Ustilago caricis* (Pers.) Fkl., *U. avenæ* (Pers.) Jensen, *U. erythronii* Clint., *U. utriculosa* (Nees) Tul., *Sphacelotheca hydropiperis* (Schum.) Schrot., *Urocystis waldsteiniæ* Pk., *Microsphæra alni* (DC.) Wint., *Hypocrea richardsoni* B. &. M., *Hypomyces lactifluorum* Schw., *Diaporthe acerina* (Pk.) Sacc., *Hypoxylon fuscum* Fr., *H. blakei* B. & C., *Pezicula carpinea* (Pers.) Tul., *Cenangium cerasi* (Pers.) Fr., *Patellaria rhabarbarina* Berk., *Sphinctrina tigillaris* B. & Br., *Monilia fructigena* Pers., *Coniosporium rhizophilum* (Pr.) Sacc., *Trimmatostroma americanum* Thüm., *Septoria œnotheræ* West.—Charles E. Bessey.

Seymour and Earle's Economic Fungi.—The fifth fascicle of this set was distributed February 1st, 1893. It includes numbers 201 to 250, represented chiefly by Uredineæ parasitic on woody plants, many numbers (226 to 250) being devoted to the gymnosporangia, with their aecidial stages. Accompanying the set is a systematic list of hosts, from which one learns that the 50 species of fungi are parasitic upon 35 hosts, representing 13 families of flowing plants.

Of the usefulness of this set to students of the injurious fungi, little need be said. It is simply indispensable.—Charles E. Bessey.

Halsted's Weed-Seeds.—One of the most useful sets of specimens recently distributed is the "One Hundred Species of American Weed-Seeds," issued by Dr. B. D. Halsted, of New Brunswick, N. J. It consists of 100 small screw-capped vials, each containing a good quantity of cleaned seeds or achenes, in the condition in which they usually occur as impurities in horticultural and agricultural seeds. It supplements most admirably the two centuries of "American Weeds," issued by the same author.—Charles E. Bessey.

Morong's Naiadaceæ.—Students of the *Naiadaceæ* will be greatly helped by the sets of named specimens which Dr. Thomas

Morong, of Columbia College, is now distributing to subscribers. A set recently received contains 83 North American and European species and varieties, representing quite satisfactorily this difficult group. When the author's "Revision of the North American Naidaceæ," now in the press, is received, there will be little reason for students and collectors neglecting these interesting acquatics.—CHARLES E. BESSEY.

Canadian Mosses and Lichens.—Several years ago, Dr. John Macoun began the distribution of sets of "Canadian Musci," from material secured in his extensive collecting expeditions in the vast forests of the north and west. During the winter the fifth century came to hand, including numbers 501 to 600, some of which are interesting new species.

With this century of mosses came Century I of "Canadian Lichens," which promises to be fully as interesting a distribution as the other. The specimens are ample, and the labels are of the same neat style as those of the mosses.—CHARLES E. BESSEY.

ZOOLOGY.

The New England species of Balanoglossus.—In 1873, Alex. Agassiz described a Tornaria from New England which he ascribed to the common Balanoglossus of the region. Bateson later, studying in Virginia and North Carolina, showed that in *B. kowalevskii* there is a direct development. The question at once arose, what form did Agassiz have? Either his Tornaria did not belong to *B. kowalevskii* or the same species has a different development in different regions. Now Prof. T. H. Morgan announces[1] that he has found Bateson's larvæ with the *Balanoglossus kowalevskii* on the southern coast of New England. This clears up one problem but it still leaves the origin of the Tornaria questionable.

Marsipobranchs.—Beard reports[2] that in young Myxines in which the pronephros was functional, the teeth were present in several rows upon the roof of the mouth. Apparently there is no Ammocete stage, but there is a metamorphosis. He further finds that at least in one specimen of a male Petromyzon in about one section in forty of the testis there was a well marked ovum, occupying a follicle for itself.

The Lateral Line of Siluroids.—Pollard has been tracing the cephalic divisions of the lateral line system in several Siluroids[3] and while his work is largely descriptive and admits of no abstract, one is struck with the support he brings to the old view of Huxley that the Arthrodira are near relatives of the Siluroids and especially to the close affinities of Clarias and Coccosteus. The parallels in the canals of the two forms are very exact. On the other hand Pollard points out a close resemblance between the African genera Clarias and Auchenaspis and the South American, Chætostomus. The facts remains, that while careful studies of the lateral line like these of Pollard may in future throw much light upon the phylogeny of various groups of fish-like forms, we have as yet not data enough for much generalization.

Prodromus of a new System of the non-venomous Snakes.—The unsatisfactory character of the existing classifications of the

[1] Zool. Anz. XV, 456, 1892.
[2] Anat. Anz. VIII, p. 59, 1892.
[3] Zoolog. Jahrbüches, VI, 1892.

non-venomous snakes is well known. That authors are not agreed as to the principles on which these animals should be classified may be learned by comparison of the systems published by Duméril and Bibron in 1853, Günther in 1858, myself in 1886 (Proceeds. Amer. Philos. Society), and Boulenger in 1892 (Reptilia of Zoology of British India). It had appeared evident to me that a further examination of the anatomy of these reptiles is necessary before a correct account of their mutual relations can be given, and that the organs of the reproductive system especially, were likely to yield important results. With the object of obtaining light on this question, I have made an examination of the hemipenis, and have obtained valuable indications of relationship which have been hitherto unknown. I have had the opportunity of examining material from the collections of the Academy of Philadelphia, of the U. S. National Museum, and of my own cabinet. I present here a general synopsis of the results, reserving for a future occasion the publication of a fuller illustrated memoir on the subject. The resulting classification is more in harmony with the systematic indications obtained from the study of other vertebrata, than those hitherto adopted, which is itself an indication of its greater approximation to nature. Some points remain obscure, and many details are omitted from the present prodromus.

The hemipenis of the Ophidia is traversed by a groove which divides the muscular investment to the internal integument (or external integument when the organ is retracted), which commences at the base internally, and soon turns to the external side of the organ and continues to its extremity. This is the sulcus spermaticus. This sulcus is always bifurcated in venomous snakes, and I find it to be equally bifurcated in many harmless snakes. The investing tissues may or may not correspond with this bifurcation. Thus the hemipenis may be more or less bifurcate. Schlegel states that it is bifurcate in venomous snakes but it is not so in *Hydrophis hardwickii*, *Bungarus semifasciatus*, *Hoplocephalus coronatus*, etc., while it is bifurcate in many non-venomous forms. Next to the bifurcation of the sulcus in importance, is the nature of the surface of the external investment (internal when retracted). In the most perfect types both venomous and non-venomous, this surface is reticulate like tripe, the enclosed areas forming calyces, which may have a suctorial function. Their borders are generally papillose, and are sometimes so deeply divided into papillæ as to lose their original character. These papillæ may be the seat of osseous deposit, becoming bristles or spines, which become larger toward the middle of the length, and lose their mutual membranous connections. These isolated spines

may extend to the apex, but they rarely extend to the base. The surface may, however, be laminate and not recticulate, and the laminæ may be longitudinal or transverse. In either of these cases they may not be spiniferous. The apex or apices of the organ may be furnished with a rigid papilla or awn. The entire surface of the organ when protruded, is designed for the maintainance of its position in the oviduct of the female, from which it cannot be withdrawn, excepting by invagination.

In the Tortricina and Peropoda, the hemipenis is not spinous, and the sulcus is bifurcate, and in the Boidae the hemipenis is bifurcate also, although in some genera (Xiphosoma, Ungualia), the branches are very short. The external integument is never reticulate, but is always laminate with elongate papillæ at the extremities, in Epicrates, Xiphosoma, and Ungualia. The laminae are pinnate from the sulcus as an axis, in Morelia, Enygrus, Lichanura and Eryx, and are transverse in Charina. In Ilysia they are pinnate, with a few longitudinal plicæ below.

The general definitions of the families exclusive of the Peropoda are as follows.

No spines; surface longitudinally plicate; *Calamariidæ.*

The surface of the hemipenis is flounced more or less transversely; *Lycodontidæ.*

The surface is more or less reticulate, and the sulcus spermaticus is undivided; hypapophyses anterior; *Colubridæ.*

The surface is reticulate or longitudinally plicate, and the sulcus is divided; hypapophyses anterior; *Xenodontidæ.*

The surface is neither reticulate nor flounced, and the spines when present are disconnected; hypapophyses continued to caudal vertebræ; *Natricidæ.*

The Calamariidæ approach in the characters of the hemipenis to such Peropoda as Eryx. The character assigned to the Lycodontidæ is more or less distinctly present in the typical or Solenoglyph venomous snakes; while the Najidæ (exclusive of Elapidæ) on the other hand, cannot be distinguished from the Xenodontidæ, by any general character. The Lycodontidæ are Old World with a single genus in America; a distribution resembling that of the Pythonidæ. The Colubridæ inhabit the Old World and North America, a few genera entering South America. The distribution is like that of the firmisternial Salientia. The Xenodontidæ are of South America and Madagascar, a few genera entering Africa and North America, a distribution nearly like that of the Iguanian lizards. The Natricidæ are distributed in the Northern Continents, very few types occurring in Africa and none in South America.

It will be observed that all of the families include burrowing types, and that the Colubridæ and Xenodontidæ include also arboreal types. This result is in accordance with the general rule that adaptations to present environment are not indications of the deepest affinities. All the families include glyphodont genera. The genera included in these families are the following:

CALAMARIIDÆ.

In *Calamaria gervaisii* the plicæ are well developed. Species formerly referred to Simotes belong here. In *Holarchus*[4] (Cope) *ancorus*, the sulcus is undivided, and the distal part of the external side is membranous. In the *H. trinotatus* the sulcus and hemipenis are shortly bifurcate, for which reason I refer it to a distant genus under the name of Dicraulax. I have had access to very few types of this group, and consider the present arrangement provisional.

LYCODONTIDÆ.

I. Aglyphodont; sulcus spermaticus undivided.

No palatine or pterygoid teeth. (In *Oligodon subquadratus* the only species of the genus examined, there are two robust papillæ on the extremity of the hemipenis); *Oligodontinæ.*

Hemipenis simple; palatine and pterygoid teeth; *Lycodontinæ.*

II. Aglyphodont; sulcus spermaticus, and generally hemipenis, bifurcate; *Boodontinæ.*

III. Glyphodont; sulcus and hemipenis bifurcate; *Cantoriinæ.*

IV. Glyphodont; sulcus simple; *Uriechinæ.*

To the Lycodontinæ belong Lycodon and Anoplophallus (=Megalops Hallow.) which has a long loreal and no preocular plate, and no spines on the hemipenis. To the Boödontinæ belong Boödon and Lamprophis; to the Uriechinæ, Uriëchis and the sole American genus, Stenorhina. The typical genus of each of the other subfamilies are the only ones I have been able to examine. The Oligodontinæ may belong to the Calamariidæ.

COLUBRIDÆ.

The subfamilies are as follows:

Aglyphodont; hemipenis reticulate; *Colubrinæ.*

Glyphodont; reticulate; *Dipsadinæ.*

Glyphodont; longitudinally laminate; *Chrysopeleinæ.*

The COLUBRINÆ are either burrowing (fusiform), terrestrial (colubriform), or arboreal (attenuate), and are so grouped for convenience.

[4] Bulletin, U. S. Natl. Museum, 32, 1887, p. 54.

Fusiform. Chilomeniscus; Ficimia; Geagras; Cemophora; Rhinochilus; Conopsis (has papillæ at the apex in addition to a few cups).; Stylosoma (spinous nearly to apex.)

Colubriform. Contia; Hypsiglena (pocketed below apex); Proterodon; Dianodon; Coronella; Ophibolus; Rhinechis; Phyllorhynchus (four rows of spines dividing calyculate apex); Salvadora; Symphimus; Epiglottophis; Pityophis; Spilotes; Coluber; Bascanium; Drymobius; Zamenis; Ptyas; Herpetodryas; Cyclophis; Liopeltis; Cynophis (has a terminal papilla which is produced into an awn); Crossanthera, (g. n.) established for *Deudrophidium melanotropis* Cope, on account of the total division of the walls of the small cups into papillæ.)

Attenuate. Dendrophis; Leptophis; Bucephalus; Dasypeltis (papillæ spinous to apex.)

In the DIPSADINÆ the same gradation appears.

Fusiform. Tantilla; Scolecophis; Ogmius (spines to apex).

Dipsadiform; (generally pocketed below apex). Sibon; Trimorphodon; Crotaphopeltis; Himantodes; Rhinobothryum; Dipsas.

Attenuate. Cladophis; Oxybelis; Dryophis (has a diverticulum simulating a bifurcation of the hemipenis); Tragops; Passerita.

The CHRYSOPELEINÆ includes only the genus Chrysopelea, so far as I have examined.

Genera of Colubridæ in which the calyces are not papillose, are Phyllorhynchus, Hypsiglena, Dianodon, Proterodon, Coronella, Symphimus, Dendrophis, Crotaphopeltis and Dipsas.

XENODONTIDÆ.

The arrangement of the genera of this family is difficult, and what is presented here is only tentative. It seems probable that some genera with a grooved posterior tooth are more nearly allied to others with a smooth tooth than to each other; but on the other hand the external form of the animal is a poor guide, as all forms pass into each other. So also the reticulate or plicate character of the integument of the hemipenis. Many of the genera may be distinguished by details of structure. As before, I desiguate the general forms as fusiform, colubriform, attenuate, and dipsadiform; and for the present I adopt two subfamilies.

Aglyphodont; *Xenodontinæ.*

Glyphodont; *Scytalinæ.*

XENODONTINÆ.

Fusiform. Catostoma; Carphophiops; Farancia*†; Pseudoeryx; Ninia.

Colubriform. Homalosoma†; Grayia; Theleus g. n.; Diadophis; Rhadinæa; Pliocercus; Opheomorphus*; Liophis*; Dromicus; Alsophis; Lianthera g. n.; Hypsirhynchus*; Amastridium; Helicops; Xenodon*; Acanthophallus†; Lystrophis*; Heterodon.

Attenuate. Uromacer.

Dipsadiform. Leptognathus†, Mesopeltis†.

The genera of this subfamily in which the surface is exclusively longitudinally plicate are marked with a star; on the other genera it is more or less reticulate. The genera in which the extremity is spinous are marked with a †. In Theleus the hemipenis is simple, and its apex is covered with short separate papillæ, below which it is coarsely spinous; type *Boodon virgatum* Hallow. from W. Africa. Lianthera is established on *Herpetodryas bernieri* of Madagascar, and related species, on account of the absence of calyculi, and weak development of spines of the hemipenis, and the isodont dentition. The genus Acanthophallus is designed to include the species formerly referred to Xenodon in which the hemipenis is spinous to the extremity. The type is *X. colubrinus* Gthr; the anal plate is entire. In Xenodon the extremity is smooth and plicate, and the anal plate is divided.

SCYTALINÆ.

Fusiform. Hydrocalamus.†

Colubriform. Pseudophis; Erythrolamprus*; Tachymenis†; Coniophanes; Conophis; Rhinostoma; Scytale; Oxyrrhopus; Tomodon†; Thamnodynastes (includes *Tachymenis hypoconia* M.), Tropidodryas; Philodryas; Jaltris.*

Attenuate. Langaha.

As in the Xenodontinæ, genera with the apex plicate only are marked with a star, and those with a spinous apex are marked with a dagger. The only species of Tomodon I have examined is the *T. ocellatus*, which is not the type. The position of Langaha I am not satisfied about, as it may be an attenuate form of the Natricidæ.

NATRICIDÆ.

This family, which I first defined from vertebral characters, is generally easily distinguished from the others by the characters of its hemipenis. This organ is never reticulate, and the spines are always small or rudimental. When present they originate in fossæ of the integument and are never connected by tegumentary folds, except when they sometimes stand on longitudinal plicæ. The aglyphodont genera (except the Pseudaspidinæ) make up for the deficiency of the spines, by the presence of one or two large hooks on one side of the sulcus spermaticus at the base. The sulcus is variable, being sometimes simple, and sometimes bifurcate. The subfamilies are as follows:

¶Glyphodont.	Spines better developed; no basal hook;	*Homalopsinæ.*
¶Aglyphodont.	Spines rudimental; no basal hook;	*Pseudaspidinæ.*
¶Aglyphodont.	Spines rudimental; a basal hook.	*Natricinæ.*

Of the HOMALOPSINÆ only the genera Homalopsis, Herpeton, and Cerberus have come under my observation; but I suppose that Hypsirhina and other allied Asiatic genera will be found to present the same characters. In both genera the sulcus is bifurcate, and the hemipenis divided.

I have been able to examine but one genus of the PSEUDASPIDINÆ, viz., Pseudaspis Cope (type *Coronella cana* L.), but I suspect that Ablabes (*A. rufulus*) which is African, belongs here. In Pseudaspis the sulcus is bifurcate, and the hemipenis is divided almost to the base, quite as in the most specialized Solenoglypha.

NATRICINÆ.

This natural group includes fusiform and colubriform genera, and presents great variations in the form of the hemipenis. The Asiatic species have that organ bifurcate, while in the European and American water snakes it is simple.

Fusiform. (Hemipenis simple). Haldea; Tropidoclonium (the apex with a pair of robust papillæ as in Oligodon;) Virginia.

Colubriform. I. Sulcus and hemipenis undivided. Storeria; Eutænia; Natrix; Clonophis; Liodytes. II. Sulcus and hemipenis divided. Diplophallus, g. n. (type *Tropidonatus piscator* Schneid.; has syncranterian dentition, and no apical papilla); Amphiesma; Ceratophallus (established on *Tropidonotus vittatus* on account of the presence of a rigid papilla on the apex of each branch of the hemipenis.)

Similar gradations in the characters of the hemipenis are to be seen in the types of venomous snakes. Thus in the Proteroglypha this organ is spinous to the tip, on a calyculate basis, in Hydrophis, Elaps, (*surinamensis*); Dendraspis. It is reticulate at the extremities and spinous below, in Callophis (*bivirgatus*); Naja; Acanthophis; Bungarus and Sepedon; the apex smooth in the two genera last named. In *Elaps nigrocinctus* the organ is usually smooth, with a few spines at the apex.

In Solenoglypha the genus Atractaspis is spinous to the apex, apparently on a longitudinally laminate basis. In the Viperidæ and Crotalidæ the spines are on a flounced basis. The apices are calyculate in Bitis, Clotho, and Vipera, and spinous in Cerastes. They are calyculate in Crotalidæ in Bothrops, Ancistrodon, Crotalophorus, Crotalus and Uropsophus. In Crotalus (*durissus* of the Neotropical fauna), the median spines are replaced by papillæ, in all the other genera they are spinous.—E. D. COPE.

Zoological News. PROTOZOA.—Prof. August Gruber, in a note on nuclear multiplication and swarm formation in the Freshwater Rhizopoda[5] describes an Arcella in which milotic cell division occurred. He also figures Arcella with 19 and 32 nuclei, and *Lecythium hyalinum* with eightnuclei. These facts are adduced in evidence that among the fresh-water Rhizopods reproduction by spore formation coexists along with simple fission. In other cases Gruber found small bodies in Arcella tests which at first sight might be taken for swarm spores but which are none other than parasitic Amoebæ.

WORMS.—Nachtrieb and Barrows are studying the leeches in Minnesota. In a preliminary note[6] Mr. Barrow states that they have found 11 species of Gnathobdellidæ, 10 of Rhynchobdellidæ and 1 of Branchiobdellidæ. It is noted that two species of Aulostoma can be distinguished by the fact that in the one the right sperm duct passes under the nerve cord; in the other the left. A final report is promised.

Henry B. Ward reports[7] the host of *Nectonema agile*.[8] Dr. McMurrich found a worm, like Nectonema except that it lacked the lateral bands of setæ, characteristic of the adult, in the thoracic cavity of Palæmonetes. This when studied by Dr. Ward, proved to be a female Nectonema.

MOLLUSCA.—H. Suter enumerates 142 species of land molluscs, 32 fluviatile, and 18 brackish water species, in New Zealand.

According to C. Hedley, *Parmacochlea fischerii* collected by the "Challenger" expedition is most nearly allied to Helicarion.

[5] Ber. Naturf. Gesellsch. Freiburg, VI, 114, 1892.

[6] Quarterly Bulletin, Univ. Minnesota I, p. 87, 1893.

[7] Proc. Amer. Acad. Arts and Sci. 1893, p. 260.

[8] See AMER. NAT. XXVI, 1037, 1892.

EMBRYOLOGY.[1]

Germ-layers of Vertebrates.[2]—Basilius Lwoff has extended his work upon the germ-layers of Amphioxus[3] to other vertebrates and put forth a preliminary paper that arouses in us a lively interest in the final detailed account that is to contain both his own discoveries and a discussion of the literature of the subject.

In the present paper he makes statements directly contrary to some opinions that up to the present time we have supposed to be well-founded in fact.

Besides Amphioxus, he has studied the formation of the germ-layers in Petromyzon, the Axolotl, Pristiurus, Torpedo, Labrax, Julis, Gobius, and Lacerta. He regards the Chordata as derived from a gastrula-like ancestor. Gastrulation is defined as the process by which the gut is formed, and the entoblastic cells are those which form the gut, whatever else they may produce. In Amphioxus and Vertebrates with holoblastic eggs, cleavage results in a blastula, one-half of which is composed of micromeres, the other of macromeres. Owing to the continued more rapid multiplication of the micromeres, they cover and grow around the macromeres. When the blastula is single layered, as in Amphioxus, this results in the invagination of the macromeres, where it is several layered, as in Petromyzon and the Amphibia, they are simply surrounded by the micromeres.

The macromeres form the gut and are therefore entoblast, while the micromeres form the outer covering and are therefore ectoblast. But there can be no distinction between entoblast and ectoblast until the micromeres have surrounded the macromeres. Besides this process of gastrulation there is a *dorsal invagination* that has nothing to do with the formation of the gut, but forms the whole ectoblastic rudiment of the chorda and the mesoblast.

The blastula of Petromyzon contains an extensive cleavage cavity, the roof of which is composed of micromeres and the floor of macromeres. The former multiplying more rapidly, grow around the latter. At the same time a new cavity is sunk into one side of the embryo, the roof being formed of invaginated ectoblast, while the floor is com-

[1] This department is edited by E. A. Andrews, Johns Hopkins University.

[2] Biol. Centblt. 13, 1893, 40–50, 76–81.

[3] See AMERICAN NATURALIST, March, 1893, p. 228.

posed of entoblast that has not been invaginated. As in Amphioxus, this invaginated ectoblast forms the chorda and part of the mesoblast, while the entoblast forms the rest of the mesoblast as well as the gut.

Nearly the same process, according to Lwoff, takes place in the Axolotls. But here the dorsal invagination begins, while the micromeres are growing over the macromeres, and the ectoblastic rudiments of the mesoblast never form part of the roof of the enteric cavity. In the frog, however, Morgan[4] and Robinson and Assheton[5] seem to have found good evidence that the micromeres do not grow around the macromeres, but that the superficial ones of the latter are themselves gradually split up into micromeres, so if we are to accept Lwoff's interpretation of the dorsal invagination, the gastrulation in this form may better be described as being by delamination than by an epibolic process. Moreover, according to the apparantly accurate work of Robinson and Assheton, there is no invagination of the ectoblast in the frog.

In Selachians and Teleosts, Lwoff believes the entire entoblast arises from the yolk-elements, that is, the periblast. This is surprising in view of the many statements to the contrary, especially H. V. Wilson's[6] work on the sea-bass. Lwoff finds the chorda and part of the mesoblast to be formed from the same elements as the nervous system. The entoblast also takes part in the formation of the mesoblast.

In Lacerta, cleavage results in a two layered germinal disc. The inner layer becomes the entoblast. An invagination from the outer layer forms the chorda and part of the axial mesoblast. The rest of the axial and the peripheral mesoblast is of entoblastic origin.

The process in the formation of the germ layers throughout the Vertebrates is practically the same as in Amphioxus, except that there is no invagination to form the entoblast, and there are, therefore, no gastrula lips. There is but one point in the embryo that is homologous in all Vertebrates, and that is the point where the ectoblastic invagination begins. The so-called neurenteric canal does not lie between the neural canal and the archenteron, but between the former and the chorda, and shows their intimate connection—R. P. B.

The Mantle of Ascidians.—In studying live specimens of larval Phallusia, A. Kowalevsky[7] at first thought with Hertwig, Sem-

[4] AMER. NAT., Aug., 1891, p. 753.

[5] Quart. Jour. Mis. Sci., 32, 1891, p. 451.

[6] Bul. U. S. Fish. Com., 9, 1891, p. 209.

[7] Mem. l'Acad. Imp. Sci. St. Petersburg, 7, 37, No. 10, 1892.

per, Maurice and others, that the mantle of this ascidian should be regarded as an epidermis-like structure, a thickening of the ectoderm with large amounts of intercellular material between the ectodermal cells.

On studying sections of this larva, however, he obtained evidence that mesodermal cells migrate out through the epidermis of the larva into the thick hyalin cuticle or secreted mantle matrix, and thus supply mesodermal cells as the fundamental cells of the mantle.

These migrating cells the author would regard as a sort of phagocytes and imagine to have a primary function in destroying the injurious parasites, bacteria, etc., that would easily lodge in the secreted mantle matrix.

In the same paper there is an interesting account of the degenerative changes that the tail of the larva undergoes when free life is given up. After peculiar histological transformations in the notachord and muscles of the tail, these cells and the epidermal cells pass into the body. The last of the tail is drawn in by an actual hollow invagination that forms a closed vesicle in the body. The ultimate changes in the muscle cells are accompanied by the activity of clusters of phagocyte-like mesoderm cells.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 5.—The following paper was read by Professor George Lincoln Goodale: "On some aspects of Australian vegetation." It was illustrated with stereopticon views.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences. Biological Section.—March 13, 1893.—Professor T. D. Quackenbos, in a paper on the Saibling of Lake Sunapee, distinguishes, in this, a fourth variety of New England Charr, demonstrating that the present abundance of this *Salvelinus* is accounted for not from its introduction and natural increase, but from destruction of inimical forms within recent years which has given a greater available food supply. Professor G. S. Huntington, on "Anomalies of Pectoralis major and minor," referred to the value of these as often presenting reversions. He emphasized the evolutionary tendency in man to proximalization of the points of attachment of the shoulder muscle group, referred to cleavage variations in anterior portion of brachiocephalic sheet, and compared these with ontogenetic characters in Anthropoids. Human anomalies in this group are best interpreted by Cynocephaloids, and not by the higher forms. Professor E. B. Wilson, "On Regeneration and the Mosaic Theory of Development," presented a brief critique on the latest results of Rous and Weissman.

BASHFORD DEAN, *Secretary.*

Natural Science Association of Staten Island.—February 18.—A series of twenty photographs of Staten Island trees were shown by Dr. N. L. Britton—duplicates of the set taken by Mr. Romeyn B. Hough, for the State Forestry exhibit at the Columbian Exposition, as mentioned at the meeting of October 15, 1892.

Mr. Joseph C. Thompson stated that since the last meeting he had made another bacteriological examination of the Crystal Water Company's water, from a sample taken from a hydrant at the corner of New York Avenue and Cliff Street, and found 185 individual bacteria per cubic centimetre. The temperature of the water was 34° Far. As previously stated, the New York City Croton water contains about 12,000 per cubic centimetere.

Mr. Arthur Hollick presented a piece of ferruginous sandstone, containing impressions of dicotyledonous leaves. The specimen resembles those found in the Drift, at Tottenville and Princes Bay, which are known to be derived from the Cretaceous clays. The specimen in question, however, was found as a Drift rock on the Serpentine hills, to the north of the Cretaceous area. It is possible that it may have been brought to the place where it was found by human agency, but if not, its occurrence there is more or less of a problem which future discoveries may solve. It is desired, at present, merely to place the fact upon record.

The Biological Society of Washington.—March 11.—The following communications were made: Dr. Frank Baker, "Recent Discoveries in the Nervous System;" Mr. Vernon Bailey, "The Burrow of the Five-toed Kangaroo-Rat;" Mr. E. M. Hasbrouck, "The Breeding of the Bald Eagle near Mount Vernon"—with exhibition of Eggs.

March 25.—The following communications were made: Mr. L. M. McCormick, "A Hybrid between *Pyranga rubra* and *Pyranga erythromelas*;" Prof. E. W. Doran, "Development of the Intestine of Tadpoles;" Dr. Theobald Smith, "The Bacteriology of Potomac Water and its Bearing on Sanitary Problems;" Mr. B. T. Galloway, "Experiments in Preventing Rusts Affecting Cereals."

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Feb. 21.—The following papers were read: "The Foundation of the Zuni Cult," Mrs. Matilda Coxe Stevenson; "Dual Civic Functions: a study in the evolution of institutions," Miss Katie Foote; "Early Man in the Mississippi Valley," Mr. Thomas Wilson.

WESTON FLINT, *Sec'y Board of Managers.*

SCIENTIFIC NEWS.

At the meeting of the Geographical Club in the Hall of the Academy of Natural Sciences of Philadelphia, it was announced that the result of the balloting among the members of the club upon the question of active co-operation in the proposed new expedition to the Arctic regions under the lead of Lieut. R. E. Peary, stood in favor of the project.

The proposed expedition will involve an expenditure of from $20,000 to $25,000. The expenditure covers two northern voyages. The first to land Peary and his party, and the second to bring it back upon the completion of its work. An auxiliary summer expedition is to be organized to take charge of the ship on her second voyage, the movements of the vessel to be under the control of the Geographical Club.

The design of the expedition is the complete determination and delineation of the detached land masses lying to the north of main Greenland. The second object will be the determination of the unknown portion of the east coast of Greenland, extending from Independence Bay to Cape Bismarck, the most northern point sighted by the German expedition in 1870. The third object will be the determination of the transverse profile of the Greenland inland ice cap, from Cape Bismarck to Inglefield Gulf.

Other aims of the expedition will be the complete detailed survey of Whale Sound and Inglefield Gulf, with studies and measurements of the glaciers in that region, and their parent ice cap; a continuation of the study of the little tribe of Arctic Highlanders. As complete collections as may be practical will be made of the natural objects of the region, and more or less extended meteorological and tidal observations carried on.

The amount of funds to be contributed by the Geographical Club will be from $8,000 to 10,000.

Botanists will hear with regret of the death at Brighton, Jan. 18, of Dr. Benjamin Carrington, the highest authority on British Hepaticæ.

The State of Iowa has assumed the expense of the publication of the papers and proceedings of its Academy of Sciences, the Legislature having made an appropriation for that purpose at its last meeting.

Professor A. M. Miller has been appointed to take charge of the department of Geology which has just been established in the State College of Kentucky, at Lexington.

Mr. John Eyerman has presented to the Princeton Museum a set of casts of *Rhytina gigas* Linn., after the originals in the British Museun. The number of casts is 20, that of the cranium, measuring 2½ feet, being the largest.

M. Johnston-Lavis has been appointed Professor of Vulcanology at the University of Naples. A similar chair existed at Catania, but it was abolished at the death of its occupant, M. Silvestri.

Mr. G. W. Lichtenthaler, one of America's most eminent conchologists, died in San Francisco. Feb. 20, 1893. For 20 years he had been a traveler and collector in almost every sea and country. During this time he brought together a large collection of specimens, which he bequeathed to the Illinois Wesleyan University, in his home city, Bloomington, Ill.

The collection embraces mainly shells, sea algae and ferns. His shells have been estimated conservatively at from six to ten thousand species, including thousands of duplicates. They embrace the Hemphill collection which he purchased, a large collection from the Hawaiian Islands, which he visited often; many from the Micronesia, Australia, Japan, the coasts of Europe, and America, and from every part of the United States.

The sea algae contain about a thousand species, all mounted in books and identified, and a large number of duplicates. They were collected from both coasts of America, from north to south, a large number from England, and many from other countries.

There are about 500 species of ferns, including the many duplicates. They represent a complete collection of the ferns of the Hawaiian Islands, and almost a complete collection of those of the United States, besides many from Europe, Asia, Australia, South America, etc.

He has also brought together many mosses and lichens, the number of which cannot be given with precison, but there are several hundred species.

The Marine Biological Laboratory of the Johns Hopkins University will be located this Summer at Port Henderson, Kingston Harbor, in the island of Jamaica.

Dr. R. P. Bigelow, present holder of the Bruce Fellowship with Messers Lamb, Siegirfuss and Lefevre left Baltimore, April 20, by a fruit steamer for Port Antonio, whence they will go to Kingston to open the Laboratory. Others with the Director, Professor W. K. Brooks expect to go down there later.

CAMBRIDGE, MASS., April 15, 1893.

THE Faculty of the MUSEUM OF COMPARATIVE ZOOLOGY will receive applications from candidates desiring to occupy the table at the NAPLES ZOOLOGICAL STATION, which has been placed at its disposal from October 1, 1893.

The applicant must be (or have been recently) a student or instructor

at some American University, preferably a person who has taken the degree of Ph.D. or S.D.; he must have published some creditable original investigation, and should be recommended as an able investigator by the professor under whom he has studied.

Applicants will please forward to the undersigned, before May 10 their recommendations and a statement of their qualifications and of the subject to which they hope to devote themselves.

In order that the Faculty may make the most satisfactory disposition of the table during the whole year, the applicants are requested to state the length of time they desire to remain at Naples, and also the earliest and latest dates within which they can avail themselves of the appointment.

The Faculty will, at its meeting in May, nominate to the Corporation of Harvard College for approval the incumbent or incumbents for the year 1893–1894.

ALEXANDER AGASSIZ,
Director.

The North American Review. Table of Contents for April, 1893.—*Charges at the World's Fair*—by Director-General Davis. Brain Surgery—Dr. William A. Hammond. Shipbuilding Here and Abroad—Naval Constructor Hichborn, U.S.N. Good and Bad Mothers—Mrs. Amelia E. Barr. *How Shall the Pension List be Revised?*—by Representative Wilson, of Missouri, Chairman of the Committee on Pensions; Gen. S. S. Burdett, Past Commander-in-Chief of the Grand Army of the Republic, and Col W. C. Church, editor of the "Army and Navy Journal." Art of Mystery in Fiction—George Manville Fenn. The Interior of the Earth—George F. Becker, of the United States Geological Survey, Two Englishwomen on America—1. by Lady Grey-Egerton; 2. by Lady Sykes. Faults in our Consular Service—the Hon. Robert Adams, Jr., Ex-Minister to Brazil. After Death—What?—the Rev. Charles F. Dole. The Negro as a Mechanic—the Hon. Robert Lowry, Ex-Governor of Mississippi. Middle-Class Life in France—the Marquise de San Carlos. *The Financial Situation*—1. The Currency and the Democratic Party—by the Hon. R. P. Bland, Chairman of the Committee on Coinage, etc.; 2. The Brussels Conference Reviewed—by the Hon. Charles Foster, Ex-Secretary of the Treasury. *Notes and Comments.*—"By Women for Women"—Lillian A. Mercur. Do the Fittest Survive?—W. A. Croffut. The Abuse of Secrecy—Clara Dixon Davidson. English Poor Law Reform—Edward Porritt.

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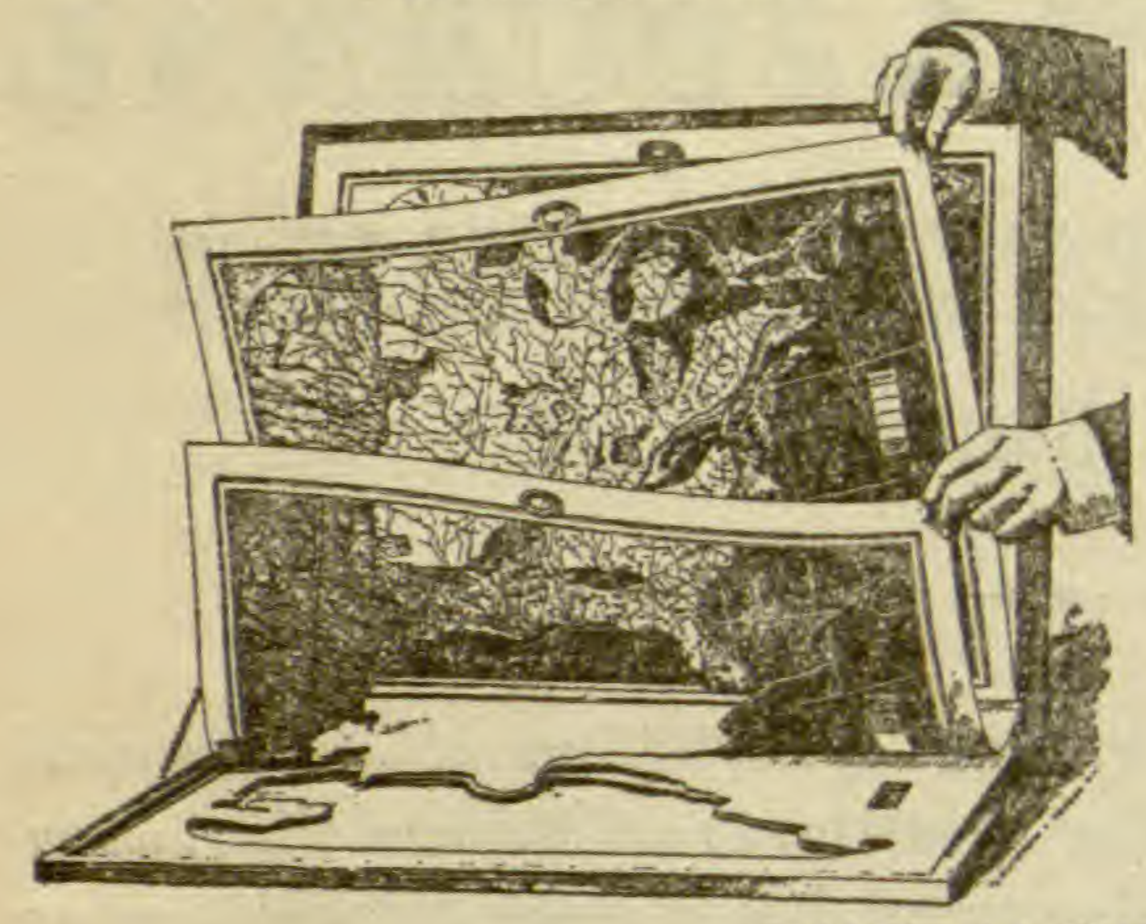

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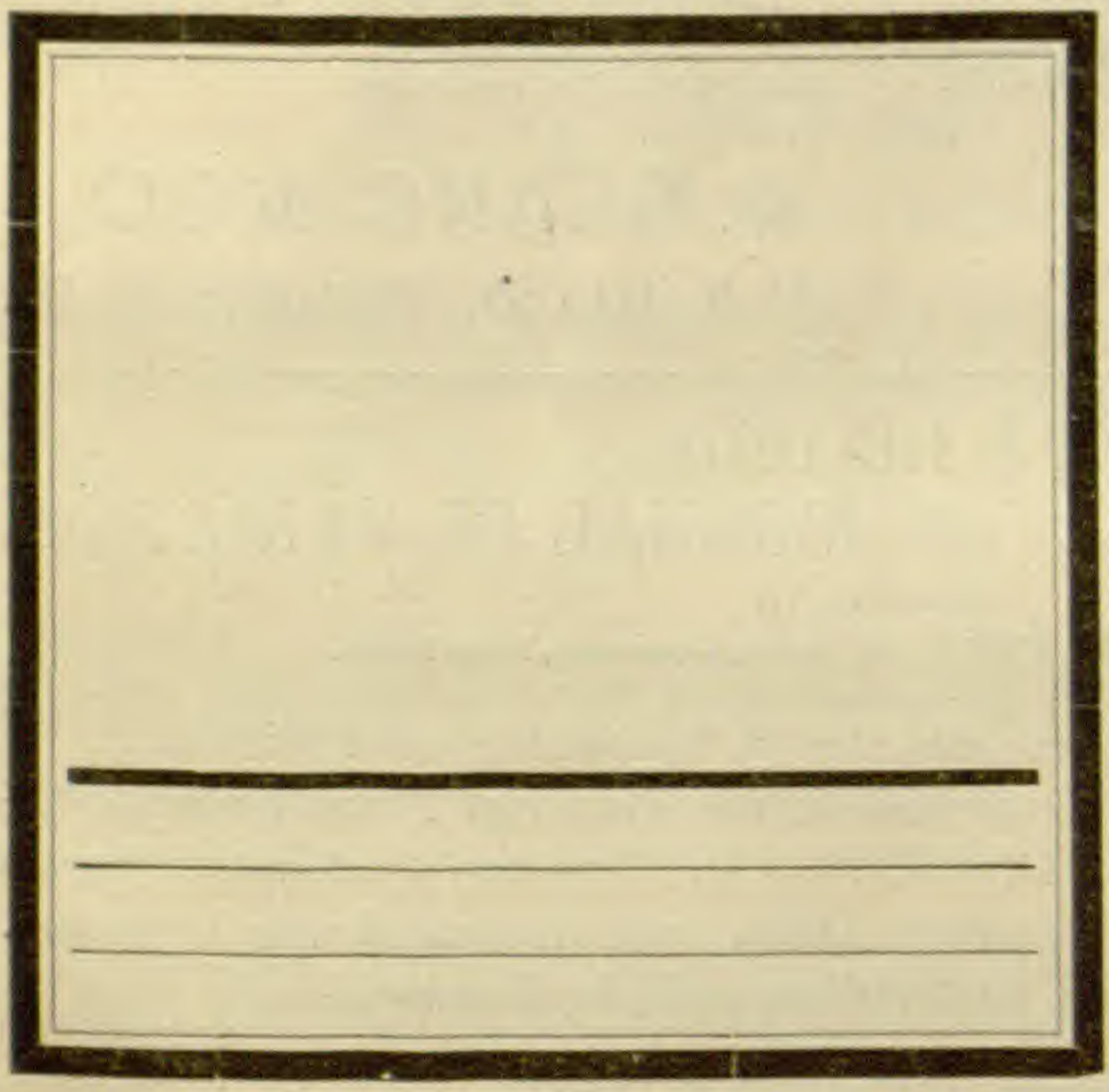

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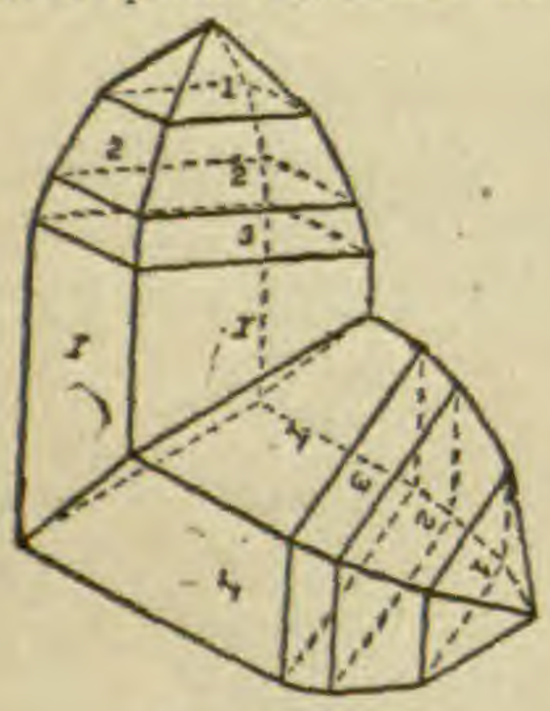

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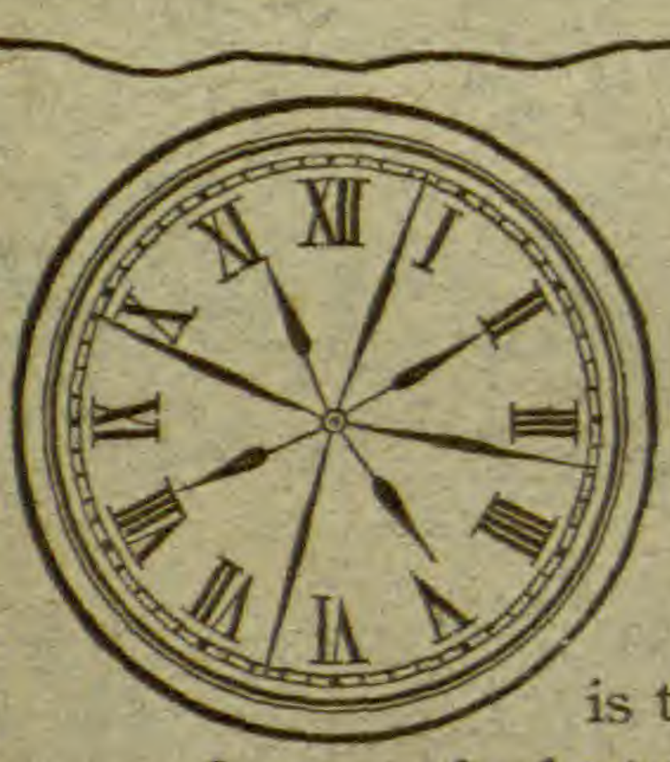

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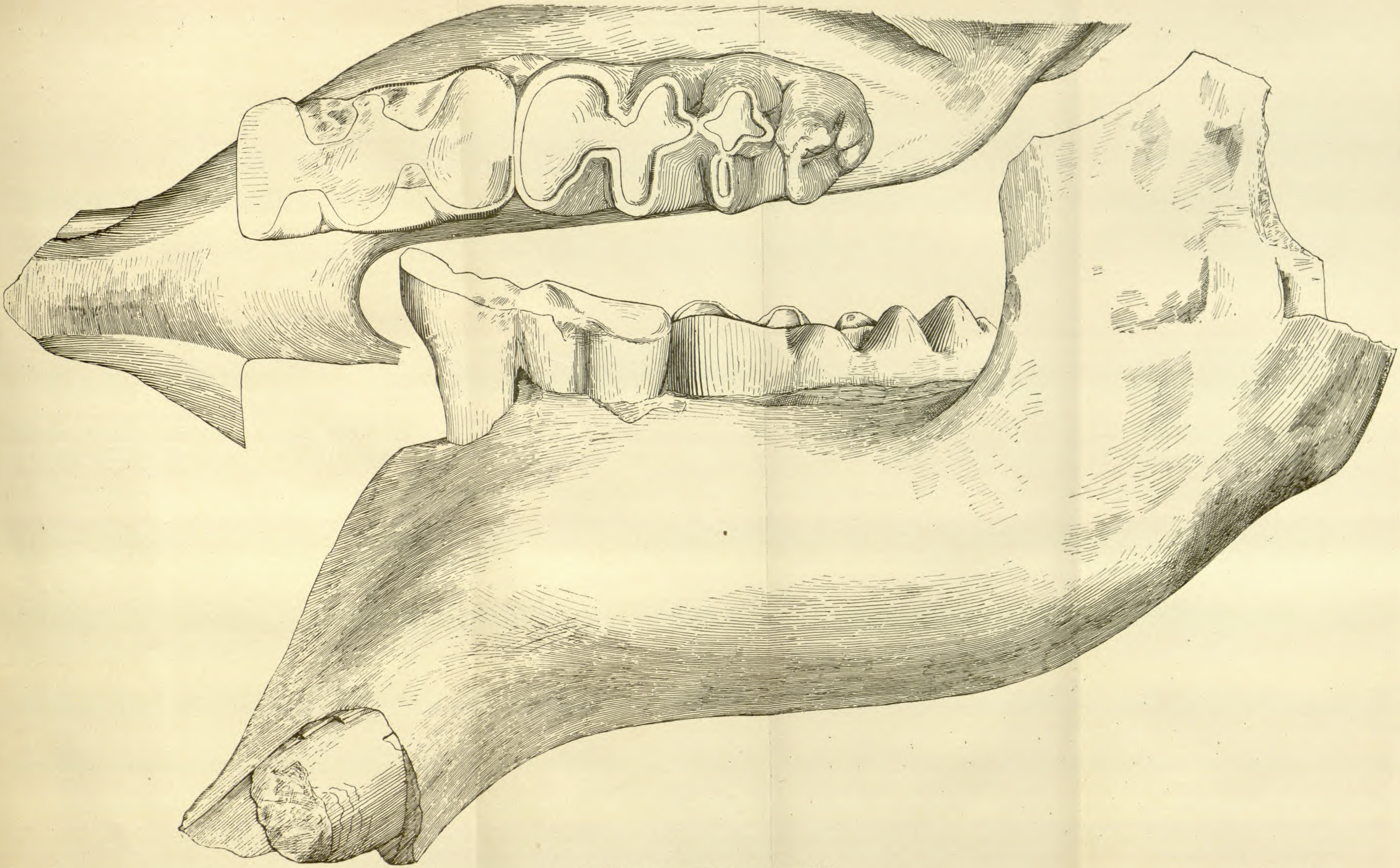

Tetrabelodon shepardii Leidy ½; (page 473.)

THE
AMERICAN NATURALIST

VOL. XXVII. June, 1893. 318

RECENT RESEARCHES UPON THE SUCCESSION OF THE TEETH IN MAMMALS.

BY HENRY FAIRFIELD OSBORN.

While American paleontologists have been making rapid advances in the phylogenetic history of mammalian teeth, the English have made notable additions to our comparative anatomical knowledge, and the Germans to the embryogenesis. The recent studies of Kükenthal, Röse and Taeker in the discovery of the complete double or milk dentition in the Marsupials, and in the discussion of its relation to that of the reptiles, also in the ontogenesis of the crowns of the teeth among the Cetaceans, Edentates, Primates and Ungulates are of the greatest interest and importance. They involve a complete revolution in our ideas as to the interpretation of the dentition in the three orders first mentioned above.

The latter authors are perhaps inclined to lay too great stress upon the testimony of ontogenesis in the order of appearance and consequent homologies of the mammalian cusps, and Röse's work is to a certain extent rendered less useful by the fact that he has substituted the conclusions of ontogeny for those based upon the more certain foundations of phylogeny. It is a subject of congratulation, however, that these authors, who constitute the rising school in Germany, recognize the value of the paleontological work done in this

country, and are ready to join hands in pushing forward these investigations upon a joint basis.

Kükenthal's Researches.

Kükenthal's studies upon toothed whales were partly directed upon the theory of Weber, Julin and others that these animals were formerly heterodont. In the embryo of the Porpoise (*Phocœna communis,*) he found traces of a heterodont condition quite sharply marked. There were twenty-five teeth in each half of the jaw, and the posterior seven were found to have two or three cusps. Having thus supported the opinion that the homodont toothed whales were primitively heterodont, Kükenthal has also proved that they are diphyodont, and that the dentition of the toothed whales is a true milk dentition, while the second or permanent dentition is represented by rudiments which display a distinct crown of enamel and even the enamel pulp, yet does not reach the surface.

In the whalebone whales in which germs of teeth had been found in the first third of foetal life, Kükenthal does not confirm the opinion of Weber that the dentition is heterodont. He denies that the posterior teeth are more complex than the nine anterior teeth, and holds that throughout they are simply conical, excepting in cases where two external teeth are fused together. This fusion of teeth does not follow any definite rule; in some cases it occurs in the anterior nine teeth. The course of embryonic development shows that these fused teeth represent an original condition, and in the opinion of the author, are to be regarded as molars. This conclusion was reached by the comparison of younger and older embryos, the number of fused teeth constantly diminishing in the latter.

Kükenthal advances the hypothesis that this was the method by which numerous homodont teeth arose from a small number of heterodont, namely, by the splitting apart of cusps. This hypothesis he promises to support by paleontological evidence. He also shows that these embryonic teeth in the whalebone whales also represent the first or milk dentition; and that the rudiments of a second series of teeth develop

beneath them. Kükenthal refers these transformations in the dentition to natural selection, terminating with diminished calcification connected with the advantage of diminished specific gravity.

His general conclusions are, that all the earliest mammals were diphyodont. This is based upon his discovery of successional teeth in Marsupials, Edentates, Odontocetes and Mystacocetes. The monophyodont and homodont condition of many mammals, such as the toothed whales, he believes has been secondarily acquired. Within the higher members of the mammalian class the second dentition is developed progressively, both as regards form and function; while in the lower divisions, the first or milk dentition is predominant. "In the rudimentary stage both dentitions are of equal value. Embryology gives us no support for the often expressed assertion, that one of the two dental rudiments has arisen in dependence upon the other. They are both sisters, whose mother is the simple invagination in the jaw, which we term the dental fold, (*Zahnleiste.*)" He continues, that there are no absolute differences between mammalian and reptilian teeth; that not one of the characters of the mammalian teeth is perfectly constant, and that the derivation of the dentition of mammals from that of the reptiles does not appear to be too hazardous. Of the several series of teeth which are found in reptiles, only two persist in the mammals.

From this I would dissent in part. The three differences between the mammalian and the reptilian teeth are shown in the capacity for the multiplication of cusps upon the crown, in the division of the fang whenever the crown becomes multicuspid, in the acquisition of the cingulum. The frequent succession of teeth in the reptiles, may be the cause of the non-progression of reptilian as compared with mammalian teeth. In the reptilia among the Theromorpha, we find true triconodont crowns, as for example in *Galesaurus*, and a heterodont dentition which closely imitates that of the mammals; but the class differences appear in the fact that in the mammalia a development of lateral cusps upon the protocone, and the stages from the protodont toward the

triconodont type, are marked step by step by the division of the fang. This law was advanced hypothetically by Cope and Wortman, and I regard it as absolutely proven by the evidence I have adduced in the study of *Dromotherium*, *Microconodon* and *Amphilestes*.

The hypothesis of Kükenthal and Röse that the numerous single pointed or homodont teeth of the whales, have arisen by the splitting up of the three cusps of a triconodont crown is an ingenious one, upon which paleontology at present throws no favorable light. *Amphilestes* of the middle Triassic with its seven triconodont molars, might by such a splitting process, furnish twenty-one homodont teeth; nevertheless this seems to me highly improbable; while the converse hypothesis suggested by Kükenthal and developed by Röse, that multicuspid crowns have originated by the fusion of single cusps, is capable of direct disproof by paleontological evidence.

The multiplication of teeth accompanying the elongation of the jaw in Cetacea, can be much more simply explained by the supposition that the dental fold was carried backward, and gave rise to new teeth caps at definite intervals. I may add that the rapid reduction of the molars in the Mesozoic period from behind forward, which reduced their number in the *Triconodontidæ* from seven to four, between the middle and upper Jurassic periods, is against the supposition that the *Amphilestes* molar, for example, furnished the material for the multiple Cetacean series.

Kükenthal's researches upon the dentition of the opossum, published in 1891,[1] mark another great step in advance in our knowledge of the dentition of the mammals. We may refer to the later researches of Röse for details, and simply quote one passage from Kükenthal:

"The permanent dentition of the Marsupials, belongs to the first series or milk dentition. Rudiments of the second dentition are actually present in an embryonic condition, but with the exception of the third premolar, they do not cut the gum." Again, the two first so-called true molars, of the

[1]Anatomischer Anzeiger, Nos. 23, 24.

upper jaw, and the first three similar teeth of the lower jaw, also belong to the first dentition and have rudimentary successors. Therefore, excepting the last upper and lower molars which appear at a late stage of development, neither dentition of *Didelphys* belongs to the so-called permanent series. This opinion has been somewhat emended by Röse.

Röse's Researches.

MARSUPIALS. Dr. Röse gives the following summary of his principal results. "When we combine the results of the foregoing researches, we find that the development of the teeth in the Marsupials follows exactly the same principle as that of man and the other mammalia. The first matrix is indicated by the dental fold, i. e. a part of the epithelium of the jaw which grows into the mesoderm aided by an extensive fold. Upon this dental fold are formed the dental caps which belong to the first series; in the case of *Didelphys*, the incisors, the canine, two premolars and the first molar. These dental caps are then immediately constricted off from the dental fold, and this ridge grows both inwards below the dental caps, and backwards behind the molar above mentioned. The posterior molars arise in exactly the same manner as I have described; in the case of man, through lateral extension of the dental ridge.

"While, however, in the case of man, the permanent ridge extends beneath the ten anterior teeth constituting the milk series and gives origin to ten permanent teeth, which cause their predecessors to be absorbed, in the Marsupials only the last premolar of the adult arises from the dental ridge of the permanent teeth. It is nevertheless, more than probable that the outer (5th) incisors of *Perameles*, as well as of Macropus and Phalangista, are built up from the permanent ridge, i. e. they belong to the second dental series. The last upper premolar belonging to the second series in some cases simply pushes its way into a gap in the first series without causing the usual absorption of the first tooth in this row. This type we find to be shown in *Didelphys*, in *Perameles*, in *Phalangista cookii*, as

well as in *Macropus.* In other cases the last premolar of the first series is absorbed, and in its place enters the premolar of the second series; this more primitive type is found in an undetermined species of the genus Phalangista; also in *Macropus lugens* and *M. gigantius*; also, according to the figures of Oldfield Thomas, in *Phascogale,* and in the fossil *Triacanthodon serrula.*

"Further researches are necessary to determine which type is the most common among the Marsupials. It also remains to ascertain through sections and models, whether the last incisor (fifth or lateral, i^5) of the upper jaw really arises from the second series, and in what species this occurs. Possibly in some Marsupials other teeth also rise from the second series. Whether this, however, is the case or not, the principal theory of Marsupial dentition is not thereby affected. It is certainly well established by my researches, as well as by those of Kükenthal, that the teeth of the Marsupials, with the exception of the last premolar and probably of the last superior incisor of some species, belong to the first series, and are analogous with the milk teeth of man and other mammalia.

"This shows that in the entire vertebrate series the principle holds good, that by the better development of the single tooth, the frequent succession of teeth of the Selachian type, is gradually limited. The Marsupials, however, in the reduction of the multiple succession of the reptilian-like ancestors of existing mammals, have together gone past the limit, and have wandered into a *cul de sac* of evolution out of which there was no return. Upon this rests the remarkable constancy of this order, from the Mesozoic period to the present time. The reduction of the former multiple succession of teeth of the vetrebates to a single series of teeth, appears therefore, only to be of service when the teeth at the same time attain a permanent growth. This stage was only attained among the Marsupials by *Phascolomys.*"

In the same paper the author restates his theory of the origin of premolars and molars by the fusion of several single teeth, and is led far astray from the actual conditions which we observe in such development. Originally, he says, the pre-

molars, like the molars, embraced three single cusps, which were arranged in the triconodont type; in Triacanthodon the premolars are altogether formed like the molars. (This observation is an error. The only Mesozoic mammal in which the premolars are even approximately similar to the molars, is *Phascolotherium*.) After the original three cusps of the premolars had been arranged in the triconodont order, he supposes, arose the degeneration of the forward cusp, leaving a tooth type which we observe especially among the Carnivora. (The cusps left here are simply the protocone and talon.)

In an earlier paper upon human dentition, the author is also led astray by ontogeny to false conclusions as to phylogeny, and at the conclusion of his extremely interesting paper upon the embryogenesis of the human dentition, he says: "The typical form of upper molars in man is unquestionably the four cusped type; while the typical form in the lower molars is the five cusped type."

EDENTATES. Dr. Röse has also contributed interesting observations upon the rudimentary development of teeth among the Edentata. He quotes Max Weber to the effect, that the reduction of the teeth in *Manis* is so absolute, that not a single rudiment remains, and that there is, so to speak, no place left for the layer either of dentine or enamel. He then goes on to say: "After, in my earlier studies, I recognized the morphological importance of the dental fold, and finding it ended as a last rudiment of an earlier dentition both in the birds and turtles, I did not doubt that also in *Manis*, at least the first stages of a dental ridge must be present in the early embryonic development." With material received from Professor Max Weber himself, Dr. Röse demonstrates the beginnings of the dental fold both in the upper and lower jaws of Manis; and in the lower jaw on both sides he finds even an unmistakable rudiment of the tooth layer, in the form of a swollen portion of the common dental fold, i. e. an abortive tooth cap. Such results were obtained in *Manis javanica*.

The forms investigated were the Nine-banded Armadillo (*Dasypus novemcinctus*), *Dasypus hybridus*, the Pangolin (*Manis javanica*), and the [Anteater (*Myrmecophaga*.) In the Nine-

banded Armadillo most careful researches were made upon the dental ridge in a series of 420 sections, leading to a discovery which was confirmed in the other species, that the dentition of the Edentata has arisen by degeneration from the dentition of a more highly organized mammalian type. This result is directly contradictory to the hypothesis of Oldfield Thomas, that the Edentata were sharply marked off as *Paratheria* by the exceptionally simple features of their dentition among other characters.

Dr. Röse continues, that the enamel of the teeth has so far retrogressed, that only an upper capping of the enamel layer is formed, which lies directly upon the dentine. "In all cases in which we have instituted exact microscopical researches, in three species of Dasypus, and in Orycteropus, it is proved that invariably in the Edentata the typical two dentitions of the mammalia are exhibited in the embryonic stages. In every case as the tooth is constricted off, the dental ridge grows further backwards, as the basis of the successional tooth, as it has been observed in the development of the teeth in man and in the Opossum; and as Kükenthal observes, from a morphological standpoint it is of no moment whether this replacing ridge gives rise to teeth or not."

Dr. Röse anticipates that the Bradypodidæ will also prove to be diphyodont.

This author further shows that there are proofs of heterodonty which weigh against the opinions of Parker and Thomas, that the Edentata stand entirely aside from the other mammalia.

In the early stages of development, a continuous dental ridge is found in the whole jaw, and in the anterior part of the jaw two rudimentary teeth are observed which must be regarded as incisors. According to Rheinhardt, the number of rudimentary incisors in the Nine-banded Armadillo is still greater (four). The lateral tooth in Bradypus may be either an incisor or canine. Dr. Röse agrees with Tomes and Osborn that the canine should be considered as the most anterior premolar. Another question arises as to whether the posterior teeth of the Edentata are to be regarded as molars or as divided into molars and premolars. As Kükenthal has

observed in the whalebone whale, we also find in young embryos of the Edentates a double pointed or biconodont tooth, which later divides secondarily into its single pointed components. The author considers it doubtful whether this biconodont type is primitive, or as seems to him more probable, is derived by degeneration from a triconodont type!

As regards the bearing of paleontology and comparative anatomy upon these facts, we find rudimentary incisors in the living *Dasypus setosus* and in the fossil *Chlamydotherium.* The latter shows the fusion of two conical points. The author refers also to Glyptodon, which has prismatic back teeth with a very evident triconodont type. He concludes by saying that these circumstances afford a very marked support for the opinion, that the present biconodont teeth of these Edentata, at least the posterior members of the series, have arisen by reduction of a typical triconodont type. If this is confirmed by further observation, it will be a fact of the very greatest importance in the phylogeny of the mammalia. For the triconodont type has been shown to prevail in the upper Triassic and lower Jurassic periods. There was unquestionably a vast period in the evolution of mammalia in which a triconodont molar was the only type.

SAUROPSIDA. In the conclusion of his work upon the development of the teeth in the crocodile, he reaches the following result: "The cause of the existence of the thecodont (fangless) teeth is to be found in the continuous growth of the epithelial sheath of Hertwig. . . . . The functional tooth of the crocodile is altogether analogous with a rooted mammalian tooth, the growth of which is not yet complete. The first embryonic tooth series of the crocodile, on the other hand, exhibits a development which we hitherto have only observed in the Selachia and Urodela through the labors of Hertwig. The theory of Hertwig as to the genesis of the mouth skeleton out of the cement sockets of tooth structure, has received an unexpected and weighty support by our researches."

The types examined by the author, included *Sterna Wilsonii,* the Ostrich, *Struthio camelus* and the turtle, *Chelone*

midas. He anticipated from his studies upon the tooth development of the reptiles, that only traces of the dental fold would be found, and if any really rudimentary dentine teeth were found, they could only represent those primitive Selachian-like teeth which constitute the first series of the crocodile. In the crocodile as above noted, a first dental layer exhibits itself altogether similar to the placoid scales and the first teeth of the Selachians in the form of free papillæ upon the surface epithelium of the jaw.

Taeker's Researches.

Dr. Taeker of the Veterinary Institute of Dorpat, has completed a most interesting series of studies upon the embryonic form of the teeth in the Ungulates.

His technical methods were an improvement on those introduced by Klever, and his material included embryos of the horse as a type of the most complex form of perrissodactyl, of the pig as a modern bunodont, and of Selenodonts he selected the embryos of the Elk, Deer, Ox and Sheep, and of greater rarity, an embryo of one of the group of Tragulids. His conclusions are summed up as follows:

1. As a result of my investigations I find that both the Suidæ with rounded or bunodont cusps, and the Ruminants with their crescentic or selenodont cusps, arise from a similar initial bunodont stage; that is, all the highly complex forms of modern cusps spring from the simple ancestral hillock in the embryonic stages.

2. The order of differentiation soon follows, in which the separate cones and conids (cusps of the lower jaw) are transformed into pyramids in the case of the pig, and into crescents in the case of the ruminants.

3. The transformation of the cones is not effected simultaneously, but successively. In the upper teeth it does not begin with the protocone (antero-internal cusp which is first developed in the paleontological history), but with the external cusps, the paracone and metacone.

Order of Appearance of the Cusps. The author observes that while in the lower jaw the order and appearance of the cusps is the same in the embryo as in the paleontological history, in the upper jaw this ontogenesis is no longer parallel with phylogenesis, (as regards the upper teeth, this exception is confirmed by Röse). In fact the external cusps not only appear before the internal cusp, which paleontology shows to be more primitive but they assume the crescentic form earlier. In other words, their development is accelerated.

The development of the premolars is also traced and it is interesting to recall the fact that in the paleontological history, the order of evolution of the cusps of the premolars is not the same as that of the molars. Taeker's results therefore show a parallelism between Ontogenesis and Phylogenesis, in that he proves that the embryonic cusp order in the premolars is different from that in the molars, and is approximately similar to that in the ancestral history as recently worked out by Scott.

Upon the whole this parallelism between embryogenesis and palingenesis is most striking, and I think we can explain the exceptions which Taeker and Röse have shown to occur in the upper teeth both in the Primates and Ungulates, in the following manner: In the most primitive types of trituberculates, the protocone was the most prominent cusp in both jaws. This is seen in all the known Triassic and Jurassic tritubercules without exception. During the Cretaceous period a change took place, in which the upper molars rapidly diverged in pattern from the lower molars. The lower were more conservative, retaining the trigonid or triangle in its primitive proportions. The upper molars, on the other hand, must have undergone a marked change, consisting mainly in the depression of the protocone below or to the level of the paracone and metacone, as seen in the primitive Carnivores, Creodonts, and Insectivores of the Puerco period. Thus we find both in the Ungulates and sub-Ungulates or early Primates, that in the upper molars the outer two cusps are slightly more elevated and decidedly more progressive in the acquisition of new forms than the older internal protocone. For example

the outer cusps often became crescentic, while the inner cusp remained rounded. And it was therefore during all the lower Eocene, that the external cusps surpassed the internal cusps in progressive development.

The bearing of these facts is this: in Embryogenesis, we are dealing with repetition of ancestral history; we should not expect, however, that this repetition would invariably extend back of the form characteristic of the Eocene period. As a matter of fact, the upper molars repeat their Eocene but not their Mesozoic form. The lower molars also repeat the Eocene form, and this, as explained above, owing to the conservative proportions of the cusps, is also the Mesozoic form, the protocone still being the most prominent cusp in the crown. While, perhaps, not thoroughly satisfactory, there is a great deal of probability that the discrepancy between the embryonic and phyletic order in the upper molars, is due to these differences in their phyletic history.

In the accompanying table I have summed up the phylogenetic order observed by Cope and myself, and the ontogenetic order observed by Röse and Taeker.

The Fusion Theory of Cusp Origin.

As we have seen, the fusion theory was first proposed by Kükenthal; it was afterward independently advanced by Röse. We find in addition to the grounds given above, one very strong argument against this theory derived from Paleontology, is in the law of molar evolution, namely, that the cusps appear at or near the apex of the crown, and development takes place from above downward. Thus, so far as we can judge from *Dromotherium* and *Microconodon*, the lateral cusps first appear on the sides of the protocone, and much later, the fang subdivides; the lateral cusps are at the outset very much smaller than the medium cusp, and it is only after a long course of evolution that they attain the same size.

Now, if the fusion theory were correct, and the triconodont crown, for example, were constituted by the fusion of three

Table showing the Phylogenetic Order as observed by COPE and OSBORN, and the Ontogenetic Order as observed by RÖSE and TAEKER.

Geological Periods	Order.	A. Phylogenetic Order. Cusps (Comparative—Human.)		B. Ontogenetic Order. Primates[2])	Marsupials[2])	Ungulates[3])	Order.
		Upper molars.					
Permian	1	Protocone	Ant. lingual.	Paracone	Paracone	Paracone	1
Triassic & Jurassic	2 & 3	Paracone	" lateral.	Protocone	Proto- "	Meta- "	2
		Metacone	Post "	Metacone	Meta- "	Proto- "	3
Cretaceous	—						
Eocene & Miocene	4	Hypocone	Post. lingual.	Hypocone	Hypo- "	Hypo- "	4
		Lower molars.					
Permian	1	Protoconid	Ant. lateral.	Protoconid	Protoconid	Protoconid	1
Triassic & Jurassic	2 & 3	Paraconid	(degenerated[1])	Metaconid	Para- "	Meta- "	2
		Metaconid	Ant. lingual	Hypoconid	Hypo- "	Hypo- "	3
Jurassic	4	Hypoconid	Post. lateral	Entoconid	Ento- "	Ento- "	4
Cretaceous	5	Entoconid	" lingual	Hypoconulid	Meta- "		5
Lower Eocene	6	Hypoconulid	" mesial				

[1]) This cusp degenerates both in the early Primates and Ungulates.
[2]) As I understand Dr. RÖSE.
[3]) As I understand Dr. TAEKER.

distinct cones, these cones should certainly appear sub-equal from the first, and they should present a division extending to the base and indicated in the fang. From the fact that Kükenthal does not mention the above genera, we infer that his attention has not been called to them. In one of his latest addresses he speaks as if the multituberculates were the only Triassic mammals. We know that the trituberculates were as old or older than the multituberculates, and reasoning by analogy, I have attempted to show elsewhere that the multituberculates will be found to have a trituberculate origin.

As I have lately criticised this theory in some detail in the "Anatomischer Anzeiger," I here refer to the well-known evidence which renders the Kükenthal-Röse hypothesis both superfluous and untenable; when we find in the series such as is represented by the genera Dromotherium, Microconodon, Spalacotherium, Amphitherium, Miacis, exhibiting in the lower jaw all the stages between the sectorial and bunodont crown, and when in the early Ungulates we are able to trace one by one the successive additions of cusps to the bunodont molar, often in the center of the crown, it certainly is not necessary to attempt to establish any new hypothesis as to cusp origin.

Summary of Results.

The general bearing of these researches upon the stem forms of the pro-mammalia is extremely important. To summarize, it is rendered probable that the earliest forms of mammals were homodont and had two or more series of successional teeth. Then within the mammalian stem the teeth were differentiated, and there arose a great heterodont group with teeth at least of three kinds—incisors, premolars and molars, all successional. From the most anterior premolar arose the canine. Then came the division between the Marsupials and the Placentals, the former tending to suppress the development of the second series of teeth, the latter retaining the second series as far back as the first molar.

We can see an obvious advantage in the line of succession

being drawn at the first molar,[1] for upon the molars rested the necessity of complex development, and such development was best effected in permanent crowns.

1. All the so-called "milk molars" plus the so-called "true molars" constitute the *first series.* Beneath one or more of the "true molars" in lower mammals are rudiments of a second series. The *second series* consists therefore of these sub-molar rudiments plus the successional or permanent premolars, incisors and canines.

2. In the stem Marsupials the entire first series persisted and became mainly permanent (non-deciduous); the second series became rudimentary and non-successional with the exception of the fourth upper and lower premolars and possibly one or two other teeth which either replaced or were intercalated between members of the first series. One or more premolars were suppressed and one more molar retained than typical in the Placentals. Thus is explained the apparently atypical dental formula of Marsupials.

3. In the stem heterodont Placentals (excepting the Cetacea and Edentata) the entire first series persisted and all the incisors, canines and premolars remained deciduous. The successional second series persisted as far back as the first molar.

4. In the stem Cetacea the entire first series persisted and the second series became rudimentary and non-successional. The tooth form changed from a heterodont to a homodont type.

5. In the stem Edentates, which also transformed from the heterodont to the homodont type, the first series became rudimentary and the second series persisted in the succession even behind the region of the first molar.

Finally, there is evidence that a primitive succession in the region of the molar teeth, lost

[1]The law of molar evolution is that complication is most rapid in teeth which are longest in use. Thus the first molar is the most progressive tooth of the true molar series and the last premolar is the most progressive of the premolar series. The apparent exception that the third milk premolar is always an advance type of the third permanent premolar is explained by the fact that the milk premolars are formed to assume the molar function.

in the Marsupials and in the Placentals, was more or less fully retained in the Cetacea and Edentates.

Biological Department, Columbia College, April 10, 1893.

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SYMBIOSIS AND MUTUALISM.[1]

By Roscoe Pound.

Symbiosis and mutualism, in the vegetable kingdom at least, are phenomena accompanying parasitism. Parasites have various effects upon their hosts, according to the nature of the parasite, its mode of life and method of attack. In some cases the host is quickly killed and the parasite becomes a sort of saprophyte upon the remains. In others the host lives longer or is only partially affected. In still others the host lives on side by side with the parasite indefinitely. A further development is attained in cases where the parasite and host not only live together, but are mutually beneficial, and, perhaps, even, in extreme cases, inter-dependent. To the first phenomenon —namely, the living together of parasite and host—DeBary, in 1869, in a work entitled *Die Erscheinung der Symbiose*, gave the name of Symbiosis. The latter phenomenon—i. e., mutual assistance or inter-dependence of parasite and host—was named mutualism in 1873 by Van Beneden in his "Animal Parasites and Messmates." Symbiosis in the strict sense and mutualism are often confounded, that is, the term symbiosis is often used to mean mutualism as such; but, in strictness, while mutualism, in the case of plants, can only exist with symbiosis, in the larger proportion of cases of symbiosis there is no mutualism.

At the outset it should be noted that the mutualism of which we are here speaking is mutualism of parasite and host—not mutualism of independent organisms. Of the latter, we have many examples in the animal kingdom, and, indeed, the human race furnishes examples of it. There is a sort of mutualism between man and wheat, for example. Wheat is cultivated by man and enabled to grow in quantities, and in localities which, under ordinary conditions, would be impossible. It gains this partial exemption from the struggle for existence only at the expense of an immense number of indi-

[1]Read before the Botanical Seminar of the University of Nebraska, December 17, 1892.

viduals sacrificed, but it is, nevertheless, a great advantage which it gains. This may be called mutualism. But there is a case of mutualism of plant and animal much more closely resembling the mutualism of parasite and host in the vegetable world. The mutual inter-dependence of *Yucca* and a moth of the genus *Pronuba*, is probably the most unique and interesting case of mutualism to be found anywhere. This is well described by Mr. Webber in the AMERICAN NATURALIST for September, 1892. In this case the plant and the moth, if not strictly sustaining the relation of parasite and host, live together for a long period, and it approaches much closer to mutualism as found between vegetable organisms than phenomena like entomophily where animals and plants are mutually beneficial, without any approach to symbiosis. In the vegetable kingdom, mutualism is a relation of mutual benefit between organisms living together as parasite and host.[2]

The most conspicuous and earliest observed instance of mutualism in the vegetable kingdom is the relation of the Lichen fungi to their gonidia or algal hosts. The relation of the lichen thallus to its contained gonidia was, at one time, the subject of no little ridicule, not only because its discovery overturned many established ideas, but because it really did seem at variance with common sense. A parasite of far larger size than its host, controlling the growth of its host—not growing within or upon the host, and following its growth at a distance, but growing outside of the host, spreading in all directions of its own motion, and being followed by the slower growth of the host—such a parasite was indeed a novel phenomenon. We cannot blame the lichenologists of the old school for their facetious remarks about the horse parasitic upon the bot and the symbiotic relations of Jonah and the whale.

If all lichens were the large, robust parasites that the commoner lichens are, we should have reason to hesitate long before accepting so remarkable a phenomenon as established.

[2]The case of the bacteria in the "pitchers" of *Nepenthes* and other carnivorous plants seems, according to the investigations of Tischutkin, to been exception. See AMERICAN NATURALIST, May 1893.

Fortunately, the lichens exhibit several intermediate forms, and enable us to see the relation between the phenomenon found in the commoner lichens and ordinary parasitism.

Lichenologists have, for a long time, distinguished, under one name or another, two classes of lichens. In the one group the thallus is entirely or substantially homogeneous—there is no differentiation into rind, medulla, etc. In the other there there is a well-defined rind, and gonidial and other zones are differentiated. The former have been called homœomerous lichens, the latter heteromerous lichens. In the first group the alga is the principal part of the lichen. The hyphæ grow within the mass of algal cells and follow them in their growth. To this class belong *Collema* and like genera, which are fungi parasitic upon *Nostoc, Scytonema*, etc., and growing within the gelatinous membranes and sheaths enveloping those algæ. Here there is symbiosis—a living together of parasite and host—but no one will contend that there is mutualism.

In the second group the fungus is the principal part of the lichen. It contains in its thallus a zone of algæ, but they follow the growth of the thallus, and their bulk is a small proportion of the whole lichen. In these lichens the algæ are *Protococcoideæ* or *Palmellaceæ*, etc., and to the different mode of growth of these algæ the difference is largely to be attributed.

Between these groups there are a number of forms, usually classed as heteromerous lichens, which, nevertheless, show no differentiation of medulla and rind, and in which the thallus consists of a weft of slender hyphæ growing around filaments of *Chroolepus* and like forms. Still another fact is important in this connection. Some of the genera of this intermediate group have species which contain no gonidia and are saprophytes upon bark, and indeed the parasitic species are often saprophytes during a part of their existence. Many genera of fungi exhibit the same phenomenon.

It is seen, then, that mutualism does not exist in all lichens, and that the steps from an ordinary case of parasitism, such as that exhibited by the homœomerous lichens, which consist of a mass of algal cells permeated by the hyphæ of a fungus and often distorted by it, to the peculiar case of the heteromerous

lichens, where the fungus forms an extensive thallus in a zone of which are contained the algæ upon which it subsists, may be traced in existing species. Not only this, but there are genera, as has been said, in which there are species that do not attack algæ, but live independently as saprophytes, and the point to be noticed here is that these genera belong to the intermediate group of what I may call pseudo-heteromerous lichens.

These considerations, of course, do not prove the existence of mutualism in lichens, but they deprive it of much of its seeming unreasonableness. Other facts, now well established, make it certain that this relation really does exist in the heteromerous lichens.

Arthonia is one of the pseudo-heteromerous lichens. Moreover, it is one of those genera in which certain species, during their entire existence, live independently as saprophytes. Of its development, De Bary says: " . . . . the hyphæ of the thallus make their way into the outer layers of the periderm in the smooth stems of oaks and ashes and there grow as saprophytes independently, that is, without algæ, into a thallus formed of an abundance of slender hyphæ which spread through the cells of the periderm. Then its proper alga, *Chroolepus umbrinum*, finds its way from without through the cell walls of the peridermis into the previously formed hyphal thallus and is seized by it. The cells of the *Chroolepus* are in rows forming filaments with apical growth, and it is by means of this growth that they penetrate into the thallus in the same way as mycelial hyphæ pierce through membranes. The alga is a frequent inhabitant of the bark of trees, and makes its way into the periderm for its own purposes. Its penetration into the thallus of the fungus can scarcely be supposed to be caused by the fungus, but is merely an adaptation which favors the formation of a lichen." This is plainly an ordinary case of parasitism on the part of the lichen, but it not only throws light on the origin of the true heteromerous lichens, but it shows in what manner the fungus may be of benefit to the algæ. In the heteromerous lichen the thallus takes the place of the bark of the tree in these pseudo-heteromerous lichens.

The gonidia of the heteromerous lichens are usually *Palmellaceæ*, which, from their different structure and mode of growth, have not the power of getting beneath the bark as does *Chroolepus*. The thallus of the lichen serves the same purpose with them—protecting the colony of algæ and absorbing and retaining unusual quantities of moisture, and enabling them to live and multiply in places where, under ordinary conditions, life would be impossible.

That the thallus does do this is shown by the fact that lichens grow in places where algæ could not maintain themselves unaided, and by the fact that the gonidia multiply with great rapidity in the thallus, often more so we are told than without, and the individual cells attain a larger growth within the thallus than without, as has been shown by taking algae from the thallus and cultivating them independently. That the fungus does not do all this for nothing, the numerous exhausted cells to be found in the gonidial zone of any ordinary lichen abundantly testify.

There is another curious phenomenon exhibited in some lichens. In these species the algæ are not confined to the gonidial zone, but grow up into the tissues of the sporocarps between the paraphyses and among the asci, so that when the ascospores are ejected, cells of the algæ are ejected with them and are promptly seized upon by the germinating spores. This can hardly be accidental, and it should be observed that it is the alga which is the moving party, not the fungus. Surely some benefit must result to the alga or it would not be done.

It is possible, also, that there are other adaptations resulting from the symbiosis of fungus and alga in the lichen. Frank claims to have discovered several, one of which deserves mention. It is well known that algæ can be separated from the lichen, and that they will then vegetate in the ordinary way independently. Frank asserts that certain species of algæ have become so adapted to life in the lichen and so accustomed to it, that they have partially or wholly lost the power of independent growth. No examples of this, however, are certainly known.

Frank also claims that the fungus exhausts the protoplasm of algal cells without entirely destroying them. If by this is meant that it does not always entirely destroy the cells it attacks, it is probably so, but if anything more is meant, it seems, like some other theories of Frank, which I shall have occasion to mention presently, if I may say so, decidedly "fishy." Such a thing is not necessary to mutualism. The alga can purchase the protection of the thallus only by the sacrifice of a large number of individual cells. If it gets *quid pro quo*, why should it not prefer to sacrifice them to the fungus in return for the shelter of the thallus rather than to leave them victims to natural conditions without compensating advantage. To put the matter in another way, if the energy spent by the alga in producing cells to be destroyed by the fungus were put to making a shelter of its own, could it effect as much as it does by taking advantage of the thallus?

Two other cases in the vegetable kingdom where mutualism is thought to exist remain to be examined. These are the cases of "*Pilzsymbiosis*" or "*Wurzelsymbiosis*" of the roots of anthophytes and certain fungi. The first noticed was what is termed "*Mycorhiza*," and of this first.

T. Hartig, in 1840, and others since, had noticed mycelia apparently parasitic on the roots of trees. In 1885, Frank published the results of investigations of mycelia growing upon the roots of various *Cupuliferæ* in which he claimed that the sustenance of these trees depends upon fungi symbiotic with their roots. The title of his paper indicates his claim: "*Ueber die auf Wurzelsymbiose beruhende Ernaehrung gewisser Baeume durch unterirdische Pilze.*" To begin with, Frank found that certain *Cupuliferæ* have almost the whole of their root system covered with mycelium associated symbiotically with the root, and he claimed that these fungi took the place of root hairs, and were the only means of absorbing water, etc., possessed by the roots, though, of course, like the gonidia of lichens, the roots could be grown independently in water cultures for years.

The mycelia, of the existence of which there is no doubt, are probably connected with some of the *Gasteromycetes* or *Tuberaceæ*. But Frank observes that the presence of a mycel-

ium does not necessarily imply the presence of the perfect fungus fructification, as mycelia may, and often do, go on growing in a sterile condition for years.

Frank did not stop here. He found symbiotic fungi on the roots of many other trees, and others after him found mycelia on the roots of various plants to which he attributes the same relations of mutualism. His final statement is that this phenomenon belongs "to all trees under certain conditions;" that "the Mycorhiza is formed only in a soil which contains humous constituents or undecomposed vegetable remains;" that "the development of Mycorhiza increases or diminishes with the poverty or richness in these constituents;" and that "the fungus of the Mycorhiza conveys to the tree, not only the necessary water and the mineral nutritive substances of the soil, but also organic matters taken direct from the humous and decomposing vegetable remains." Finally, he claims that only through the fungus can the tree employ such organic matter directly.

If the fungus develops only in soil containing undecomposed vegetable remains, we might ask why it takes the trouble to attach itself symbiotically to the root and give the tree the benefit of its saprophytism; especially, as Frank says that the protoplasm of the cells and the fungus live together "without the former being parasitically affected or its vital phenomena disturbed." This reminds one of the exhausted gonidial cells which are still uninjured, and is not the only one of Frank's statements calculated to try our patience and credulity.

In 1886, Warlich (*Botanische Zeitung*, 1886, p. 481, et seq.) investigated certain fungi on the roots of orchids. He examined several hundred species, all of which he found affected on both aerial and subterranean roots with the mycelia of what he showed to be a species of *Nectria*. The hyphæ of this fungus affect spots here and there, forming knots or coils in certain cells and causing them to enlarge, but, as a rule, only partly filling the cell and not destroying the protoplasm. Frank, of course, took this up, and he claims that the protoplasm of the cell is not affected or disturbed by

the fungus; that the fungus is strictly connected with that part of the plant which absorbs the food materials; and that those orchids which are chlorophyll-less, and therefore depend on the humus of the soil for carbonaceous matter, always exhibit this fungus highly developed. Accordingly, he includes this too in Mycorhiza, calling it "endotropic Mycorhiza" (i. e. the hyphæ live *in* the cells) as opposed to "ectotropic Mycorhiza" in which the fungus is entirely *outside* of the cells.

As to Frank's statement that the protoplasm of the cell is not affected by endotropic Mycorhiza, Marshall Ward, in the *Annals of Botany* for February, 1888, says: "This can only be an assumption, and the impression I gather from the study of what is known of this orchid fungus is in favor of the view that the fungus *does* disturb or 'parasitically affect' the protoplasm of the cell, and that an outward and visible sign of some such action exists in the hypertrophy of the cells affected and in the turning yellow of the chlorophyll-grains."

R. Hartig, a more sober and trustworthy writer than Frank, said the last word so far on Mycorhiza in 1891. He admits that the mycelia of some of the *Tuberaceæ* or *Gasteromycetes* are found symbiotic with the roots of certain trees. But his conclusion is that they are of no use to the tree, and are probably injurious by taking nourishment properly belonging to the tree. It would seem that they must do this, even were there mutualism between them and the roots—else why are they there? Organisms are not given to gratuitously assisting one another. Mycorhiza undoubtedly exists—i. e., mycelial stages of many fungi of different groups are parasitic upon and in the roots of anthophytes. But that there is, in any of these cases, more than the ordinary symbiosis of parasite and host, has not been shown, and is improbable. That every tree has its root system covered with mycelia, proves nothing. Every tree has its bark covered with lichens, its twigs with black fungi, and its leaves with parasitic fungi of every description.

The second case of "*Wurzelsymbiosis*" is the root tubercles of the *Leguminosæ*. These tubercles have long been known upon clover, and of late years—since 1885, in fact—have been found upon nearly all of the *Leguminosæ*. Naegeli found a

Chytridium-like parasite in the cells of *Iris* which has never been seen since, and named it *Schinzia.* So when, in 1879, Frank first worked upon clover tubercle, he considered it similar to Naegeli's *Schinzia*, and named it *Schinzia leguminosarum.* Subsequently, a tubercle was found on the roots of *Alnus* by Woronin, called by him *Schinzia alni.* Tubercles have been found in this country on the roots of *Ceanothus*, and are known on a few other plants besides the *Leguminosæ.*

There has been considerable uncertainty as to the cause of clover tubercle and the nature of the parasite to which it is due. Schroeter took the parasite for a Myxomycete similar to *Plasmodiophora* and named it *Phytomyxa.* Marshall Ward, in the article cited, compares it to the yeast fungi. De Bary, in 1884, dismissed the matter with a sneer. Frank now puts the parasite among the *Schizomycetes*, and, indeed, the best view seems to be that the parasites are bacteria pure and simple. There are, in some tubercles, hyphæ, or something very like hyphæ, which Frank now calls "*Infektionsfaden.*" Marshall Ward considered these the hyphæ of which what some call the "*baktroiden*"—i. e., the bacteria—were spores. Schroeter saw in them a plasmodium. Frank, always unique and startling, has finally (1891) decided that the "*Infektionsfaden*" have nothing to do with the fungus, but are products of the host for the purpose of self infection! These hyphæ are usually filled with the "*baktroiden*," and Thaxter's recent discovery of *Myxobacteria* may throw some light upon their true nature. In an article in the *Torrey Bulletin* for July, 1892, Mr. Schneider concludes that these tubes have nothing to do with the bacteria, or *Rhizobia*, as Frank now calls them, and considers them hyphal fungi related to the parasite of *Alnus* tubercle. As these tubes often contain the bacteria, this seems improbable. From all that I have read and seen, I am satisfied that the parasites are bacteria, and I see no reason for separating them from the rest of the *Schizomycetes* as Schneider does. I even doubt the necessity of creating a separate genus for them, as Frank did in 1890, under the name of "*Rhizobium*" (*Pilzsymbiose der Leguminosen*).

These tubercles are fine examples of symbiosis, and it has recently appeared probable that they exhibit mutualism of an unexpected kind, analogous to that claimed by Frank for his Mycorhiza. I can only go into this briefly. It is known that the plant cannot directly assimilate free nitrogen. Yet, as Marshall Ward puts it, "For a long time it has been generally known that the *Leguminosæ*, especially, have what we may term a special aptitude for seizing large quantities of nitrogenous substances from the soil, and this problem has become a classical puzzle in vegetable physiology." In 1886, Hellriegel and Wilfarth published some investigations of this matter. Subsequent experiments founded on theirs have been very numerous, and are yet in progress, but their researches remain our principal authority on the subject. Without detailing them, I may say that these researches seem to demonstrate that this power of taking up large quantities of nitrogen depends entirely upon the presence or absence of the tubercles —that without them it does not exist, and that it exists in greater or less degree according to their abundance. Conceding this, two theories are possible as to the cause.

In 1888, Marshall Ward appeared to think that the parasite stimulated the cells to extraordinary metabolic activity, and that was probably all it did. This view has had no followers so far as I can find.

The other possible theory is that the parasite does this work and the host takes advantage of it. Frank, as might be expected, takes this view. The most recent observations seem to have settled pretty thoroughly that the tubercles do assist the plant in some way in assimilating free nitrogen, and that here is a case of mutualism analogous to that of the lichens. The bacteria (as I assume that they are) are parasites. They are there for their own purposes, and are incidentally beneficial to the plant. The plant, it is generally admitted, can exist and thrive without them. In some cases it appears, and the analogy of the lichens makes this probable, that the bacteria are purely parasitic, and that there is symbiosis without mutualism. But, in most cases of the *Leguminosæ*, it seems to be shown that the plants affected do better than those unaf-

fected. Much research is needed in this matter. The manner in which the parasite acts and the host takes advantage of its work are not known with any certainty.

To these probabilities, Frank adds certain characteristic improbabilities. One has already been spoken of, namely, that the plant develops tubes or hyphæ for the purpose of self-infection which it sends through its tissues. This is somewhat like the algæ in some lichens which grow up among the asci in the sporocarp and are ejected with the spores. Only the latter is an established fact, the former a feat of the imagination. Another of his ideas, pronounced a "settled fact" by Schneider in the article cited, is that "at the close of vegetation and on other special occasions, the plant reabsorbs the protoplasm of the fungi." After all the trouble of self-infection to which the host has been, this seems rather like killing the hen that laid the golden egg. There is no sufficient evidence to establish so remarkable a phenomenon. Finally, Frank thinks that the roots of the *Leguminosæ* possess the power of attracting *Rhizobia*, due, as he considers, to some secretion. This is too much for his followers, and I think all will agree that it is the last straw of an unsupportable load with which he has already burdened our credulity. The exuberance of Frank's enthusiasm, however, should not blind us to the fact that some relation of mutualism between the *Leguminosæ* and the tubercle parasites probably—almost certainly—does exist.

It is not necessary, as Frank seems to think, in order to establish mutualism to show that the organisms do no injury to each other. Mutualism of the kind we meet with in the vegetable kingdom involves sacrifices on the part of the host. The parasite is not there gratuitously. It is there to steal from its host the living it is hereditarily and constitutionally indisposed to make for itself. If the host gains any advantage from the relation, it can only do so by sacrificing—by giving the parasite the benefit of its labor that it may subsist. If the plant or the plant colony benefits as a whole, it purchases the benefit by the sacrifice of certain parts or individuals. Mr. Webber, in a note on the Yucca moth in the AMERICAN NATURALIST for Sep-

tember, 1892, makes a significant remark to the same effect: "The larva of *Pronuba* uses up only from 10 to 12 seeds, so that even in those capsules where the most abundant larvæ develop, hundreds of good seeds are nevertheless developed. The few seeds destroyed may well be sacrificed to insure the pollination and development of the others."

Ethically, there is nothing in the phenomena of symbiosis to justify the sentimentalism they have excited in certain writers. Practically, in some instances, symbiosis seems to result in mutual advantage. In all cases it results advantageously to one of the parties, and we can never be sure that the other would not have been nearly as well off, if left to itself.

EVOLUTION AND DICHROMATISM IN THE GENUS MEGASCOPS.

By E. M. Hasbrouck.

INTRODUCTION.

The subject of Dichromatism has ever been a stumbling-block to scientific research, and from the time of its earliest admittance into zoological discussion, has been without apparent cause and without explanation. Few, if any, theories have been published as to what it really is, or as to the possible influence governing it, while any theories that have been advanced stand without proof of their correctness; a new theory, therefore, cannot be considered as conflicting with any *settled* doctrine upon the subject. When we find a peculiarity common to all forms of animal life, it becomes apparent that if thoroughly understood in one form, a flood of light will be thrown upon the same perplexing problem affecting the rest of the animal kingdom.

In attempting to explain the causes and effects of dichromatism in the Screech Owl, no stone has been left unturned to prove the correctness of the views herein set forth. The writer has labored lovingly and patiently, following a course of reasoning which he believes to be correct, and in submitting his work and its results to fellow-workers would ask for it their kindly consideration. The collection of the necessary data has been an extremely difficult task, and more information is still desirable from certain localities, although sufficient has been received to make possible the construction of a comparatively accurate map of the color distribution. It is a lamentable fact that scientific observers of bird life are exceedingly scarce in the southern states and in the lower part of the Mississippi Valley. The data obtained from these regions, although to a certain extent more scanty than could be desired, has been used to the best possible advantage. In obtaining information, copies of the following circular letter

were sent out by the National Museum, and the matter received in reply was turned over to me for study and investigation, together with the privilege of preparing the results for publication.

UNITED STATES NATIONAL MUSEUM
UNDER DIRECTION OF
THE SMITHSONIAN INSTITUTION.

Dear Sir:

The National Museum is engaged in a systematic investigation of the color-phases of the Screech Owl (*Megascops asio*), with the view of determining the relative abundance of the red and gray plumages in different parts of the country, the plumage of the young, produced by parents of known character as to plumage, and the other related questions.

In order that the investigation may be as thorough as possible, assistance in the matter is requested; and if you can give information on the subject, your kind co-operation will be much appreciated.

Should you favor us with any information on the subject, please arrange the data in the following order:

(1) Name your locality, including County and State.

(2) State about how many specimens have come under your notice, and how many of them were in the gray plumage.

(3) If you have obtained or observed a pair of old birds with their young, state the character of plumage of the former (whether both red, both gray, or one red and one gray—and if the latter, the sex represented by each phase), and also the plumage of the young.

The above are the principal points upon which information is desired, but any additional memoranda will be very acceptable.

Yours truly,

ROBERT RIDGWAY,
Curator, Department of Birds.

In conclusion I wish to express my gratitude to Professor G. Brown Goode, Assist. Secretary of the Smithsonian, and Mr. Robert Ridgway, Curator of Birds, who rendered every assistance and courtesy in their power; while to all who responded to the request for information, without which the task would have been impossible, is due the sincere thanks of The Author

PART I.

RELATIONSHIP OF DICHROMATISM TO EVOLUTION.

So universally adopted has the theory of evolution become, that it scarcely seems necessary to refer to it as forming the

foundation of the theory here advanced, regarding the dichromatic phases of the common Screech Owl (*Megascops asio*).

"In the Systema Naturæ (Vol. I, 12 Ed., 1766, p. 132), the Red Owl is first described by Linnæus under the name of *Strix asio*. Twenty-two years later (1788) Gmelin described (Systema Naturæ, Vol. I, 13 Ed., p. 289) the Mottled Owl as *Strix nævia*. In 1812, in the fifth volume of his American Ornithology, Alexander Wilson re-describes the two under the same names, also as distinct species, and not until 1828 does it appear to have been publicly hinted that the two were really identical, when Prince C. L. Bonaparte united them, he considering the red bird as the young, and the gray the old. Audubon, in 1832, sustains this view; one of the red birds he figures as the young, being one he reared from a fledgling. Nuttall, a few years later, supports the same view. In 1837, Dr. S. Cabot, Jr. (Journ. Bost. Soc. Nat. Hist., Vol. II, p. 126), while considering the two birds identical in species, reverses the order, making the red plumage the old and the gray the young, and in confirmation of his views exhibited as seeming conclusive evidence, an old red bird which he shot while in the act of feeding some gray young, which he also exhibited. In July of the same year, Dr. Ezra Michener, in a paper (Phila. Acad. Nat. Sci., Vol. 7, p. 53) entitled, *A few Facts, in Relation to the Identity of the Red and Mottled Owl*, states that he had seen young Screech Owls, accompanied by their parents, after leaving the nest, of both red and gray colors, the parents being always of the same color as the young. "The conclusion is, therefore," he says, "evident, either that the color of both old and young is variable or uncertain, or that they are specifically distinct." The latter opinion he adopts, ignoring the then sole known case of different colors in the young and parent exhibited by Dr. Cabot, very positively concluding that there are *two* species, and that Wilson was right.

Dr. P. R. Hoy, in his *Notes on the Birds of Wisconsin* (Proc. Phil. Acad. Nat. Sci., 1853, Vol. 6), gives them as two distinct species, while Cassin, in his various papers on the owls, adopts the conclusion of Bonaparte; considering them as one species, and the gray the adult."[1]

[1]Am. Nat., II, 1866, 327–328.

Again, Dr. W. Wood (Am. Nat., Vol. II, 1868, p. 371), mentions two cases:—the one, a Mottled Owl, taken from the nest with one young, neither of which had a red mark on them; the other, a Red Owl, taken with four young, all red. His deductions are, that there are two adults, one red without a gray feather, the other gray without the slightest trace of red; also, that there are young of each before they are able to fly, one gray and white without a red feather, the other with a reddish tinge to all the feathers. These facts he is unable to reconcile, unless, as he says, "It is admitted that the color of the plumage is either 'variable or uncertain,' or else there are two distinct species as described by Wilson."

The whole is admirably summarized and described in Baird, Brewer and Ridgway (Vol. III, 1874, p. 51), in the following words, "That these two very different plumages are entirely independent of age, sex or season, and that they are purely individual there can be no doubt, since in one nest there may often be found both red and gray young ones, while their parents may be either both red or both gray, the male red and the female gray, or *vice versa*. Occasionally specimens are exactly intermediate between these two plumages, it being difficult to decide which predominates."

This difference in plumage has been termed Dichromatism, and while a hundred and twenty-five years have succeeded in establishing the fact that the red and gray screech owls are one and the same species, no satisfactory theory known to the writer has been advanced as to what dichromatism is due in this case or as to the possible causes governing it.

Naturally enough, this is far from satisfactory, while the opinions of various authors just quoted, and which comprise the most of what has been written upon the subject, tend but to raise innumerable queries for which there appear to be no satisfactory answers. Why, for instance, is the gray form dominant in one part of the country and the red in another? Why are both forms equally common in a third? Why is the red phase peculiar to the eastern members of the genus, while in the western forms it is unknown? Above all, why, at the northern boundary of *asio* proper, is the red form entirely

PLATE XIII.

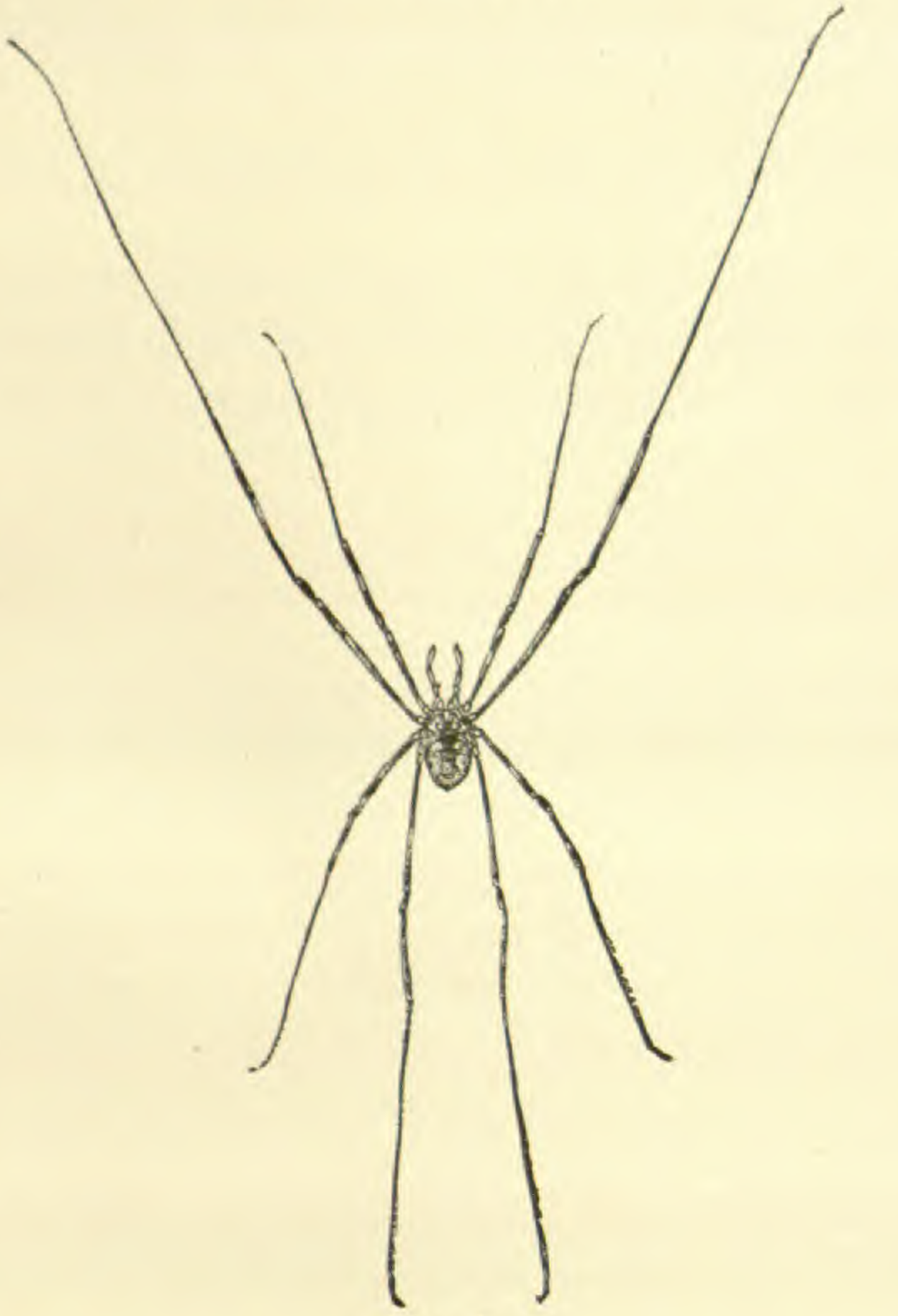

FIG. 1.

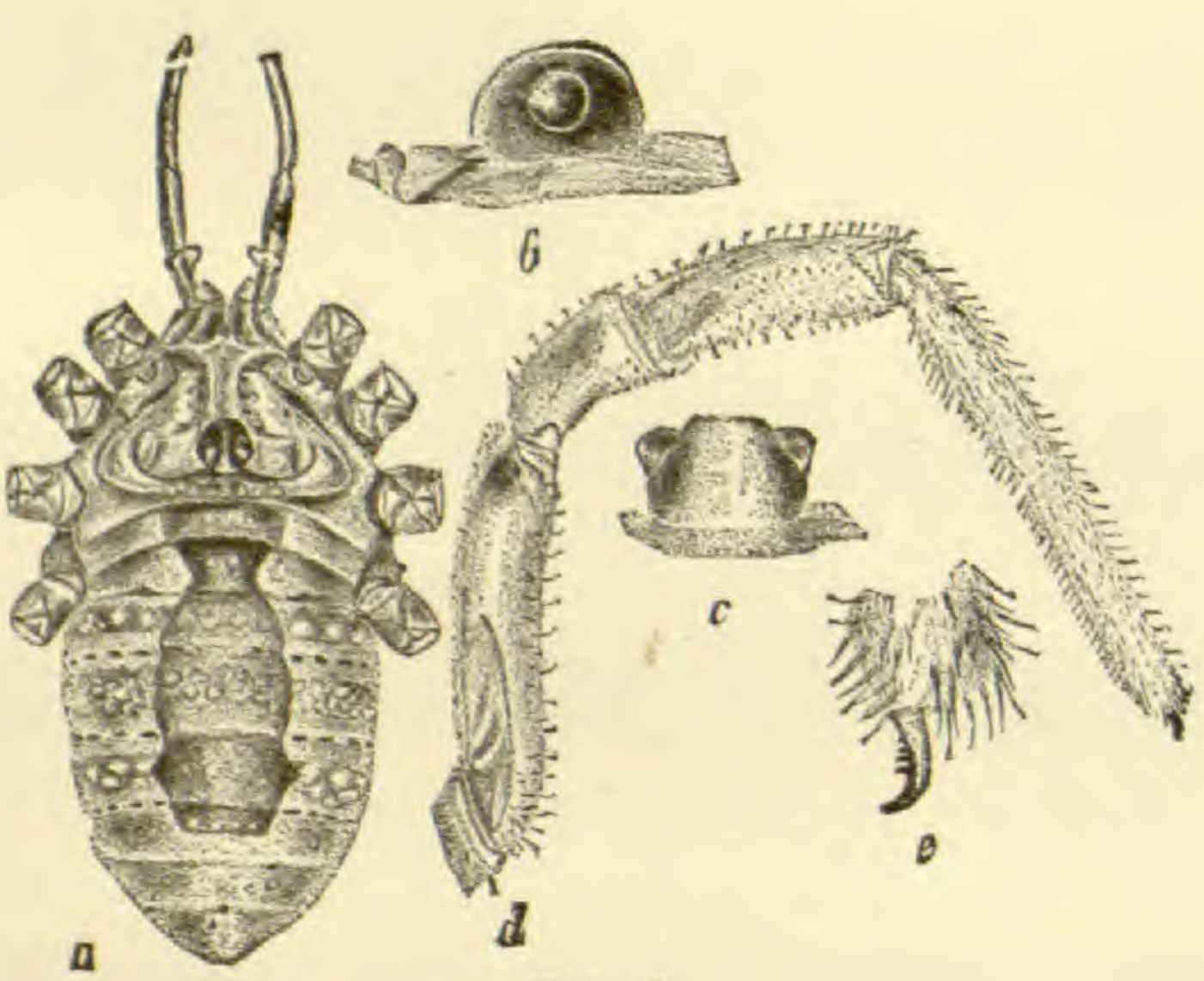

FIG. 2.

Liobunum ventricosum hyemale Weed. Immature.

absent, while at the southern limit it is greatly in the majority? These and many other questions of equal importance present themselves, and but confuse and leave the reader more than ever in the dark.

While collecting screech owls in the District of Columbia during the winter of 1890–91, these questions arose very forcibly, and upon investigating, I found that while the matter was apparently settled to the satisfaction of ornithologists, as regards the identity of the two forms, nothing further appeared to be known about it. Further investigation showed that dichromatism is principally confined to the typical form of *Megascops asio*, appearing but slightly in the Florida form (*Megascops a. floridanus*), and barely reaching the Texan subspecies, *mccallii*. The remaining members of the group, four in number,[1] remaining true to their normal color.[2]

Three phases of plumage were clearly defined—the red, the gray, and the intermediate (the last less frequently seen than the others). Three distinct phases, represented indiscriminately by individuals of one species, regardless of age, sex or season! Such an unusual circumstance that the possibility of some great and important change gradually taking place at once suggested itself, which has been proved to be in reality the case.

An attempt will be made to show, first, that while the red, the gray and the intermediate phases are at present but individual variations of the same species—the gray was the ancestral stock; second, that from the gray bird has evolved the red, which at some future time will be a recognized sub-species with a range peculiar to itself, and thus dichromatism is one step in the evolution of the Screech Owl, while the various phases exhibited are the transitorial stages of development of one species from another; third, that this condition of affairs is influenced by four powerful factors (two of which

[1] Three sub-species recently described by Brewster (Auk, Vol. VIII, 1891, 139–144) would make the number seven, but these are not as yet admitted to the check list.

[2] *M. a. kennicottii* exhibits a dichromatic phase, but it is a decided dark brown, and not a reddish phase, and is not included in the present treatise.

temperature and humidity, are dominant powers in geographic distribution), the most potent of which is temperature; fourth, that the *predominating* distribution of the respective colors is largely confined to the faunal divisions of the Eastern United States, and as such is approaching the sub-specific differentiation of the two phases; lastly, that the Darwinian theory of 'Reproduction with variation and the survival of the fittest,' is well exemplified in our common little *Megascops asio*.

The Screech Owl has been made the subject of investigation simply because it offers one of the best known examples of dichromatism: if explained and disposed of in one case, much light will be thrown upon the same problem relating to many forms of animal life.

To begin with, a short description of the young, together with the manner of attaining the adult plumage of both phases, may be of service to many not thoroughly acquainted with the species. When first hatched they are covered with pure white down, which in a week or ten days begins to show faint traces of transverse dusky bars. At the age of four weeks they are fully barred with gray and white alternately, which markings they retain until the appearance of the first full plumage. As a usual thing, those destined to be red assume a rufous cast in the down shortly before the appearance of the feathers, but this is not always the case, as instances are known where the first intimation of red was the appearance of a rufous feather pushing its way through the gray or mottled down. Such instances, however, are rare, and but few are known to the writer. At the period when feathers first appear, the future color of the young bird is settled beyond a doubt; both the gray and the red birds rapidly attain their mantle, and the colors once assumed are never changed. Much confusion has arisen from the fact that some observers apparently make no distinction between the bird in the gray or mottled down and the gray or mottled plumage and upon the appearance of the red feathers through the gray down, the assertion has been made that the gray feathers changed to red. The gray birds, on the other hand, attain

their plumage at precisely the same time and in the same manner as the reds, only that their feathers are gray instead of rufous. If the above simple facts are borne in mind, no trouble need be experienced in undertanding the appearance of the two plumages.

The first step in the work was to ascertain the relative proportion of the red and gray phase in every section of the area covered by the *asio* group of *Megascops* affected by dichromatism. For this purpose nearly one thousand copies of the circular letter referred to in the introduction, were sent to the ornithologists distributed over this territory. Over two hundred replies were received, a few of which failed to be sufficiently explicit to make their contents available, but enough were obtained to compile in a reasonably accurate manner the map showing the distribution of the two color phases (map 2).

On the northern border of the range of *Megascops asio* where gray is the only form known (see map 2), correspondents from southern Ontario state that at occasional rare intervals a red specimen has been taken *in the spring*; all these birds were taken close to Lakes Erie and Ontario—while at Toronto, one pair composed of a gray and red have been known to breed, which necessitates considering the red phase in Ontario. McInraith states that the species is migratory there, to a certain extent, and it is probable that some of the red birds may be chance visitors that have come north with others. With this exception the gray belt is unbroken from Picton, Nova Scotia, through New Brunswick; northern Maine, New Hampshire, Vermont and New York; the southern part of Quebec and Ontario; northern Michigan and Wisconsin; a strip through central Minnesota, thence south-westward across Dakota and most of Nebraska, and ending in a long point near Leavenworth, Kansas. On the south this gray belt is somewhat broken as shown on map 2; in the future more complete data may show it as unbroken here from east to west as it is on the north. Beginning at a point near St. Augustine, in Florida, it encompasses nearly the whole of that state and much of the range of the Florida form, *Megascops a. floridanus*; runs northward and westward to Eufaula in

Alabama, and terminates near Mobile (this terminal point is arbitrary); while in Texas it is resumed in the southwestern portion of the range of *mccallii*.[3]

Next to this belt comes that wherein both phases occur, but where the gray predominates. It begins near Belfast, Maine, follows the exclusive gray belt with irregular outline to its termination in northern Kansas, and continues southward in a broad belt into Louisiana, where it is a question whether or not it becomes broken at New Orleans. Immediately north of New Orleans it begins again at Mandeville, La. (based on specimens in Am. Museum), and continues eastward to the coast in the neighborhood of Savannah. In its northern half it sends a long arm southward, through eastern Massachusetts, into central Rhode Island and Connecticut, again in Western Pennsylvania, it reaches in a narrow strip far down the Alleghanies into Virginia and West Virginia, terminating near latitude 37°, covers practically the whole of Ohio, with a good share of Indiana, and continues thence to Leavenworth, Kansas, the delta of the Mississippi, and to the Atlantic.

Within this area lies the region in which both forms occur, but in which *red* largely predominates (which in turn includes the exclusive red areas), and which occupies nearly one-half the area inhabited by *asio* proper. It of course conforms to the outline of the last described belt, and extends along the entire Atlantic coast from New England to Savannah.

Lastly are the two areas where *red* is the exclusive form. The one of considerable size and importance based upon substantial evidence, lies wholly within the Mississippi Valley: the other, a small strip, extends from a little northwest of Oakdale, North Carolina, to Variety Mills, in Virginia, and including Wytheville. At present the grays are apparently unknown from these areas. It has been impossible to examine material from either, and to those who may have the opportunity, I would point out the desirability of collecting all the specimens possible.

[3] The intermediate region is mapped upon very insufficient data, it being next to impossible to learn anything of this territory, but the best has been done that was possible under the circumstances.

The following table shows the data arranged by states, upon which the map (No. 2) of color distribution is based. The original letters had to be consulted in many cases as to the proper placing of the lines marking the several divisions; the table itself shows but two things: the areas where reds or grays are the exclusive form known, and where each predominates in the mixture of the two; the finer distinctions it is of course impossible to show in tabular form.

It will be remembered from quotations at the beginning, that the young produced by parents of different colors were said to be either all red, all gray, or both; that those produced by parents both of which were *red* were the same; this much is true, *but not a single record can be found of the offsprings of a pair of gray birds showing the slightest trace of red.* That the grays invariably breed true even in a region where red is the predominating color, *and where the individuals in question may themselves be the offspring of red parents,* is of itself a strong point in support of the theory that the gray was the ancestral color. Further, taking into consideration that there are certain areas where a red bird is unknown, it is evident that the grays do certainly produce young the color of their parents; and that where we take the red birds over a very large area and find them continually producing gray birds *together* with red, and compare them with the gray birds which *never* produce a red; it would appear that the gray bird was the original stock, and that the red was an offshoot—a branch, so to speak, which, owing to certain climatic conditions, or certain elements in the environment, gave it the supremacy in the struggle for existence, and that the producing of gray birds by red parents is an evident tendency to revert to ancestral characters. Nor is that old maxim in natural history, *natura non facit saltum* to be ignored; that natural selection played and is playing an important part in the matter is evident, else how came that area in which the grays are entirely absent? That the red birds were a 'sport,' or a freak, and suddenly acquired their characters, is not to be supposed for a moment; but on the theory of 'reproduction with variation' and 'natural selection,' I hold that some slight deviation from the parent stock did at one

TABLE SHOWING DATA BY STATES, UPON WHICH MAP OF COLOR DISTRIBUTION IS BASED.

State.	Red.	Gray.	Source of Information.
Alabama.		Eufaula.	E. L. Brown.
Arkansas.	Cerro Gordo.		Chas. A. Strawn.
	Clinton.		Mrs. Lillie Pleas (Oologist, VIII, 1891, 195).
Connecticut.	Portland.		Jno. H. Sage.
		East Hartford.	Willard E. Treat.
Delaware.	Wilmington.		Walter D. Bush.
Florida.		Palatka.	Jas. Sands.
		Thonotosassa.	W. H. Steacy.
		Citronelle.	Wm. H. Jeremiah.
Georgia.		Faceville.	W. B. McDaniel.
Illinois.	Mt. Carmel.		R. Ridgway (Nat. Hist. Surv. Ill., I, 1889, 417.)
	Odin.		C. B. Vaudycook.
	Jacksonville.		Chas. W. Tindall.
	Warsaw.		Chas. K. Worthen.
	Rockford.		J. E. Dickinson.
	Glen Ellyn.		B. T. Gault.
Indiana.		Camden	Trans. Ind. Hort. Soc., 1890, 52.
	Terre Haute.		Trans. Ind. Hort. Soc., 1890, 52.
		Dunreith.	C. E. Pleas.
	Richmond.		Mrs. Lillie E. Pleas.
	Indianapolis.		Fletcher M. Noe.
Iowa.	La Porte City.		Geo. D. Peck.
		Sioux City.	Dr. Guy C. Rich.
	Grinnell.		Lynds Jones.
Kansas.	Argentine.		G. E. Stilwell.
		Manhattan.	D. E. Lantz.
Kentucky.		Ellis.	Dr. Louis Watson.
	Morganfield.		C. J. Lemen.
	Garrard Co.		G. V. Young.
	Versailles.		L. O. Pindar.
	Bell.		Carrington C. Bacon.
Louisiana.	New Orleans.		Gustave Kohn.
		Mandeville.	Collection Aus. Mus. Nat. Hist.
Maine.		Bangor.	Harry Merrill.
Maryland & Dist. of Columbia.	Washington.		A. E. Colburn.
	Washington.		Wm. Palmer.
	Washington.		C. W. Richmond.
	Washington.		J. D. Figgins.
	Washington.		E. M. Hasbrouck.
	Sandy Spring.		James P. Stabler.
	Laurel.		Geo. Marshall.
Massachusetts.	North Stoughton		C. A. Rummey.
		Boston.	Wm. Brewster & E. W. Ricker.
	Holyoke.		W. F. Lamb.
	Taunton.		A. C. Bent.
Michigan.	Grand Rapids.		Stewart E. White.
	Kalamazoo.		Morris Gibbs.
		East Saginaw.	Peter Lepp.

State.	Red.	Gray.	Source of Information.
Minnesota.	Rochester.		W. D. Hurlbut.
		Lake City.	E. A. Wise.
Mississippi.	Waverly.		G. V. Young.
Missouri.	Fayette.		J. W. Kilpatrick.
		Butler.	Harvey Clark.
		Independence.	Charles W. Tindall.
Nebraska.		Ong.	Joel Nelson.
	London.		Geo. A. Coleman.
New Hampshire.		Milford.	J. P. Melzer.
	Webster.		Charles F. Goodhue (F. & S., VIII, 113).
New Brunswick.		New Castle.	Phillip Cox.
New Jersey.	Morristown.		Specimens in Am. Mus. Nat. Hist.
New York.		Albany.	B. W. Arnold.
		Oneida Co.	B. W. Arnold.
		Lowville.	C. Fred. Boshart.
		Lockport.	J. L. Davison.
		Owego.	J. Alden Loring.
		Binghampton.	Willard N. Clute.
		Port Byron.	E. M. Hasbrouck.
North Carolina.	Oakdale.		Robt. J. Thompson.
	Weaverville.		J. S. Cairns.
	Raleigh.		H. H. & C. S. Brimley.
Nova Scotia.		Pictou (?).	Prof. A. M. McQuarrie & Prof. McCulloch
Ohio.		Ney.	Jno. O. Snyder.
		Hamilton.	Geo. Harbron & Dr. F. W. Langdon.
		Canton.	R. H. Bulley.
	Cincinnati.		John. W. Shorten (Jour. Cin. Soc. Nat. Hist., VIII, 1885, 52).
		Lebanon.	Raymond W. Smith.
		Salineville.	Wm. A. Savage.
Ontario.		Plover Mills.	Robert Elliott.
		Lansdowne.	C. J. Young.
		Yarker.	John Ewart.
		Danville.	Dr. G. A. McCallum.
		Hamilton.	T. McIluraith.
		Bradford.	A. C. Sloam.
		Listowell.	Wm. D. Kells.
		Annan.	A. C. Sloam.
		Ardtrea.	John Blair.
		Toronto.	James R. Thurston.
		Belleville.	James T. Bell.
Pennsylvania.	Philadelphia.		Chas. A. Voelker (Proc. Del. Val. Orn. Club, I, '90–'91, p. 12).
	Williamsport.		August Koch.
		Scranton.	Arthur B. Williams, Jr.
Rhode Island.		Providence.	Chas. E. Doe.
	Pawtucket.		H. A. Cash.
		Providence.	H. A. Cash.
South Carolina.	Mount Pleasant.		Arthur. T. Wayne.
	Beaufort.		Walter Hoxie.
Tennessee.	Duck River.		J. B. Cathey.
	Tazewell.		B. F. Schultz.
Texas.		Giddings.	J. O. Singley.
		San Antonio.	H. P. Attwater.
		Gainesville.	G. H. Ragsdale.

State.	Red.	Gray.	Source of Information.
Texas.	Tyler.		W. L. McDaniel.
		Travis Co.	Chas. D. Oldright.
Vermont.		East Berkshire	G. B. Hopkins.
		Strafford.	Chas. P. Collins.
		Lunnenburg.	W. E. Balch.
		Castleton.	A. O. Johnson.
		St. Johnsbury.	Franklin Fairbanks.
Virginia.	Variety Mills.		H. M. Micklem.
	Wytheville.		John B. Barrett, Jr.
		Eagle Rock.	J. T. Paxton.
		New Market.	Geo. M. Neese.
West Virginia.	Charlestown.		B. W. Mitchell.
		French Creek.	Earle A. Brooks.
		White Sulphur Springs.	Thaddeus Surber.
Wisconsin.	Madison.		Chas. F. Carr.
	Madison.		Wisconsin Nat. Vol. I, 188.
	Racine.		Dr. P. R. Hoy.
	Jefferson.		Ludwig Kumlein.
		Pewaukee.	B. F. Goss.

time occur, which in some way better fitted the individual for the struggle for existance. Through countless generations this has been perpetuated by the inter-breeding of those possessing it, in consequence, the grays, as has been seen (see map), have entirely disappeared in at least one portion of the country, and have become extremely rare in others. Many difficulties exist, both in showing the original condition, and in explaining the present state of affairs. In early scientific work, as is well known, no attention whatever was paid to matters of this nature, consequently it is impossible to ascertain the proportion of red and gray birds at a period say four hundred years ago—still, I hope to reason by analogy. As for the possible causes influencing the change, they will be found fully treated in their proper place; at present the theory is either to be proved or disproved.

Assuming that the gray was the ancestral stock, and that the producing of gray birds by red parents is a tendency to revert to ancestral characters, an analogous case will be found in Darwin's own experiments.

As is well known, many of these were performed with pigeons, which proved to be the best subjects, and the following is quoted from the "Origin of Species:"[1]

[1]Origin of Species, pp. 17–19.

"Great as are the differences between the breeds of the pigeon, I am fully convinced that the common opinion of naturalists is correct, namely, that all are descended from the rock pigeon, *Columba livia* * * * * * * The rock pigeon is of a slaty blue with white loins, * * The tail has a terminal dark bar, with the outer feathers externally edged at the base with white. The wings have two black bars. * * Now in every one of the domestic breeds, taking thoroughly well bred birds, all the above marks, even to the white edging of the outer tail feathers, sometimes occur perfectly developed. Moreover, when birds belonging to two or more distinct breeds are crossed, none of which are blue or have any of the specified marks, the mongrel offspring are very apt suddenly to acquire these characters." (If this be true of distinct species, how much more is it true of different color phases of the same species). "To give one instance out of several I have observed: I crossed some white fantails, which breed very true, with some black barbs—and it so happens that blue varieties of barbs are so rare that I never heard of an instance in England, and the mongrels were black brown and mottled. I also crossed a barb with a spot, which is a white bird with red tail and red spot on the forehead, and which notoriously breeds very true; the mongrels were dusky and mottled. I then crossed one of the mongrel barb-fantails with a mongrel barb-spot, and they produced a bird of as beautiful a blue color, with the white loins, double black wing bar, and barred and white edged tail feathers, as any wild rock pigeon! We can understand these facts, on the well known principle of reversion to ancestral characters, if all the domestic breeds are descended from the rock pigeon."

Now if this reversion to ancestral characters occurs in breeds so far removed from the parent stock and from each other—how much more is it reasonable to suppose that a color phase of the screech owl, when found continually producing gray birds, while gray birds produce grays alone—is but a repetition only between birds more closely related, of the same performance?

(To be continued.)

THE CINNAMON HARVEST-SPIDER AND ITS VARIATIONS.

By Clarence M. Weed.

In his monograph of the Phalangiidæ, published[1] in 1868, Dr. H. C. Wood described a well-marked harvest-spider as *Phalangium ventricosum*. The description was drawn up from a single female taken near Philadelphia, and specimens of a male Phalangium collected in West Virginia supposed to belong to the same species. Besides these Dr. Wood had a number of female harvest-spiders from Nebraska "which present apparently the same specific characters as the former, except that the legs are a little shorter. Suites of specimens from the two localities would however probably show them to be distinct."

In the same paper, Dr. Wood described as *Phalangium formosum* another well-marked form found in spring.

Aside from a mention in 1869 by Dr. Packard in his Guide to the Study of Insects (p. 657), and a bibliographical reference in 1885 by Professor Underwood,[2] these species appear not to have been noticed in our literature for nearly twenty years. Since then, however, I have referred to them in a number of papers.

My first mention was published in 1887[3] when I provisionally referred *P. formosum* to the genus Liobunum, and conjectured, without having seen specimens, that *P. ventricosum* also belonged to that genus. Two years later I published[4] extended descriptions of *P. formosum* referring it to Liobunum "with considerable hesitancy, as it does not strictly belong there on account of the projecting inner angle of the palpal patella."

[1]Comm. Essex Institute, Vol. VI.

[2]Con. Ent., XVII, 169.

[3]Amer. Nat., XXI, 935.

[4]Bull. Ill. St. Lab. Nat. Hist., III, 91.

These forms were next discussed in my paper on "The Harvest-spiders of North America,"[5] in which *P. ventricosum* is definitely placed in Liobunum, and *P. formosum* together with a southern form not before described is referred to the new genus Forbesium. The new form is named *F. hyemale.* "The former (*F. formosum*) is a distinctly northern species, ranging from New York to Colorado, while the latter (*F. hyemale*) is evidently its southern representative."

Finally in the AMERICAN NATURALIST for September, 1892, I announced that by keeping specimens of *F. formosum* taken in early spring in vivaria, I had determined that it was the immature form of *L. ventricosum*; and about the same time I published[6] extended descriptions of adults of both sexes of *L. ventricosum.*

For the purposes of the present study I have had a considererable number of adult specimens from nine widely separated states, viz.; Maine, New Hampshire, New York, Ohio, Michigan, Illinois, Nebraska, North Carolina and Mississippi. Besides the adults I have had an immense number of the immature form (*formosum*) and a few of the form at present called *F. hyemale.*

The first glance at the adult specimens shows that there is a great variation in the size of the body and length of legs in different localities. The Mississippi forms are twice as large as those from New Hampshire; while those from the states between present intermediate sizes. This is shown by the measurements in millimeters in the following table; numbers 1 to 6 are males, and 7 to 12 females.

To show graphically the gradual lengthening of the legs of this harvest-spider as it goes southward I have reduced the length of the second pair, as given in this table, to the straight lines reproduced on the opposite page. The Mississippi specimens were taken at the Agricultural College in the central part of the state. I regret that I have not more specimens from the region between Ohio and Mississippi to show the transition more completely.

[5]Am. Nat., Oct., 1890.

[6]Trans. Am. Ent., Soc., XIX, 188.

Table I.—Variations of *Liobunum ventricosum*.

Number of Specimen.	Locality	Body.		Legs.			
		Length	Width	First	Second	Third	Fourth
1	New Hampshire	5.8	4.	27.5	47.5	28	36.5
2	Michigan	7.	4.4	27.5	55.5	26	42.
3	"	7.1	4.2	28.	57.5	29	44.6
4	Ohio	7.6	5.	36.5	67.5	36	—
5	North Carolina	8.	5.	44.	74.	—	—
6	Mississippi	9.	6.	52.	101.	50	73.
7	Maine	9.	5.6	25.	47.	24	—
8	New York	10.2	5.5	27.8	55.	27	39.
9	Michigan	10.	6.	28.	53.	28	40.
10	Ohio	10.	6.	—	62.	—	48.6
11	Mississippi	13.4	7.	46.	89.	44	—
12	"	11.	6.2	48.	93.5	46	68.

Males.

New Hampshire.

Michigan.

Ohio.

North Carolina.

Mississippi.

Females.

Maine.

Michigan.

New York.

Ohio.

Mississippi.

Like other harvest-spiders this species also varies considerably in a given locality. It is so rare that it is difficult to get long series from one place so that I cannot tabulate at present these variations as fully as has been done for *Phalangium cinereum* and *Liobunum vittatum dorsatum.*[7] To indicate the variation that sometimes occurs in a single state I may record that of two specimens from Dover, New Hampshire, measured since the above tables were prepared, the body of the male was 8 mm. long, and the second legs 63 mm., while the body of the female was 10 mm. long, and the second legs 50 mm. The second legs of this male specimen were 15.5 mm. longer than the one from Hanover recorded in the table. It should be stated however that Dover is distinctly within the region of the Alleghanian fauna, and Hanover is on the border between the Alleghanian and Canadian faunas.

A study of all the specimens of my *Forbesium hyemale* now accessible leads to the conclusion that this is the immature stage of the southern form of *L. ventricosum*, just as Wood's *P. formosum* is the immature stage of the northern form of this species. The dissection of specimens shows that they are not

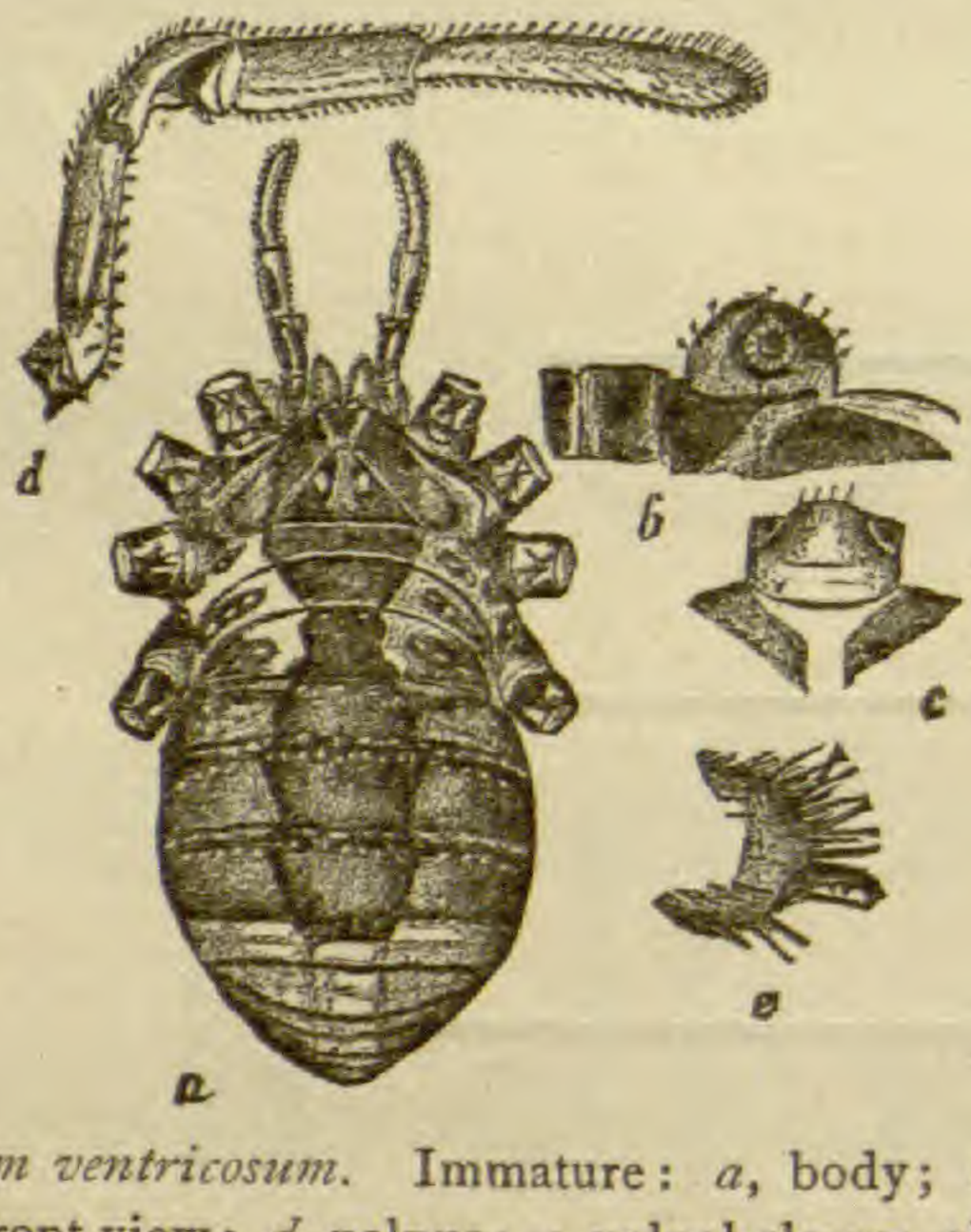

FIGURE 1.—*Liobunum ventricosum.* Immature: *a*, body; *b*, eye eminence, side view: *c*, same, front view; *d*, palpus; *e*, palpal claws; all magnified.

sexually mature, and the dates of capture indicate that they disappear late in spring or early in summer at the time the

[7]AMERICAN NATURALIST, Vol. XXVI, pp. 34–36.

adult *L. ventricosum* appear. This is precisely the condition in the northern states. An idea of the similarity of the two immature forms in structural details may be obtained by comparing Fig. 1 with Plate XIV, Fig. 2.

The southern form of *L. ventricosum* should evidently be considered a geographical race sufficiently distinct for subspecific name. Inasmuch as *hyemale* has already been applied to the stage immediately preceding the adult it may well be used for this race, and the form be known as *Liobunum ventricosum hyemale.* Just where the line dividing the two forms should be drawn is difficult to say without more material, but it probably occurs near the latitude of southern Ohio.

Laws of Variation in Harvest-spiders.

Comparatively little definite investigation of the geographical variation of North American invertebrates has yet been undertaken. In the vertebrates—especially birds and mammals—much attention to the subject has been given by Baird, Allen and other well-known zoologists, so that a number of general laws have been formulated.[8] To determine to what extent these laws hold true for the invertebrates, as represented by the Phalangiidæ, I have ventured to formulate some of the results obtained in my studies of this group—results which in part have already appeared in the Naturalist and in part are yet unpublished. At the present stage of investigation such formulæ cannot be considered as final by any means, but if they serve no other purpose they will be useful in determining the direction of future work.

(1.) In mature individuals of the same species and sex from a given locality there may be found a decided variation in size of body and length of legs. In a series of fifty or a hundred such individuals taken at random the body of the largest specimen will usually be from one-fifth to one-fourth longer than that of the smallest; and the legs of the longest-legged individual are likely to be from one-fifth to one-third longer than those of the shortest-legged specimen.

[8]See the American Naturalist, Vol. XXVI, pp. 87–89.

(2.) As a rule, not without exceptions, the legs vary together in a given direction; that is, if in a certain individual the first pair are longer than the first pair of another individual, the other legs of the former are likely to be longer than the corresponding legs of the latter. The hind legs are the most irregular in their variation.

(3.) There is a gradual increase in size of body and length of legs in the individuals of a species from the north, southward at least as far as latitude 37° in the Mississippi Valley near which region the sub-family Phalangiinæ appears to attain its maximum development.

(4.) The proportionate increase in the length of the legs to the southward appears to be greater than that of the body.

These last two propositions are true of all the harvest-spiders having an extended northern and southern distribution studied with reference to their variations, viz; *Liobunum vittatum*, *L. ventricosum*, *L. politum* and *L. longipes*. Probably the most important factor in determining this increase in size is to be found in the climatic conditions which permit a longer period of growth and feeding at the south than in the north. The arachnids undergo no definite series of molts, simply casting their skins as increase in size requires. Such climatic conditions, combined presumably with a more abundant food supply, may tend, apparently, to increase the size of these harvest-spiders by at least three methods:

(*a.*) By the direct effect of a long warm period of growth with abundant food upon the individual before attaining its full size.

(*b.*) By the effect of a long period of development of the eggs in the ovaries of the female.

(*c.*) By the action of the eliminating principle in natural selection in fostering those individuals which attain the maximum size compatible with their environment.

This increase in size of individual may possibly be of benefit to the species (1) by enabling it to prey upon larger insects, thus increasing the source and variety of its food-supply; (2) by enabling it better to elude predaceous enemies, or (3) to catch fleeing prey.

PLATE XIV.

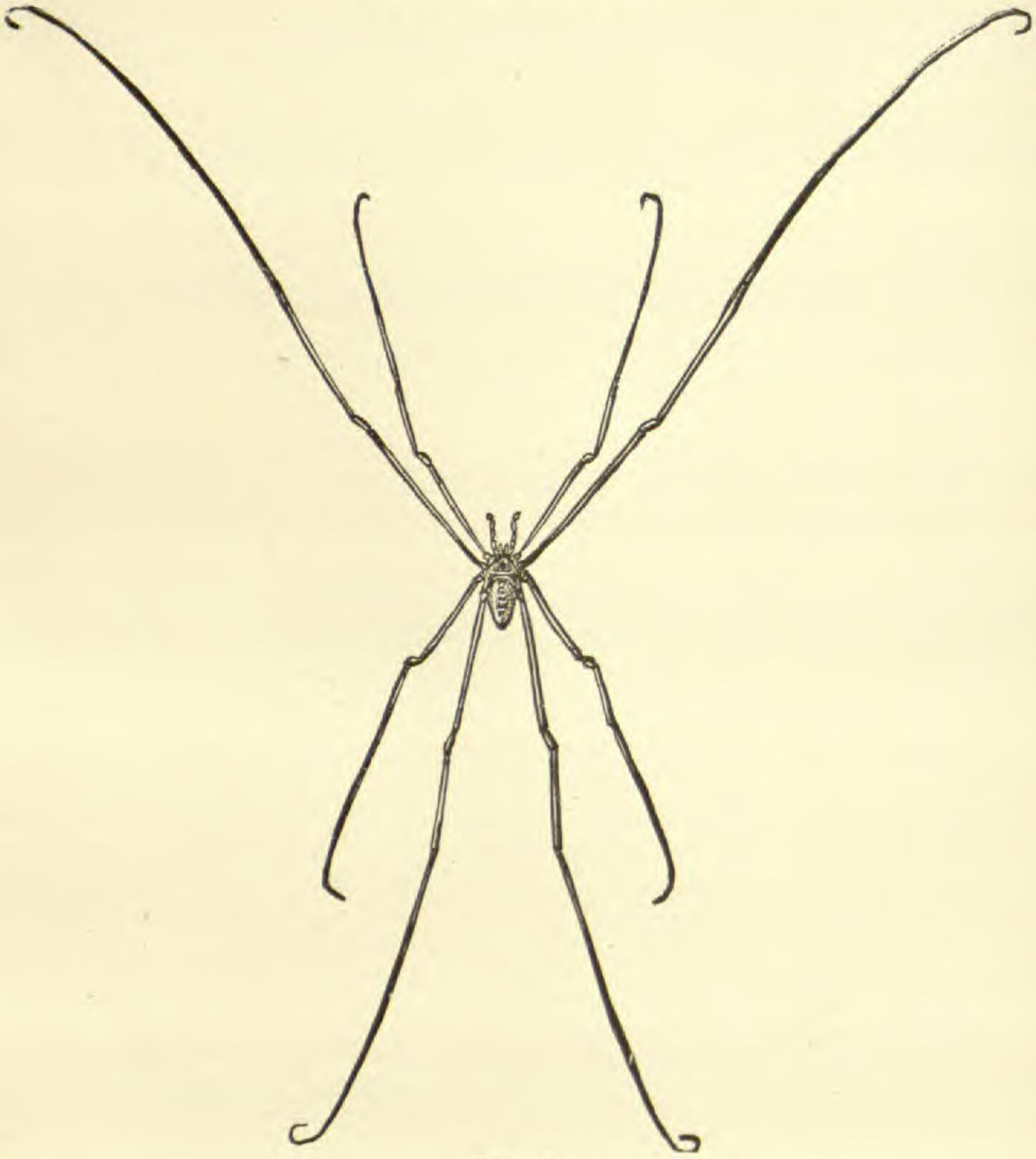

FIG. 1.

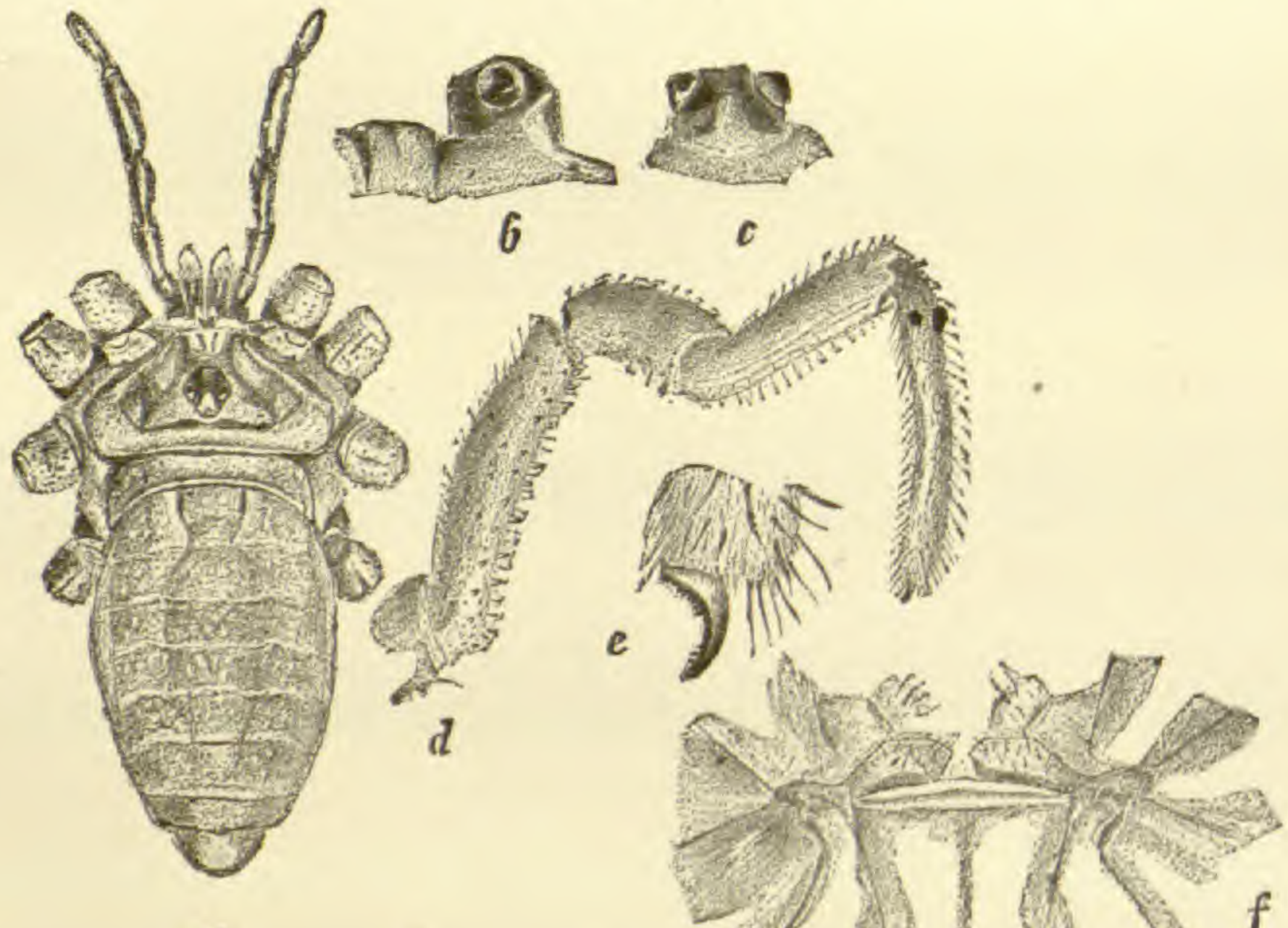

FIG. 2.

Liobunum ventricosum (Wood.)

(4.) In the plains region of the Northwest (Dakota, Nebraska) the legs are considerably shorter than in similar latitudes in New England.

For example, the second legs of a male *Liobunum longipes* from Brookings, South Dakota, measure 62 mm., while those of a Hanover, New Hampshire specimen measure 74 mm. The case of the Striped Harvest-spider (*L. vittatum dorsatum*) is still more striking; the second legs of a New Hampshire specimen measure 71 mm., while the normal length in South Dakota seems to be only 35 mm.

In addition to the above the following laws of vertebrate variation appear to hold good in the Phalangiidæ.

(5.) "The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.

(6.) "The most typical or most generalized representatives of a group are found near its center of distribution, outlying forms being generally more or less aberrant or specialized."

Explanation of Plates.

Plate XIII. Fig. 1.—*Liobunum ventricosum* (Wood), male. Natural size.

" 2.—Parts of same. Magnified.

" 2*a*.—Body.

" 2*b*.—Eye eminence. Side view.

" 2*c*.—Eye eminence. Front view.

" 2*d*.—Palpus. Side view.

" 2*e*.—Claw of palpus. Side view.

" 2*f*.—Maxillary lobe of second pair of legs.

Plate XIV. Fig. 1.—*L. ventricosum hyemale.* Immature. Natural size.

" 2.—Parts of same. Magnified.

" 2*a*.—Body.

" 2*b*.—Eye eminence. Side view.

" 2*c*.—Eye eminence. Front view.

" 2*d*.—Palpus. Side view.

" 2*e*.—Claw of palpus. Side view.

EDITORIALS.

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

—We have received from the Secretary of the American Philosophical Society, a programme of the exercises on the occasion of the celebration of the 150th anniversary of the foundation of the Society. The celebration commences on Monday, May 22d, at 8 P. M., and continues until Friday the 26th inclusive, and consists of sessions commencing at 11 o'clock A. M., excepting on Monday, when the session opens at 8 o'clock, P. M.

The programme is the work of a committee, and was not submitted to the Society until its terms could not be altered without discourtesy to the persons who had been invited to participate in it. This much is due to the Society, since it is, under such circumstances, not responsible for the committee's work. As to the committee, its work is disappointing, for since there is one member of it who is presumably competent for the work it undertook, he should have been able to so influence the other members as to have produced a widely different result. The adoption of such a programme is to misrepresent the position which Philadelphia holds in the wide field of labor covered by the Society, since it does not include any paper or address by any one of its citizens presenting his own original work in art, science or philosophy. On the contrary, the best that can be said of the programme is that its subject-matter, so far as contributed by Americans, consists of those generalities to which popular assemblies are wont to be treated, and, perhaps, entertained, if not satisfied. For a Society whose fundamental object is the "increase of knowledge," to occupy its time in platitudinous disquisitions of this kind, displays a misconception of its own position and, a lowering of the standard of achievement which it is of all the societies in this city called upon to bear.

When an active Society, such as the one in question, celebrates an anniversary of significance, it usually presents to the world some evidence of its activity by securing for the occasion the services of such of its members as are competent so to do. Such occasions are usually selected for the announcement of the results of their work before the wider audience which the occasion is expected to attract. A memorial volume of permanent value is the usual result.

As an illustration, in 1880, the Boston Society of Natural History celebrated the fiftieth anniversary of its foundation. A memorial volume was issued, which includes the papers read on that occasion, and it is a monumental work. The same course should have been pursued by the American Philosophical Society. There is no deficiency of workers or of work. The members of this Society produce *original work* in Prehistoric Archeology, Philology and Ancient and Modern History; in Chemistry, Geology Biology; in Political Science, and in pure Philosophy. We emphasize the words *original work.* That none of these men and none of this work appear in the programme will be cause of astonishment both in Philadelphia and out of it.

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RECENT LITERATURE.

Evolution of the Colors of North American Land Birds.[1]—This octavo of 361 pages, published by the California Academy of Sciences, the author Mr. Charles A. Keeler, modestly calls a study. The views set forth are more or less provisional and tentative, and are intended to direct research into this new field of ornithological inquiry. The subject-matter of the essay is preceded by a discussion of the various views held as to the laws conditioning evolution, such as inheritance of acquired characters; the nature of species; natural and sexual selection, and isolation, as factors in the evolution of species. In concluding this rather lengthy introduction, the author remarks " that life has evolved in accordance with tolerably definite and unvarying laws, and that the element of chance, if any such there be, is a very limited one."

In Part II the colors of North American birds, are treated of under the following heads: Modes of plumage changes; General principles of color in Birds; The proportion and distribution of the colors in the North American genera; The pattern of markings; Variation of color with sex, age and season; The direct influences of the environment; Geographical distribution as a factor in the evolution of colors; Orders, families and genera of North American Birds, considered from the stand-point of their evolution.

The theory of bird colors which Mr. Keeler seeks to establish is as follows: Pigment is a chemical composition thrown off from the system of the bird, probably as a product of waste, and lodged in the integument. The chemical substance thus generated varies in different groups of birds, but is probably generally constant in the species of one genus, or frequently in an entire family. A certain genus would thus be capable of generating only a given number of fundamental colors, but natural and sexual selection by combining and rearranging this limited assortment can produce a variety of effects.

Associated with this theory is the Law of Assortment of Pigments; that is, that the primitive color is a composite which, when more or less completely resolved into its component elements gives the specialized tints of the species or genus. If the system of the bird from which

[1]Evolution of the Colors af North American Land Birds. Occasional Papers of the California Academy of Sciences III. By Charles A. Keeler. San Francisco, January, 1893.

some of the present highly colored genera were evolved produced normally two pigments, unless some distributing force were brought to bear upon them, they would naturally be combined at first. It is only after long selection that the component colors become apparent. The examples cited are, as might be expected, among the most highly specialized genera. The woodpeckers are colored black, white and scarlet. The combination would produce brown, which is still the body color of some species. In the genus Tyrannus the original color was probably olive green, the special colors are black and yellow. In the blue jays that are blue in the adult together with black and white, the mixture of these colors gives the grays of the young, and of the less specialized forms, as Perisoreus and Picicorvus. Besides black and white, most North American genera appear to contain but two fundamental colors, but in the tropics three frequently occur in a single genus.

In discussing protective coloring, repetitive marks, and recognition marks, the most recent literature upon this subject is cited and illustrated with numerous facts of the author's own observation.

Having considered the factors that influence the evolution of colors of North American birds, Mr. Keeler gives a brief account of the families and genera with an application of the principles discussed.

Mr. Keeler's review of the factors of organic evolution is comprehensive and intelligent. He appreciates the fundamental difference between the origin of characters and the selection of characters, though occasionally he slips into the customary confusion on this point by ascribing the origin of some color marks to natural selection. The reviewer takes this opportunity to refer to one misunderstanding into which he in common with many others has fallen, in his reference to effort as prior to use in developing structure. He says (p. 75) "All that can be said to the above [the theory of effort] is that it may be true but that it has not yet been demonstrated. There is indeed a vast difference between the assumption that use can modify a part which already exists, and the assumption that desire or effort can originate something which does not exist. Moreover, even if effort be a valid factor in creation, it cannot it seems to me have the general application ascribed to it by Professor Cope. For example, it could apparently have no influence on the origination of new colors. Does the bird desire to be protectively colored? If so it must decide what colors would be most in harmony with its surroundings, and then make an effort of will to have these colors developed; all of which is on the face of it inconceivable. Or by what imaginable sort of effort could

feathers be originated? Effort then, if it can be shown to have any creative power, must be relegated to a very special field, and cannot be considered as the sole or even principal originator of the fittest."

The above paragraph indicates a radical misconception of the proposition.

Effort is simply the conscious preliminary to motion, and motion is the fundamental efficient cause of the leading modifications of structure. No knowledge or intention as to the result or effect (final cause) of the motion is to be supposed. It is motion which changes the environment of an animal, and which is thus at the bottom of whatever results from that change, let the immediate efficient agency be physical, chemical or mechanical. The psychic cause of this effort is a sensation. Of course in purely reflex acts, effort (which is assumed to be conscious by its definition), is wanting, but the hypothesis sustained in the work quoted by Mr. Keeler, (The Origin of the Fittest), is that reflex acts have had their origin in conscious acts, and are the result of automatization, which is the ordinary process of education. Reflex motions then have had their origin in effort as well as the so-called voluntary acts, but at an earlier period. For this reason they have relatively little to do with the molar movements of animals at the present time, and therefore little to do with the *present* origin of specific characters. It is present effort which precedes most of the motions of animals, and which thus has everything to do with the environment, to which evolutionists of all shades appeal as an efficient cause.

The most important contribution towards the discovery of the origin of colors in birds by Mr. Keeler, is his demonstration of the law of the Assortment of Pigments. His classification of our birds in accordance with their color relations, is a valuable preliminary to further research. When we reach the final stage of the subject, the origin of the tints themselves, no definite progress is made in the book before us. As one of the most difficult problems in organic molecular physics, it requires a very special mode of experimental treatment, and one which Mr. Keeler has not attempted. The origin of color patterns is less difficult of approach, and some progress has been made in this direction, but the subject is yet in a very primitive stage.

The illustrations of the book are numerous and often in colors, and they add greatly to its value. The work is gotten up in excellent style, and is a credit to all concerned in its publication. C.

Wright's Man and the Glacial Period.[1]—This book is the best synopsis of present knowledge of the glacial epochs and its relations to human history which has yet appeared. The compass of the work necessarily does not permit as great detail as would be appropriate to a technical monograph, but it is admirably adapted for the purpose for which it is designed, i. e., that of giving the greatest amount of information in a readable form in the smallest space. The treatment of disputed topics is generally judicial, and the author has brought to bear on the subject a great wealth of facts not only from all published sources, but also from his own original research in North America and Europe. A question of much general interest is that of the age of the great ice period. He brings together evidences from various observers to show that its close cannot have been more than 15,000 years ago, and that its duration may have been twice as long. The basis of this estimate is the rate of cutting of various post-glacial gorges, of which well-known examples are that of the Niagara River, and that of the Mississippi below the falls of St. Anthony. This shortened time is in remarkable contrast to the estimate made by the geologists who first attacked the problem.

The portion of the book relating to the antiquity of man is the smaller half, but the conclusive evidences of man's existence during the glacial epoch are necessarily local. Such evidence as this is handled judiciously, and all objections are duly considered. Professor Wright is of the opinion that some of the finds which indicate the existence of man during the glacial epoch are trustworthy evidence to that effect. He cites especially as American localities, Trenton, New Jersey, (Abbott); Newcomerstown and Madisonville, Ohio; Little Falls, Minnesota, Miss Babbitt; Nampa, Idaho, and Calaveras Co., California. These finds will be mentioned again below. He considers the supposed finds of human implements in beds of Neocene age as not established.

Dr. Wright's book has been made the object of a vigorous attack by the geologists of the U. S. Geological Survey in a way which shows an animus on their part not strictly scientific. President Chamberlin in the Chicago Dial, charged the author with improperly alleging on the title page that he was an assistant on the U. S. Geological Survey. To this Dr. Wright replied that he was so employed at the time the book was written and demonstrated satisfactorily his right to use the title assistant. One of the other criticisms was regrettably free from the amenities which should characterize scientific discussion, while others

[1]Man and the Glacial Period by G. Frederick Wright, D.D. LL.D. International Scientific Series No. LXIX. New York, D. Appleton & Co., 1892.

exaggerated unimportant details, and ignored the general value and utility of the book. To all this Dr. Wright has replied temperately and convincingly.

The ethnologists of the Bureau at Washington have made destructive criticisms of the evidence for glacial man contained in the book. Probably the most expert makers in the world of human implements of the stone age are Messrs Holmes and Maguire of Washington. They show convincingly that it is easier to make neolithic or pecked and polished stone implements, than to make fine chipped flints of paleolithic type. Hence they conclude that either the order of age should be reversed, or that paleoliths and neoliths are of con-

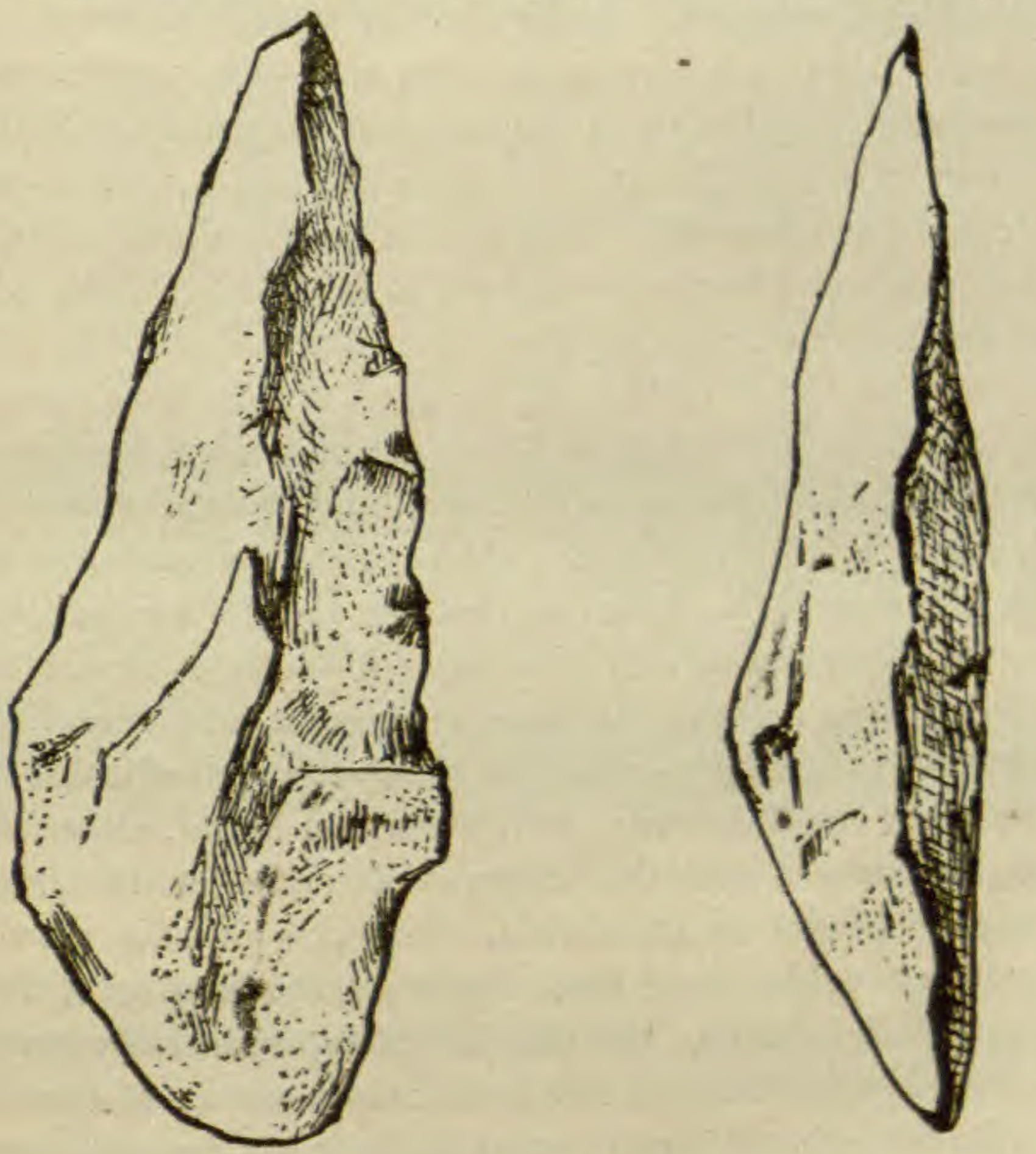

FIG. 1.

Fig. 1. Argillite implement found by Dr. C. C. Abbott, March, 1879 at K. K. Rowan's farm, Trenton, N. J., in gravel 16 feet from surface. From G. F. Wright's Man and the Glacial Period.

temporary age, and that the absence of neolithic implements from some deposits is simply due to accident or to the soft material of which such implements were made. This conclusion, if correct, revolutionizes prehistoric archeology. These gentlemen think that it should be

revolutionized, and that paleolithic man in both Europe and North America is a myth. The great collections of paleoliths of the turtle-back and Chelléen types they look upon as cores and rejects of pieces from which better implements have been made and taken away. This view leads them to look with suspicion on the alleged discoveries of glacial man, and Mr. Holmes has accordingly written articles discrediting the finds described in Dr. Wright's book.

It may be remarked apropos of the observations of Messrs Holmes and Maguire, that though it may be true that pecked and ground implements are more easily made than well chipped flints their actual relations in time can only be ascertained by stratigraphic and paleontologic research. A flint broken once or twice so as to produce an edge is more easily made than a neolith, and gives a great deal better edge, so that such implements may very probably have antedated the latter, while the finer ones are well-known to have been neolithic, and have been made up to the present day. The question is however, not which implement ought to have come first, but which actually did come first.

As regards the finds in Europe, those of the caves are the result of so much careful investigation, and are characterized by such satisfactory stratigraphic conditions, that they cannot be impeached by observations made in this country. The paleoliths and human bones have been conclusively shown to belong to the age of the glacial fauna. In North America the paleontologic evidence is not so good, but such as there is, indicates strongly that the earliest known American was not more modern than the paleolithic European. Those who saw the Calaveras skull when first found, allege that it was more or less covered with the adherent cement so characteristic of the gold bearing gravel of California. The age of this gravel is not exactly determinable, since data respecting the finding of fossils in it are not generally reliable. But that it is of approximately glacial age no one doubts. Mr. Holmes believes that the implements of the Abbott and Babbitt finds occur only in the talus, and are not from the undisturbed glacial gravels (American Geologist); but so far as regards part of the Babbitt, and all of the Abbott finds, other observers hold a different opinion. In the Journal of Geology he shows that the evidence for the stratigraphic position of the finds at Madisonville and Newcomerstown, Ohio, is defective. It may be added here that the Nampa image, whatever may be its real stratigraphic origin, displays in its form an artistic skill on the part of its maker, not to be looked for in primitive man; nevertheless it is time that the name of the person who alleges

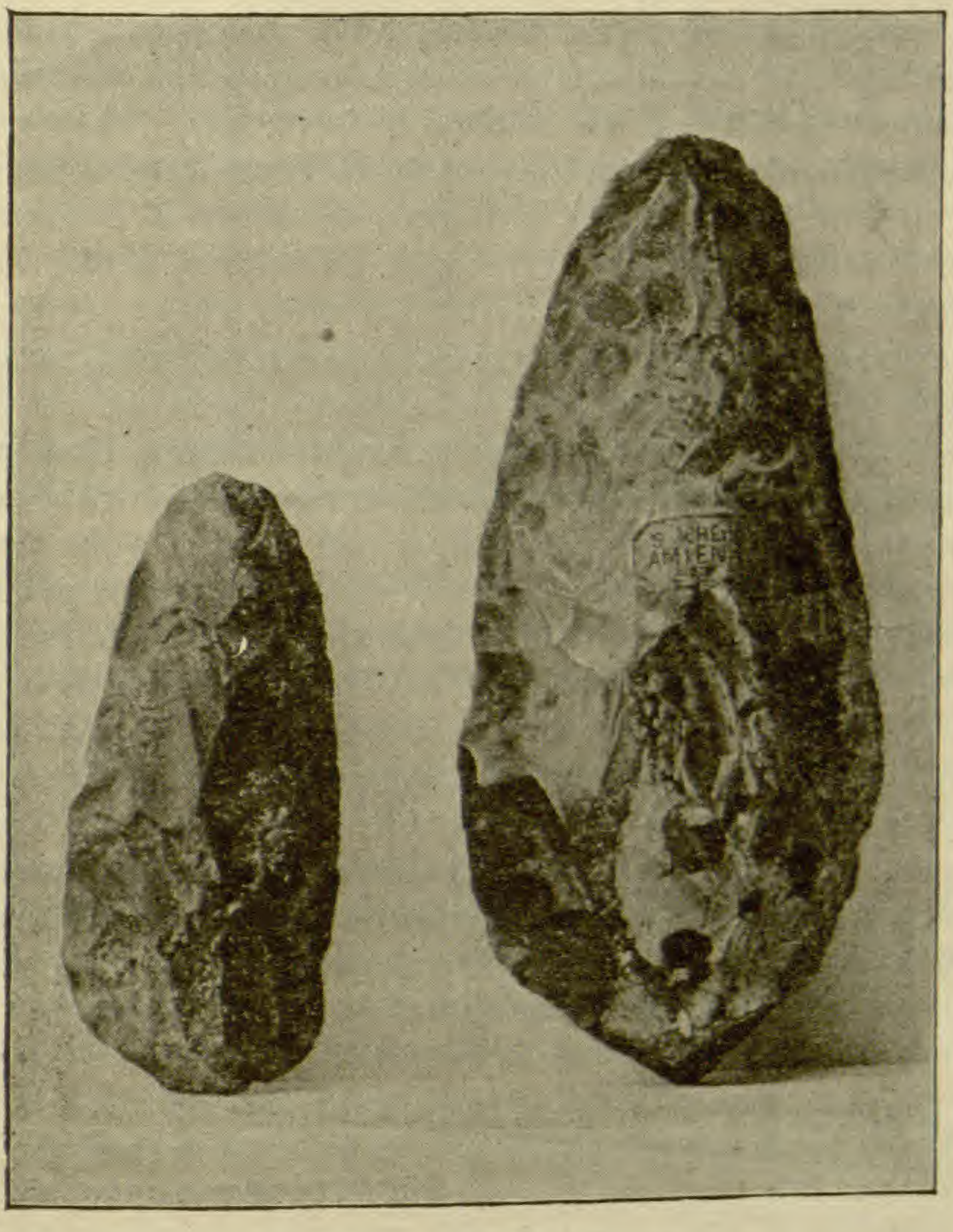

FIG. 2.

Fig. 2. Smaller figure, paleolith from Newcomerstown, Ohio; larger figure do from Amiens, France; both one-half size. From G. F. Wright's Man and the Glacial Period.

that he intentionally deceived Professor Wright in this matter, be produced; and the authority for the statement that such an assertion was made, should make himself known. The image cannot well be the work of any existing Indian tribe, as has been asserted. In any case it seems that the evidence for Plistocene man in America, must be further investigated with careful methods, and under more favorable circumstances than are furnished by most of the so-called glacial gravels.

We give figures of two characteristic types of paleoliths; one of argillite found by Abbott at Trenton, N. J.; and one flint from Newcomerstown, Ohio.

E. D. COPE.

Some Recent Books on Bacteriology.—One of the most recent works dealing with the bacteria is Dr. Sternberg's[1] Manual of Bacteriology. He is well known as an investigator in this field, and is moreover one of the pioneers in the United States. The work is a most comprehensive one, the best published in the English language. While perhaps not so full on pathogenic organisms as Baumgarten's Lehrbuch der Pathologischen Mycologie, yet it is sufficiently full and complete to make it one of the best books of its kind. It moreover contains accounts of the most recent discoveries in regard to pathogenic organisms.

One hundred and one pages are devoted to history, classification, morphology and general bacteriological technology. The author adopts the classification of Baumgarten (1890) with slight modifications. He divides the species into (1) relatively monomorphous and (2) pleomorphous. Under the first micrococci, bacilli, and spirilla are grouped; under the second spirulina of Hueppe, leptotricheæ (Zopf) and cladotricheæ. Hauser's Proteus also belongs here. Part second is devoted to general biological characters; including an account of the action of antiseptics and germicides. Dr. Sternberg's work on antiseptics and germicides is so well known that it will not be necessary to refer to this part of the work at length. Three hundred pages are devoted to pathogenic bacteria, 158 species are carefully described, and many are illustrated. In some cases the colors of the growth when grown in different nutrient media are given. Botanists will be chiefly interested in the account given of the saprophytic bacteria. Chapters are devoted to the bacteria of the air and water, bacteria found in the stomach and intestinal canal, articles of food and soil, in which the usual methods of culture are given. Three hundred and thirty one species are described. This feature of the book makes it especially commendable. Those who have had occasion to use the classification of De Toni in Saccardo's Sylloge Fungorum or that of Crookshank in his Manual of Bacteriology have found the descriptions of the species far from satisfactory. The descriptions given by Sternberg are ample for the determination of the species.

The biological characters are very full. An excellent bacteriological diagnosis is a great aid in the determination of the species. A few errors have made their way into this part of the book. On page 758, *Bacillus citreus-cadaveris* is said to be motile, but turning to page

[1]A Manual of Bacteriology. Illustrated by heliotype and chromolithographic plates and two hundred and sixty-eight engravings, 886 pp. New York, Wm. Wood and Co., 1892.

633 where the species are described it is said to be non-motile. The same for *Bacillus fulvus*, which p. 758, is said to be motile, but on p. 629 is described as non-motile. Notwithstanding that a few of these defects occur, this part will certainly be appreciated by working bacteriologists. In this key the following characters are used. (1) Morphologic; Micrococci, Bacilli, Spirilla, Leptotricheæ and Cladotricheæ. Formation of spores, independent motion. (2) Physiological characters; relation to oxygen, ærobic, strictly anærobic, facultative anærobic, growth in gelatin, liquefy or do not, no growth in gelatin, growth on potato, in milk, coagulate milk, do not coagulate milk, color of growth, chromogenes, not chromogenic, pathogenesis.

The bibliography has been gotten together with great care, and is very full, containing the titles of 2,582 papers grouped under historical classification, staining methods, culture media, sterilization of culture media, etc. A very large number of papers are cited on the physiological properties, such as lactic acid fermentation, viscous fermentation, putrefaction, etc. The literature on pathogenic microorganisms is especially full. Bacteriologists should feel grateful to Dr. Sternberg for this work, and also to the publishers for the excellent manner in which their part also has been performed.

Wm. Wood & Co. have during the past four years issued two other text books on bacteriology; the English translation of Salomonsen's Bacteriological Technology, by Professor Trelease is well known and needs no introduction. A second admirable work, antedating Sternberg's Manual, is Fränkel's Grundriss der Bakterienkunde translated by J. H. Linsley.[2] It has been translated into six different languages, and those who have been fortunate enough to use the German edition know its admirable qualities. The translation before us is an admirable one. The style is clear and there is no difficulty in understanding the author. The work contains a great deal on the biology of many species that hitherto has not been found its way into English works. It is to be regretted however that references to literature are not given, but these may readily be obtained from Sternberg's Manual. No figures are given in the book, but the accounts are clear. Future editions should have figures.

For a limited amount of work both of the books noticed above are too large. One of the best of the small books with which the writer is familiar is Abbott's[3] Principles of Bacteriology.

[2]Text-book of Bacteriology, third edition, translated and edited by J. H. Linsley, pp. 376. New York, Wm. Wood & Co., 1891.

[3]The Principles of Bacteriology. A manual for students and physicians. Lea Brothers & Co., Philadelphia, 1892, pp. 263

This book is well suited for class room work. Its technique is stated in clear and concise language, accompanied with numerous illustrations. The writer having used this for a large class is prepared to say that it is an excellent work of its kind.

Another hand-book intended for a larger circle of readers is Woodhead's[4] small volume on Bacteria and their Products. It treats the subject in a somewhat different manner than the others. It gives considerable attention to historical matters, and treats quite fully the different systems of classification used by Ehrenberg, Cohn, Van Tiegham, Zopf, De Bary, Hueppe and Flügge. The chapter on fermentations contains a great deal on chemistry, but it is far from being a popular exposition of the question. The author has of course largely drawn from Hansen, Pasteur, and Schützenberger. The author uses the word parasite and saprophyte in a somewhat peculiar way. He speaks of the bacteria of the mouth as being parasites, contradicting a previous statement made with reference to parasitic bacteria. The work has been edited rather carelessly, the word "parasiticism" for parasitism occurs in several places as well as the word "saprophyticism."—L. H. PAMMEL.

Report on the Fish and Fisheries of the United States for 1888.[5]—This volume, an octavo of 902 pages, contains in addition to the Reports of the Commissioner, Hon. Marshall McDonald and his two assistants, 11 important papers bearing upon the Fish Industry. The results of the sea-coast inquiries conducted during the year 1888 are embodied in the reports of Mr. J. W. Collins and Lieutenant Commander S. L. Tanner. The work accomplished at the laboratory of Woods Holl, Massachusetts is reported on by Mr. J. A. Ryder. Notes on Entozoa of Marine Fishes, with descriptions of new species and the anatomy of *Thysanocephalum crispum* Linton are given by Mr. E. Linton.

Number 8 in the series of Appendices is a review of the Fresh-water Sunfishes of North America by Mr. C. H. Bollman. It is the beginning of the systematic investigation of interior waters by volunteer naturalists under the direction of Dr. D. S. Jordan. The Apodal Fishes inhabiting the waters of America and Europe are reviewed by

[4]Bacteria and their Products. The contemporary Science series, edited by Havelock Ellis, pp. 459, with 20 photo-micographs. London, Walter Scott, 24 Warwick Lane, Charles Scribner Sons, New York, 1892.

[5]U. S. Commission of Fish and Fisheries. Part XVI. Report of the commissioner for 1888. Washington, 1892.

Dr. Jordan and Mr. B. M. Davies. The work undertaken by Prof. W. O. Atwater ten years ago, viz., a comprehensive series of experiments upon the chemical composition and nutritive values of the American food-fishes, has been completed, and his report upon the subject is published as Appendix 10 to this volume. The last paper is J. W. Collins' Report upon the participation of the U. S. Fish Commission in the Centennial Exposition held at Cincinnati, Ohio, in 1888.

The numerous illustrations and maps give additional interest to this comprehensive report.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Oneonta and Chemung Formations in Eastern Central New York.—The Oneonta formation comprises a thick mass of red shales and red and gray sandstones, similar in character to the rocks of the Catskill Mountains. They overlie the Chemung formation in southern New York and northern Pennsylvania. The recent investigations of Mr. N. H. Darton confirm Professor Hall's supposition that the Oneonta beds represent the eastern extension of the Portage formation. The former is characterized by a large quantity of red shale which occurs as streaks in the lower beds, a thick mass a little higher in the series, and constitutes elongated lenses in the gray flags and red sandstones of the upper member of the formation. Toward the western termination of the Oneonta formation the red material rapidly disappears and its place is taken by gray shales and thin bedded sandstone. There can be no doubt of the continuity of sedimentation throughout. Toward the east the formation increases in thickness until it comprises the lower thousand feet of beds in the Catskill Mountains. The Chemung fossiliferous shales which overlie the Oneonta formation south of Franklin grade upward through a series of flags into hard, coarse, cross-bedded gray sandstones with intercalated red shale layers. Toward the east the fossiliferous shales merge into flags, and then into hard, coarse sandstone with flaggy layers along the eastern front of the Catskill Mountains.

Since the rocks of the Catskill Mountains comprise the Chemung and Portage horizons, Mr. Darton proposes to discard the use of Catskill to designate a formation, and to use the term Catskill group to include the Chemung and Portage formations. (Am. Journ. Science, March, 1893.)

Tertiary Insects from Colorado and Utah.—Bulletin No. 93 of the Geological Survey comprises descriptions of eight species of Oligocene insects from Florissant and other points in Colorado and Utah, by Samuel H. Scudder.

Of this group of interesting fossils six are referred to new genera. In a short introduction the author gives the special claim which each

has for consideration. The Trichocemsis represents a type hitherto considered exclusively gerontogeic; the Stenogomphus is the first Gomphine fossil found in this country; the Cicada for its great size and for being the first member of its family known from American rocks; the Hymenoptera is curiously related to Oriental forms; the Diptera are interesting departures from the modern types to which they are most nearly allied; the two Coleoptera present some curious features; the butterfly is of exceptional interest as belonging to a waning type which probably flourished remarkably in Oligocene times, if the published figures are to be regarded as having any weight at all.

A Supposed New Order of Gigantic Fossils from Nebraska.—In "University Studies," published by the University of Nebraska, 1893, Mr. E. H. Barbour describes and figures a number of gigantic mineral bodies of such anomalous form and structure, that the author offers as a merely provisional classification until their place can be more definitely determined.

These fossils are found in the Miocene beds which follow the divide between the White and Niobrara rivers in Sioux County, Nebraska. They are very abundant and increase in size toward the southern limit of the beds. In appearance they resemble colossal corkscrews varying from two to nine feet in length. A transverse piece corresponding to the handle of the corkscrew, for which the term rhizome is adopted by the author, is often three feet in diameter. The fossil corkscrew is invariably vertical, while the so-called rhizome as invariably curves rapidly upward and extends outward an indefinite distance. Some of the screws coil about an axis, others are unsupported. The author is positive as to their organic origin, and is inclined to believe them to be sponges. Five microscopic slides show certain smooth spindle-shaped rods suggestive of sponge spicules, but a sixth section reveals unmistakable plant cells. A third evidence of their organic nature is the characteristic intricate network of minute silicious tubes in the stems. To add to the difficulty of the problem, a well-preserved skeleton of a rodent was found in the great stem of one specimen. This rodent is the size of a "jack rabbit," with proportionately large incisors, sagittal and occipital crests high and sharp, and a mole-like shoulder girdle.

In order to preserve the appropriate name—"Devil's Corkscrew"—bestowed by the ranchmen, Mr. Barbour calls these strange fossil forms Daimonelix.

The most probable explanation of these objects seems to be that they are the casts of the burrows of some large rodent. The horizontal portion will then be the entrance; the enlargements the position of the

nests, and the spiral vertical portions shafts for safety or escape of the occupants, or for the admission of air; the spiral being necessary for the convenient ascent of the animal. It is well known that species of Thomomys make spiral burrows; and remains of this genus are not rare in the Plistocene beds of Kansas.—C.

Mammalia from the "Pits of Gargas."—In the grotto of Gargas, not far from Montréjean, a number of pits have been found about 100 metres from the entrance. These pits are 20 metres in depth and have mouths so narrow that it is with difficulty that a man can force himself through the openings. M. Regnault has recently explored these pits and found them rich in fossil remains of bears (*Ursus spelæus*, the small variety), wolves (*Canis lupus*), and hyaenas (*Hyaena crocuta*). M. Gaudry notes the unusual circumstance of the fine state of preservation of the fossils, particularly of a hyaena and a wolf, of which almost complete skeletons were obtained. These finds have been made the subject of a joint paper by MM. Gaudry and Boule, in which they discuss the affinities of these cave animals, and give tabular statements of the genealogy of the bears and of the hyaenas. The latter differs from the one published by Schlosser in 1890.

A series of fine plates illustrates the paper. (Materiaux Pour. l' Histoire des Temps Quaternaires. Quatrième Fascicle, Paris, 1892.)

Mr. G. F. Matthew reports a new genus, Protolemus, of Trilobites from the St. John group of the lower Cambrian beds. The new genus is represented by two species, *P. elegans* and *P. parodoxoides.* (Bull. New Brunswick Nat. Hist. Soc., 1892.)

The Cleveland shale of Ohio has yielded a new Coccostean, which is described by Professor Claypole under the specific name *Coccosteus cuyahogae.* This species comes from a higher horizon than either *C. hercynius* or *C. occidentalis*, and is remarkable for its large size. (Am. Geol., March, 1893).

Paleozóic.—Mr. H. E. Sauvage has been studying the fish fauna of the Permian of France. He finds that of 24 species, 14 are, for the present, peculiar to France. This fauna is, undoubtedly, that of the Lower Permian, and is characterized by a predominance of species belonging to the genera Amblypterus. (Revue Scientifique, Avril, 1893.)

Mesozoic.—According to Chapman, the Phosphatic Chalk of Taplow, England, has yielded 5 species and varieties of Ostracoda, all previously known, and 98 species and varieties of Foraminifera, of which the following are new to science: *Nubecularia jonesiana, Textu-*

laria decurrens, *Textularia serrata*, *Bulimina trigona*, and *Bolivina strigillata*. (Quart. Journ. Geol. Soc., Nov., 1892).

Cenozoic.—The Pliocene fauna of Rousillon, which now numbers over 30 species of vertebrata, has recently had a second Proboscidian, *Mastodon borsonii*, added to the list of mammalia. The specimen, found near Villeneuve-de-Raho, consists of the series of upper molars, a tusk, and a part of the right occipital region. This discovery is important, as it gives a wide geographical range to *M. borsonii*, which has not before been known from any pliocene bed of southern France. (Revue Scientifique, Mars, 1893.)

Dr. Noetling, in a report on Jade in Upper Burmah, says that jade is found in association with and enclosed in an eruptive rock closely resembling serpentine, and that this serpentine pierces strata of perhaps lower, but more probably Upper Miocene date. The jade found in Burmah belongs to a group of eruptive rocks of late Tertiary age. (Nat. Sci., April, 1893.)

The prevalence of lake basins in glaciated countries is accounted for by Mr. J. C. Hawkshaw by the following conditions:

Earth movements in limited areas tend to form basins; these movements are gradual, and, under ordinary circumstances, the basins are obliterated by water-borne detritus, growth of vegetation and erosion. In glaciated regions the basins are not only protected by the ice from such destructive action, but they are still further deepened by its grinding action. (Nature, April 13, 1893.)

M. M. Boule has described and figured the *Hyaena brevirostris* found by M. Aymard in the Pliocene deposits of Sainzelles near Puy (Haute Loire). Although this fossil has been referred to by Pomel, Gervais, Gaudry and Weithofer, no detailed description of it accompanied by figures has ever before been given. (Ann. Sci. Nat. Zool. t. XV, 1893.)

According to Mr. R. T. Hill, the Hematite and Martite iron ores of Mexico occur in the Cretaceous and Tertiary rocks, and are undoubtedly of later age than the rocks in which they occur. This is an unusual geologic age for ore. (Am. Journ. Sci., Feb., 1893.)

Mr. Warren gives, as a result of a comparison between pleistocene and present ice-sheets, an opinion that the Ice Age was a continuous and geologically brief period. (Bull. Geol. Soc. Am., Vol. IV, 1893.)

Mr. E. T. Dumble reports the occurrence of Grahamite in two localities in Texas. The first specimen came from the Fayette beds in Webb County, the second from the lowest strata of the Eocene exposed on the Rio Grande River in Fayette County. (Trans. Am. Inst. Mine Engineers, 1892.)

MINERALOGY AND PETROGRAPHY.[1]

The Petrography of the Abukuma Plateau, Japan.—The northern half of the Japanese Archean area, the Abukuma Plateau, is thought by Koto[2] to consist of a series of Laurentian granites and pressure gneisses, cut by younger granites and other eruptives, and overlying these a series of schists, divided by the author into lower and upper Huronian. The Laurentian granitic are an older amphibole-biotite variety and a younger, intruding biotite granite. The former contains, in addition to the usual granite components, microcline, and a bluish-green, weakly pleochroic hornblende, that very frequently plays the *role* of an ophitic groundmass for the other constituents. This granite passes by dynamo-metamorphism into foliated phases, in which the various minerals have been compressed, and the quartz, in addition, granulated. The Huronian (?) beds are principally schists and gneisses, that differ from the Laurentian gneisses in having the plane parallel structure, i. e., they are composed of bands of different composition. The most important schists of the lower division are: gneissic mica schists, containing andalusite and sillimanite, two-mica schists, one of whose constituents is margarite, garnet-biotite schist and hornblende schist. A peculiar member of the series is a titanite amphibole schist, consisting of bands whose structure is granular. Its black bands are made up of green-hornblende, plagioclase and a little biotite, and its white ones of sphene and granular sahlite in a ground-mass of altered feldspar. The upper Huronian series embraces foliated amphibolites, mica-schists, and green schists that may be tufas. The distinction between the lower and upper members of the group seems to be based mainly upon petrographical characteristics. Among the rocks cutting these various schists may be mentioned an amphibole-picrite, pegmatites, and several varieties of diorite-porphyrite.

The Leucite-Tephrite of Hussak, from New Jersey.—The eleolite syenite eruption of Beemerville, N. J., was accompanied by basic extrusions now represented by the smaller dykes associated with the large eleolite-syenite dyke in this region. One of the most interesting of the basic dykes is the one at Hamburg, Sussex Co. It is from 15 to 20 feet wide and consists of a dark, tough, biotite rock, holding

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

[2] Jour. Coll. Science, Imperial University, Japan, v, 3., p. 197.

spheroidal inclusions, that have been taken for Hussak[3] to be leucites. Kemp[4] has recently examined this rock very carefully, and now describes it as composed of biotite and pyroxene imbedded in an isotropic groundmass that is chiefly analcite. The biotite is dark brown and the pyroxene of a faint yellow color, with an extinction of 33°. The spheroidal inclusions are analcites, about whose ruins are often grouped grains of biotite and crystals of sphene. An analysis of one of the spheroids, after deducting 3.886 % of Ca Co_2, gave:

H_2O	SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O
6.31	52.44	26.44	.43	1.94	3.54	8.90

As to the origin of the analcite the author is not certain. It may have been derived either from leucite, in which case the rock would be a leucite-tephrite, as considered by Hussak, or it may be alteration product of nepheline.

A Sodalite-Syenite from Montana.—In the mountains forming the northern portion of Montana, Lindgren[5] and Melville have discovered post-cretaceous quartz-porphyrites, lamprophyres, augite-trachytes, analcite basalts, and a peculiar sodalite-syenite, somewhat resembling certain rocks described by Chrustschoff from Russia. The Montana syenite is from Square Butte, situated thirty miles southeast of Fort Benton. It is a light gray eruptive, associated with sheets of theralite and analcite basalt. Macroscopically it consists of lath-shaped feldspars, prisms of hornblende and pale brown grains of sodalite. In addition, analcite and plagioclase are discoverable under the microscope. Many of the feldspar crystals are corroded in an extraordinary manner and the cavities thus formed in them are filled with analcite which is believed to be an alteration product of albite. The hornblende is very dark brown, almost opaque, with a strong pleochroism, an extinction of 13° and a density of 3.437. Its analysis indicates its identity with the variety barkevikite:[6]

H_2O	SiO_2	$Al_2O_3(TiO_2)$	Fe_2O_3	FeO	NiO	MnO	CaO	MgO	Na_2O	K_2O
.24	38.41	17.65	3.75	21.75	tr	.15	10.52	2.54	2.95	1.95

The sodalite is quite fresh. It forms irregular grains that are bounded by crystal faces when in contact with analcite. It was evidently formed after the feldspar but before the analcite. The composition of

[3] AMERICAN NATURALIST., March, 1893, p. 274.
[4] Amer. Journ. Sci., Apr., 1893, p. 298.
[5] Amer. Journ. Sci., June, 1893, p. 286.
[6] AMERICAN NATURALIST, June, 1890, p. 576.

the rock as calculated from its analysis is: 23% hornblende, 50% orthoclase, 16% albite, 8% sodalite, and 3% analcite.

The Anorthosites of Canada.—The Canadian geologists have long considered the Laurentian of northern North America as consisting of an upper and a lower division, of which the latter rests unconformably upon the former. This upper division is made up largely of basic schists to which the name Novian was given by Hunt. Adams[7] has examined all of the important occurrences of the supposed schists, and has discovered that in all cases they show an irruptive contact with the surrounding gneisses, which they evidently cut. They are thus unquestionably post-Laurentian, and, from their relations to the overlying rocks, they are thought to be pre-Cambrian. The dark rocks are anorthosites—aggregates of plagioclase, with a little pyroxene, olivine and some accessories—which are in places schistose, and in other places are connected genetically with gabbros. The schistosity of the rock is accompanied by the possession of cataclastic structure, regarded by the author as due not to dynamic processes, but to the movement of the magma just before final consolidation. The plagioclase of the rock which is by far its most prominent component, is a labradorite so filled with tiny inclusions of microlites, thought by the author to be ilmenite tables, that fragments of the mineral are dark and often show the play of colors so beautifully seen in the labradorite of Labrador. The pyroxenes are a weakly pleochroic green augite, and a strongly pleochroic hypersthene. Hornblende, biotite, quartz, garnet and zircon are also present in small quantities in all specimens of the anorthosite. In the Saguenay river occurrence, olivine is enclosed in the plagioclase, and between it and the latter mineral is a reaction rim, composed of an inner zone of hypersthene, and an outer one of actinolite, including many small, green spinels. All the occurrences of the rock in Canada are briefly described, and with them are compared similar occurrences found elsewhere.

The Melibocus "Massiv" and its Dyke Rocks.—The peak of Melibocus[8] in the Odenwald consists mainly of a medium-grained white granite to the West, and a complex of schists and gneisses to the East. The granitic constituents, orthoclase and quartz, are usually aggregates of small grains variously orientated, and the biotite shows evidence of having been subjected to pressure. Near the contact with

[7] Neues Jahrb. f. Min., etc., B. B. viii, p. 419.

[8] C. Chelius: Notizbl. d. Ver. f. Erdk. z. Darmstadt, 1892, iv, F. 13 H., p. 1.

the surrounding rocks the granite becomes gneissic, and everywhere it is cut by dykes of aplites, porphyries and lamprophyres. Where the aptites penetrate the gneisses they possess the usual characteristics of these rocks, but where they pass from the schists into the granite they become porphyritic, showing a fine grained groundmass of quartz, orthoclase and mica and numerous phenocrysts of the same minerals and garnet. Like the granite the aplite components exhibit evidences of the effect of pressure. The large crystals are granulated and the rock's structure is more or less schistose. For this aplitic rock with porphyritic crystals the author, Chelius, used the name Alsbachite. An analysis of an alsbachite from the northwest side of the mountain gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
74.13	12.61	2.87	.86	.16	1.60	.23	2.13	4.55	.66

The dioritic aplites, malchite, luciite and orbite are also represented among these dyke rocks—the malchite being the panidiomorphic diorite aplite, the luciite the hypidiomorphic granular forms, and the orbite the corresponding porphyritic phases. One of the luciites is described as made up almost exclusively of plagioclase and hornblende. Among the lamprophyric dykes, mention is made of a gabbrophyre, or odinite, which differs from the gabbro-aplite, beerbachite, in consisting of phenocrysts of plagioclase and colorless augite in a matrix of plagioclase laths and hornblende needles, while the aplite is a panidiomorphic aggregate of diallage and feldspar, with the addition, sometimes, of hornblende crystals that enclose the other constituents. The descriptions of all these rare rocks are very brief.

The Granites of Argentina, S. A.—In an elaborate description of 185 hand specimens of stock and dyke granites and pegmatites, cutting the archean and paleozoic beds of Argentina, and of younger granites cutting these older ones, Romberg[9] discusses at some length the origin of the micropegmatitic intergrowth of quartz and feldspar. He believes that in the rocks studied by him the quartz in the intergrowths is secondary, and that it has originated in the decomposition of orthoclase and plagioclase. Many micro-photographs accompanying the author's article illustrate clearly the steps by which this conclusion was reached. Although the description of the specimens is exhaustive, it contains no points of special interest. At the conclusion of the paper is a list of the specimens examined, with their localities,

[9] Neues Jahrb. J. Min., etc. B. B. viii, p. 275.

and appended to it are twelve plates containing seventy-two micro-photographic reproductions of their sections.

New Minerals.—*Geikielite.*[10]—This mineral was found as pebbles in the gem washings near Rakwana, Ceylon. It is essentially a magnesium titanate, $MgTiO_3$, corresponding to the calcium compound, perofskite. The mineral is bluish-black and opaque, with a brilliant lustre, and possessing two cleavages at right angles to each other. Its density is 3.98 and hardness 6.5. In thin section it is translucent with a purplish-red tint, and in converged light it shows a uniaxial figure.

Baddeleyite,[10] also occurring as pebbles in the above-mentioned locality, is a black substance with a density of 6.02 and a hardness of 6.5, thus strongly resembling columbite. Under the microscope small fragments are seen to be dichroic in greenish-yellow and brown tints, and to possess a biaxial symmetry. The crystallization is thought to be monoclinic, though only a few plans could be detected on the specimen. In chemical composition the substance is zirconia ZrO_2.

Folgerite, blueite and *whartonite* are all nickel-iron-sulphides from the Sudbury nickel mines at Algoma, Ontario. Emmens[11] describes the first named as a massive, bronze-yellow substance, with a grayish-black streak, a density of 4.73 and hardness 3.5. Its composition (Fe = 33.70; Ni = 35.20; S = 31.10) corresponds to Ni Fe S_2.

The *blueite* is also massive. Its color 'is olive-gray or bronze; its streak black, density 4.2 and hardness 3–3.5. Its analysis yielded Fe = 41.01; Ni = 3.70; S = 55.29, corresponding to pyrite with a thirteenth of the Fe replaced by Ni. Unlike pyrite, however, it dissolves easily in nitric acid, without the precipitation of sulphur.

Whartonite differs from blueite in containing more Ni. Its composition is Fe = 41.44; Ni = 6.27; S = 52.29, corresponding to (Fe Ni) S_2 in which Fe : Ni = 7 : 1. Its hardness is 4, density 3.73, and color and streak like those of blueite.

Hauchecornite is another nickel mineral. It is described by Scheibe[12] from the Friederich mine in the Hamm mining district, Germany. It is found in bronze-yellow tetragonal crystals, with a hardness of 5, and a density of 6.4. It is thought to have the composition corresponding to the formula Ni (Bi. Sb. S), though analysis yields discordant results.

Cuprocassiterite was described by Ulke[13] from the Etta mine, South

[10] Fletcher: Nature, Oct. 27, 1892, p. 620.
[11] Jour. Amer. Chem. Soc., Vol. xiv, No. 7.
[12] Jahrb. A. preuss. geol. Landeranst, 1891, p. 91.
[13] Proc. Amer. Inst. Min. Engineers, Feb. 1892.

Dakota, but the author's data were so scanty that Headdon[14] has thought it advisable to add a small additional contribution to the literature of the mineral. This last-named writer obtained a small quantity of what he supposed to be Ulke's new mineral from both the Etta and Peerless mines, and found upon examination that in the interior of a small mass from the Peerless mine is a nucleus of stannite containing a little cadmium. Intergrown with this and also forming an envelope around it is a green clayey substance, which, upon its exterior, passes into a yellow earth. The green substance has a density of 3.312–3.374. Its analysis shows it to be a mixture of about 7 SnO_2, 6 CuO, 2 FeO and 11 H_2O. The author regards it is an alteration product of stannite, but not as a well-defined mineral species.

New Edition of Rosenbusch's Volume on Minerals.—The new edition of Professor Rosenbusch's[15] Microscopic Physiography of the Rock-forming Minerals is an enlargement rather than a revision of the second edition. There is no material difference in the arrangement of the matter in the two editions, but there have been large additions made in the later volume in the shape of descriptions of new petrographical apparatus and methods, and in the number of minerals treated. The plates illustrating the text have been decreased by one. The remainder are much better executed than was the case in the earlier volume.

Mineral Syntheses.—Michel[16] has obtained *melanite* garnets and *sphene* crystals by cooling slowly a mixture of 10 parts titanic iron, 10 parts calcium sulphide, 8 parts silica and 2 parts carbon, that had been heated to 1200° for five hours.

Crystallized *leucite*, *potassium cryolite* and *potassium nepheline* results from the fusion of silica or of fluosilicate of potassium and alumina with an excess of fluoride of potassium. Prolonged heating produces leucite, and potassium cryolite. Less prolonged treatment yields a potassium nepheline, which crystallizes in negative orthorhombic prisms.[17].

Instruments.—For measuring the curves of isotherms on mineral plates Jannetaz[18] has constructed a new ellipsometer, which it is

[14] Amer. Jour. Sci., Feb., 1893, p. 105.

[15] H. Rosenbusch: Mikroskopische Physiographie der petrographisch wichtigen Mineralien, Stuttgart, 1892, pp. 712, Fig. 239, etc.

[16] Comptes Rendus, Vol. cxv, p. 830.

[17] Duboin, Bull. Soc. Franc. d. Minn., Vol. xv, p. 191.

[18] Bull. Soc. Franc. d. Minn., Vol. xv, p. 237.

believed will enable its user to measure accurately the axes of the isothermal ellipses, and to determine rapidly in each case whether apparently circular isotherms are in reality circles or slightly eccentric ellipses.

A new machine for cutting and grinding thin sections of rocks and minerals, with stored electricity as the motive power, is described by G. H. Williams[19].

Rock Separations.—Thallium-silver-nitrate [Tl Ag $(NO_3)_2$], according to Retgers,[20] is an excellent medium for the separation of mineral grains of great density. The double salt fuses at 75°, and in the fused condition is clear and mobile. In this condition its specific gravity is 5, and this may easily be lowered by the addition of water. Its manipulation is simple. A small beaker containing the solid salt is placed in a water bath and heated. Upon its liquefaction the powder to be separated is added and the mixture is allowed to stand for a short time. As soon as a layer of clear liquid forms between the precipitated and the floating grains the beaker is plunged into cold water. The salt thus consolidates rapidly. The beaker is now broken and the heavy grains are collected by scraping and washing.

A new method of separating the constituents of rock powders, whose densities are above 2.60, has been devised by Dafert and Derby.[21] The principle involved is the suspension of small particles in gentle currents of water. The apparatus necessary for the operation is fully described by the authors. Separation is not complete between powders of nearly the same density, but there is a strong concentration of the heavier and the lighter ingredients in the two resulting portions of the separated material.

[19] Amer. Jour. Sci., Feb. 1893, p. 102.

[20] Neues Jahrb. f. Min., etc., 1893, Vol. I, p. 90.

[21] Proc. Roch. Acad. Sci., Vol. II, p. 122.

BOTANY.

Cæoma nitens.—The development of *Cæoma nitens* has recently been studied by Mr. H. M. Richards, and the results published in an interesting paper in the Proceedings of the American Academy of Arts and Sciences. The particular question investigated was whether or not the spermogonia are developed within the cavities of the epidermal cells of the host. By means of carefully made sections, Mr. Richards demonstrates that they arise as masses of hyphæ which push up *between* the epidermal cells, and that later the walls of some of these cells become absorbed. The spermogonia are therefore at first intercellular, but by the absorption of the walls they become intracellular.

CHARLES E. BESSEY.

Our Naiads.—Thomas Morong's monograph "The Naiadaceæ of North America" has been brought out in the *Memoirs of the Torrey Botanical Club.* It contains descriptions and plates of 54 species distributed as follows: *Triglochin,* 3 species; *Scheuchzeria,* 1; *Lilæa,* 1; *Potamogeton,* 37; *Ruppia,* 2; *Zannichellia,* 1; *Naias,* 4; *Zostera,* 3; *Phyllospadix,* 2. Among these we find one new species *Potamogeton faxoni* from Lake Champlain, and several new varieties of previously described species. Quite a number of changes have been made in the nomenclature of the species.

Thus comparing Dr. Morong's list with that in the 6th edition of Gray's "Manual," we note the following changes: *Potamogeton pennsylvanicus* Cham. and Sch. becomes *P. nuttallii* Cham. and Sch., since the latter was described on an earlier page of *Linnæa* than the former (II. 1827); *P. hybridus* Mx. (1803) being preoccupied (by Thuillier in 1790), gives way to *P. diversifolius* Raf. (1808); *P. rufescens* Schrad. (1815) is antedated by *P. alpinus* Balbis (1804); *P. fluitans* Roth. (1788), gives way to *P. lonchites* Tuck. (1848), inasmuch as it is highly improbable that the European and American species are identical; *P. zizii* Mert. and Koch. of the "Manual" appears to have included two species which are now to be known as *P. spathulæformis* (Robbins) Morong, (*P. gramineus,* var. (?) *spathulæformis* Robbins, *P. spathæformis* Tuck., and *P. varians* Morong), and *P. angustifolius* Berch. and Presl. (*P. lucens,* var. *minor* Nolte); the var. *lanceolatus* Robbins (1867) of *P. perfoliatus L.* being preoccupied by Blytt (1861) must give way to var. *richardsonii* Ar. Bennett (1889); *P. pauciflorus* Pursh. (1814) must be replaced by *P. foliosus* Raf. (1808); *P. mucron-*

atus Schrader, being uncertain, the species is to bear the name of *P. major* (Fries) Morong; *P. tuckermani* Robbins (1856) gives way to the earlier *P. confervoides* Reichb.; *P. marinus* L. turns out not to be that species, and must take the name *P. filiformis* Pers. (1805).

CHARLES E. BESSEY.

Hough's American Woods.—The third part of R. B. Hough's "American Woods" has recently been distributed. The twenty-five species in this part are *Magnolia glauca, Ilex opaca, Acer rubrum, A. negundo, Prunus pennsylvanica, P. avium, Pyrus communis, Cratægus punctata, Amelanchier canadensis, Liquidamber, styraciflua, Diospyros virginiana, Fraxinus sambucifolia, Morus rubra, Hicoria sulcata (Carya sulcata), H. glabra (Carya porcina), Quercus bicolor, Q. prinus, Q. muhlenbergii, Q. coccinea, Betula populifolia, Salix amygdaloides, Populus tremuloides, P. dilatata, Chamæcyparis thyoides, Pinus mitis.*

Each species is represented by three sections of the wood, transverse, radial and tangential, each 4½ by 2 inches. A good descriptive text accompanies the set of specimens. The parts are sold by the author at Lowville, N. Y., for the low price of five dollars each.

CHARLES E. BESSEY.

Allen's Characeæ of America.—Five years ago Dr. T. F. Allen of New York City brought out Part I of a promising work on the Characeæ of America, consisting of an introductory chapter on the structure, followed by the keys to the species of all our genera. He has now brought out the first fascicle of Part II in which he begins the work of carefully describing and illustrating every species. The illustrations are ample, there being no less than fourteen plates for the eight species of *Nitella* included. The descriptions are full and apparently well drawn up, measurements being fully given. The following are the species described:

N. opaca Ag.—New England and Canada to California and Mexico.

N. obtusa Allen.—A new species from Lake Tamiscouata, Canada.

N. montana Allen.—A new species from Montana.

N. blankinshipii Allen.—A new species from Missouri.

N. missouriensis Allen.—A new species from Missouri.

N. flexilis Ag.—Across the continent.

N. subglomerata A. Br.—N. Y. and N. J. to Oregon, Texas and Missouri and the var. *brachyteles* A. Br. of this species occurs in Mexico Alabama.

N. glomerulifera A. Br.—Mass. to N. J., Ohio and Louisiana.

Every botanist will hope for the early appearance of the succeeding fascicles.

CHARLES E. BESSEY.

ZOOLOGY.

A Medusa from Lake Tanganyika.—In the "Annals of Natural History," for the present month, will be found an account of a very interesting zoological novelty. Mr. R. T. Günther describes and figures a remarkable new form of Medusa, or jelly-fish, that occurs in Lake Tanganyika. Until recent years, when the little Limnocodium was found living in the Victoria lily-tank of the Botanic Gardens, Regents Park, it was believed that the Medusæ were nearly exclusively oceanic. It is now shown that the freshwater lake Tanganyika is the home of a peculiar member of this group. The existence of such an organism in Tanganyika was asserted some years ago by the German naturalist, Dr. Boehm, and Professor v. Martens, of Berlin, even went so far as to name it Tanganjicæ, although he had never seen a specimen. Mr. Günther now supplies us with a full description of this singular Hydrozoon, which he refers to a new genus, Limnocnida, adopting the suggestion of v. Martens as to its specific name. *Limnocnida tanganjicæ* is, as might have been anticipated, perfectly different from all the members of the group hitherto known, and probably represents a distinct family, but its exact position cannot be settled positively until the mode of its development has been ascertained. (Nature, April 13, 1893.)

The Air-Bladder and Weberian Ossicles in the Siluroid Fishes.—A study of the physiology of the Weberian ossicles and of the air-bladder in general has been made by Professors T. W. Bridge and A. C. Haddon, for the purpose of discovering the physiological relation of the Weberian mechanism to one of the several functions that have been ascribed to the auditory organ or to the air-bladder. With this object in view they discuss (I) how far the function of the Weberian mechanism is conditioned by the anatomical structure of the air-bladder and auditory organs as well as by the character of the mechanism itself; (II) to which of the known functions of the air-bladder and auditory organ the Weberian ossicles are to be regarded as accessory structures; and (III) the utility of the mechanism to the fish possessing it.

The authors find (I) that from the anatomical structure of the parts the Weberian apparatus is better adapted to register the more forcible distentions or contractions of the anterior chamber of the air-bladder

rather than the slight or rapidly recurring vibrations of its lateral walls. (II) The ossicles under consideration are accessory to the hydrostatic function of the air-bladder. (III) The Weberian mechanism is of great functional importance to the fish possessing it, since it confers on them an exceptional capacity for freedom of locomotion in a vertical direction. The possession of this mechanism permits all movements to be made with the maximum economy of muscular effort and tissue metabolism.

In regard to the evolution of the Weberian mechanism the authors reach the following tentative conclusions:

1. The special feature of a fresh-water habitat that has conditioned the development of the Weberian mechanism in the Ostariophyseæ is the occurrence of seasonal or periodic quantitative variations in the food supply, variations to which the Ostariophyseæ, from their herbivorous or omnivorous habits are specially liable.

2. In view of such unfavorable nutritive conditions, the special advantage which is conferred upon the Ostariophyseæ by the possession of the Weberian mechanism is a capacity for executing locomotor movements in any plane, with an almost irreducible minimum of muscular effort and tissue metabolism.

3. If a variable and inconstant food supply is to be regarded as one of the inevitable conditions of a fresh-water existence, and necessitates strict economy in the expenditure of muscular energy, any mechanism which secures this result must be of unquestionable importance to the species, and hence it may be that the Ostariophyseæ owe their dominant position among fresh-water fishes to the possession of the Weberian mechanism.

4. The evolution of the Weberian mechanism has not only conditioned the predominancy of the Ostariophyseæ, but, indirectly, has favored the existence in fresh water of a large number of purely carnivorous fishes, which depend on the former for their food, and therefore may also be regarded as one of the primary causes of the anomalous abundance and diversity of fresh-water piscine life, as compared with the remarkable poverty of all other groups of fresh-water organisms. (Proceeds. Roy. Soc. Vol. LII, 1892).

Age Modifications of the Mucous Lining of the Stomach of Ruminants.—In a study of the Comparative Anatomy of the Stomachs of Ruminants, Mr. J. A. Cordier has discovered the following interesting facts.

The interior of the stomach of a young adult is covered with papillæ closely packed, which are larger in the region which Wilkins calls the

"col" of the paunch, than on the rest of the surface. In the stomach of a very old animal a different condition exists. The large papillæ of the "col" are few and far between—two or three times as far apart as in the younger animal, much smaller, twisted once on the base, evidently becoming atrophied. Between these papillæ can be seen traces of many others which have disappeared, leaving their bases only as vestiges, and these are entirely covered by the ordinary epithelium of the stomach.

That these papillæ do not renew themselves is shown by histological sections of the papillæ. In a bison, thirty years of age, the papillæ were almost entirely wanting. An antelope and a ram showed the process of degeneration very clearly.

The second age modification is the appearance of a black coloration more or less intense over the entire surface of the stomach. Observations so far, however, show that this modification takes place in domestic animals only. [Bull. Soc. Zool., T. XVII, 1892.]

Zoological News.—According to C. H. Eigenmann, the development of the Point Loma blind fish (*Typhlogobius californiensis* Steindachner), is a striking example of the degeneration of the eyes. The embryo, before it is hatched, has eyes developed as well as the embryo of any other fish. When the individuals have reached the length of an inch they can still see a short distance, but it is evident that the eye has stopped growing long before this age is reached. In the adult condition the eye has become degenerated and covered with a thick skin, and the fish is totally blind. (Proc. U. S. Natl. Mus., 1892.)

In his Comparative Notes on Swifts and Humming-Birds, Dr. Shufeldt submits 61 important structural differences existing between the *Cypseli* and the *Trochili*. These differences, in the author's opinion, establishes the fact that these two groups, morphologically speaking, are not related. (The Ibis, Jan., 1893).

A new rat, *Perognathus merriamii*, is described by J. A. Allen, from southeastern Texas. It is allied to *P. flavus*, but differs from it in coloration, in the general form of the skull, and in the relative size and proportions of special parts of the skull. The species is based on 17 specimens from Brownsville, Texas. (Bull. Am. Mus. Nat. Hist., 1892.)

Mr. Amos Butler reports that the "Least Shrew," *Blarina parva* (Say), the smallest mammal in the United States, is rather common in the Whitewater Valley in Indiana. (Proc. Indiana Acad. Science, 1891, p. 163, 1893.)

Mr. Witmer Stone notes the occurrence of the genus Neotoma in Pennsylvania. The specimens, which were secured near the top of South Mountain in Cumberland Co., evidently belong to a new species, and are described by Mr. Stone under the name *Neotoma pennsylvanica*. This species is distinguished from *N. floridana* by its larger size, its densely hairy and distinctly bicolored tail, and by certain well-marked cranial characters. (Proceeds. Phila. Acad., 1893.)

ENTOMOLOGY.[1]

North American Cosmetidæ—A recent study of a considerable collection of Cosmetidæ from the Southern States shows that three well-marked species occur in our fauna. This family belongs to the sub-order Mecostethi of Simon or Laniatores of Thorell, of the order Opileonea. Say described one species, Wood another and Sorensen the third. The three species are closely related and all belong to the genus Cynorta. They may be separated by the following key:

Posterior pair of abdominal tubercles very prominent; four or five times as large as anterior pair. . . . . *C. ornata.*

Posterior pair of abdominal tubercles little larger than anterior pair.

Dorsum with a distinct yellow Y connected posteriorly with a transverse yellow line. *C. albolineata.*

Dorsum without or with very little yellow marking. *C. sayi.*

Cynorta ornata is abundant in Florida and probably occurs in the South Atlantic States; *C. albolineata* is found in Louisiana and Mississippi; and *C. sayi* in Texas. An illustrated descriptive synopsis of these species is now in the hands of the American Entomological Society for publication in the *Transactions*.—CLARENCE M. WEED.

An American species of Sabacon.—In 1879, the French Arachnologist, M. Eugene Simon established[2] the genus Sabacon for a very peculiar species (*S. paradoxus*) of the family Ischryopsalidæ—one of the smaller families of the Opileonea. The specimen described was immature and the lateral pores were not distinct. No other species of the genus appear to have since been described.

The genus Sabacon is especially characterized by the peculiar form of the palpi, the joints of which are large and swollen, and the short

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

[2]Arachnides de France, VII, 266.

tarsus is not provided with a claw, but is capable of being turned back against a depression in the tibia. The mandibles are shorter than the body.

During the autumn of 1892, I found under a piece of driftwood along a small creek, a fully developed male belonging to this genus. The species is evidently rare for I have never been able to find another although I have searched persistently.

Sabacon spinosus, n. sp.

Male.—Body 3 mm. long, 2 mm. wide; palpi, 3 mm. long. Legs: first, 11.5 mm.; second, 19 mm.; third, 12 mm.; fourth, 16.5 mm.—Body testaceous with dusky markings; the markings on dorsum arranged transversely and following segmentation. Palpi and legs light testaceous with almost continuous dusky blotches. Ocular tubercle black, very near front margin of cephalothorax, much wider than long, low, with a deep longitudinal sinus but no spines on carinæ. A small round, not very distinct pore on each cephalo-lateral angle of the dorsum, not isolated by distinct oblique sinuses. On the dorsum of the cephalothorax and the ocular tubercle are many short, acute, black spines arranged more or less irregularly; back of ocular tubercle on cephalothorax are two transverse rows of similar spines, and on

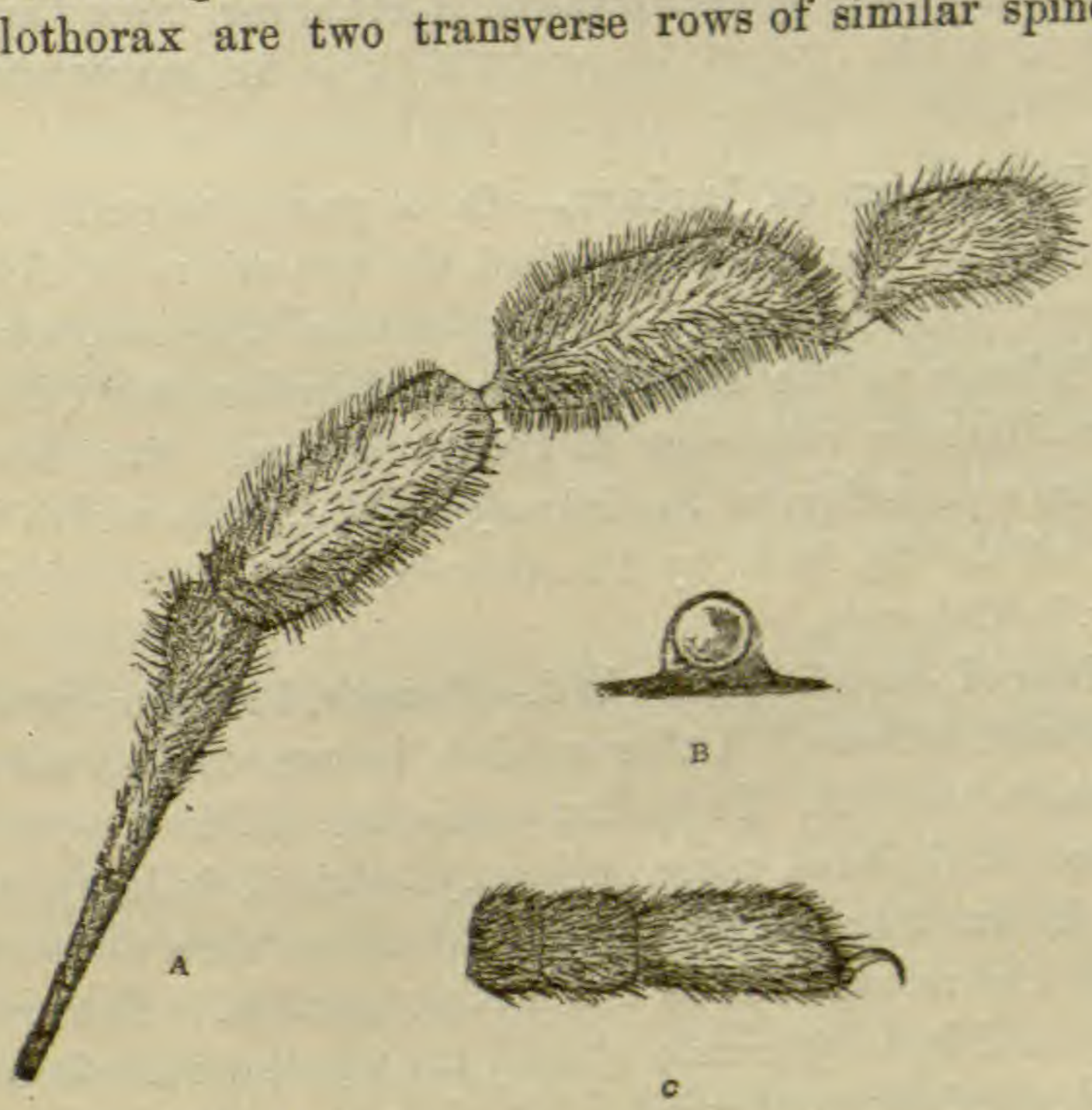

Fig. 1.—*Sabacon spinosus.* Male: *A*, palpus; *B*, eye eminence; *C*, distal tarsi of first leg. All magnified.

abdomen are many more similar rows. The ventrum of abdomen is also provided with such rows, and the ventrum of the cephalothorax including coxæ is covered with these spines. Palpi large and longer than the body; thickly covered with long black spines; femur enlarging a little from base to apex; patella thick, subcylindrical, with a conical tubercle on ventral surface near distal end; tibia slightly petiolated, curved and attenuated distally, hollowed out on under side to receive tarsus; tarsus petiolated, swollen, a little more than half as long as tibia, rounded at end and having no claw; capable of being turned back upon the tibia like a thumb. Mandibles short, much shorter than body; first joint having a large, truncate, wart-like tubercle on dorsal surface near distal end; top of tubercle and dorsal surface of distal portion of the joint thickly furnished with stiff spinose hairs; second joint short and thick, provided dorsally with similar hairs; claws curved, unequal. Legs rather slender, with rows of spinose hairs on proximal joints. Shaft of genital organ long, flattened; toward tip enlarging into a spoon-shaped portion, from which there projects forward a long slender piece gradually coming to very acute point.

Described from one specimen taken at Hanover, New Hampshire.

CLARENCE M. WEED.

The Puparium of Jurinia.—In a paper recently sent to the AMERICAN NATURALIST, I described the puparium of *Blepharipeza*. The present paper describes the puparium of *Jurinia*, which genus, while it belongs to the same group as *Blepharipeza* (Hystriciinæ), shows considerable difference in the puparium. The description is drawn from a puparium of *Jurinia algens* Wd., from which issued a ♀ specimen of the fly, bred by Professor C. P. Gillette from *Hadena lignicolor*, in Colorado.

Puparium of *Jurinia algens* Wd.—Length, 12 mm.; greatest width (8th segment), 5½ mm. Color reddish brown, capital tubercles and anal stigmata blackish. Puparium consisting of 12 segments, including capital and anal plates, more or less cylindrical, bulging a little posteriorly, the anterior end being less in diameter than the posterior end, while the eighth segment is the widest portion. The rugose belts described in *Blepharipeza* are absent, the whole surface being more or less fluted, the flutings showing most plainly on the three anterior segments next the capital plate, becoming less distinct in the middle or giving way to an almost smooth surface, and reappearing in irregular flutings, or minute furrows and ridges, on the last three segments and

anal plate. The larval mouth parts are represented on a portion of the capital plate forming part of the single anterior flap which is present, by two small erect tubercles projecting straight out from the surface of the integument, situated at edge of capital plate, and on opposing sides. The remaining portion of the capital plate, which is absent, the other flap being detached and missing, doubtless bears a third similar erect tubercle, the three being so arranged that they represent the corners of a nearly equilateral triangle. These tubercles are erect, about as high as their basal diameter, ending in a blunt but laterally compressed apex, the apical diameter one way equalling the basal while the other way it is much less than the basal, the apical surface with about 4 faint transverse notches leaving 5 faint transverse ridges. The longitudinal axis of the compressed apex of each tubercle is at an angle of about 45 degrees with the margin of the capital plate. The surface of the capital plate is more or less irregularly transversely, not circularly, fluted. Anal stigmata situated in center of anal plate, consisting of two erect raised organs, not as far apart as the diameter of either, each consisting of 3 ridge-like sections separated by deep notches, the flap-like ridges of each stigma quite closely approximated at their inner ends and widely divergent outwardly, the superior and inferior ones diverging at nearly a right angle. Each of these keel-like ridges bears a longitudinal median suture or fissure its whole length. These stigmatic organs, unlike those of *Blepharipeza* and many other tachinids, project straight out from the surface of the integument, being about as high as their diameter. A little distance ventrally (? dorsally) of the pair of anal stigmata, being situated on anterior border of 10th segment, is a small slit-like opening in the integument resembling a spiracle, its longer diameter being longitudinal to the puparium. The vent-like anal tubercle described in *Blepharipeza* is not present.

Supplementary note to description of puparium of *Blepharipeza*.—In the description above referred to, of the puparium of *Blepharipeza adusta* Lw., I mentioned only one tubercle on the capital plate. This was all that was present on the nearly detached anterior flap of the puparium, the correspondihg flap on the opposite side being missing. It should have been mentioned that the absent portion of the capital plate doubtless bore two more tubercles similar to the one described, situated near the edges of the plate as was also the latter, the three being arranged in a triangle, but not so far apart as in *Jurinia*, being of larger size.—C. H. TYLER TOWNSEND.

Notes.—In Bulletin No. 19 of the Iowa Experiment Station, Prof. Herbert Osborn reports further experiments in destroying leaf-hoppers; Mr. H. A. Gossard discusses the Clover-seed Caterpillar (*Grapholitha interstinctana*); and Mr. F. A. Sirrine treats of the Potato-stalk-weevil (*Trichobaris trinotata*). The latter species has been found breeding in "ground cherries" (*Physalis*).

Prof. S. W. Williston contributes to the third number of the Kansas University Quarterly the third part of his Diptera Brasiliana, and an illustrated paper on the Apioceridæ and their allies.

Mr. F. M. Webster publishes[3] extended accounts of the insects affecting the blackberry and raspberry, and the underground insect destroyers of wheat. The former article enumerates 88 species.

Mr. M. V. Slingerland[4] calls attention to the fact that the black peach aphis (*Aphis persicæ-niger*) is being introduced into New York through peach trees purchased in Delaware. The author describes the indications of the presence of the pest; its past history; its classification, appearance, and life history and remedial measures.

Professor J. B. Smith presents[5] an interesting illustrated discussion of the grasshoppers, locusts and crickets affecting cranberries. He shows that contrary to the usual belief it is the katydids and not the common grasshoppers that attack this fruit.

A catalogue of the South American species of Calyptrate Muscidæ by Prof. C. H. Tyler Townsend has lately appeared in the Annals of the New York Academy of Sciences. (Vol. VII, Dec., 1892).

[3]Ohio Agr. Expt. Station, Bulletins 45 and 46.

[4]Cornell Univers. Agr. Exp. Station, Bull. 49, p. 325.

[5]New Jersey Agr. Exp. Station, Bull. 98.

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Americanists.—(Continued from page 305)—Fifth Congress at Copenhagen, 1883.—The following papers were read and addresses made:

Observations upon some of the skulls and human bones of the Minasgeraes in Brazil, by M. Lutken; Note on the Quaternary Fossil Animals, Fauna of the Plateaux of the Andes; An Examination of the Discovery of the American Continent by Christopher Columbus, and the assistance given to him by Martin Alonzo Pinzon, by M. Herrera; Aboriginal American Literature, by Dr. Brinton; The Vineland Excursions of the Ancient Scandinavians, by M. Loffler; The Pre-Columbian Relations of the Gaels with Mexico, by M. Beauvois; Old Scandinavian Ruins in the District of Julianehaab, South Greenland, by M. K. Steenstrup, with two plates; Three Ancient Charts of the North, by Baron Nordenskiöld, explained by M. Christian Bahnson; M. Lucien Adam, upon the theory announced by M. Hale, relative to the Origin of America; M. Bamps, On the Traditions Relative to the White Man and the Sign of the Cross in America, prior to the Discovery; and a Criticism upon the Theory of Abbe Schmidt, which had been announced in the former Congress; The Lost History of America, by Mr. Steven Blackett; To what Point did the Ancient Scandinavians Penetrate near the North Pole in their Expeditions over the Glacial Sea? by M. Brynjulfson; The Voyages of the Brothers Zeni in the North, by M. J. Steenstrup; Nautical Remarks about the Zeni Voyages, by M. Irminger; Cartography of the American Continent, by M. Anatole Bamps; The Voyages of the Danes in Greenland, by M. Valdemar Schmidt; Peruvian Vases in the Archæologic Museum of Madrid, by M. de la Rada; Polynesian Antiquities, a Link Between the Ancient Civilizations of Asia and America, by Mr. Francis A. Allen; American Pottery in Pate and Fabrication, by Anatole Bamps; On the Paleolithic Implements of the Valley of the Delaware near Trenton, by Dr. C. C. Abbott; Ancient Ornaments of Pottery, by E. Barber; Memoir on the Shell Mounds of the Chesapeake Bay and Potomac and Wycomico Rivers, by Elmer T. Reynolds; Prehistoric Archæology, by Baron Joseph de Baye; The Art of Ornamentation Among the American People, by M. Stolpe; The Dialect of the Eskimo Language, with a synoptical table of words arranged after the system of the Greenland

[1]This department is edited by Dr. Thomas Wilson, of the U. S. National Museum.

Dictionary by M. Rink. The author divides the Eskimos into six groups: the Greenlander, the Labradorian, the Eskimos of Makenzie, the Eskimos of the West, and the Aleutes—Wherein does the Eskimo Language Differ Grammatically from the other Languages of North America, by M. Lucien Adam; M. Leon de Rosny had made a Volume on the Deciphering of the Maya Inscriptions, the which M. Rada Translated and Presented to the Congress with an Analysis and Criticism; The Language Timucua, by M. Vinson; M. Vahl presented an ethnographic chart of North America for the Danish Missionary Society, which he explained; The Coloring Matter Employed by the American Indian, by M. Vera; The Variations in the Physical Geography of the American Continent, from the discovery to the present—M. Vera; and the Formation of the Words of the Maya Language, by the Count de Charencey.

The Fourth and Sixth Sessions were held respectively at Madrid, and Turin. I have no report of these Congresses.

The Seventh Session was held at Berlin from the 2d to the 5th of October, 1888. The papers read and addresses delivered were substantially as follows:

The Basques, Britons and Normans on the Coast of North America during the early part of the XVI Century, by M. Gaffarel, 9 pages; Publication of the Writings and Documents Relative to Christopher Columbus and his Time on the Occasion of the Celebration of the Fourth Centenary of the Discovery of America, by M. Cora; An Historical Essay on the Primitive Legislation of the Spanish State of America, by M. Fabie; On the Nahuatl Version of Sahagun's Historia de la Nueva Espana, by Dr. Brinton, with its discussion, 6 pages; On Certain Archæologic Objects of Mexico and South America, by M. Heger, 5 pages; The Stone Colliers of Porto Rico, by Jimenez de la Espada; Antiquities of Vera Cruz; Archæologic Results of the Later Voyages in Mexico, by M. Seler; An Ancient Mexican Mosaic, by M. Andree; Notes on the Origin, Working Hypothesis and Primary Researches of the Hemenway Southwestern Archælogical Exposition, by Mr. F. H. Cushing; The Antiquities of Nicaragua, by M. Bovallius; The Ceramic Antiquities of the Isle of Marajo, and also on Nephrite and Jadeite, by M. Netto; Place of Origin of Nephrite and Jadeite, by M. Virchow; The Aztecs and their Probable Relation to the Pueblo Indians of New Mexico, by Mr. S. B. Evans; The Employ of Cocoa in the Northern Part of South America; American Craniology, by Virchow; An Anatomical Characteristic of the Hyoid Bone of Pre-Columbian Pueblo Indians of Arizona, by Drs. Wortmann and Ten

Kate; The Chronology of Dilluvial Man in North America, Emile Schmidt; Indication of the Vestiges of the Pre-Columbian Population of Nicaragua, M. Desiré Pector; Human Sacrifice in America During Pre-Columbian Times, by M. Grossi; Cremation in America Before and After Christopher Columbus, by M. Grossi; Anthropology of the People d'Anahuac in the Times of Cortez, by M. Hartmann; Was America Peopled from Polynesia? by Horatio Hale; Study of the Mam Language, by the Comte de Charency; Vocabulary of the Language Timucua, by M. Raoule de la Grasserie; The Linguistic Family of Pano, by the same; The Historic Archives of the Hemenway Southwestern Archæological Expedition, by M. Bandelier; On the Sambaquis of Brazil, by M. H. Muller; Ancient Map of America, by Gaffarel; Three Linguistic Families in the Amazon and Orinoco Rivers, by M. Adam; Bibliography of Recent Linguistic Investigations in South America, by the same; Maya Handwriting by M. Förstemann; A Chronologic Classification of the Architectural Monuments of Ancient Peru, by M. Borsari; Contribution to Americanism of Cauca (United States of Columbia) by M. Douay; The Language of the People of the Center of South America by M. Von Den Steinen; Peruvian Figures in Silver, by M. Luders.

Language vs. Anatomy in Determining Human Races.—"Anthropologie," replying to criticisms of Dr. Sergi's work, thus states the position of French Anthropologists on this controverted subject:

The Anthropologists of France are unanimous that some or a few (anatomic) characters are not sufficient to determine a type of race; but there should be an investigation of all or as many as possible, and Anthropology does not interfere with Ethnography. They are occupied with different things. Anthropology does not say that physical characters are superior or inferior to linguistic characters; it says the two sciences are of a different order and for a different purpose. The first relates to the physical element constituting peoples; the second to the classification of these peoples. Language grows, loses, borrows, changes, transforms, and all this independent of the Anthropological characters, such as beliefs, customs, industries. Physical characters are hereditary and inherent in the blood, while linguistic characters are not. A red Indian, born among strangers and without the society of his parents or race, will speak, not his own language, but the language of those who rear him, and, nevertheless, retain all the physical characters of his race. Different and opposing races may speak the same language, and per contra, the same race may speak different languages.

Much of the contest which has developed in the United States as to the relative value of language arises from the confusion of the terms Anthropology, Ethnology, Ethnography. The French writer makes a distinction easily understood and maintained, and quite harmonious with the "Nomenclature of Anthropology" as presented by Dr. Brinton and commented on by Major Powell before the Anthropological Society of Washington (Amer. Anthrop., July, 1892, Vol. V, No. 3, p. 265, et seq).

Language may be of great value, and should never be neglected in determining living or historic races. In determining prehistoric races, it cannot be studied because in most cases it is unknown, and so we are driven to consider the physical characters. Because language assists in determining historic races, it does not follow that in the prehistoric races no other means can be used.

The true rule seems to require the employment of all possible means, and even then the decision may not be either harmonious or correct.

The Nephrite of New Zealand.—MM. Duparc and Morazec have published in the Archives of Natural and Physical Science, Geneva, a paper on Nephrite of New Zealand. Speaking of the number of hatchets and other objects from the Swiss Lakes in the museums which have passed as Nephrite, they express doubt and counsel circumspection. They do right and are to be approved. But when they say that they have found but one piece which from its appearance could be identified as nephrite, their proposition is doubtful. There are many polished specimens of the hard, greenish stone in the Swiss Museums, which stand tests of hardness and density required for Nephrite, and which have been called so. If not Nephrite, they are still some varieties of Jade. One or more of their components may be soda or aluminum instead of lime or magnesia; and they may be Jadeite, fibrolite, saussaurite or another variety of Jade.

While many of these polished objects can be determined with reasonable certainty on inspection and from appearance, yet there are many which possibly cannot be. That is to say, they correspond in appearance, and they stand the tests of hardness and density, and may be either the one or the other, depending upon their chemical combination, and this similarity may be so great that it is doubtful if, in disputed cases, anyone can determine without analysis or microscopic examination of thin sections. If MM. Dupare and Morazec examined the doubtful or contested specimens of the Swiss Museums in this way, their determination would be accepted, but if from mere external

appearance, the subject is still open. Their conclusions may be quite correct, but examination from external appearance does not prove it. One great trouble arising in the discussion of this subject is that the destruction of the object consequent upon analysis and thin section prevents a satisfactory and competent determination.

MICROSCOPY.[1]

A Method for Injecting the Blood-Vessels in Birds.— I presume all who give a laboratory course in Comparative Anatomy have, in common with myself, experienced difficulty in injecting the arterial and venous systems of birds. The usual directions are to inject the arterial system through the pectoral artery, and the venous system either through the pectoral vein or through the coccygeo-mesenteric vein. The blood of birds coagulates very rapidly, and even when the procedure is carried out as expeditiously as possible, failure frequently occurs from the inability of the operator to remove the greater part of the blood from the animal, or from vexatious delays in tying a canula in the divided vessel. For some time I have been using the following method, and have not failed in securing the most satisfactory results. It possesses the additional advantage of being quickly performed.

The bird, a pigeon for example, is placed under a bell-jar and chloroformed in the usual way. While the bird is getting under the influence of the anesthetic, the operator should see that there is, within convenient reach, a scalpel, a pair of stout scissors with both points rounded off, two canulae and the necessary ligatures for tying them in place.

As soon as the pigeon is thoroughly under the anesthetic, the bell-jar is removed, a towel is wrapped about the head and a few drops of chloroform poured over it; the feathers are rapidly plucked from the breast and abdomen to a point just anterior to the cloaca; the skin is divided the entire distance over the keel, and the pectoral muscles dissected off from their attachment to the keel and body of the sternum for a distance of half an inch on either side of the keel.

The muscles attached to the posterior margin of the sternum are next divided close to the sternum for the distance of half an inch on either side of the median line; now raise the sternum carefully and divide the attachment of the heart. Beginning at the outer angle of the divided abdominal muscles, the body of the sternum is cut through

[1]This department is edited by C. O. Whitman, University of Chicago.

with the stout, blunt-pointed scissors, in a direction forward and inward, until a point is reached directly over the origin of the vascular trunks; repeat on the opposite side. Now grasping the keel firmly with the left hand, make traction directly upward, at the same time steadying the bird with the right hand; by this procedure the sternum is broken equally across, and the heart exposed without causing any damage to it or to the vascular trunks. Next, tear the pericardium open as quickly as possible, seize the heart, still strongly beating, between the thumb and index finger of the left hand, invert the bird over a sink and cut off with the blunt-pointed scissors the apex of the heart. In this way the blood-vessels are thoroughly emptied and the bird killed without any unnecessary suffering.

Although the description of the procedure may make it seem long, I have repeatedly done it in less than three minutes.

A canula is now inserted through the left ventricle into the aorta, and a ligature placed around it close to the point where the aorta leaves the heart. In passing the ligature around the canula, care should be exercised not to injure the vena cava or the right auricle. A second canula is passed through the right ventricle into the right auricle and secured by tying a stout ligature about the whole heart.

I have found that the best injecting mass is Gage's modification of Pausch's, colored with vermilion or ultramarine blue; this does not pass through the capillaries, sets quickly, leaving the vessels well-distended with a firm mass.

I employ a constant pressure apparatus in injecting, using a pressure of 100 mm. for the artery, but only 60 mm. for the vein; more than this will usually cause a rupture.

W. S. Miller.

Univ. of Wisconsin.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—The following papers were read at the meeting commencing April 18, 1893: On the Systematic Relations of the Ophidia, E. D. Cope; Biographical Memoir of General Montgomery C. Meigs, H. L. Abbott; On the Nature of Certain Solutions, and on a New Means of Investigating Them, M. C. Lea; The Relations of Allied Branches of Biological Research to the Study of the Development of the Individual, and the Evolution of Groups, A. Hyatt; The Endosiphonoidea (Endoceras, etc.), considered as a New Order of Cephalopods, A. Hyatt; A New Type of Fossil Cephalopods, A. Hyatt; Results of Recent Researches upon Fossil Cephalopods of the Carboniferous, A. Hyatt; Biographical Memoir of Julius Erasmus Hilgard, E. W. Hilgard; Monograph of the Bombycine Moths of America, North of Mexico: Part I.—Notodontidæ, A. S. Packard; Intermediary Orbits, G. W. Hill; The Relations Between the Statistics of Immigration and the Census Returns of the Foreign-born Population of the United States, Richmond Mayo-Smith; Statistical Data for the Study of the Assimilation of Races and Nationalities of the United States, Richmond Mayo-Smith; Telegraphic Gravity Determinations, T. C. Mendenhall; Comparison of Latitude Determinations at Waikiki, T. C. Mendenhall; A One-volt Standard Cell; H. S. Carhart (introduced by T. C. Mendenhall); Fundamental Standards of Length and Mass, T. C. Mendenhall; Peptonization in Gastric Digestion, R. H. Chittenden; Helen Kellar, Alexander Graham Bell; On a Potentiality of Internal Work in the Wind, S. P. Langley; On a Bolograph of the Infra-red Solar Spectrum, S. P. Langley.

No election of members took place. The following were elected foreign correspondents: Tissandier, astronomer, Paris; Rammelsberg, chemist, Berlin; Ludwig, physiologist, Leipzig.

Boston Society of Natural History.—April 19.—The following papers were read: Mr. J. B. Woodworth: Traces of a Fauna in the Cambridge Slates; Mr. Charles P. Bowditch: Ruins of Central America. The annual meeting was held May 3d. The following paper was read: Dr. R. T. Jackson—Notes on the Development of Palms.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences.—April 10, 1893.—*Biological Section.*—H. F. Osborn, on "The Evolution of Teeth in Mammalia in its Bearing Upon the Problem of Phylogeny," reviewed the recent researches and theories of Kükenthal, Röse and Taeker upon the formation and succession of the dental series in mammalia, and pointed out that, especially in marsupials, cetaceans and edentates (with other placentalia) the existence of two series of teeth was now abundantly proven, as well as the fact that *Homodynamous* forms were derived from early *Heterodont.* He then showed that recent discoveries demonstrated that in marsupials, teeth of the second series might be interposed in the first series—to explain the typical dentition of such forms as Didelphys. This transposition enables a comparison of dentition of marsupials with that of Jurassic mammalia ($=$ i, $\frac{4}{4}$, c, $\frac{1}{1}$, p, $\frac{4}{4}$, m, $\frac{8}{8}$). It was further noted that the triconodont type (as Amphilestes) was probably the hypothetical point of divergence of placental mammalia. As to the form of crowns, the theory (Kükenthal-Röse) that complex mammalian types were made by concrescence of simple reptilian cusps was upon the evidence of the Jurassic mammalia shown untenable, as well as the converse theory that cetaceans have derived their homodynamous form by the splitting of the cusps of triconodont.

Bashford Dean, in "Contributions to the Anatomy of Dinithhys," correlated the parts of this Devon-Lower Carboniferous Arthrodiran to those of Coccosteus. Notes were made upon the (1) disposition and character of the lateral line organs, (2) pineal foramen, (3) nasal capsules, (4) dentary plates (homologies), (5) ginglymoid articulation of lateral shoulder plates, (6) character of shagreen, (7) probable disposition of paired and unpaired fins.

N. L. Britton presented a "Note on the Genus *Lechea.*" This genus of *Cistineæ* is entirely American, and from the investigations of Mr. Wm. H. Leggett and Dr. Britton appears to consist of about fourteen species.

Natural Science Association of Staten Island.—March 18. —Mr. Wm. T. Davis exhibited specimens of the Leopard Moth and read the following communication:

On the 23d of June, 1888, I found on the sidewalk, under a partly decayed white maple on Fort Hill, a large white and black moth that was rendered helpless by having one of its fore wings broken in two. It was not until last year, when Col. Nicholas Pike's article and accompanying figures on the ravages of the Leopard Moth—*Zeuzera æsculi* (Linn.)—in Brooklyn, appeared in "Insect Life," that the moth

found by me was proved to be the same species from Staten Island. Col. Pike found in 1889 that it had bored nearly all of the trees, mostly maples, from Carlton Avenue to the entrance of the park, and that in 1891 it had extended its ravages throughout the city. He also mentioned it as having appeared in Astoria, New Rochelle, Jamaica, New Lots and Flatbush.

In August, 1887, Mr. J. B. Engelman took three specimens of the Leopard Moth in Newark, N. J., and in 1888 many more were found. Previous to this the very rare occurrence of the moths in this country had been credited to the importation of wood containing the larvæ. In 1889, Mr. Beutenmuller mentions it as having been found not uncommonly in Central Park. From these facts it will be seen that this destructive insect from the Old World has become quite generally distributed in this vicinity.

Mr. Davis also read the following note:

With Messrs Kerr and Leng, on the 26th of last February, I observed about twenty-five Snow Buntings—*Plectrophenax nivalis* (Linn.)—in a field on Todt Hill, near the highest point of the island. They were feeding in the few places where there was no snow, and flew occasionally in a remarkably compact flock, from one to another of these isolated spots. This bird has not been reported on the island for a number of years, and its present occurrence is undoubtedly due to the severity of the winter.

Mr. J. H. Bowles, in "Science," for January 13th, 1893, comments upon the abundance of the Pine Grosbeak—*Pinicola enucleator* (Linn.) —and the scarcity of the Snow Bunting about Ponkapoag, in eastern Massachusetts, and gives as a cause the unusually cold weather. The Grosbeaks and the Buntings have each ranged further south than for several years past. Though the weather has been severe, robins have been seen sparingly on the island during every month of the winter.

Mr. Arthur Hollick remarked that the last time he remembered seeing the Snow Buntings in abundance in this vicinity was during the winter of 1872–73, when they appeared in great flocks, accompanied by the Horned Lark—*Otocoris alpestris* (Linn.). That winter they were particularly numerous on Fort Hill, New Brighton, during many days in December and January, and large numbers were killed by gunners.

Mr. Walter C. Kerr exhibited, under the microscope, leaves of *Quercus nigra* L., *Q. ilicifolia* Wang., and *Q. brittonii* Davis, and read the following paper in connection with them:

In describing the new hybrid, *Quercus brittonii*, in our Proceedings for September 10th, 1892, Mr. Davis refers to the pubescence of the under surface of its leaves being intermediate between that of *Q. ilicifolia* and *Q. nigra*. This observation was made from casual inspection, without reference to the exact nature of the pubescence. Under the microscope it will be seen, as in specimens submitted, that the *Q. ilicifolia* has so dense a pubescence that the epidermis is completely hidden, while in *Q. nigra* the tufts are quite separated, even isolated. In *Q. brittoni*, the hybrid between these species, the intermediate character of the pubescence is most striking, the under surface of the leaves being starred at regular intervals by the tufts, which are usually sufficiently close to allow their spreading hairs to touch one another. These tufts seem to be composed of six to twelve hairs spreading from a common base and occupying a space about .15 to .2 mm. in diameter.

An average specimen contains about sixteen tufts per square mm., while in any other, representing the strongest pubescence which the hybrid seems to attain, about twice this number were present and somewhat smaller in size, indicating considerable variation in these appendages.

The wide difference in pubescence of *ilicifolia* and *nigra*, however, is such that a variation of even one hundred per cent. between different specimens of *Q. britonii* is not sufficient to materially affect the distinctiveness of this characteristic.

Mr. Arthur Hollick called attention to the fact that an earthquake shock had been experienced on the island shortly after midnight on March 8th, which had been sufficiently severe to awaken many people, especially those who resided on the hills in New Brighton, but that it did not seem to have been felt generally throughout the rest of the island.

Mr. Jos. G. Thompson stated than he found, on South Beach, a dead specimen of the Tom-Cod (*Gadus tomcodus*), about eight inches long, which had made a meal of eight mud-killies (*Umbri limi*). Those that were in the foremost part of the stomach were quite perfect, while the others that were further down had begun to be dissolved by the digestive fluids.

April 8.—Mr. Arthur Hollick exhibited specimens of Indian rubbing stones and read the following paper concerning them :.

Since our last meeting, while on a tramp across the island from Pleasant Plains to Rossville, I was struck by the fact that the shell heaps, which have been noticed in that region at different times, form practically a continuous chain or trail from shore to shore. They follow

the course of Sandy Brook up to Woodrow road, and from thence may be found in nearly every field or piece of cleared ground until we reach the village of Rossville. Indian implements of various kinds, with fragments of pottery have been picked up at many points and are likely to be met with in any part of the region. The distance of some of these accumulations from the shore, their elevation above the water, and the fact that in many places they are spread thinly and evenly on the surface has led me to think that the more distant ones from the salt water may have been carried there in recent times by the farmers for purposes of fertilization, as is frequently done. Whether this be so or not, implements may be found wherever the shells occur, proving their origin indisputably.

Amongst a number of relics found at the time mentioned was an unusually fine specimen of a rubbing or polishing stone—an implement of which few have turned up on Staten Island, and in regard to which I believe, the attention of the Association has never been called. Amongst the hundreds of implements which our members have collected during the past ten or twelve years from all parts of the island, I find but seven which can be classed in this category—all, with the exception of this one, from Tottenville.

Mr. William T. Davis presented nine plants, new or rare to the flora of the Island, with the following memoranda:

Rubus odoratus L. Side of Todt Hill road near the highest point. Spreading from introduced plants. *Aethusa cynapium* L. Abundant in a field corner Crescent and Jersey streets, New Brighton. Previously reported only from Clove Lake swamp. *Oxycoccus macrocarpus* Pers. Near Sprague avenue, Tottenville, and accompanied by the "Cotton grass" (*Eriophorum*) as in the swamp near Richmond village. *Vaccinium pennsylvanicum* Lam. Watchogue and Arlington. *Stachys palustris* L. var. *cordata*. Abundant in field near Eltingville station. *Pinus mitis* Michx. Abundant at Linoleumville. *Habenaria blephariglottis* Hook. Sparingly at Watchogue along Merrill's road. *Calopogon pulchellus* R. Br. Merrill's road near trap ridge. Collected by C. W. Leng. *Smilacina stellata* Desf. Borders of salt meadow at Great Kills.

Mr. Walter C. Kerr exhibited a large fragment from the broken trunk of a horse chestnut tree, showing profuse budding, and read the following paper:

Some features surrounding the adventitious budding of a horse chestnut, *Æsculus hippocastanum* L., on Tompkinsville Hill may be worthy of passing notice. On the bleak eastern brow of the hill there stands,

among the few scattered trees remaining, a horse chestnut about 18 inches in diameter, branching about three feet from the ground into two trunks, each about ten inches in diameter. The trunk leaning to the eastward is thriving and about the normal height for its diameter. The one leading to the westward has broken off, with an irregular splintery fracture, about five feet from the ground, perhaps on account of its lesser resistance to our easterly gales, and the stump has rotted badly. The bark, however, retains its vigor, and from the cambium layer, where exposed along the irregular edges of the ruptured section, adventitious buds have sprouted profusely. They are also found where the bark has split, and in the crotch where the tree has forked, where the bark of the two trunks unite. Some of the thickest colonies of buds were at the apex of the splintered stump, and I therefore sawed off about fifteen inches with its buds and three young shoots which have seemed fortunate enough to grow to the length of some eight inches. It will be noted that the bark is in a good state of preservation, the inner layers alive, while the wood is not only dead, but far gone in decay. The thickest cluster of buds is 8 inches long by 1½ inches wide, and within this space I have counted 200, about 30 of which are alive, the others being mostly the remains of a previous crop. There is no evidence of accidental destruction of the buds, though a few small shoots may have been cut off. Cows would scarcely browse on them, and one cluster occupied an inaccessible position in the fork.

One is not surprised at the dense growth of shoots which rise from adventitious buds on a decapitated willow or the spraying branches of elm which are of similar origin, but I have never before noticed so profuse a crop of buds whose mission seems to be entirely futile. They seem to represent an especially vigorous effort of the broken organism to survive, and under the circumstances this effort might be very persistent because of the opportunity afforded the unfortunate trunk, deprived of means of assimilation, to draw on the sister trunk, fully developed, for the requisite nourishment. It therefore might seem to have more opportunity to thus maintain its life than had it been a single trunk snapped off and dependent only on the residual nourishment within its roots. This supposition is, in some degree, supported by the fact that this particular tree stands on a hill some 300 feet high, rooted in the thin, dry soil covering a barren serpentine ledge, and hence would scarcely be expected to show a vigor which compares favorably with the sprouting of the adventitious shoots of the brookside willow. The specimen from the stump shows only three small surviving shoots, and may it not be fairly surmised that if the budding effort

of the cambium layer of this old stump could have been concentrated into a few buds and their resultant shoots, the struggle for existence would have been more successful. It would seem, even in the absence of positive evidence, as though the prolificness with which the buds were formed seriously retarded the survival of any, and thus the ability of the cambium layer of this stump to restore the interrupted growth was handicapped by the opportunity afforded for abnormal budding effort through the supply of nourishment obtainable from the uninjured half.

Mr. George Dupuy exhibited a series of about 400 drawings representing Staten Island pond life—diatoms, desmids, algae and infusoria—all drawn to scale on cards, handsomely colored and arranged.

The Biological Society of Washington.—April 8.—The following communications were made: Professor J. W. Chickering—The Botanical Landscape; Frederick V. Coville—Characteristics and Adaptations of a Desert Flora; Dr. C. W. Stiles—Notes on Parasites; The Cause of "Measly Duck," with microscopic demonstration; Dr. R. R. Gurley—Natural Selection as Exemplified by the Cackling of Hens.

April 22.—The following communications were made: Mr. O. F. Cook—Notes on the Natural History of Liberia; Dr. J. N. Rose—Two New Trees of Economic Importance from Mexico; Dr. V. A. Moore—Observations on the Distribution and Specific Characters of the Streptococci Group of Bacteria; Dr. Erwin F. Smith—Peach Yellows and Plant Nutrition. FREDERICK V. COVILLE, *Secretary.*

Geological Society of Washington.—A Geological Society has recently been organized in Washington, D. C., for the presentation and discussion of topics of interest to geologists. The constitution and standing rules were subscribed to by 109 founders at the first public meeting, March 8th, 1893. Its members are of two classes, active and corresponding. The annual dues of the first are $2, and of the second, $1. Meetings will be held on the second and generally also on the fourth Wednesday of each month from October to May, inclusive.

The journals and bulletins of the various societies appear to furnish sufficient opportunity for the publication of papers read before the Society, so that for the present the Society will not undertake to publish the papers presented. It will probably issue one bulletin each year containing the address of the retiring President, and such other matter as the Council directs. J. S. DILLER, *Secretary.*

SCIENTIFIC NEWS.

Correction.—Dr. D. S. Jordan informs me that the name *albeolus* is not available for a new species of *Notropis* since it has been used in that connection. The species called *Notropis albeolus* in the AMERICAN NATURALIST, January, 1893, p. 152, may stand as *Notropis jordanii.*

C. H. & R. S. EIGENMANN.

Alphonse Louis Pierre Pyramus DeCandolle, born in Paris, October 27, 1806, died in Geneva, April 4, 1893. The son of an eminent botanist (Augustin Pyramus DeCandolle, 1778–1841), with whom he labored many years, and himself the father of one who ranks high among living botanists (Casimir Pyramus DeCandolle, 1836——), the subject of this sketch lived all his days a botanist. His first paper, *Monographie des Campanulées,* appeared in 1830, and from that date until within a short time, his brain and pen have been busy. In 1839 he began his contributions to the "Prodromus" which his father had inaugurated fifteen years earlier, continuing until the final abandonment of the work in 1873. A few years later (1878) he and his son Casimir brought out the first volume of *Monographiae Phanerogamarum,* which was intended as in part, a continuation and revision of the *Prodromus.* Of this great work, seven stately volumes have appeared.

Aside from this systematic and descriptive work, DeCandolle will be remembered for his treatise on geographical botany, *Geographie Botanique Raisonnée* (2 vols., 1855), and his well known *Lois de la Nomenclature Botanique* (1867), of which an English translation appeared the year following. The latter, in these days of discussion, is not likely to be forgotten or overlooked. *La Phytographie,* which appeared from his pen in 1880, is not as well known as its merits deserve. The much more popular *Origin du Plants Cultivés* (1885), of which an English translation appeared in the International Scientific Series is one of the most widely read of botanical works.

Lectures at the Paris Museum.—The following course of lectures will be given at the Museum of Natural History during 1893:

April 25, Preliminary Lesson, M. Milne-Edwards; April 27, Anthropology, M. Hamy; April 29, Ethnography, M. Verneau; May 2, Mammalia, M. Oustalet; May 4, Birds, M. Oustalet; May 6,

Reptiles and Fishes, M. Vaillant; May 9, Molluscs, M. Perrier; May 13, Worms and Zoophytes, M. Bernard; May 16, Insects and Crustaceans, M. Ch. Brongniart; May 18, Comparative Anatomy, M. Pouchet; May 20, Botany (Phanerogams), M. E. Bureau; May 23, Botany (Wood, Cryptogams), M. Van Tieghem; May 25, Living Plants, M. Cornu; May 27, Paleontology, M. Albert Gaudry; May 30, Geology, M. Stanislas Meunier; June 1, Meteorology, M. Daniel Berthelot; June 3, Mineralogy, M. Lacroix; June 6, Hygiene for Travelers, M. Gréhaut. (Revue Scientifique, April, 1893.)

The Nottingham Meeting of the British Association for the Advancement of Science will be held under the presidency of Professor Burdon-Sanderson, the well-known physiologist. The presidents of the Natural History Sections are to be: Geology, J. J. H. Teall; Biology the Rev. Canon Tristram; Geography, Mr. Henry Seebohm; Anthropology, Dr. Robert Monro.

Dr. Dall has done a good work in ascertaining the dates of the late Timothy A. Conrad's books upon the Tertiary fossils of the United States. The quarrel which was their cause or their effect has fortunately passed into ancient history, and these unfortunate volumes show the ground of its permanent settlement.

The cousins Sarasin, so well known for their expedition to Ceylon to study the development of the Cæcilians, are about to start for a several years' stay in the Celebes.

The Rev. H. N. Hutchinson, 30 Vincent Square, Westminster, London, S. W., England, has, for sale, plaster casts of a model of the horned saurian Agathaumas, 12 inches long, for ten shillings.

Professor Karl August Lossen, Chief Geologist of the Prussian Survey and Professor of Geology in the University of Berlin, died February 24, 1893. Most of his geological work was done in the Hartz Mountains. He was born January 5, 1841.

Professor Karl Prantl, of the University of Breslau, died February 24, 1893, in his forty-fourth year. He is best known for his text-book translated by Professor Vines, and for his share in the "Pflanzenfamilien" of which he and Professor Engler of Berlin were joint editors. This work is, however, so near completion that it will probably be but slightly delayed. He also edited the Moss magazine, "Hedwigia."

Edward Parfitt, a student of the Geology of Devonshire, England, died June 15, 1893, in his 73d year.

The Marine Biological Laboratory at Woods Hall, Mass.

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OFFICERS OF INSTRUCTION.

C. O. Whitman, Director, Head Professor of Zoology the University of Chicago; Editor of the Journal of Morphology.

ZOOLOGY.

A. *Investigation.*

Howard Ayers, Director of the Allis Lake Laboratory, Milwaukee; J. Playfair McMurrich, Professor of Biology, University of Cincinnati; E. G. Conklin, Professor of Biology, Ohio Wesleyan University; F. R. Lillie, Fellow in Zoology, Chicago University.

B. *Instruction.*

H. C. Bumpus, Professor of Comparative Anatomy, Brown University; W. M. Rankin, Instructor in Zoology, Princeton College; Pierre A. Fish, Instructor in Physiology and Anatomy, Cornell University; A. D. Mead, Fellow in Zoology, University of Chicago.

BOTANY.

W. A. Setchell, Instructor in Botany, Yale University; W. J. V. Osterhout, Brown University.

PHYSIOLOGY.

Jacques Loeb, Assistant Professor of Physiology, University of Chicago.

Ryoiche Takano, Artist; F. W. Walmsley, Collector; G. M. Gray, Laboratory Assistant.

In addition to the regular courses of instruction in Zoology, Botany, Embryology and Microscopical Technique, consisting of lectures and laboratory work under the constant supervision of the instructors, there will be a number of lectures on special subjects by members of the staff. A course of lectures in Embryology will be given by Professor Whitman; on the Morphology of Vertebrate Head, by Dr. Ayers, and two or more courses in Invertebrate Zoology, by Drs. Bumpus, McMurrich, Rankin and Morgan.

There will also be ten or more evening lectures on biological subjects of general interest. Among those who may contribute these lectures may be mentioned, in addition to the instructors above-named, the following:

Drs. E. A. Andrews, Johns Hopkins University; Howard Ayers, of the Allis Lake Laboratory; Professors W. G. Farlow, Harvard University; William Libbey, Jr., Princeton College; J. M. Macfarlane, University of Pennsylvania; C. S. Minot, Harvard Medical School; E. S. Morse, Salem; H. F. Osborn, Columbia College; John A. Ryder, University of Pennsylvania; W. T. Sedgwick, Mass. Institute of Technology; E. B. Wilson, Columbia College.

The Laboratory is located on the coast at Woods Holl, Massachusetts, near the Laboratories of the United States Fish Commission. The building consists of two stories, and has 33 private laboratories for investigators and 5 general laboratories—two for beginners in investigation in Zoology, one for teachers and students receiving instruction in Zoology, one for Botany, and one for Physiology. The Laboratory has aquaria supplied with running sea water, boats, a steam launch, collecting apparatus and dredges; it is also supplied with reagents, glassware and a limited number of microtomes and microscopes. *No alcohol can be supplied beyond what is required for work in the laboratory.*

By the munificence of friends, the library will be provided not only with the ordinary text-books and works of reference, but also with the more important journals of zoology and botany, some of them in complete series.

THE LABORATORIES FOR INVESTIGATORS

will be open from June 1 to August 30. They will be equipped with aquaria, glassware, reagents, etc., *but microscopes will not be provided.* In this department there are 33 private laboratories for the exclusive use of investigators.

Those who are prepared to begin original work under the guidance of instructors, will occupy tables in the general Laboratories for Investigators, paying for the privilege a fee of fifty dollars. The number of such tables is limited to 20.

An Elementary Course in vertebrate embryology will be introduced this season, designed to meet the needs of those who have completed the general courses in the Students' Laboratory. The study will be confined mainly to the fish egg, as the best type for elucidating vertebrate development. Each member of the class will be supplied with material, and be expected to work out each step in the development from the moment of fecundation. The aim will be not only to master the details of development, but also to acquire a thorough knowledge of the methods of work. Methods of preparing surface views, imbed-

ding in paraffin and celloidin, various methods of staining and mounting, drawing, reconstructing, modeling, etc. The course will thus combine just what is needed as a preparation for investigation.

This course will open Wednesday, July 5, and continue six weeks, and it will be conducted by Mr. Lillie and Professor Whitman. The fee for this course will be fifty dollars, and the class be limited to ten.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz.: a compound microscope, a dissecting microscope (the Paul Mayer pattern made by Zeiss is the best), camera-lucida, microtome, etc. In case these instruments are furnished by the Laboratory, an additional fee of ten dollars will be charged therefor. No application for less than the whole course will be granted.

THE ZOOLOGICAL LABORATORY FOR TEACHERS AND STUDENTS

will be opened on Wednesday July 5, for regular courses of six weeks in Zoology and Microscopical Technique. The number admitted to this department will be limited to fifty, and preference will be given to teachers and others already qualified. By permission of the Director and by the payment of additional fees, students may begin their individual work as early as June 15, but the regular instruction will not begin before July 5.

Though more advanced students who may wish to limit their work to special groups will have an opportunity to do so, the regular course in Zoology, in charge of Professor Bumpus, will embrace a study of the more typical marine forms and elementary methods of Microscopical Technique. The Laboratory work, outlined below, will be accompanied by lectures.

July 5–8, Study of the Lobster (general anatomy, methods of injecting, preparation of histological material); July 10–15, Coelenterates (*Campanularia, Tubularia, Metridium, Mnemeopsis*); July 17–22, Vermes (*Nereis, Balanoglossus* and *Phascolosoma, Polyzoa, Bdelloura*); July 24–29, Echinoderms (*Asterias, Arbacia, Echinarachinus, Thyone*); Molluscs (*Venus, Sycotypus, Loligo*); July 31–Aug. 5, Crustaceans (*Branchipus, Pandarus, Lepas, Idotea, Talorchestia, Cancer, Limulus*); August 7–15, Vertebrates (*Amphioxus, Raja,* Teleost).

The tuition fee is thirty-five dollars, payable in advance. Applicants should state whether they can supply themselves with simple and compound microscopes, or whether they wish to hire. Microscope slides, dissecting and drawing instruments, bottles, and other supplies, to be finally taken away, are on sale at the Laboratory. Further

information in regard to this department may be had by addressing Professor Hermon C. Bumpus, Woods Holl, Mass., to whom applications for admission should also be made.

THE BOTANICAL LABORATORY FOR TEACHERS AND STUDENTS

will be opened on Wednesday, July 5. The laboratory work in Botany will be restricted to the study of the structures and development of types of the various orders of the Cryptogamous Plants. Especial attention will be given to the study of the various species of Marine Algæ which occur so abundantly in the waters about Woods Holl, and students desiring to give their entire attention to these plants will be encouraged to do so. The Fungi and Higher Cryptogams will receive less attention than the Algae, and will be studied in fewer types. Lectures will accompany the laboratory work. The course may be outlined somewhat as follows:

First week, *Cyanophyceæ*—Lyngbya, Calothrix, Rivularia, Stigonema, Tolypothrix, Anabæna. Second week, *Chlorophyceæ*—Spirogyra, Ulva, Enteromorpha, Chætomorpha, Bryopsis, Vaucheria, Œdogonium; *Phaeophyceae*, Ectocarpus, Mesogloia, Leathesia, Laminaria, Fucus, Sargassum. Third week, *Rhodophyceæ*—Batrachospermum, Nemalion, Callithamnion, Chondriopsis, Rhabdonia. Fourth week, *Phycomycetes*—Mucor, Sporodinia, Peronospora, Cystopus, Achlya; *Uredinei*, Æcidium, Uredo, Puccinia, Uromyces. Fifth week, *Basidiomycetes*—Agaricus, Lycoperdon; *Ascomycetes*—Microsphæra, Sordaria, Peziza, Physcia. Sixth week, *Muscineæ*—Riccia, Madotheca, Marchantia, Mnium, Tetraphis, Hypnum; *Filicineæ*—Dicksonia, Adiantum, Equisetum, Lycopodium, Marsilia, Selaginella.

The tuition for students in the regular course of laboratory work and lectures is thirty-five dollars, payable in advance; for students engaged in investigation the tuition is fifty dollars.

Students are expected to supply their own instruments, or to pay an extra fee for those borrowed from the Laboratory. Applications should be addressed to William A. Setchell, 2 Hillhouse Ave., New Haven, Conn.

The Physiological Laboratory will be open from June 1 to September, for investigators.

Rooms accommodating two persons may be obtained near the Laboratory, at prices varying from $2.00 to $4.00 a week, and board from from $4.50 to $6.00. By special arrangement, board will be supplied to members at The Homestead at $5.00 a week.

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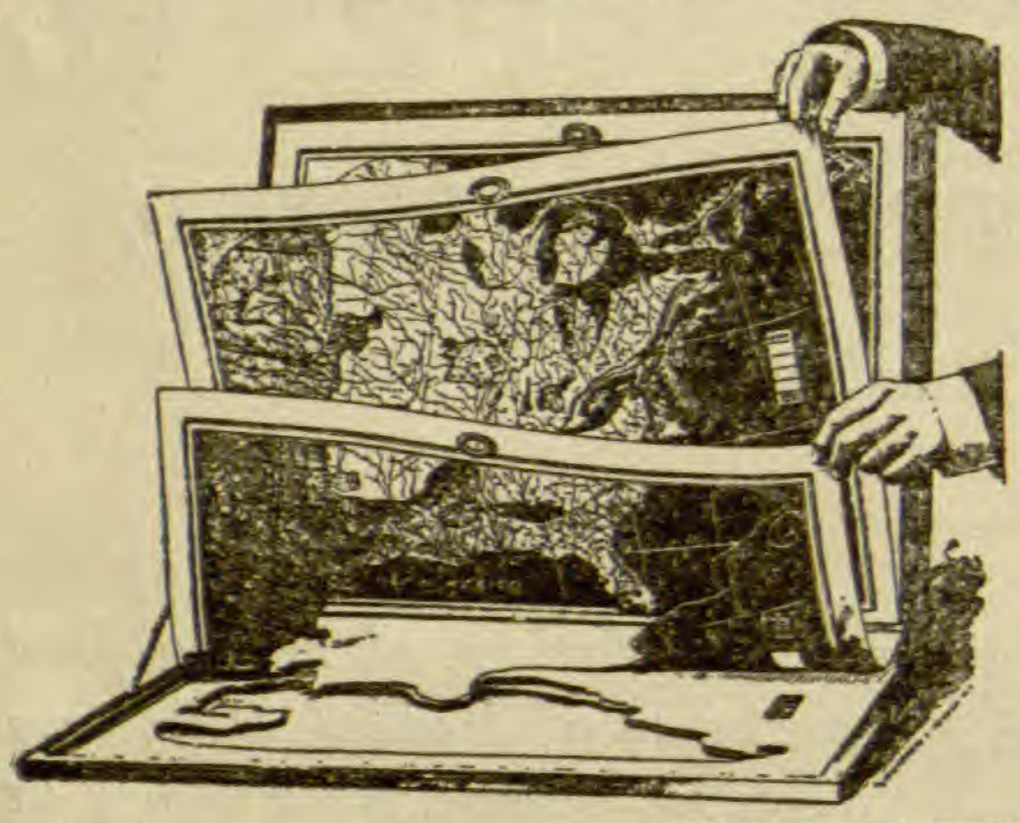

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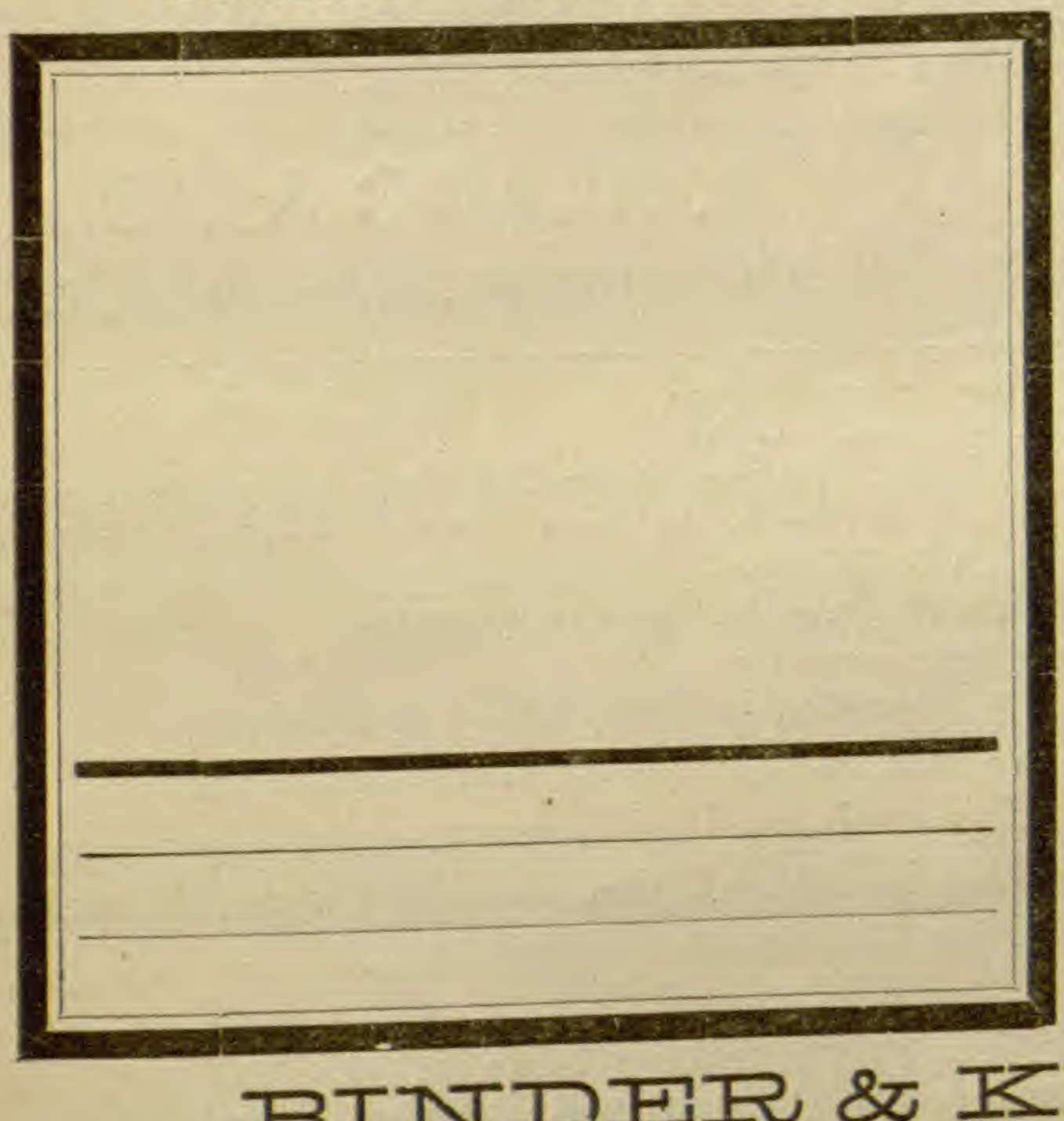

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