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1883.

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February 28, 1884.

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EDWARD J. NOLAN,
Recording Secretary.

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LIST OF CONTRIBUTORS.

With reference to the several articles contributed by each.

For Verbal Communications see General Index.

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1883.

JANUARY 2, 1883.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

The deaths of J. T. Reinhardt, of Copenhagen, a correspondent, and of Edmund Draper, a member, were announced.

JANUARY 9.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

A paper, entitled "Notes on the Geographical Distribution of Batrachia and Reptilia of Western North America," by Edw. D. Cope, was presented for publication.

JANUARY 16.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

Twenty-one persons present.

A paper, entitled "On Quercus Durandii," by S. B. Buckley, was presented for publication.

The following was ordered to be printed :—

NOTES ON THE GEOGRAPHICAL DISTRIBUTION OF BATRACHIA AND REPTILIA IN WESTERN NORTH AMERICA.

BY E. D. COPE.

The following notes are based on collections made by myself and my assistants at various points in the Rocky Mountain and Pacific regions during the last ten years. They describe the range of various species of our terrestrial cold-blooded vertebrata, and contribute to the final definition of the zoölogical provinces and districts of the continent.

1. Lake Valley, New Mexico.

This locality is at the western border of Doñana County, twenty miles N. E. of Fort Cummings. It is in the foot-hills of the Mimbres or Negretta range. The region is rather arid, springs not being numerous; but during July and August there are frequent rains. Vegetation is abundant in the form of grass and herbaceous plants and shrubs.

Scaphiopus sp. Young.

Rana halecina Kalm.

Phrynosoma cornutum Harl.

Full of eggs in June.

Phrynosoma modestum Gird.

Very abundant in August; not seen during two days' visit in June.

Crotaphytus collaris Say. Abundant.

Uta schotti Baird.

There is but one median smaller row of dorsal scales, so that the single specimen approaches the *U. nigricauda.* Specimens of this genus are abundant.

Sceloporus

A large species seen.

Sceloporus.

A small species seen.

Holbrookia maculata B. and G. Abundant.

Var. *flavilenta*, differs from the typical form in having larger prenasal scales separated by only two flat scales in front instead of four tubercular ones, and in having only four flat scales between the nostrils above instead of six tubercular ones, and in having the scales of the front flatter. The spots are obscure or entirely wanting; when present they are more numerous than in the var. *maculata*, there being eight between axilla and groin instead of six. The sides and dorso-lateral regions are thickly marked with small yellow spots. Two specimens.

Cnemidophorus sexlineatus L.

Very abundant.

Stenostoma dulce Bd. and Gird.

One specimen.

Bascanium testaceum Say.

Eutænia cyrtopsis Kenn.

Eutænia ornata B. and G.

Crotalus scutulatus Kenn. Not rare.

Crotalus confluentus Say, var. **pulverulentus** Cope.

I propose this name for a well-marked variety of rattlesnake, which is abundant in the region of Lake Valley, especially on the grassy plains. In order to determine its relations to the species to which I refer it, I instituted a comparison with the allied forms represented in my collection. These are: Two specimens from Fort Benton, Montana; two from Central Oregon; two from Eastern California; one from Socorro, New Mexico; one from Fort Wingate, New Mexico; two from Lake Valley, New Mexico, and one from Haskell County, Texas. These represent a wide range in latitude, and are likely to give the greatest range of variation. The comparison indicates three varieties, defined as follows:—

Cephalic scales larger; four rows between superciliary plates; four rows below orbit; dorsal spots and cephalic bands light-edged; few posterior cross-bands; *confluentus*.

Cephalic scales intermediate; six rows between superciliaries; three rows below orbit (probably sometimes four); dorsal spots square, with the head-bands, not light-edged; posterior cross-bands more numerous; colors dotted with brown specks; *pulverulentus*.

Cephalic scales smallest; eight rows between superciliaries; four rows below orbit; dorsal spots and head-bands light-edged or not; numerous posterior cross-bands; *lucifer*.

The var. *pulverulentus*, at first sight, resembles the *Crotalus mitchilli*, having much the same coloration, but the head-scales and plates are quite different. It gives out a powerful musky odor when excited, which I have not noticed in the typical form of the species. It is quite probable that it is to this variety that the specimens from Arizona should be referred, which I have heretofore placed under *C. lucifer.*[1] Not having access to the specimens at this time, I cannot determine this point positively. Of those above enumerated, the specimens from Fort Benton, Fort Wingate, from Socorro, and from Texas, belong to the typical *C. confluentus.* The others are the *C. c. lucifer.*

Crotalus molossus B. and G.

I killed a fine specimen of this species, which I discovered in the act of springing through a bush. When I struck it, it was suspended over a branch, looking at me. It was heavy in its movements, except at the moment of leaping.

2. Socorro, New Mexico.

The collection from this region was made by Prof. Frank Snow, of the University of Kansas, at Lawrence. I here express my indebtedness to Prof. Snow for the opportunity of studying it.

Phrynosoma modestum Girard.

Phrynosoma cornutum Harl.

Phrynosoma douglassi Bell.

Crotaphytus collaris Say.

Holbrookia texana Trosch.

Holbrookia maculata B. and G.

Sceloporus poinsettii B. and G.

Uta stansburiana B. and G.

Cnemidophorus sexlineatus L.

Diadophis regalis Bd. and Girl.

The first time this rare species has been found within the limits of the United States. The single specimen obtained differs from the typical one in having eight superior labials, with the eye above the fourth and fifth. As the preorbital labials are very short, variation to seven in all may be anticipated, as is found in the type. This specimen is smaller than the one from Sonora originally described.

Bascanium constrictor L.

Eutænia marciana B. and G.

The common species of the Rio Grande valley.

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[1] Proceedings Philada. Academy, 1866, 307.

Crotalus confluentus Say.

Typical variety from near the southern end of the Socorro Mountain, five miles from Socorro.

Crotalus lepidus Kennicott.

Prof. Snow was fortunate enough to obtain the first entire specimen of this species, it having been described by Kennicott from two heads. We are thus made acquainted with the most peculiar of the North American rattlesnakes. I proposed for it the genus *Haploaspis* on account of the undivided nasal plates of the typical specimens. In the present specimen, that plate is divided below the nostril. It is therefore probable that this generic name should be abandoned.

Mr. Kennicott has well described the scutellation of the head. It may be summarized here by saying that the top of the muzzle is covered by eight smooth scuta; that the rostral plate is rather low, and is in contact with the prenasal; that there are two preoculars and two loreals; and that but two scales separate the orbit from the superior labial scuta. Of the latter there are twelve. Occipital scales smooth. Scales of body in twenty-three rows, the two external on each side smooth. Urosteges, 153; gastrosteges, 27. The rattle consists of seven segments and a button, and narrows gradually towards the extremity.

The color above is a greenish gray, which is crossed by nineteen jet-black rings on the body, which do not extend on the abdomen. These rings are two and a half scales wide on the middle line, and narrow downwards on each side so as to cover but one scale in width. The scales which border the annuli are half black and half green, the effect of which is to give the edge of the ring a turreted outline. The edges of the ground-color are paler than any other part of the scales, thus throwing the black into greater relief. A large black spot, shaped like two hearts side by side, with the apices posterior, marks the nape; and there is an irregular small black spot on each side of the occiput. Some black specks between the orbits. No other marks on the head. Near the middle of the gray spaces of the body, some of the scales of many of the rows have black tips. The tail is light brown above, and has a basal broad black, and two other narrow brown annuli. Below dirty white, with closely placed shades of brown.

Total length, m. ·555 ; to constriction of neck, ·027 ; length of tail, ·074 ; do. without rattle, ·026.

This is one of the smallest species of *Crotalus*, and is one of the most handsomely colored. Its coloration is entirely unique in the genus. The scutellation of the muzzle places it between the two sections of the genus, typified respectively by *C. horridus* and *C. durissus*.

The specimen was captured on the summit of the Magdalena Mountains, which are northwest from Socorro twenty miles.

3. St. Thomas, Nevada.

This locality is on the Virgen River, in southeastern Nevada, nearly in the latitude of the southern boundary of Utah. The collection now referred to was made by Dr. Edward Palmer and sent by him to the Smithsonian Institution. Through Professor Baird, the distinguished Secretary, it was referred to me for identification.

Bufo lentiginosus frontosus Cope.

This is the toad of the Great Basin, representing the *B. columbiensis* of more northern regions.

Crotaphytus wislizeni B. and G.

Cnemidophorus tessellatus Say.

Ophibolus getulus boyli B. and G.

The most northern locality for this species in the Great Basin. It has been previously obtained by Palmer and Coues, near Prescott, Arizona.

Phimothyra grahamiæ B. and G.

A variety with the dorsal bands nearly obsolete, and separated by three rows of dorsal scales on all parts of the body. Two preoculars on one side and three on the other. The most northern locality for this species.

4. Santa Fé, New Mexico.

Amblystoma mavortium Baird.

Not uncommon.

Spea hammondii Baird.

Abundant in July and August, when it deposits its eggs in the pools of rain-water. It is very noisy at such times, and the open lots in the city of Santa Fé resound with its cries. They are much like those of the *Scaphiopus holbrookii*.

The range of this species is extensive. It was originally obtained near Redding in Northern California. My friend, James S. Lippincott, has sent it to me from the extreme south of California, San Diego. The Smithsonian Institution has a slightly differentiated variety from Chihuahua; and a specimen from my friend Dr. Duges, from Guanajuato, Mexico, though rather young, is apparently the same. I suspect that the *Scaphiopus dugesi* Brocchi from that locality is the same species.

This species is much like the *Scaphiopus intermontanus* described further on. It is always smaller, and the middle pair of light dorsal bands is nearly always wanting. It is still more different from the *S. varius*, which has the vomerine teeth entirely posterior to the nares, banded upper lip and marbled back.

5. San Francisco Mountains, Utah.

Lizards are very abundant in this region, especially in the Wah Wah Valley, on the west side of the range.

Phrynosoma platyrhinum Gird.

Very abundant.

Crotaphytus wislizeni Bd. and Gird.

Very abundant.

Crotaphytus collaris Say.

Very common.

Uta stansburiana Bd. and Gird.

Abundant.

Secloporus smaragdinus Cope.

Not rare.

Sceloporus consobrinus B. and G.

Cnemidophorus sp.

Many seen but not caught.

6. Provo and Salt Lake City, Utah.

Bufo lentiginosus frontosus Cope.

Abundant near Salt Lake City.

Scaphiopus intermontanus sp. nov.

I took a specimen of this species within the limits of Salt Lake City, and subsequently obtained three or four specimens from Pyramid Lake, Nevada. It resembles the *Spea hammondi* more than it does any other species. The frontoparietal bones, though ossified, are not roughened as in the other species of *Scaphiopus*. It is nearest the *S. varius* (from near San Antonio, Texas). In that species the vomerine teeth are entirely posterior to the internal nares; in this one they are between the posterior borders of the same. The lips are not cross-barred as in the *S. varius*; and the superior region has two pale lines on each side. In *S. varius* these lines are replaced by a coarse marbling. As compared with *Spea hammondi*, this frog differs in its larger size, lighter colors, and the presence of the superior pair of light lines.

It represents the *S. hammondi* in more northern regions, and the complete cranial ossification and larger size mark it as a more fully developed form.

Rana halecina Kalm. From Provo.

Rana pretiosa B. & G.

A variety without a trace of dorso-lateral folds, and of a uniform dusky color above and on the sides. Lip not striped. The posterior part of the abdomen and the inferior face of the thighs are salmon-red. Skin smooth; diameter of membranum tympani three-fifths that of the eye. Salt Lake City. This is the most southern locality of this species known.

Sceloporus consobrinus B. & G. Provo.

7. Atlanta, Idaho.

Atlanta is a small town situated on the headwaters of the South Boise River, on the southern drainage of the Sawtooth Mountain Range. The valley is quite elevated, and is shut in by granitic mountains; water and vegetation are abundant; and the snow lies on the ground late in the spring. During a short visit there in 1882, I obtained the following species:

Amblystoma epixanthum sp. nov.

Nearly related to *Amblystoma macrodactylum* Baird, and to be placed next to that species in any synopsis of the genus.[1] Costal folds twelve. No canthus rostralis. Upper jaw overlapping lower. Tail strongly compressed, as long as head and body to groin. Head wide-oval; its greatest width one-fourth its total length to the groin. Digits all rather short; four phalanges in

[1] Proc. Acad. Phila., 1867, p. 171.

fourth posterior digit. Internal nares as widely separated as the external. Eye-fissure one-half width between the anterior canthus. Median dental series presenting an angle forwards. Tongue large, deeply plicate. Length, m. ·083; length to axilla, ·017; to groin, ·040; length of anterior limb, ·012; of anterior foot, ·004; of hind limb, ·014; of posterior foot, ·0065.

Sides of body and tail, and superior surfaces of limbs, shining black. Dorsal region to end of tail and muzzle, gamboge yellow. The yellow expands on the head, and forms two cross-bands on the upper surfaces of each of the limbs. The black of the sides is occasionally interrupted by the yellow spots irregularly placed. Below, dilute black, dusted with minute white speckles. The structural differences between this and the *A. macrodactylum* are not many, but are well marked. They are: 1. The greater width of the head, which enters the length (without the tail) five times in the latter, and four times in the *A. epixanthum*; and is also seen in the greater interorbital width. 2. In the short toes, which are very much longer in the *A. macrodactylum*. In color, this species is the more brilliant; the coast species being described as brown, with gray dorsal stripes, instead of black, with yellow dorsal stripes. In it the limbs are not banded, and the belly is uniformly pale, contrary to what holds in the present species, which is the most handsome of the genus. I obtained four specimens of this salamander, under logs, in a swamp near the head of the South Boise River, on the south side of the Sawtooth Mountain Range, Idaho.

Bufo columbiensis Bd. and Gird.

Abundant. I also obtained it at Bellevue on the Wood River, about one hundred miles southeast of Atlanta.

Bascanium vetustum Bd. and Gird.

Eutænia sirtalis Linn.

These are all, except the last, species characteristic of the northern fauna of Washington Territory. The *Bufo columbiensis* ranges to the headwaters of the Missouri.

8. Mouth of Bruneau River, Idaho.

This locality is on Snake River, which cuts through the great lava outflow of southern Idaho and Oregon. The reptiles are different from those of Atlanta, and are those of the great basin of Utah. I am indebted to Mr. J. L. Wortman for these specimens.

Phrynosoma platyrhinum Gird.

Crotaphytus collaris Say.

Crotaphytus wislizeni B. and G.

Uta stansburiana B. and G.

Sceloporus smaragdinus Cope.

Pityophis catenifer Blainv.

Bascanium vetustum B. and G.

The head is a little longer than in a specimen from central Oregon, and the muzzle is less conical. The fifth superior labial just reaches the inferior postorbital.

9. From Reno to Pyramid Lake, Nevada.

The road from Reno to the southern extremity of Surprise Valley, California, passes through an arid and forbidding country. The rocks are entirely basaltic, and frequently present a rugged foundation for the road. The vegetation consists of *Artemisia*, and where alkali abounds, of *Sarcobatus*. North of Pyramid Lake, the dry alkaline flats once covered by the Alkali Lake, have a wide extent. During the hot weather of July, 1882, the region swarmed with lizards, and rattlesnakes were numerous. The greatest number of both was met with from Pyramid Lake northwards for twenty miles.

Bufo columbiensis Bd. and Gird. Pyramid Lake.

Scaphiopus intermontanus Cope.

With the preceding species in a pond near the shore of Pyramid Lake. Like other allied species, it was very noisy, almost obscuring the voice of the less vociferous *Bufo*.

Phrynosoma platyrhinum Gird.

Very abundant.

Crotaphytus collaris Say.

Crotaphytus wislizeni B. and G.

More abundant than the *C. collaris*.

Holbrookia sp.

A fine species was seen north of Pyramid Lake, but it was so swift that I did not succeed in catching a specimen. It resembles the *H. texana*, and may be an undescribed species.

Sceloporus smaragdinus Cope.

A variety with one additional row of small supraorbital scales, making six rows in all.

Cnemidophorus tessellatus Say. Abundant.

Bascanium sp. Young.

Crotalus confluentus lucifer B. and G. Cope emend. supra, p. 11.

Two specimens from Buffalo Canyon, north of Pyramid Lake. In one of the specimens the dorsal spots are first darker, then lighter-bordered, and there are twenty-three rows of scales on the body. In the other there are twenty-five rows of scales, and the spots have neither dark nor pale borders, but have pale scales scattered through them, and they have a more transverse form.

10. The Lakes of South and West Central Oregon.

This region possesses much zoölogical interest from the position which it occupies as the border-land between the faunæ of the Pacific slope and that of the great interior basin. It is here that we find the transition between the sage-brush (*Artemisia*) desert and the forest-covered Sierra Nevada Mountains and valleys. Here also we have the transition between the almost fresh lakes near the mountains, to the intensely alkaline ones east of them. An especial interest attaches to the lake faunæ; since we find in them the means of determining the characters of the fossils found in the remains of pliocene and post-pliocene lakes of the Oregon desert. This part of the subject will be more fully considered in an essay on the fishes of these lakes, now in course of preparation.

The routes on which the species of the list below given, were collected, are as follows: Along the east shore of the Great Klamath Lake to its northern extremity. From the eastern side of the lake northeastward to Silver Lake. This was part of my expedition of 1879. In 1882, I passed along the three southern Warner Lakes, and then crossed southwest to Goose Lake. Thence I traveled north to Summer Lake, crossing the Chewaucan River, which flows into Abert's Lake. Then north to Silver Lake, connecting with my route of 1879. After that, south to Goose Lake, passing along its entire eastern shore.

Bufo columbiensis Bd. and Gird.

Abundant throughout the entire region. It is especially numerous at Klamath Lake, where it covers the basaltic blocks which lie partially in the water, concealed by the *Typhæ*, which grow from the bottom. They accumulate there in large piles, sometimes as large as a bushel-measure, and afford abundant food for the *Eutæniæ*, which are scarcely less abundant. One specimen of this toad was as large as the average *Bufo marinus* of Brazil, and a specimen seen at Warner's Lake was but little smaller.

Hyla regilla B. and G.

Abundant at Silver Lake, at Warner's Lake, Goose Lake and at Fort Bidwell, twenty miles east of Goose Lake, in California, I found numbers of what I suppose to be a variety of this species. It is little over half as large in linear dimensions, and the skin is more distinctly tubercular above. Some of those from Goose Lake are more spotted; those from Fort Bidwell are nearly uniform golden-yellow and green. This species lives in swamps and on the edge of water, representing in this region the *Acris* and *Chorophilus* of the east.

Rana pretiosa Bd. and Gird.

This is the characteristic *Rana* of the northwestern interior, being accompanied by *Bufo columbiensis* and *Bascanium vetustum*. In life the posterior part of the abdomen, with the inferior faces of the thighs, are of a bright salmon-red. I obtained it the entire length of the valley of the Warner Lakes, but not at Fort Bidwell. I have found it to range as far as the eastern foot of the Rocky Mountains in Montana;[1] and the specimens assigned by me[2] to *Rana septentrionalis*, from the Yellowstone Basin, may be the variety described above from Salt Lake City. I do not now have them before me for decision. Specimens of this species are in the National Museum, from Puget's Sound (Dr. Kennerly, No. 5975 a) and from "Camp Moryie" (Dr. Kennerly, No. 5973). The first-named specimens are accompanied by the *R. temporaria aurora*. It habits are aquatic.

Phrynosoma douglassi Bell. Var.

On the elevated land which represents the Sierra Nevada Range, between Warner's Lake and Goose Lake, in the basaltic region, near the former, I found a peculiar variety of this species. The horns are even more rudimental than in the usual form, but are all represented. The prominent scales of the back are smaller and less prominent. In some of the specimens the head is shorter relatively to the body. The color is an ironrust-brown, with darker lateral spots, each with a small posterior yellow border.

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[1] American Naturalist, 1879, p. 435.

[2] Annual Report U. S. Geol. Survey Terrs., 1871, p. 469.

Individuals are abundant; some of those taken are full of eggs. All are much smaller than the true *P. douglassi.*

Uta stansburiana B. and G.

Abundant on the crags of basalt on the sides of Warner's Valley. It is also common at Summer Lake, which is the most northern locality for the species and genus.

Sceloporus graciosus B. and G.

This very pretty species extends as far north as Summer Lake, and is quite abundant.

Sceloporus smaragdinus Cope.

Common as far north as Summer Lake. A specimen taken there has large torquoise-blue spots behind each brown cross-bar, on each side of the dorsal region.

Charina plumbea Bd. and Gird.

I found a single specimen of this curious snake in the road along the west side of Summer Lake. Although living, its muscles were alternately contracted in such a way as to give it the appearance of a knotted root. It was very tame, allowing itself to be handled without offering resistance. In life the inferior surfaces are of a rich yellow.

Pityophis mexicanus bellona B. and G.

From Summer Lake.

Bascanium vetustum B. and G.

Common in Warner's Valley, at Summer Lake and at Klamath Lake.

Eutænia pickeringii B. and G.

Very common everywhere near water, in all parts of the Lake country.

Eutænia sirtalis sirtalis Linn.

This species accompanies the preceding at Warner's third Lake, at Summer Lake and at Goose Lake, and retains its distinctive features. The specimens seen at Goose Lake have the bands brighter yellow than usual, and are very pugnacious. They preferred fighting to escaping, and bit furiously.

Eutænia sirtalis elegans B. and G.

Abundant. In young specimens the dorsal spots are distinct.

Eutænia biscutata sp. nov.

This is one of the best defined species of the genus. I have only two specimens, which agree in the following characters.

They differ in the number of rows of scales, however, one having twenty-three and the other twenty-two. All the rows of scales keeled, the median ones very strongly. Labials eight, the eye resting on the fourth and fifth. Two preoculars; three post-oculars. The muzzle is rather short, the frontal plate exceeding in length the region anterior to it, and equaling the common suture of the parietal scuta. Nasals rather short; loreal as long as high; inferior preocular nearly square; superior preocular not reaching frontal. Superior labials all truncate above and none of them elevated, the sixth touching the inferior postorbital. Temporals, 1 · 2 · 3; the anterior are rather large. Pairs of geneials subequal. Gastrosteges, 156; urosteges, 79.

Color everywhere black, except on the chin and throat, and on the inferior side of the tail. The former was reddish in life. There are very faint traces of stripes on the third and fourth, and on the median dorsal rows of scales. No traces of spots on the parietal scuta.

Total length, m. 0·265; length to canthus of mouth (axial), ·012; length of tail, ·062.

This species is one of the best characterized of the genus. Its leading peculiarities are: first, the two preocular scuta; second, its twenty-three rows of scales. In both respects it is unique in the genus. Its color is characteristic. Its place is nearest the *E. radix* B. and G., with which it agrees in its rather robust proportions, and the position of the lateral stripe.

This species is not uncommon in the swamp vegetation on the borders of the lake. The specimens I took displayed little activity.

Crotalus confluentus lucifer B. and G.

This species is abundant at Warner's second Lake, and I took one at Silver Lake. The specimens are identical with those from near Pyramid Lake, Nevada.

11. The Willamet Valley, Oregon.

The fauna of this valley is that of western Oregon, and may be expected to differ from that of central and eastern Oregon. The climate of the Willamet Valley is very wet, and the soil is densely covered with forests. This is a state of things almost exactly the reverse of what obtains in central Oregon. Appropriately we have numerous species of salamanders and fewer lizards than in the latter region. This collection was made by my friend, Professor O. B. Johnson, at that time residing at Salem. The specimens were obtained at various points between that city and Portland, north of it.

Amblystoma tenebrosum Bd.

Amblystoma macrodactylum Bd.

Plethodon intermedius Bd.

Cynops torosus Esch.

Bufo halophilus B. and G.

Hyla regilla B. and G.

Eumeces skiltonianus Bd.

Gerrhonotus multicarinatus Blv.

Sceloporus undulatus thayeri B. and G.

Phrynosoma douglassi Bell.

Charina plumbea B. and G.

Diadophis punctatus pulchellus B. and G.

Bascanium vetustum B. and G.

Eutænia leptocephala B. and G.

Of three specimens, two exhibit only seventeen rows of scales. These probably represent the supposed species *E. cooperi*, which is therefore not distinct.

Eutænia concinna Hallow.

I took a specimen of this beautiful snake at Eugene City, south of Salem. Not only the lateral vertical bars, but the muzzle, lips and gular region are a brilliant red.

12. Northern California.

The species referred to in this list were found near the United States fish-hatching establishment on the McCloud River, in Shasta County. I desire here to express my indebtedness to Mr. Livingston Stone, superintendent of the hatching station, for the hospitality which he extended to me at the time of my visit there.

Amblystoma (?) tenebrosum B. and G.

A large siredon from a small tributary of the McCloud is probably this species. It has peculiarities of the branchial structure, and I describe it by comparison with those found in other genera of American salamanders. These are mostly derived from specimens placed in my hands by the Smithsonian Institution, to which my acknowledgments are due. The coloration which appears in the larger larvæ of the present collection, approaches nearest that of the *Amblystoma tenebrosum*. These animals were abundant in the small stream I examined, and swam with great rapidity, darting about and hiding themselves among the fallen leaves that covered the bottom.

I. Processes with two rows of rami:

Rami with many thread-like fimbriæ; *Siren.*

II. Processes with one—an outer—row of rami; processes horizontal.

A rudimental inner row of rami; fimbriæ thread-like; *Proteus.*

III. No principal rami;

A. Processes compressed; fimbriæ dependent from lower edge;

Fimbriæ thread-like, extending on both outer and inner face of process; *Necturus.*

Fimbriæ flat, long, chiefly confined to the lower margin of process; Larvæ of *Spelerpes ruber; S. bilineatus*, and *Gyrinophilus porphyriticus.*

Fimbriæ few, subclavate; *Plethodon cinereus.*

AA. Processes long, narrow; bearing fimbriæ only on the side next the body;

Fimbriæ simple, flat, sub-equal; *Amblystoma.*

AAA. No processes nor rami; fimbriæ on the vertical septa.

Fimbriæ in numerous rows on the edge of the septa; slender, unbranched; *Larva of Amblystoma tenebrosum.*

AAAA. Processes vertical septa, with rami on the anterior edge;

Rami bearing flat, thread-like fimbriæ, which arise from the processes posteriorly and are often divided. *Larva from Simiahmoo, Washington Terr.*

Plethodon iëcanus sp. nov.

This salamander resembles the *Plethodon glutinosus* in various respects, especially in coloration. It has, however, a compressed tail like the *P. intermedius*, and short series of vomerine teeth.

The vomerine series are straight, and do not quite meet on the middle line. They are entirely behind the nares, and do not extend exterior to them. The parasphenoid patches are united into one, and are well separated from the vomerines.

Form rather stout, and the tail short, equaling (from vent) the length of the body (with vent) to the gular fold. Costal folds 13. Head a longitudinal oval, with rather narrowed, and not truncate muzzle; its length (to occiput) contained three and two-third times in length from muzzle to groin.

Limbs short; when pressed along the side they are separated by three intercostal spaces. The digits are short, and the internal ones are rudimental.

The color is black everywhere, and the superior surfaces are dusted over with minute light specks.

Measurements.	M.
Total length,	·053
Length from muzzle to axilla,	·0105
Length from muzzle to groin,	·0275
Width of head at canthus oris,	·006
Length of anterior limb,	·006
Length of anterior foot,	·002
Length of posterior limb,	·0075
Length of posterior foot,	·0032

This species is to be compared with the *Plethodon intermedius* of western Oregon. It is shorter and more robust in form, having only thirteen costal plicæ instead of fifteen.[1] The color is very different.

This species is named from the aboriginal name Iëka, of the grand peak of northern California, Mount Shasta. From the same name the town of Yreka derives its name. So I am informed by Judge Roseborough of that place, to whom I am under great obligations for many facilities and much information.

Cynops torosus Esch. *Diemyctylus torosus* Cope, Check List, Batr. Rept., N. Amer.

Bufo halophilus Bd. and Gird.

Hyla regilla B. and G.

The typical form.

Rana pachyderma sp. nov.

Represented by five specimens of different ages and sizes from

[1] On page 99, Proc. Phila. Academy, 1869, in my monograph of the *Plethodontidæ* the number of plicæ is given at 13. This is a misprint for 15. On p. 209, Proceedings for 1867, the number is correctly given as 15.

the McCloud River, and by two specimens from Ashland at the northern base of the Siskiyou Mountains, Oregon.

This species belongs to the *Rana temporaria* group, and must be compared with *Rana temporaria aurora* B. and G., and *R. pretiosa* B. and G. The vomerine teeth are opposite the posterior border of the choanæ, and form two short, transverse series. The toes are webbed to the base of the terminal phalange of the fourth digit. The hind-leg extended reaches the extremity of the muzzle with the heel. There are two plantar tubercles. The internal is narrow, rather prominent and with obtuse extremity; the other is at the base of the fourth metatarsal bone, and is rounded.

The muzzle is obtuse and the head rather wide. Its greatest width at the position of the membranum tympani, equals the length from the end of the muzzle to the line connecting the axillæ in some specimens; in others to that connecting the middle of the humeri. The skin is on all the superior surfaces thick and glandular. This condition is especially marked in the dorso-lateral fold of each side, which is so thickened in front as to resemble a parotoid gland. This becomes less visible in alcohol. The tympanic membrane is either entirely concealed, or is represented by a depression only. The skin covering it is roughened. A groove extends downwards and backwards from it. Between this and the canthus oris is a glandular thickening, and behind it are two others, one above the other. Posterior to these on the sides is a succession of rounded, roughened warts, similar to those of the toads. Similar warts, but less prominent, are scattered over the dorsal region, and are numerous near the extremity of the coccyx. The skin of the superior surfaces of the head, body and limbs is minutely but very distinctly roughened by small warts, each of which gives exit to a pore. Inferior surfaces smooth. Length of fingers beginning with the shortest, 2 · 1 · 4 · 3.

The color is dark brown or nearly black, with indistinct darker spots on the back; sides brown. Axilla and groin yellow, marbled with black. Thighs above light or dark brown, with three darker crossbars. Tibiæ similar, with three crossbars. Thighs behind, black, coarsely vermiculated with yellow, or yellow closely spotted with black. Below light yellow, spotted with brown on the gular region and on front of femora.

Measurements.	M.
Length of head and body to vent,	·066
Length from muzzle to axilla (axial),	·030
Length from muzzle to groin (axial),	·054
Length of anterior leg,	·043
Length of manus,	·019
Length of posterior leg,	·117
Length of femur,	·033
Length of tibia,	·038
Length of tarsus,	·018

The specimens from Ashland agree with those from the McCloud, except that they are nearly black above and do not exhibit the dorsal spots.

I compare this species with the *Rana temporaria aurora* from the Russian River near the coast of California. That species has but one palmar tubercle, the internal, which is of similar proportions to that of the *R. pachyderma.* The skin is not thickened, and is much less glandular everywhere. The membranum tympani is entirely distinct. The posterior face of the femur is not vermiculated with yellow, but is covered with large black masses. The whole of the under surfaces are brown-spotted. There are four brown crossbars on the tibia: traces of the fourth sometimes appear in the *R. pachyderma.* From *Rana pretiosa* it differs in all these characters; besides those that belong to the latter, *i. e.*, the posteriorly-placed vomerine teeth and the short hind-legs.

Eumeces skiltonianus B. and G.

Gerrhonotus multicarinatus Blv.

The movements of this species are not nearly so active as are those of the *Iguanidæ* and especially of the *Lacertidæ.*

Sceloporus undulatus thayeri B. and G.

Diadophis punctatus pulchellus B. and G.

Different from the typical form of the subspecies in having no spots on the inferior surfaces. I did not admit this form as distinct in my check list, but it had best be retained. It differs from the subspecies *amabilis* in having the inferior two rows of scales unicolor with the abdomen. In life this is a brilliant orange.[1]

[1] At this locality I found, under bark of logs, numerous specimens of *Brachycybe lecontei* Wood. This beautiful myriapod was originally described

13. Mouth of Russian River, California.

This locality is one hundred miles north of San Francisco. The collection was made by myself, in and on the border of the great redwood forest which there covers the hills and mountains of the coast range.

Batrachoseps attenuatus Esch. Abundant.

Plethodon oregonensis Gird.

Abundant, and especially pleasing from its liquid, prominent eyes. Always under the redwoods.

Cynops torosus Esch.

Abundant. This species is entirely aquatic.

Rana temporaria aurora B. and G. *Rana draytoni* B. and G. *Rana longipes* Hallow.

Not distinguishable as a species, in my opinion, from the *Rana temporaria* of the palæarctic realm.

Gerrhonotus multicarinatus Blv.

Eutænia sirtalis elegans B. and G.

14. Los Angeles, California.

Two collections from this locality are before me. One of these was made by Mr. DeCorse, Hospital Steward, at Drum Barracks, and was sent to the Smithsonian Institution. Prof. Baird submitted it to me for determination. The second collection was given me by Mr. Horatio N. Rust, the archæologist, who made it at Passadena, a short distance from the city.

Cynops torosus Esch. Rust.

Batrachoseps attenuatus Esch. Rust.

Phrynosoma blainvillii Gray. DeCorse.

Sceloporus undulatus thayeri B. and G. Rust.

Uta stansburiana B. and G.

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as from California, where it was supposed to have been collected by Dr. J. L. Leconte. I, however, subsequently obtained it from East Tennessee, and as Dr. Leconte had collected it in Georgia, it was supposed by Dr. Wood that the locality California was an error. Its rediscovery on the McCloud River shows that this species is found on the Pacific coast, as originally stated by Wood, and that it ranges over the width of the continent. In like manner a myriapod which I sent Mr. Ryder from the Russian River, is stated by him to be much like *Andrognathus* Cope, a genus heretofore known from the Alleghenies of Virginia.

Specimens remarkably large, and with the postinguinal black spot unusually large and distinct. DeCorse.

Gerrhonotus multicarinatus Blv. Rust.

Eumeces skiltonianus Bd. Rust, DeCorse.

Ophibolus getulus boylii B. and G. Rust.

Pityophis catenifer Blv. Rust, DeCorse.

Bascanium testaceum Say. Rust, DeCorse.

Eutænia hammondi Kenn. DeCorse.

Note on a Species of Xantusia.

The species described below was found by Dr. J. G. Cooper, Zoölogist of the State Geological Survey of California, and was placed in the collections of the University of California, where I saw it. It was kindly lent me for examination by the authorities of the University. The locality from which the specimen was derived is unknown, beyond that it is Californian.

Xantusia riversiana Cope. American Naturalist, 1879, p. 801.

The position of this genus in the system has been discussed by M. Bocourt[1] and myself.[2] I associated it with the genera *Lepidophyma* Dum., and *Cricosaura* Peters, and stated that I was not able to distinguish them from the family *Lacertidæ.* M. Bocourt places these genera in the family "Trachydermi," which also includes *Heloderma* Wiegm. This family is divided by M. Bocourt into two subfamilies, the *Glyphodonti* for *Heloderma*, and the *Aglyphodonti* for the three genera named, together with *Xenosaurus* Pet. Previously to this[3] I had examined and compared the osteology of *Heloderma* and *Xenosaurus.* On account of the differences in the form of the mesosternum, and in some other points, I regarded *Xenosaurus* as the type of a peculiar family to be placed with the *Helodermidæ* in the tribe Diploglossa. *Xantusia, Lepidophyma* and *Cricosaura* are, on the other hand, not Diploglossa, but are *Leptoglossa.* They are allied to the *Lacertidæ*, and especially to the Asiatic *Ophiops*, which is, like them, without eyelids. The character of the tongue is like that of the *Ecpleopidæ*, uniformly squamous, and has no resemblance to that of the *Diploglossa.* The characters of the scapular arch are those of the *Leptoglossa.* The clavicle is loop-shaped proximally, and the

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[1] Mision Scientifique de Mexique, Herpetology, p. 303, 1878.

[2] Proceedings of the Academy of Philadelphia, 1864, p. 229.

[3] Loc. cit. 1866, p. 322.

mesosternum is cruciform in *Lepidophyma* and *Xantusia.* I have not been able to examine *Cricosaura* as to these points. In my paper first mentioned, I stated that these genera have distinct parietal bones. I think that they should, on this account, be distinguished from the *Lacertidæ*, where they are coössified. Whether they are distinct or united in the Ecpleopidæ, I do not know, but the absence of eyelids will separate the group from that family. I use for it the name first given by Baird,[1] *Xantusidæ*, and characterize the three genera as follows :—

I. A large interfrontonasal plate; frontoparietals meeting on the middle line.

Superciliary scales none; pupil round; *Lepidophyma.*
Superciliary scales present; pupil vertical; *Xantusia.*

II. Two interfrontonasals; frontoparietals separated by interparietal.

Superciliary scales; *Cricosaura.*

All of these genera have femoral pores, and an exposed membranum tympani.

The species which has given occasion for the above discussion is the second one of the genus. It is several times as large as the type *X. vigilis* Baird, and has a different coloration. The digits are shorter.

The scales of the dorsal and lateral regions are rather coarsely and uniformly granular. The abdominal scales are quadrate, and are in sixteen longitudinal and thirty-two transverse rows. The preanal scales are in three transverse rows, the anterior two of four scales, with the median pair in both much enlarged, and the posterior row of six scales. Scales of the gular region flat and hexagonal, one row on the gular fold a little larger, and equal to the anterior gulars. Scales of the anterior aspects of the fore-leg and femur larger than the others; those of the tibia small, and those of the posterior face of the femur still smaller. Scales of the tail in whorls of equal width. The scales of equal size, and all convex in cross-section but not keeled. None of the scales of the body or limbs keeled.

The nostril is situated in a small scute at the junction of the sutures which separate the internasal, rostral, first labial, and first

[1] Proceedings Academy Philadelphia, 1858, December.

loreal scuta. Three loreals, increasing in size posteriorly. A circle of scales surrounds the eye, of which the superior or superciliary are the largest. The latter are separated by one row of scales from the parietal, supraorbital and frontal on each side. The interfrontonasal is nearly square. The frontonasals are considerably in contact. The frontal is hexagonal, and is broader than long. The interparietal is as large as each parietal. It is longer than wide, and notches the contact of the frontoparietals. The occipitals are large and quadrate. A single large temporal bounds the parietals and occipital, and it is followed by two small scuta which are in contact with the occipital. There are eight scales on the upper lip. Of these the fifth is the largest, and is part of an annulus which begins with two small scales at the posterior loreal, and terminates at the seventh scale, opposite the middle of the pupil posteriorly. The posterior labials are small, and are separated by nine rows of still smaller scales from the large temporal. No large auricular scales. The eye is rather large and its diameter is contained in the length of muzzle in front of it 1·75 times. The vertical diameter of the auricular meatus is a little less.

The first digits of both extremities are very short. The second of the pes is very little longer than the fifth. All the ungues are acute and are moderately curved. The hind-legs are remarkably short, not exceeding the fore-legs. Extended forwards the extremity of the fourth digit reaches the elbow of the appressed fore-leg. Femoral pores twelve on each side; no anal pores. The tail is not long, and its form is compressed with a flat inferior surface. The section is a triangle, higher than wide, with the apex narrowly truncate.

The color is light brown, with dark umber-brown spots on the superior surface. These spots form, in general, one median and two lateral rows, but as their forms are very irregular this order is obscure. The median dorsal are the largest, and they send branches laterally and anteroposteriorly, so that the result is rather confused. Dark brown bands cross the muzzle on the frontonasal plates and on the frontal, and form a wide U from the frontoparietals passing around the posterior edge of the occipitals. Sides of head with rather large brown spots. Inferior surfaces with minute brown spots which are least numerous on the middle line. Tail with irregular pale spots.

Measurements.	M.
Total length,	·118
Length to posterior edge of occipital plates,	·0162
Length to axilla,	·029
Length to groin,	·055
Length to vent,	·060
Width between orbits above,	·007
Width at temples,	·0115
Length of fore-limb,	·017
Length of manus,	·008
Length of hind-limb,	·023
Length of pes,	·011
Length of tibia,	·007

15. San Diego, California.

My friend, James S. Lippincott, made a collection of reptiles and batrachians at this locality, which throws considerable light on some points of geographical distribution. A catalogue of the species is here given :—

Bufo columbiensis Bd. and Gird.

A single specimen with smoother skin than the more northern forms. Gland on the surface of the tibia very distinct.

Spea hammondi B. and G.

See *antea*, page 14. Four specimens.

Eumeces skiltonianus Baird.

A specimen with the scales of the dark bands pale centered, and with a very thick tail.

Verticaria hyperythra Cope.

Cnemidophorus tessellatus tigris B. and G.

Aniella pulchra Gray.

Gerrhonotus multicarinatus Blv.

Uta stansburiana B. and G.

Crotaphytus wislizeni Bd. and Gird.

Phrynosoma blainvillei Gray.

Rhinochilus lecontei B. and G.

Hypsiglena ochrorhynchus Cope.

Bascanium testaceum Say.

General Observations.

The results to zoölogical geography obtained by the preceding identifications are as follows :—Collection No 1. The extension northwards of the ranges of *Crotalus molossus* and *Stenostoma dulce*. No. 2. The extension northwards of the ranges of *Diadophis regalis*, *Crotalus lepidus* and *Holbrookia texana*. No. 4. The extension to the Rocky Mountains of the range of *Spea hammondi*. No. 6. The discovery of a new *Scaphiopus* in the Great Basin district; and of the southern extension of *Rana pretiosa* into the same. No. 7. The discovery that the Northern Pacific fauna extends east to the Rocky Mountains. This fauna is especially represented by *Bascanium vetustum*, *Rana pretiosa* and *Bufo columbiensis*. No. 8. The fact that the Great Basin district of the Sonoran fauna extends north to the southern slope of the Rocky Mountains in Idaho, where are found several of its species. These are *Phrynosoma platyrhinum*, *Crotaphytus wislizeni*, and *Uta stansburiana*. No. 9. The discovery that the same fauna extends north along the eastern slope of the Sierra Nevada to the beginning of Surprise Valley, California. No. 10. The determination that the Northern Pacific fauna extends from Surprise Valley, eastern California, northwards as far as my explorations have extended, viz., to Silver Lake and Klamath Lakes. No. 15. The determination of a wide southern range for *Spea hammondi* and *Bufo columbiensis*, and northern range for *Verticaria hyperythra*.

These results indicate that the Pacific region has a much greater extension eastward than it has been supposed to have, but which was foreshadowed in my paper on the Zoölogy of Montana, published in 1879.[1] They also indicate that it must be divided into three districts. These I call the Idaho, the Willamet, and the South Californian districts. The first is characterized by the absence of *Gerrhonotus* and *Cynops* and of certain species of *Amblystoma*. The South Californian is characterized by the presence of *Hypsiglena* and *Rhinochilus*, and absence of *Amblystoma*. It is allied to the Sonoran region, to which it is adjacent.

As regards the relation which the Sonoran region as a whole bears to the Nearctic and Neotropical realms, some remarks may be in place here. It is a question with some naturalists to which of the two it should be referred, and some would exclude it from the Nearctic without fully determining its relations to the Neotropical realm.

There can, however, be no doubt that it lacks all the peculiar

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[1] American Naturalist, p. 435.

features of the Neotropical realm, and if it lacks some of those of the Nearctic also, its types are mostly representative of the latter rather of the former. I content myself here with confirming this general principle by reference to the principal families and genera of cold-blooded vertebrata.

R. Nearctica.	R. Sonoriana.	R. Neotropicalia.
	PISCES.	
Salmonidæ.	Salmonidæ.	
Cyprinidæ.	Cyprinidæ.	Characinidæ.
Catostomidæ.	Catostomidæ.	
	BATRACHIA.	
Ranidæ.	Ranidæ.	
Scaphiopidæ.	Scaphiopidæ.	
		Cystignathidæ.
Amblystomidæ.	Amblystomidæ.	
	REPTILIA.	
	Lacertilia.	
Sceloporus.	Sceloporus.	Liocephalus.
Eumeces.	Eumeces.	Mabuia.
	Ophidia.	
		Bothrops.
Bascanium.	Bascanium.	Drymobius.
Tropidonotus.	Tropidonotus.	Helicops.
Eutænia.	Eutænia.	
Pityophis.	Pityophis.	
Diadophis.	Diadophis.	Rhadinæa.
		Coniophanes.
Ophibolus.	Ophibolus.	Erythrolamprus.
		Pliocercus.
		Oxyrrhopus.
		Sibon.
		Leptognathus.
		Boa.
		Xiphosoma.
	Stenostoma.	Stenostoma.

There are a good many genera which are found in the Sonoran district, which do not occur in other parts of the Nearctic realm. These genera are frequently confined to it, but when they are not, they are to be looked for in the Mexican region of the Neotropical realm. I give a list of these genera, with a corresponding one of the Mexican region, to illustrate the extent of the similarity between the two regions.

R. Sonoriana.		R. Mexicana.
	PISCES.	
Plagopterinæ.		
	REPTILIA.	
	Lacertilia.	
Heloderma.		Heloderma.
Crotaphytus.		
Uta.		
Uma.		
Callisaurus.		
	Ophidia.	
Gyalopium.		Ficimia.
Phimothyra.		Phimothyra.
Trimorphodon.		Trimorphodon.
Hypsiglena.		Hypsiglena.

It seems then that the Neotropical relationships of the Sonoran region are not great. In this consideration I have omitted the genera which are common to the Mexican region and the Nearctic realm in general. Such are *Ranidæ*, *Cnemidophorus*, *Sceloporus*, *Bascanium*, *Tropidonotus*, *Eutænia*, *Pityophis*, *Spilotes*, *Ophibolus* and *Elaps*. These forms serve to indicate the affinity between the Nearctic realm and the Mexican region. The line between the two is, however, not yet exactly drawn. The former extends on the west coast at least as far south as Guaymas, and on the plateau as far as Guanajuato. On the east coast the Neotropical fauna reaches near to the Rio Grande. See On the Zoölogical Position of Texas, by the writer, in Bulletin U. S. National Museum, No. 20, August, 1880; and Eleventh Contribution to the Herpetology of Tropical America, by E. D. Cope, Proceedings Amer. Philosoph. Society, 1879, p. 267.

January 23.

The President, Dr. Leidy, in the chair.

Twenty-six persons present.

Ovipositing of Argynnis cybele.—Mr. H. Skinner remarked that he had noticed a female of *Argynnis cybele* acting as though it were ovipositing, and seeing that it behaved in a peculiar manner, he was led to watch its proceedings carefully. Instead of attaching or cementing its eggs to the plant on which the young or larvæ are destined to feed, which is the usual habit of butterflies and moths, it hovered about a foot in height over a bed of violets, and at intervals would remain stationary and drop an egg from this distance to the food plant below. This seemed a remarkable procedure, inasmuch as it differed from the method which has been found to be so constant in this order. It remains to be seen whether this species always drops it eggs from a height, or only behaves in the peculiar manner occasionally while ovipositing. Also whether the other species of the genus *Argynnis* lay their eggs in a like manner. He thought it quite likely that *A. myrina* and *A. bellona* do so occasionally, as they differ from the other butterflies in the readiness with which they lay their eggs. He had known them to oviposit in chip boxes or other receptacles in which they were confined. He knew of no other species which behave thus. It had been stated that the species of the genus feed only on violets, which was probably not the case.

The following, received through the Botanical Section, was ordered to be printed :—

ON QUERCUS DURANDII Buckley.

BY CHARLES MOHR.

The rediscovery of this fine tree in Alabama adds now definitely another one to the number of oaks known to inhabit the forests east of the Mississippi River. First discovered by Prof. Buckley in 1841 in Wilcox County, Alabama, it was described from specimens collected near Austin, Texas, twenty years afterwards. I had occasion to study the tree in several localities in its western home during my investigations of the forest growth of south-western Texas, in December, 1880; subsequently I directed my attention to its rediscovery in the eastern Gulf region, and particularly in Alabama. After a fruitless search through three seasons, I was finally rewarded at the close of the one just passed, in finding this oak in the woods covering the limestone ridges bordering the Little Cahabe River in Bibb County, Alabama.

The largest of the trees observed measured 2 feet in diameter by an estimated height of about 70 feet. The trunk divides at a height from 30 to 35 feet above the ground; the heavy primary limbs are erect, tall, and the head of the tree is of an oblong shape; it resembles in the habit of growth greatly the white oak; the bark is close, more so than in the Texan tree, where it is found inclined to be somewhat flaky, of a bright, almost pure white color, by which it is at once distinguished from the latter. There is scarcely a tree which shows greater variation in the size and shape of its leaves, which were at the date of its rediscovery, 11th November, for the greatest part shed. Only on some late, vigorous shoots, was the foliage yet fresh and green found to persist. The leaves are short petioled, from 2 to $3\frac{1}{2}$ inches in length, and from $\frac{1}{2}$ to $2\frac{1}{2}$ inches at their greatest width, always attenuated at the base. They are either roundish, ovate or obovate towards the apex, largely dilated, irregularly and obtusely, more or less deeply three-lobed, or narrowed to lanceolate with shallow, distant lobes, a mere wavy or entire margin. Of a firm texture, the leaves are pubescent along the veins beneath when older, with a fine, close, pale tomentum.

The fruit is of annual maturation and (at least during this season) produced in abundance, short peduncled to sessile, single, in pairs or in clusters of three and four; small, from three-eighths to five-eighths of an inch long. The nut is perfectly smooth, shining, of a light tan-color, ovate, somewhat narrowed towards the base, with the apex slightly compressed and umbonate to about one-third of its length, immersed in a shallow cup with closely appressed, slight, knobby and smoothish scales. The nut is sweet and regarded as the best of mast. The acorns seem to germinate in situations more or less exposed to light; the large trees are in more open situations found surrounded by their numerous offspring in all stages of growth.

From the limited knowledge we possess, but little can be said of the distribution of this oak. So far as known, it is confined to a calcareous soil, be it on the rocky uplands or in the bottom lands, the soil of which in western Texas consists of a fine calcareous silt. It seems not to occur west of the basin of the Colorado River; it was not found near New Braunfels or around San Antonio; on the dry, rocky hills near Austin, it scarcely reaches the dimensions of a middle-sized tree; in the rich bottom of the lower Guadeloupe it attains the proportion of the larger trees of the forest; there a number of trees were measured and found from 2 to fully 3 feet in diameter. One felled to the ground measured 37 inches through and 86 feet in length, being perfectly sound. In such localities most favorable to its development, it is esteemed as the most valuable of the timber trees; in its quality equal to the best of white oak timber, it enters into all the manifold uses to which the latter is applied, and which render the white oak of such great importance.

As far as known, the tree has not been found in eastern Texas, Louisiana, Mississippi, and the northern part of Alabama. In the latter State it seems in its northern extension confined to the southern edge of the silurian limestone formation at the 33° of latitude, at an elevation not exceeding 250 or 300 feet above the Gulf of Mexico. In reply to several inquiries made since, in regard to its occurrence in the central and lower part of the State, where the tree is called "Bastard Oak," it has become evident that it is not rare southward throughout the cretaceous belt on the rocky banks lining the water courses, to the tertiary limestone hills below. Its absence in the extensive territory between the latter and the calcareous hills on the Colorado River, nearly 700 miles to the westward, can be accounted for by the prevailing sandy or argillaceous soils quite destitute of lime, whose presence seems to be a necessary requirement for its growth.

JANUARY 30.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

The following papers were presented for publication :—

" Urnatella gracilis," by Joseph Leidy, M. D.

" On the Extinct Peccaries of North America," by Joseph Leidy, M. D.

" The Terrestrial Mollusca inhabiting the Society Islands," by Andrew Garrett.

The death of John Wister, a member, was announced.

Hybrid Birds.—CHAS. TOWNSEND referred to the rare occurrence of hybridity among N. Am. *Passeres*, and stated that two species of native warblers had recently been found to be hybrids, between species of the genus *Helminthophaga*. He exhibited a bird taken by Mr. W. L. Baily in Dec., 1882, near Haverford College, Pa., which proved to be a hybrid between the Snowbird and the White-throated Sparrow, birds of different genera, which was more remarkable.

After referring to the marks of hybrid origin borne by some doubtful species, handed down by the earlier ornithologists, he remarked that hybridity would doubtless be found a sufficient explanation for many obscure species that are standing puzzles to the ornithologists of to-day.

Mr. Chas. Morris was elected a member of the Council, to fill the vacancy caused by the election of Dr. Ruschenberger as Curator.

The following were elected members :—

F. A. Genth, Jr., Clarence R. Claghorn, G. Howard Parker, John B. Deaver, M. D., Wm. L. Springs, H. T. Cresson, Jacob L. Wortman and Emily G. Hunt.

FEBRUARY 6.

The President, Dr. LEIDY, in the chair.

Twenty-three persons present.

A paper entitled "A new Extinct Genus of Sirenia," by Edw. D. Cope, was presented for publication.

On a supposed Human Implement from the Gravel at Philadelphia.—Professor H. CARVILL LEWIS stated that through the kindness of Mr. John Sartain, the well-known engraver of this city, a supposed stone implement had come into his hands, which, from the circumstances in which it was found, becomes of great interest. In digging a pit below the cellar of the house No. 728 Sansom Street, Philadelphia, after passing through regularly stratified layers of gravel and sand, a loose, clean "water gravel" was reached at a depth of 24 feet from the surface of the street. The grade of the street is here about 35 feet above the mean level of the Delaware River, and the depth of the drift deposits, as shown by an artesian-well boring at the Continental Hotel, a few hundred feet distant, is 45 feet, gneiss rock being reached at that depth. The drift deposits consist of the usual alternations of sand and gravel with occasional streaks of clay, the whole being horizontally stratified.

The specimen was found at a depth of 24 feet in a loose gravel, where water flowed freely, and lay beneath a series of horizontally stratified layers of gravel and clay, which were entirely undisturbed, and were as originally deposited. Mr. Sartain saw the specimen taken out and testifies as to the accuracy of the above statement.

The supposed implement is an oblong rectangle in shape, 16½ inches in length, nearly 4 inches in width, and in thickness varying from ½ inch at the edge to 1½ inches at the centre. It is ground to a smooth cutting-edge at the two extremities. It is rectangular in section, the sides forming right-angles with the faces. The sides are parallel with each other, but the faces are undulating surfaces, on one of which is a prominent longitudinal ridge, an inch and a half in width.

Each end of the implement appears to have been smoothly ground to form a square, even cutting-edge, an equal amount of grinding having been done on either side. Both extremities are similar. The implement is as unusual in shape as it is in size. It is double the length of ordinary celts, and was possibly a lapstone of some kind.

The late Professor Haldeman, who examined the specimen, expressed great interest in it, and pronounced it undoubtedly of human workmanship.[1]

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[1] Mr. E. A. Barber, a well-known archæologist, reports, after a close examination of the implement, as follows:—"The peculiar marking or *pecking* shows it to be undoubtedly artificial. This pecking is characteristic of many pestles and other heavy stone implements found in this part of the country. There are certain small surfaces (the sides and part of the face) which have not been worked, but the greater part of the implement has been artificially pecked, and the ends have been ground down by abrasion, as may distinctly be seen. The character and use of the implement are not indicated by its shape, but there is no doubt at all as to its artificial workmanship."

Professor Lewis was not prepared to express such a positive opinion as to its artificial origin. The straight, parallel sides of the specimen, resemble the form of natural cleavage fragments of some sandstones and flagstones. Such cleavage fragments are frequently harder in the centre than along the edges, this being the result of a concretionary force, and if the specimen has been shaped by subsequent water action, the harder central portion would resist action and form the ridge already described. The regular bevelling at each extremity would, however, be a very unusual form to be produced by natural erosive forces.

The implement, if such it be, would be the first that has been discovered in the Philadelphia gravel, and would become of great interest in its bearing upon the antiquity of man on the Delaware. The implements found by Dr. Abbott in the gravel at Trenton are of a much more rude type, being closely allied in shape with the palæolithic implements of the river drift of several European localities. They are never ground down to an edge like the specimen now described, but are rudely chipped. The Trenton implements, moreover, are made from Triassic argillite, while this one is made from a compact yellowish-brown sandstone.

As the speaker had endeavored to show in a former communication,[1] the Trenton gravel is a post-glacial deposit made at the time of the final disappearance of glaciers from the headwaters of the Delaware, while the Philadelphia red gravel is somewhat older, having been formed during the glacial epoch at a time when this region was depressed 150–180 feet lower than its present level. Both gravels are true river gravels.

From the geographical position of the locality where the implement was found, it is probable that it belongs to the older of the two gravels. As, however, Professor Lewis had not seen the gravel at this place, judgment was reserved upon this point.

It would, indeed, be a curious fact if it were proved that an implement of neolithic type belonged to a gravel older than that which contained only palæolithic implements.

Should the specimen under consideration really belong to the gravel, and be proved to be artificial, it will carry back the antiquity of man to glacial times—an antiquity already assigned by numerous discoveries elsewhere. Unlike as this is to the palæolithic implements of Trenton, it is by no means the first neolithic implement reported from a river gravel.

Mr. John Ford[2] has discovered a polished stone axe in the gravel forming the outer bluff of the Mississippi River, near Alton, Ill., which is of great interest. This axe, now in the archæological collection of the Academy, was taken by Mr. Ford from a perpendicular face of gravel freshly cut and exposed by a road cutting; and, accompanied by a number of fossil land and

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[1] Proc. Acad. Nat. Sc. (Min. and Geol. Section), Nov. 24, 1879.

[2] Proc. Acad. Nat. Sc. Phila., 1877, p. 305.

fresh-water shells of Quaternary age, a bone of *Canis*, and a specimen of lignite, lay at a depth of twenty feet in the gravel, and at an elevation of 50 feet above the river. Mr. Ford states that "the wall referred to presented in every part a solid front, without fissure or crevice, everywhere hard and impenetrable except by pick or crowbar, and yet twenty feet under the surface, within this strong matrix deposited by water thousands of years ago, laid the evidence of the presence of the man of the period, a stone axe artistically made, and doubtless used for the purposes of battle." The implement thus found by Mr. Ford is more finely finished than that from the Philadelphia gravel. It is made of hard syenite.

The implements said to occur in the auriferous gravels of California, described by Professor Whitney and others, and those from the loess of the Missouri Valley in Nebraska, discovered by Professor Aughey, are also of neolithic type, the California implements being as perfect as anything now made.

It may be, therefore, that in America rudeness of workmanship is not necessarily associated with great antiquity.

Opportunity is here taken to refer to a recent paper by Professor H W. Haynes,[1] entitled "Some indications of an early race of men in New England," in which the author describes some rough fragments of granite and quartzite found in various localities in Massachusetts, Vermont, and New Hampshire, which he considers to be rude forms of implements, more primitive than those of the Delaware gravels, and which are therefore to be regarded as relics of primeval man.

These objects are of various shapes, sometimes pointed, sometimes with sharp edges all around, and frequently sharp on one side and irregular on the other. These latter were regarded as implements adapted for being held in the hand for use in chopping or cutting. All these forms are of ruder type and coarser fabric than the implements of the Trenton gravel. They were found at localities where none of the ordinary traces of Indian occupation could be discovered, and the author infers from them the former existence in New England of a race of men different from and less advanced than the Indians.

With characteristic courtesy, Professor Haynes invited the speaker to make a personal examination of his full collection of these interesting objects.

A careful study of each specimen convinced Professor Lewis that the angularity of these rock fragments, while often resembling that of artificial forms, is in reality due to natural causes rather than to any human workmanship. Cleavage and frost-fracture and weathering planes appear to have been the sole agents in the production of the greater part of these forms. Upon most of the specimens examined, Professor Lewis was able to detect traces of

[1] Proc. Bost. Soc. Nat. Hist., xxi, p. 382, Feb. 1, 1882.

the original cleavage or weathering planes parallel to certain sides of the fragment, which clearly indicated their mode of formation. Similar fragments occur in almost every portion of the country, their shape varying with the material of which they are formed. Professor Haynes himself states in the paper referred to, "Wherever it has been in my power to make the long and laborious search that is required, I have succeeded in finding them," etc. It is readily understood how a skilled archæologist, accustomed to find a use for every rude implement, would naturally find design also in the close imitations made by Nature.

Among these objects of natural origin there were also a very few which bore traces of human handiwork, some of these being apparently "skin-scrapers." These latter often occur with the most highly finished Indian arrow-heads, and offer, therefore, no evidence of high antiquity. The cases where the same Indian tribe has manufactured implements of the finest workmanship at the same time with those of rudest make, each being intended for different uses, are so numerous as to need only to be mentioned.[1]

Returning finally to the supposed implement from the Philadelphia gravel, now brought before the attention of the Academy, Professor Lewis stated that he did not desire to urge any one interpretation of it, but merely to offer some particulars which might not otherwise see the light, and to show their meaning if verified hereafter. Whatever value might be attached to the circumstances of the discovery of this specimen or to its apparent artificial origin, it would at least serve to stimulate a further search for evidences of man in the gravels underlying the city. An implement found in a thickly populated district, more especially as it occurred in a shifting water gravel, would always be open to suspicion, and at all events a single specimen is not sufficient upon which to base the broad conclusions which would otherwise be warranted.

Note on a Drilled Mall in the Haldeman Collection of Antiquities.—Mr. H. T. CRESSON called attention to a large drilled mall or hammer-head of stone, from the Haldeman collection of antiquities. It was found at Peach Bottom, Lancaster County, Pennsylvania, in 1866, and weighs eight and three-quarter pounds. Most pre-historic hammer-heads or stone malls, consist of oval pebbles, small boulders of quartzite, granite, or other hard materials, which show modification by the hand of man, and have generally undergone more or less of pecking and polishing to bring them into a required shape. The mall exhibited did not possess any groove, but had a drilled hole for the insertion of a haft, which

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[1] At a meeting of the Academy held a week ago, Mr. Aubrey H. Smith presented two Indian implements picked up by himself on the shores of the Loyalsock Creek, Lycoming Co., Pa., where they lay side by side. One was a rudely chipped implement like those of the Trenton gravel, while the other was a delicately formed arrow-point.

is of rare occurrence in any form of axes or hammers belonging to our American Indians, except in the case of ceremonial weapons. The length of the haft-hole in this mall is four and a half inches; but its width of one inch, which in the drilling from either end toward the centre, narrows to half an inch, does not seem to be sufficient in comparison with its size to warrant the insertion of a handle; for this reason the speaker was inclined to believe that it was in an unfinished condition. Malls have been found in the ancient copper mines at Keeweenaw Point and Isle Royal in Lake Superior without grooves for hafting, and occasionally with double grooves. There are malls in use at present among the Sioux Indians for breaking bones and pounding pemmican, but these are firmly encased in raw hide, except that portion of the head used in striking. The occurrence of this kind of haft-hole, excepting as before stated in the ceremonial weapons, is not often seen, resembling in this respect some of the neolithic malls and hammers of the eastern continent.

February 13.

The President, Dr. Leidy, in the chair.

Thirty-three persons present.

The following papers were presented for publication:—

"A new Unio from Florida," by Berlin H. Wright.

"Notes on the Birds of Westmoreland Co., Penna.," by Chas. H. Townsend.

The Publication Committee reported in favor of publishing the following papers in the Journal of the Academy:—

"Urnatella gracilis," by Jos. Leidy, M. D.

"On the Extinct Peccaries of North America," by Jos. Leidy, M. D.

"The Terrestrial Mollusca inhabiting the Society Islands," by Andrew Garrett.

Change of Color in a Katydid.—Professor Lewis recorded a curious instance of modification in color in the case of a katydid, where the normal light green tint had been replaced by a bright scarlet, the complementary color. The insect, which was found at Point Pleasant, N. J., differs in no way from the common katydid, *Cyrtophyllum concavum* Say, except in the unusual color.

On the Reproduction and Parasites of Anodonta fluviatilis.—Prof. Leidy directed attention to a basketful of living fresh-water mussels, *Anodonta fluviatilis*, which were obtained for him through the kindness of Rev. Jesse Y. Burke, and are now placed at the disposal of members who wish to have them. They are fine robust specimens, the larger ones measuring 6 inches in length by 3 inches in height and almost $2\frac{1}{2}$ inches in thickness. They were obtained from a little pond occupying an old marl pit, near Clarksboro, Gloucester Co., N. J.

These mussels appear to be exceedingly prolific. The pregnant females have the branchial uteri, as they have been appropriately named by Dr. Isaac Lea, enormously distended with perfected embryos. These appear with a cinnamon-brown shell, having a conspicuous spinous tooth or hook to each valve, and are furnished with long byssal threads. Wishing to ascertain the proportionate amount of embryos, the following plan was adopted:—In an individual 6 inches long the soft parts were weighed and found to be 135·44 grammes. The branchial uteri weighed 64 grammes and the inner gills 7·34 grammes. Supposing the latter to be of the same weight as the outer gills, free from embryos, this weight subtracted would leave 56·66 grammes as that of the embryos, and 78·78 grammes as the weight of the rest of the animal. In another specimen in which the weight of the soft parts was 113·75 grammes, the branchial uteri weighed 45·5 grammes, and the inner gills 5·2 grammes. Subtracting the weight of these would leave 40·3 grammes as the weight of the embryos, and 73·45 grammes for the rest of the animal. In another specimen by weight, and counting, the embryos in a milligramme were estimated to be 1,280,000.

The mussels are infested with many water mites creeping about among the gills. The young of the same, in various stages, were observed imbedded in the mantle. The mite appears to be identical with the species *Atax ypsilophorus*, which is a parasite of the common mussel, *Anodonta cygnea*, of Europe. It was discovered and described just 100 years ago, under the name *Acarus ypsilophorus*, by Dr. Christophori Gottlieb Bonz (Nova Acta Phys. Med. Acad. C. L. C. Nat. Cur., Nuremberg, 1783, 52, Tab. I, figs. 1–4). It is described and figured by Pfeiffer, with the name of *Limnochares Anodontæ* (Naturg. deutscher land und süss-wasser Mollusken, 1821, Taf. I, fig. 12); by Dr. Karl Ernst v. Baer, under the name of *Hydrachne concharum* (Nova Acta, Bonn, 1826, 590, Taf. XXIX, fig. 19); by P. J. van Beneden (Mem. de l'Acad. R. des Sciences de Belgique, XXIV, 1850), and by Ed. Claparede (Zeits. f. wiss. Zoologie, 1868, 445).

Dr. Bonz's description, referring chiefly to the form, color and marking of the mite, applies to ours; and further he thought the description of the details, of Claparede, applies sufficiently well to the same.

The characters of our mite are briefly as follows:—

Body ovoid, black, with a sulphur-yellow median line, often more or less interrupted, forked in front, and ending in an angular spot behind. The yellow marking divides the black into a pair of lateral reniform spots and an anterior irregular lozenge spot. Sides brown, from the eggs shining through. Head gray, with dumb-bell eye-spots. Limbs gray, translucent, with the chitinous investment bluish black, hirsute, ending in pairs of double falcate ungues. Terminal joint of the palps ending in three minute uncinate denticles. Anal plates of the females usually with about 18 to 22 acetabula to each. Length of body 1·375 to 1·75 mm., breadth 1·125 to 1·5 mm. Inhabits the branchiæ and mantle of *Anodonta fluviatilis.*

The colors depend mainly on the contents shining through the transparent chitinous investment, which under reflected light exhibits a bluish-black tint. Commonly the black color is intense; and in alcoholic specimens the whole body is black. In several individuals the black passed into a chocolate hue. Dr. Bonz describes the European mite as black, with the median dorsal mark pale yellow; Pfeiffer as red-brown with a citron-yellow mark, and Beneden says it shows a Y in white, from which it was named.

The number of acetabula to the anal plates is variable; in one mite he found 23 to each plate, in a second 22 to each, in a third 22 to one and 17 to the other, and in a fourth 18 to one and 17 to the other. Claparede gives from 15 to 20 as the number to each plate in the European mite.

The variations of our mite, from the characters given of the European mite, are such as occur among individuals of either, and he therefore saw nothing distinguishing ours as a different species. Claparede describes another mite which infests the European Unios, which he distinguishes under the name of *Atax Bonzi.* The speaker had also observed a different mite, infesting the common mussel, *Unio complanatus*, of the Delaware River; of this mite he exhibited a drawing made in November, 1854. He suspected it to be the *Atax Bonzi;* but the question can only be more positively answered after the examination of certain details, which he hoped soon to have the opportunity of making.

If our two parasitic mites are identical with those of European mussels, it not only makes it appear probable that they are of common origin, but renders it the more probable that this is likewise the case with their hosts, even if these are not regarded of the same species.

Professor Leidy also exhibited a collection of body-lice, *Pediculus vestimenti*, from Jews of Odessa, Russia, presented by Dr. A. G. Stratton. They range in size from 1·25 to 3·875 mm. in length, and appear in no respect to differ from those found on natives of our own country.

The Ice of the Glacial Period.—Professor Heilprin, referring to the subject of glaciation, stated that in his opinion the vast sheet of ice which is generally supposed to have covered during the great ice age a considerable portion of the northern regions of the European and North American continents, could not have had its origin, as is maintained by most geologists, in a polar "ice-cap," since it may reasonably be doubted whether there could ever have been formed in the extreme North an accumulation of snow and ice of a magnitude sufficient to propel southward a glacier, with an estimated thickness of several thousands of feet, to a distance of hundreds of miles, and up mountain slopes to heights equaling five or six thousand feet. The magnitude (as to height) to which such a snow accumulation may attain, will be dependent upon two conditions—(1), the quantity of aqueous (snow) precipitation, and (2), the upper limit in the atmosphere reached by clouds. It is well known that clouds, as a rule, rise highest in the regions of highest temperature—the equatorial—where the vapor absorption by the atmosphere is greatest, and where the planes of aqueous condensation are most distantly removed from the earth's surface; and, likewise, they rise higher in summer than in winter. The minimum rise will necessarily be in the extreme North (or South), and during the period of greatest cold, or winter. High (discharge) clouds are a rarity in the polar regions, and consequently precipitation will be mainly restricted to a comparatively low atmospheric zone. Above this zone, which will mark the upper limit of the "ice-cap," there can be but little snow accumulation. As a matter of fact, the officers of various Arctic expeditions have repeatedly noted that the high mountain-crests and elevations in the far North were frequently devoid of a snow covering, and that there was but very little precipitation, even over the low lands, during the winter, heavy precipitations setting in only with the spring months. The highest snow-clad elevation in the region of greatest cold (the West), in Greenland, appears to be Washington Land, with an estimated height of six thousand feet, which gives rise to the great Humboldt Glacier. Although this peak is completely buried under a mantle of snow (of undetermined thickness, however), it may yet safely be doubted whether snow of any great thickness (*unless under a much warmer climate*), could accumulate on a summit of much greater elevation. If not, this elevation, in the opinion of the speaker, was entirely inadequate to account for the southward propulsion of a glacier to the extent required by geologists.

Professor Lewis remarked that notwithstanding the difficulties in a theoretical explanation, the fact of a great continuous glacier at the time of maximum glaciation seemed clearly indicated, at least in America, by the numerous observations recently made. He described the extent of the glacier in America, as indicated by its terminal moraine, and stated that the close similarity of its phenomena at distant portions of its southern edge indicated a continuous ice-sheet. The continuous motion of its upper portion is shown by the uniform direction of glacial striæ upon elevated points. Thus the S. W. direction of the striæ upon the mountain tops of N. E. Penna., was identical with that upon the Overlook Mountain of the Catskills, and of that upon the summits of the Laurentians of Canada. The striæ at lower elevations conformed more or less to the valleys, and did not indicate the general movement of the ice. The thickness of the glacier increased northward, the rate of increase diminishing as its source is approached. This latter point has not heretofore been appreciated, although observed some time ago by Dr. Hayes in the case of the Greenland glacier.

Recent observations by the speaker in Pennsylvania had shown the glacier to be 800 feet thick at a point five miles north of its extreme southern edge, and 2000 feet thick at a point eight miles from its edge, while it was only about 3100 feet thick one hundred miles farther northeast, and about 5000 feet thick three hundred miles back from its edge. The amount of erosion caused by it upon rock surfaces was in some degree a measure of its thickness, being far greater in Canada, even upon the hard Laurentian granites of that region, than in Pennsylvania, where even soft and friable rocks were but slightly eroded.

The present thickness of the glacier in central Greenland was considered, and the magnitude of certain icebergs detached from it was given. A friend of the speaker had, within a few months, seen a floating iceberg near the coast of Newfoundland, which stood 800 feet above the water by measurement, and may have been therefore nearly a mile in depth. Dr. Hayes saw an iceberg aground in water nearly half a mile deep.

That the great glacier flowed up steep inclines was abundantly proven by recent observations of the speaker in Pennsylvania. He instanced the striæ covering the north flank of the Kittatinny Mountain, and a boulder of limestone perched on the summit which, within a distance of three miles, had been carried up 800 feet vertically.

Referring to a paper recently published by Mr. W. J. McGee, who found difficulties similar to those of Professor Heilprin in the assumption of a polar ice-cap of great thickness, and who imagined the glacier to increase by additions to its outer rim, the speaker held that the single fact of the transportation by the glacier of far-traveled boulders to its terminal moraine, was a fatal objection to any such hypothesis.

Nor did he believe that the hypothesis adopted by Professor Dana and others, of a great elevation of land in the North, was a probable one The facts now in the possession of geologists do not indicate such a great and local upheaval as required by that hypothesis.

An explanation, therefore, must still be sought for the southward flow of a continuous ice-sheet – a flow in some regions up-hill. The action of gravity was certainly not sufficient. Even in the case of the downward flow of the steeply inclined Swiss glaciers, it had been shown that gravity was more than counterbalanced by friction of the sides and bottom, and that these glaciers moved by reason of an inherent moving power of the molecules of the ice. It was probable that similar action occurred in the great continental glacier.

He suggested, therefore, a hypothesis which, while preserving the unity of the glacier, as indicated by observed facts, neither assumed an unreasonable land elevation in polar regions, nor required a thickness of ice so great as to be open to the objections of the last speaker.

He suggested that the ice-cap flowed south simply because it flowed toward a source of heat. Such flow does not depend upon gravity, but would occur in a nearly flat field of ice, and he thought that the ice need not to have been more than a few times its present thickness in Greenland to account for all existing phenomena upon the hypothesis now suggested.

Professor HEILPRIN maintained that we were unacquainted with any laws of glacial action which would account for the indiscriminate progression of an ice-sheet toward a source of heat. The molecular-expansion theory as applied to the glacial phenomena of the Alps, took no cognizance of the position of the heat power, but merely of that of least resistance (the direction of slope). As to the magnitude of icebergs, the height above water gave no positive indication as to the development (in depth) beneath the surface, since this would largely depend upon the form assumed by the berg. As a matter of fact, however, the highest bergs observed by Hayes and Nares in the northern regions, rose only about 300 ft. out of the water, a height somewhat exceeding the highest Antarctic bergs encountered by the "Challenger." We had, therefore, no indications of any extraordinary development of ice in Greenland.

Chalcedony containing Liquid.—Professor H. CARVILL LEWIS called attention to a geode of chalcedony from the Salto River, Uraguay, presented by Mr. S. R Colbroun, of the United States Navy. The specimen contained an unusual quantity of liquid—from two to three drachms; it was derived from an extensive basaltic formation of amygdaloid and black melaphyr, and was coated with a substance resembling asbestos. He described the method of formation of such hollow masses of mammillary chalcedony as being endogenous and referred to an interesting paper recently published by I. Anson and Parkhurst upon the artificial manufacture of chalcedony.

On the Flowering of the Stapelia.—At the meeting of the Botanical Section, February 12th, Mr. THOMAS MEEHAN exhibited specimens of *Stapelia bufonia* in various stages of growth, inflorescence and fruit, and pointed out that though there were axillary buds of more or less prominence at the base of what we had to call leaves, yet the flowers rarely proceeded from these, but from lateral accessory buds. When the axillary buds developed, they produced branches and not flowers. The lateral accessory buds usually developed into minute abortive flowers, with a membranous scale or bract in the place of the primary leaf. These observations were made on plants which had been planted in the open ground during the summer and were repotted in the fall and replaced in a warm greenhouse. The branches commented on had grown since that time, and might be termed the second growth of the same season. When the plants were being potted, having more than were needed, one was thrown carelessly under the greenhouse stage, where it shriveled considerably, but retained some vital power, enough in fact to send down a few fibrous roots into the earth. It had shriveled so as to be reduced to about half its normal weight. Its behavior under these conditions had not been observed till a few days since this date, when an examination showed that the greater portion of the axillary buds had developed into minute flowers, as in the case of the accessory buds under the normal condition. Some of these, judging by their dry remains, had grown to nearly one-fourth the usual size of the normal flowers, though most of them were much smaller. In these cases no lateral accessory buds had been produced. A perfect flower from a healthy pot-plant was exhibited, but not more than two-thirds the size of those produced in the growth of the first part of the season when the plant was in the open air. Numbers had been produced during the winter from the accessory buds at the base of the secondary growths. One of these had borne a fine seed-vessel, which was also exhibited. No seed-vessels had followed the numerous stronger flowers produced by the plants in the open air during the summer.

In commenting on these facts, Mr. Meehan pointed out their harmony with others bearing on the relation between nutrition and the various phases of the vegetative and reproductive conditions of vegetation. Morphologically every development from the bud to the fruit is primarily the same. We imagine all these developments to be founded on a primary leaf or leaves. Just when and how the various stages of development are brought about it is for physiology to determine. The student of fruit and forest trees knows that a rapid-growing young tree does not flower, and often when it commenced to flower, no fruit followed. Its vegetative vigor had to be somewhat checked before the reproductive forces induced flowers. The gardener brings about this condition by root-pruning or ringing, that is, taking off a portion of the bark of the vigorous tree. Transplanting often makes a barren tree fruitful. What would have been leaves, become petals and parts of fructification in the transplanted tree. He had himself placed on record many illustrations of this. The *Wistaria* and other climbing plants might flower, but rarely produce fruit when growing vigorously over trees or trellises, but as soon as branches were thrown off which could not attach themselves to supports, these lost their vigor, and the flowers produced seeds. But even when seeds resulted from the flowers of the *Wistaria*, they were rarely from the most vigorous at the commencement of the raceme, but only after the weaker flowers had been reached By a careful count, in many hundred cases he had found that in racemes of the *Wistaria* which had produced seed-vessels, some forty or fifty flowers, on the average, faded before one produced seed.

These observations on *Stapelia* were of a similar character. The axillary buds, in the normal condition of the plant, resulted in branches only, the flowers proceeding only from the weaker lateral accessory ones. But when the vegetative powers of the plant are weakened, the axillary buds become flowering ones. The rarity with which seed-vessels are produced by the *Stapelia* under cultivation, he thought, might possibly be traced to some cause relating to nutrition, rather than to matters connected with pollination.

The observations were made solely on these winter-growing plants, as illustrated by the specimens exhibited; how far they might be paralleled by open air growth during the summer, the speaker could not say.

The following paper was ordered to be printed:—

ON A NEW EXTINCT GENUS OF SIRENIA, FROM SOUTH CAROLINA.

BY E. D. COPE.

Mr. Gabriel Manigault, the accomplished director of the Museum of the University of South Carolina, at Charleston, has placed in my hands for determination an interesting fossil of that region. It is the greater part of the right premaxillary bone of a large sirenian mammal, containing the large incisor tooth or tusk characteristic of the genus *Halitherium.* It, however, exhibits the peculiarity of possessing, exterior to this tusk, a second large tooth, which is probably also an incisor. This character distinguishes the form generically from other members of the order. In *Prorastomus* Owen, there are an inferior incisor and a canine not of sirenian type, but probably no superior incisors, or if present, they are minute and conic. I propose that the genus be named *Dioplotherium.* The only form with which it is necessary to compare it is *Hemicaulodon* Cope,[1] the number of whose incisor teeth is unknown. The one from which the genus is known, has a dense external sheath of cementum, which is wanting from the present genus.

The color of the specimen indicates that it belongs to the blue-gray marl of the Carolinian (Heilprin) miocene of our Atlantic region. It has, however, been exposed to the action of the water of a later sea, as it carries the bases of several *Balani.*

The premaxillary bone differs from that of the *Halitherium minor* Cuv. (*H. serresi* Gerv.) and *H. capgrandi* Lart., in the much shorter symphysis. The nareal border is also shorter, judging from the position of the maxillary suture, which is further anterior than in the species named. The nareal border is rounded and thickened, so as to overhang its lateral face at the maxillary suture. The alveolus of the second incisor is large, and is in close proximity to that of the first. Its posterior wall is lost. Its fundus reaches to the maxillopremaxillary suture, but as its anterior wall is entirely premaxillary, the tooth is probably an incisor, and not a canine.

The anterior incisor is a tusk of flattened form, with a slight taper from base to apex, and a narrow diamond-shaped section.

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[1] Proceedings Amer. Philos. Soc., 1869, p. 190.

Two end-sides of the diamond which present anteriorly, are shorter and more divergent than the posterior two. The latter encloses a wedge-shaped space, with an obtuse apex. Thus the posterior edge of the tooth is narrow and rounded. Of the anterior lateral angles the external is the more prominent. The tusk is gently curved outwards, and the posterior lateral face is also concave in anteroposterior section. The pulp cavity enters the crown for two-fifths of its length. The latter is composed of uniform dentine, and there are no traces of cementum or enamel. There are transverse bands of several delicate rugæ each, separated by considerable spaces. I count eleven from apex to base. The tooth is also obsoletely longitudinally striate, but cannot be called sulcate on the external face. On the internal face the longitudinal concave face is divided into a narrower and wider portion by a longitudinal ridge which marks the middle of the shaft. The triturating surface is narrow. and presents obliquely backwards. The projection of the crown beyond the alveolar border is not more than one-fourth the total length of the tooth.

The second incisor tooth is lost. Its alveolus shows that its form was less compressed than that of the first. While its size is considerable, it is evidently less developed than the first. Its anterior border slightly overlaps the posterior narrow edge of the anterior tooth.

Measurements.

			M.
Vertical depth of premaxillary at septum between I. 1, and I. 2,			·128
Length of ditto at middle of side,			·118
Length of symphysis,			·126
Length of first incisor,			·176
Diameters do. at base	anteroposterior,		·050
	transverse	anteriorly,	·027
		posteriorly,	·011
Diameters do. at ·02 m. from apex,	anteroposterior,		·037
	transverse	anteriorly,	·020
		posteriorly,	·007
Projection of do. beyond alveolus (about),			·053
Transverse diameter of alveolus of I. 2, anteriorly,			·025

This species may be called *Dioplotherium manigaulti*, in honor of Mr. Manigault, to whom the University of South Carolina owes the present admirable condition of its Museum. The typical specimen was found in or on the Wando River, northeast of the city of Charleston.

This genus furnishes a first step in tracing backwards the phylogeny of the *Sirenia*. These animals doubtless present the same phenomenon as that witnessed in the series of the Rhinoceroses, Ruminants, and some others, viz., a gradual reduction in number, and final extinction of the superior incisor teeth. In *Rhytina* the extinction is complete; in *Halicore* one remains. *Dioplotherium* with two, forms the passage to the primitive types, not yet known, which possessed three. They are considerably specialized in the present genus, and a reduction of size is to be looked for in the first ancestral genera of the *Sirenia*.

From the proportions of the parts preserved, the *Dioplotherium manigaulti* was rather larger than a dugong.

A portion of a Sirenian pelvis said to have been procured from the same locality, Wando River, was given me by Mr. Jacob Geismar. It resembles considerably that of *Halitherium*. A portion of the ischium and pelvis is broken away, so that it is not easy to determine positively whether there is an obturator foramen or not. Their bases are, however, united for a considerable distance beyond the acetabulum, and form a wide plate. The ilium is a stout rod, expanding a little towards the crest, which is broken away. The sacral articular surface is in two planes, one the inner side, the other the posterior edge of the bone, and are strongly impressed. The section of the shaft is subtriangular. The acetabulum is small, has raised edges, and an irregular *fossa ligamenti teris* notching its superior border.

Measurements.

Length from acetabulum to sacral face, exclusive,		·052
Width acetabulum,		·027
Diameter shaft ilium,	anteroposterior,	·018
	transverse,	·015

FEBRUARY 20.

The President, Dr. LEIDY, in the chair.

Forty-nine persons present.

The death of B. Howard Rand, M. D., a member, was announced.

Notes on Prehistoric Copper Implements.—Mr. H. T. CRESSON made some remarks upon a hammer of native copper found in the Bohemian Mine, at Greenland, Michigan, in 1866, by Mr. S. F. Peck, and now in the Academy's collection. It exhibits a distinct laminar surface, caused by hammering pieces of native copper together while in a cold state, a process in which our aborigines living in districts north of Mexico, seemed to have acquired great proficiency. This is shown by the numerous wedges, chisels, hammers, and other articles found in the ancient mining-pits at Keewenaw Point, Lake Superior, and at Isle Royal, together with axes, spear- and arrow-points, ornaments, etc., in Ohio, and throughout those sections of our country which at one time were inhabited by the mound-builders, a race of people whose remains indicate a state of advancement in the arts and manufactures superior to the savage nations who succeeded them. It is a very interesting fact, that recent discoveries have shown upon various forms of copper implements, deposited in their burial places by the mound-builders—markings similar to those left by moulds in the process of casting. It may, therefore, be supposed that these people were acquainted with the art of smelting, besides that of hammering copper. Professor Foster in his "Prehistoric Races of the United States," mentions the fact, that in a collection made by Mr. Perkins, he saw copper implements of mound origin, that bear well-defined traces of the mould. . . . "It is impossible," he adds, "to infer after a careful examination of these specimens, that the ridges have been left in the process of hammering or oxidation." . . . "The more I examine their arts and manufactures the stronger becomes my conviction that they were something more than a race of barbarian people." From these observations of Professor Foster, a skilful and cautious observer, it would appear that two processes were used, not only of hammering, but that of smelting, which latter process was in all probability suggested by their supposed method of extracting the masses of copper from their pits—remains of which may still be seen in the Lake Superior copper regions before mentioned. Some of these pits have been explored by Colonel Whittlesey, an account of which was published in the "Smithsonian Contributions to Knowledge for 1863." They were found to contain, in all cases, among the debris, fragments of charcoal and ashes, with traces of fires against the sides thereof, indicating the use of heat in the process of extracting their ores, thereby aiding the wedges and copper chisels which were driven in by means of stone mauls until the desired pieces were detached. It may, therefore, be probable from the fact, that the melting point of copper is about 1000° C. to 1398°, there was sufficient heat generated by fires, used in above-mentioned method, to smelt the small points of copper attached to the larger masses, and that these people possessing the intelligence and quick perception of the Indian races, were led to notice and utilize it in smelting copper and casting their work. The artistic forms and finish of their copper implements, whether cast or hammered, cannot fail to impress the observer that a race of men existed in the early history of our continent, whose origin is enveloped in mystery, and whose skill rivals man of historic times, assisted by all the inventions of this mighty age of Iron.

The Tritubercular Type of Superior Molar Tooth.—Prof. COPE made some observations on the trituberculate type of superior molar tooth among the mammalia. He remarked that it is now apparent that the type of superior molar tooth which predominated during the Puerco epoch was triangular; that is, with two external, and one internal tubercles. Thus of forty-one species of Mammalia of which the superior molars are known, all but four have three tubercles of the crown, though of these thirty-seven triangular ones, those of three species of *Periptychus* have a small supplementary lobe on each side of the median principal inner tubercle.

This fact is important as indicating the mode of development of the various types of superior molar teeth, on which we have not heretofore had clear light. In the first place, this type of molar exists to-day only in the insectivorous and carnivorous Marsupialia; in the Insectivora, and the tubercular molars of such Carnivora as possess them (excepting the plantigrades). In the Ungulates the only later forms of it in the Eocene are to be found in the molars of the *Coryphodontidæ* of the Wasatch, and *Dinocerata* of the Bridger Eocenes. In later epochs it is chiefly seen only in the last superior molar.

It is also evident that the quadritubercular molar is derived from the tritubercular by the addition of a lobe of the inner part of a cingulum of the posterior base of the crown. Transitional states are seen in some of the *Periptychidæ* (*Anisonchus*) and in the sectorials of the *Procyonidæ*.

The Spinal Chord of Batrachia and Reptilia.—Dr. HARRISON ALLEN called attention to the characters furnished by the spinal chord in the systematic study of batrachians and reptiles. In making a resumé of the researches of Stieda Lüderitz, S. H. Gage and J. J. Mason he had formulated the following structural features which may be added to those characters already employed by systematists. In batrachians, as illustrated in *Rana*, *Menopoma* and *Siren* the connective is seen about the central canal to be of unusual development, and in *Siren* to embrace the entire chord in a conspicuous cortical layer. In addition to these features, connective-tissue corpuscles are sparsely distributed through the chord when studied in transverse sections. The posterior columns are projected above the plane of the lateral columns and exhibit distinct differences in the arrangement of nerve-fibres. In lacertilians and crocodilians the commissures are perforated longitudinally by a pair of columns of nerve-fibres. In ophidians the posterior nerve-roots are seen to be rudimentary or absent and when present to tend to arise from the *cervix cornu* of the posterior horn of gray matter. In chelonians the motor-cells are few in number; the anterior median fissure is of great width, the commissure of relatively great size, and the reticular fibres lying to the lateral aspect of the gray columns are unusually well developed.

FEBRUARY 27.

The President, Dr. LEIDY, in the chair.

Thirty-seven persons present.

Walter Rogers Furness was elected a member.

On Dinodipsas and Causus.—Prof. COPE drew attention to a recent important discovery made by Prof. Peters, of Berlin, of the new genus of venomous snakes, *Dinodipsas*. He stated that he regarded the genus as pertaining to the *Causidæ*, a family he had proposed as a subfamily in his first paper read before the Academy in 1859. As the only genus heretofore known, *Causus*, is African, the statement of Peters that *Dinodipsas* is South American, adds an important fact to geographical zoölogy. Prof. Cope then corrected a statement made by Peters in his Herpetology of the Reise nach Mozambique (1882), that he (Prof. Cope) had referred *Causus* to the Vipers. In 1859 he had divided the venomous snakes with vertical and hinged maxillary bone, into the subdivisions of the rattlesnakes, the vipers, the Atractospidines and the Causines. He then designated the entire group Viperidæ after Bonaparte, and had not until later used Duméril and Bibron's term *Solenoglypha* for that division. But this did not justify Peters in stating that he had referred the genus *Causus* to the Vipers, and that he, Peters, was the author of the separate family to receive that genus and *Dinodipsas*, the "Vipernattern."

He also corrected some other references to himself by Prof. Peters in the Reise nach Mozambique. In one of these, Peters had supposed him to refer to a combination of the genera *Breviceps* and *Chelydobatrachus* by Peters, when he had really separated them. Prof. Cope said that his language referred to their union in the *same family* by Peters, which he did not approve.

Prof. Peters also states that the peculiarities of the tongue in the genus *Hemisus*, described by Steindachner and Prof. Cope, are due to mutilation. Prof. Cope could not coincide with this view, and regards the structures described as normal.

The following were ordered to be printed:—

A NEW UNIO FROM FLORIDA.

BY BERLIN H. WRIGHT.

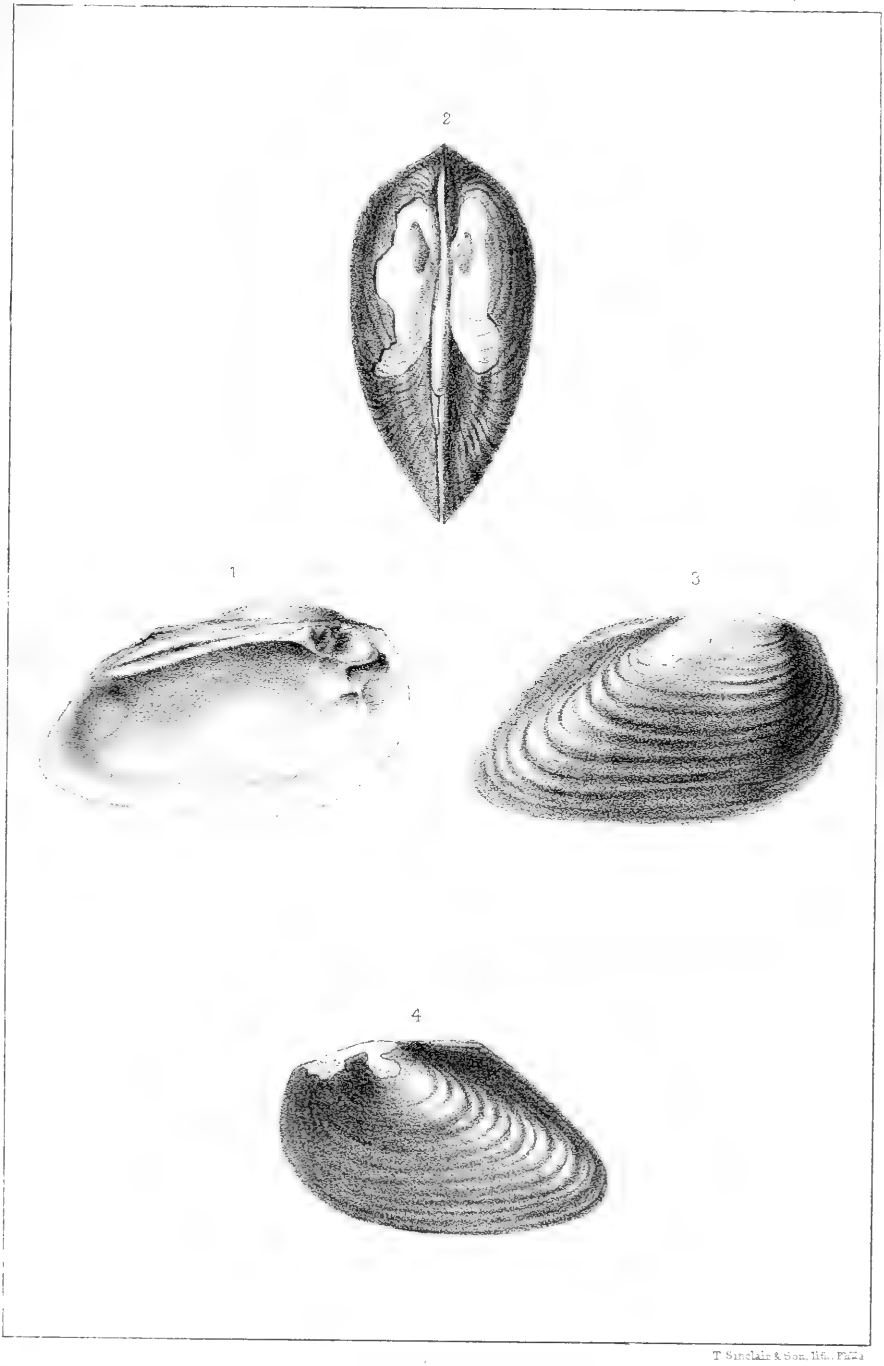
Unio Cunninghami. Plate I, figs. 1–4.

Shell ovate, ventricose and very inequilateral, smooth, interrupted by numerous irregular, undulating lines of growth, causing a scaly appearance near the margins, and very highly polished above; substance of shell very thick, constricted posteriorly, angular behind and truncated before; ligament margin moderately arcuate and angular at the terminus (tip); posterior margin wedge-shaped and slightly acuminate; ligamental area elongately cordiform and wide, nearly forming a plane in old individuals; umbonal slope subangular from beak to margin; anterior margin angular above and somewhat abruptly rounded beneath; basal margin emarginate posteriorly in the males and uniformly curved in the females; epidermis usually dark chestnut or reddish brown, interspersed with marginal bands of light horn-color; occasionally the entire shell is of uniform light horn-color, wrinkled and entirely destitute of rays; greatest diameter near the middle of the umbos; beaks eroded and obtuse; umbo broad and flattened; nacre usually a delicate pink: occasionally white; cardinal and lateral teeth both single in the right and double in the left valve, lateral teeth short, slightly and uniformly curved and separated from the cardinal teeth by a space equal to one-half of their own length; cavity of the shell and beak both shallow; dorsal cicatrices five and situated above the centre of the cavity of the beak; distinct anterior and confluent posterior cicatrices; ventral cicatrix usually present and placed anterior to the centre of the cavity of the shell.

Habitat.—Lakes of Sumter County, Florida.

This beautiful shell belongs near *U. Buckleyi* Lea, from which it differs in being strictly rayless in all stages of its growth, greater diameter, more angular anteriorly above and more abruptly rounded beneath, broader and flatter umbos and more abrupt posterior slope. The cardinal teeth are much heavier and not as oblique as in *U. Buckleyi*. A large suite of the shells was sent to me by Mr. T. L. Cunningham, of Yalaha, Sumter County, Florida, in whose honor we name it.

Plate I, fig. 1, *Unio Cunninghami*, old male; 2, full-grown female; 3, old male; 4, young male.



T. Sinclair & Son, lith. Phila

UNIO CUNNINGHAMI Wright

NOTES ON THE BIRDS OF WESTMORELAND COUNTY, PENNA.

BY CHAS. H. TOWNSEND.

Local lists have added so much to our knowledge of the range and distribution of birds, that the following notes are submitted as a contribution to the general fund of information. The species enumerated represent perhaps not more than two-thirds of the actual bird fauna of Westmoreland County. Many more might probably be added, but I wish to restrict this list to those birds identified with certainty, and have given only such as have come under my personal notice, not having enjoyed the advantage of comparing notes with a fellow-naturalist.

No special effort was made to find new birds, and this catalogue, merely the result of observations jotted down from time to time in my note-book, is very incomplete. It is hoped that its present publication will call forth additional information, so that a supplemental paper may appear in the future.

Not having been a constant resident of the county since commencing to note the birds, I could not always collect at the most fruitful seasons, consequently a large number of migratory birds have escaped notice. The district being wooded and hilly, there are no very extensive marshes to harbor rail, snipe and other swamp-loving birds. I feel confident that the number of water-birds in general will hereafter be largely increased.

My rambles were mainly in the central portions of the county, along the Loyalhanna Creek, and in the vicinity of Latrobe, on the line of the Penna. R. R. The Chestnut Ridge, a range of the Alleghenies, extending through the S. E. part of Westmoreland, is covered with heavy forests, and furrowed by deep wild ravines. Many rare wood-birds doubtless lurk in these secluded spots, and remain to be discovered by any one diligent enough to make the search.

I may add that I have seldom taken a tramp through the forests of Chestnut Ridge without seeing or shooting one or more birds new to the region.

The species are arranged according to the second edition of Dr. Coues' Check List.

TURDIDÆ.

1. **Turdus migratorius.** Robin.

A common and familiar bird. Stragglers are occasionally seen in winter. Breeds abundantly.

2. **Turdus mustelinus.** Wood Thrush.

Common in dense woods. An excellent songster, but not equal to the Brown Thrush.

3. **Turdus fuscescens.** Wilson's Thrush.

Not very common.

4. **Turdus unalascæ nanus.** Hermit Thrush.

An inhabitant of retired woods.

5. **Mimus carolinensis.** Cat-bird.

An abundant summer resident; breeds.

6. **Harporhynchus rufus.** Brown Thrush.

Common; nests in thickets and brush-heaps.

SAXICOLIDÆ.

7. **Sialia sialis.** Blue-bird.

Common summer resident; nests freely in artificial bird-boxes near houses.

SYLVIIDÆ.

8. **Regulus calendula.** Ruby-crowned Kinglet.

This and the next species are frequent in spring and fall.

9. **Regulus satrapa.** Golden-crested Kinglet.

10. **Polioptila cœrulea.** Blue-gray Gnatcatcher.

Have taken but one specimen.

PARIDÆ.

11. **Lophophanes bicolor.** Tuf ed Titmouse.

Common; noticed oftener in winter than in summer.

12. **Parus atricapillus.** Black-capped Chickadee.

Associates with the last.

SITTIDÆ.

13. **Sitta carolinensis.** White-bellied Nut-hatch.

Resident, quite common. The Nut-hatches and smaller Woodpeckers are indifferently known as "sap-suckers" in this region.

14. **Sitta canadensis.** Red-bellied Nut-hatch.

Seen occasionally in spring.

CERTHIDÆ.

15. **Certhia familiaris.** Brown Creeper.

A shy inhabitant of the woods.

TROGLODYTIDÆ.

16. **Troglodytes domesticus.** House Wren.

Apparently not common. A pair nested on a beam in our cellar, in 1880, and remained with their brood until the latter part of July.

17. **Anorthura troglodytes hiemalis.** Winter Wren.

Resident; frequently seen in winter in ravines and thickets.

18. **Telmatodytes palustris.** Long-billed Marsh Wren.

Seldom seen; inhabits reedy swamps.

SYLVICOLIDÆ.

19. **Mniotilta varia.** Black-and-white Creeper.

Occasionally seen in summer.

20. **Dendrœca æstiva.** Summer Warbler.

Common in spring and summer.

21. **Dendrœca virens.** Black-throated Green Warbler.

Migratory.

22. **Dendrœca cœrulescens.** Black-throated Blue Warbler.

Migratory.

23. **Dendrœca coronata.** Yellow-rumped Warbler.

Migratory; common.

24. **Dendrœca blackburnæ.** Blackburn's Warbler.

Common during spring migrations.

25. **Dendrœca striata.** Black-poll Warbler.

Migratory.

26. **Dendrœca castanea.** Bay-breasted Warbler.

Saw several in the spring of 1881.

27. **Siurus auricapillus.** Golden-crowned Thrush.

Rather common in damp woods; remarkable for its oven-shaped nest on the ground.

28. **Siurus motacilla.** Large-billed Water Thrush.

Have seen it twice in a rocky ravine in Chestnut Ridge.

29. **Geothlypis trichas.** Maryland Yellow-throat.

Summer resident; common in briar patches and dense thickets.

30. **Myiodioctes canadensis.** Canadian Flycatching Warbler.

Migratory; taken but once.

31. **Setophaga ruticilla.** Redstart.

Not common.

TANAGRIDÆ.

32. **Pyranga rubra.** Scarlet Tanager.

Summer resident; common.

HIRUNDINIDÆ.

33. **Hirundo erythrogastra horreorum.** Barn Swallow.

Common.

34. **Petrochelidon lunifrons.** Cliff or Eave Swallow.

Breeds abundantly.

35. **Stelgidopteryx serripennis.** Rough-winged Swallow.

Have a single specimen, which I shot near Youngstown.

36. **Progne subis.** Purple Martin.

Very common; breeds freely in bird-houses in the villages.

AMPELIDÆ.

37. **Ampelis cedrorum.** Cedar Waxwing; Cherry-bird.

Quite common, especially when cherry-trees are in fruit.

VIREONIDÆ.

38. **Vireo olivaceus.** Red-eyed Greenlet.

Common in orchards and groves.

39. **Vireo solitarius.** Blue-headed Greenlet.

Apparently migratory.

LANIIDÆ.

40. **Lanius borealis.** Gt. Northern Shrike; Butcher-bird.

Very rare; I have seen it near Latrobe.

FRINGILLIDÆ.

41. **Passer domesticus.** House Sparrow; European Sparrow.

This irrepressible foreigner has established himself in our towns and villages, to the total exclusion of native songsters.

42. **Carpodacus purpureus.** Purple Finch.

Not common; have seen but few individuals, and those in spring. Probably only migratory here.

43. **Astragalinus tristis.** Am. Goldfinch; Thistle-bird.

Summer resident; abundant; breeds.

44. **Plectrophanes nivalis.** Snow Bunting.

One of my friends described to me a flock of birds which he saw flying about the fields during very severe weather in Jan., 1881, which, from his description, must have been Snow Buntings

45. **Poœcetes gramineus.** Grass Finch.

Common; breeds.

46. **Melospiza palustris.** Swamp Sparrow.

Common.

47. **Melospiza fasciata.** Song Sparrow.

Common; breeds.

48. **Junco hiemalis.** Snow-bird.
Common in winter.

49. **Spizella monticola.** Tree Sparrow.
Common in winter.

50. **Spizella domestica.** Chipping Sparrow; Chippy.
Summer resident; very common, nesting in garden bushes.

51. **Spizella agrestis.** Field Sparrow.
Common in summer.

52. **Zonotrichia albicollis.** White-throated Sparrow.
Not common.

53. **Zonotrichia leucophrys.** White-crowned Sparrow.
Not common.

54. **Passerella iliaca.** Fox Sparrow.
Rather rare; occasionally seen late in autumn.

55. **Zamelodia ludoviciana.** Rose-breasted Grosbeak.
Uncommon; have taken occasional specimens in midsummer in the forests of Chestnut Ridge.

56. **Passerina cyanea.** Indigo-bird.
Common summer resident.

57. **Cardinalis virginiana.** Cardinal Grosbeak; Red-bird.
Frequent both in summer and winter; have seen numbers of them in Chestnut Ridge, where they probably breed, as I have seen quite young birds there. One which I crippled by a shot in the wing, lived in a cage for more than a year and became an accomplished whistler.

58. **Pipilo erythrophthalmus.** Chewink; Ground Robin.
Common everywhere, in bushes and hedges.

ICTERIDÆ.

59. **Dolichonyx oryzivorus.** Bobolink.
Summer resident; gregarious in the fall migrations.

60. **Molothrus ater.** Cow-bird.
Very common in summer; I have seen its eggs in nests of the Indigo-bird and Chipping Sparrow.

61. **Agelæus phœniceus.** Red-winged Blackbird.
Breeds plentifully.

62. **Sturnella magna.** Meadow Lark.
Abundant; breeds regularly, gregarious in the fall. Have seen stragglers in midwinter.

63. **Icterus spurius.** Orchard Oriole.
Not common.

64. **Icterus galbula.** Baltimore Oriole; Hang-nest.

A familiar bird in summer. A pair nested regularly for several seasons in the same tree near our door.

65. **Scolecophagus ferrugineus.** Rusty Grackle.

Common.

66. **Quiscalus purpureus.** Crow Blackbird.

Common everywhere.

CORVIDÆ.

67. **Corvus corax.** Raven.

Old residents report a "crow" of very large size, as once common. It was doubtless the Raven.

68. **Corvus frugivorus.** Common Crow.

Breeds regularly.

69. **Cyanocitta cristata.** Blue Jay.

Resident throughout the year; common.

TYRANNIDÆ.

70. **Tyrannus carolinensis.** King-bird; "Bee-bird."

Summer resident; common; much persecuted by bee-keepers, who imagine it is destructive to bees.

71. **Myiarchus crinitus.** Gt. Crested Flycatcher.

Not as common as the last.

72. **Sayiornis fusca.** Pewee.

Very common; has nested under the eaves of our porch frequently.

73. **Contopus virens.** Wood Pewee.

Quite common in woodlands.

CAPRIMULGIDÆ.

74. **Antrostomus vociferus.** Whip-poor-will.

Common in summer; a bird often heard after nightfall, but seldom seen.

75. **Chordediles popetue.** Night-hawk.

Very common in summer; confounded with the last by many persons; but, unlike it, the Night-hawk soars high in the air; both species nest on the ground.

CYPSELIDÆ.

76. **Chætura pelasgica.** Chimney Swift.

Common; have seen numbers of them circling about tall chimneys, where they had nests.

TROCHILIDÆ.

77. **Trochilus colubris.** Ruby-throated Humming-bird.

Quite common; I once found a nest containing eggs, near Beatty Station, P. R. R.

ALCEDINIDÆ.

78. **Ceryle alcyon.** Belted Kingfisher.

Common; breeds regularly; have seen stragglers as late as Dec. 20, when all streams were frozen.

CUCULIDÆ.

79. **Coccygus erythrophthalmus.** Black-billed Cuckoo.

Common; breeds.

80. **Coccygus americanus.** Yellow-billed Cuckoo.

More common than the last; usually called Rain-bird by schoolboys.

PICIDÆ.

81. **Hylotomus pileatus.** Pileated Woodpecker.

Occasionally seen in heavy-timbered localities.

82. **Picus villosus.** Hairy Woodpecker.

Resident; common.

83. **Picus pubescens.** Downy Woodpecker.

Resident; quite common.

84. **Sphyropicus varius.** Yellow-bellied Woodpecker.

Apparently not common.

85. **Centurus carolinus.** Red-bellied Woodpecker.

Rather common.

86. **Melanerpes erythrocephalus.** Red headed Woodpecker.

Abundant.

87. **Colaptes auratus.** Flicker; Golden-winged Woodpecker.

Very common summer resident.

STRIGIDÆ.

88. **Bubo virginianus.** Gt. Horned Owl.

A common resident.

89. **Scops asio.** Screech Owl.

Resident, very common.

90. **Strix nebulosa.** Barred Owl.

Resident, common.

91. **Nyctea scandiaca.** Snowy Owl.

Very rare.

FALCONIDÆ.

92. **Accipiter fuscus.** Sharp-shinned Hawk; Pigeon Hawk.

Not as common as the next species.

93. **Accipiter cooperi.** Cooper's Hawk.

Common; have taken its nest.

94. **Falco sparverius.** Sparrow Hawk.

Very common; breeds.

95. **Buteo borealis.** Red-tailed Buzzard; Chicken Hawk.

Common; breeds.

96. **Buteo lineatus.** Red-shouldered Buzzard.

Rather common.

97. **Archibuteo lagopus sancti-johannis.** Am. Rough-legged Buzzard; Black Hawk.

Very rare. A specimen was shot near Latrobe, in the spring of 1879, by Mr. Edgar Chambers. If I remember rightly, the bird was perfectly black.

98. **Pandion haliaëtus.** Fish Hawk; Osprey.

Rare; I saw a specimen which was shot in the Loyalhanna Creek, near Latrobe, in 1879. Have seen specimens shot on the Allegheny River, at the N. W. boundary of Westmoreland Co.

99. **Haliaëtus leucocephalus.** Bald Eagle.

Occasional specimens have been taken. Fragments of one are in my possession.

CATHARTIDÆ.

100. **Cathartes aura.** Turkey Buzzard.

Very rare; formerly common, according to the statements of old residents. Have seen several in an adjoining county.

COLUMBIDÆ.

101. **Ectopistes migratorius.** Wild Pigeon.

Migratory; appears in immense flocks in some seasons.

102. **Zenaidura carolinensis.** Carolina Dove; "Turtle Dove."

Breeds regularly; abundant.

MELEAGRIDÆ.

103. **Meleagris gallipavo americana.** Wild Turkey.

Resident; no longer common; a few are killed in the mountains every year.

TETRAONIDÆ.

104. **Bonasa umbella.** Ruffled Grouse; "Pheasant."

A well-known game-bird; resident, common.

105. **Ortyx virginianus.** Quail; "Bob-white."

Resident, common; neither this nor the last species as abundant as in former years.

CHARADRIIDÆ.

106. **Ægialites vociferus.** Killdeer Plover.

Summer resident; abundant.

SCOLOPACIDÆ.

107. **Philohela minor.** Woodcock.

Common; have seen it as early as March 13.

108. **Gallinago wilsoni.** Snipe.

Summer resident.

109. **Tringoides macularius.** Spotted Sandpiper.

Common in summer; breeds.

ARDEIDÆ.

110. **Ardea herodias.** Gt. Blue Heron.

Migratory, occasional; have two specimens in my collection, shot on the Loyalhanna Creek.

111. **Herodias egretta.** Gt. White Egret.

Migratory; irregular.

112. **Butorides virescens.** Green Heron.

Quite common in summer; breeds.

113. **Botaurus mugitans.** Bittern.

Not common; have one specimen shot by Mr. J. C. Head, of Latrobe.

RALLIDÆ.

114. **Rallus virginianus.** Virginia Rail.

Summer visitant.

115. **Porzana carolina.** Carolina Rail: Sora.

Mr. G. N. Beckwith, of Latrobe, reports it common. Mr. G. H. Adams, agent of the P. R. R., gave me the only specimen I have seen in Westmoreland. It was found in a freight-car at Beatty Station.

116. **Fulica americana.** Coot: "Mud Hen."

Rather common.

ANATIDÆ.

117. **Cygnus columbianus.** Am. Swan.

Occasionally shot on the Loyalhanna Creek.

118. **Bernicla canadensis.** Wild Goose.

Migratory; rather common.

119. **Anas boscas** Mallard Duck.

Mr. G. N. Beckwith assures me of the occurrence of this and the next two species.

120. **Anas obscura.** Black Duck; Dusky Duck.

121. **Dafila acuta.** Pintail.

122. **Querquedula carolinensis.** Green-winged Teal.
Migratory.

123. **Querquedula discors.** Blue-winged Teal.
More frequent than the last.

124. **Aix sponsa.** Wood or Summer Duck.
Summer resident; breeds.

125. **Fuligula marila.** Scaup Duck; Black-head.
Migratory; usually abundant.

126. **Fuligula ferina americana.** Red-head; Pochard.
Probably migratory.

127. **Clangula albeola.** Buffle-head Duck; Butter-ball.
Migratory; common.

128. **Harelda glacialis.** Long-tailed Duck.
On February 5, 1881, Mr. Harry Chambers shot a male of this species, on the creek at Latrobe. It is the only instance of the occurrence of this maritime duck so far inland, so far as I am aware.

129. **Erismatura rubida.** Ruddy Duck.
Migratory; abundant in spring.

130. **Mergus merganser.** Goosander; Fish Duck.
Regularly migratory.

131. **Mergus serrator.** Red-breasted Merganser.
Migratory, occasional.

132. **Mergus cucullatus.** Hooded Merganser.
Irregularly migratory.

LARIDÆ.

133. **Larus delawarensis.** Ring-billed Gull.
I have a specimen, shot on the Loyalhanna Creek, May 7, 1881. Other species of gulls doubtless visit our streams during migration.

COLYMBIDÆ.

134. **Colymbus torquatus.** Loon; Gt. Northern Diver.
Migratory; a few are shot every season by the gunners.

PODICIPIDÆ.

135. **Podicipes cornutus.** Horned Grebe.
Rare; Mr. Harry Chambers gave me a specimen which he shot on the Loyalhanna Creek. This is the only instance of its occurrence that I can cite.

136. **Podilymbus podicipes.** Pied-billed Grebe; "Dipper."
Resident; well known to gunners everywhere.

MARCH 6.

Mr. GEO. W. TRYON, JR., in the chair.

Twenty-six persons present.

Permian Fishes and Reptiles.—Prof. COPE exhibited some specimens of fishes and reptiles from the Permian formation of Texas. One of these was a new species of Crossopterygian fish which he named *Ectosteorhachis ciceronius*, which exhibited some important characters of the posterior cranial region. He stated that the base of the skull consists of ossified parachordals, and these embrace the chordadorsalis posteriorly, and are continued for a short distance posteriorly as a tube. Anteriorly the chordal groove is open. Trabeculæ not ossified. He considered the cranial structure to be an excellent illustration of a permanent embryonic type.

The most interesting reptile was a new genus which occupies a place between the *Pelycosauria* with molar teeth, and those with raptorial teeth, but with more resemblance to the former, or *Diadectidæ.* The teeth are placed transversely in the jaws, but the crowns terminate in an incurved apex, without ledge. He named the genus *Chilonyx*, and referred it provisionally to the *Bolosauridæ.* The typical species is the *Bolosaurus rapidens* (Cope, 1878), an animal with a skull as large as that of a hog, and with robust limbs. The surface of the skull is divided by grooves into numerous swollen areas, and some of these are, on the lateral occipital region, developed into tuberosities like the rudimental horns of the *Phrynosoma douglassi.*

Phenomena of Glaciation.—Professor HEILPRIN, referring to his former communication on the phenomena of glaciation, stated that if the principles laid down by him as to the limitation (in height) of a polar ice-cap be correct, then the same principles must likewise hold good for all portions of the earth's surface. In other words, given an elevation of sufficient magnitude, then the upper portion of the same, by virtue of its rising above the cloud-line, must be either bare of snow or covered only with a comparatively feeble thickness of the same. This view, which the speaker believed was first enunciated by Humboldt, receives confirmation from observations made on the Alps and on other high mountain peaks. Thus, according to Tschudi, only a comparatively very feeble thickness of snow falls on the Alpine summits above an altitude of about 10,800 feet, the heavy precipitation being principally confined to a zone comprised between 7000 and 9000 feet. The brothers Schlagintweit determined the cumulus line in the same region to lie at a general elevation of 8-9800 feet, above which storms were of only exceptional occurrence, and the atmosphere usually clear and serene. These observations as to feeble precipitation were further confirmed by Dollfuss, who found that on the Théodule Pass (10,800 feet) the total precipitation for the six winter months amounted to only $7\frac{1}{2}$ feet of snow. On the St. Gothard, on the other hand, at an elevation almost exactly 4000 feet lower, nearly the same quantity fell in a single day. Again, on the Grimsel (6150 feet) Agassiz found the winter snow-fall to amount to $57\frac{1}{2}$ feet. While, therefore, the highest Alpine summits generally appear to be buried in an almost unfathomable thickness of snow, there can be but little doubt that in actual fact this thickness is but very moderate. This is proved by the circumstance that under exceptional conditions the snow covering may almost completely disappear as a result of a single season's melting. Thus in September, 1842, the Ewigschneehorn was completely dismantled of its cap, and in 1860–1862 a whole series of the usually snow-clad peaks showed only patches of snow. During the same period the Stralech (11,000) feet could be crossed without the traveler encountering a single patch of either hard or soft snow (Reclus). With these facts before us, we have good grounds for doubting whether any extraordinary accumulation of snow, unless with a much warmer climate, could take place in the region of the far north (with a descending cloud line) on elevations of very great magnitude. Granting, however, the possibility of a huge polar glacier tending southward, some singular facts are brought out by a calculation of its rate of progression. Allowing an average rate of one foot per day, which is about that of the average Alpine glacier, it would necessitate for a glacier starting from about the sixty-fifth parallel of latitude a period of no less than 25,000 years for it to have reached the line of its terminal extension, the terminal moraine. But with such an infinitesimal slope as such a glacier must necessarily have had, it may be questioned whether its rate of progression would have been more than one-fifth or even one-tenth of that which has been here given it. At the average rate of two and one-half inches daily, 125,000 years would have been required for its southerly progression, a period that would nearly tide over the interval between the periods of greatest eccentricity indicated by astronomers.

Professor Lewis remarked that arguments drawn from meteorological conditions as they now exist will not in all cases apply in considering the glacial epoch. The distribution of land and water was so different in glacial times that meteorological conditions must also have been different. He instanced facts which he had observed in the valley of the Delaware and elsewhere, indicating a depression south of the glaciated area, which produced a greater water surface in the glacial epoch, and therefore different meteorological conditions. He remarked also that it was unsafe to found arguments upon any close analogy between the conditions of local glaciers or isolated peaks and the great ice sheet of the glacial epoch. While analogies might be drawn from the glacier of interior Greenland or from the Antarctic ice-cap, he thought that errors often arose from a too close comparison with more local centres of glaciation.

Referring to the subject of glacial motion, Professor LEWIS said that while there were not yet sufficient facts at hand to determine its rate, its general direction and continuity were clearly shown in the striæ on elevated summits. He spoke of the importance of distinguishing these high-level striæ from those occurring in valleys, remarking that erroneous conclusions had frequently been drawn from an examination of maps of striæ, where the relative elevation of the individual striæ was not noted. While the striæ upon mountain summits indicate the general direction of the top of the ice, and are uniform over large areas, those in valleys show merely the local movement of the lower strata, and, conforming more or less to the direction of the valley in which they occur, vary in each locality and are therefore of minor importance. As an instance he described some striæ near White Haven, Luzerne Co., Pa. Those in the valley of the Lehigh near the town bore S. 35° E. or approximately down the valley, while on the other hand, upon the summit of Penobscot Knob, 1100 feet higher than the valley (2250 feet above the sea), the striæ bore S. 10° W., this being the general direction of ice-flow across northeastern Pennsylvania. In all cases the striæ are at right-angles to the terminal moraine, and they therefore point S. E. in western Pennsylvania. He gave other facts which he had observed in Pennsylvania and elsewhere, all pointing to the continuity of action and consequent great size of the glacier. He spoke of the probable analogy between the Antarctic ice-cap, some 2500 miles in diameter, and the Polar ice-cap of glacial times, and mentioned Croll's estimate that the former is twelve miles thick at its centre. In speaking of a Polar ice-cap, he did not mean to imply, however, that the ice was necessarily thickest on the Pole. As in Europe the mountains of Scandinavia and Scotland were probable centres of glaciation, the glaciers from which joined to form the great *mer-de-glace*, so in America either Greenland, Labrador, the Hudson Bay region, or elsewhere, may have been centres from which glaciers grew finally to coalesce into one mass of ice, the top strata of which flowed southward to the great terminal moraine.

MARCH 13.

The President, Dr. LEIDY, in the chair.

Thirty-nine members present.

The death of Henry Seybert, a member, was announced.

A paper entitled "On the mutual relations of the Bunotherian Mammalia," by Edw. D. Cope, was presented for publication.

Crystallized Serpentine from Delaware.—Professor H. CARVILL LEWIS remarked that a short time ago, his venerable friend, Dr. Isaac Lea, had handed him for examination a specimen of Deweylite from Way's feldspar quarry, near Wilmington, Delaware, upon which were some crystals of an unknown micaceous substance.

The white, waxy deweylite, weathering to a pale yellow color on the surface, contains numerous angular fragments of transparent quartz, which vary in size from microscopic dimensions to fragments two inches long by one-half inch wide. In all cases these fragments are perfectly sharp and are generally rhomboidal in shape. These rhombic cleavage fragments are just such as would be produced by throwing a heated crystal of quartz into cold water. Under the microscope, the quartz is shown to contain hair-like microlites and minute oval cavities, the major axes of which are usually placed in one direction.[1]

The deweylite also contains irregular masses of feldspar (albite), which are more or less altered into deweylite. Unlike the fragments of quartz, these feldspar nodules are almost invariably rounded in outline, as though partially dissolved away. The feldspar has lost both its lustre and its hardness. It has a waxy appearance, and its hardness is reduced to 4·5. In some specimens one end is more altered than the other, and it is evident that the deweylite is the result of the alteration of albite.

The third mineral in the deweylite is in the form of plates or crystals of a micaceous substance of a pale smoky pearl color with a faint greenish tinge. The plates may be several inches in diameter, and are traversed by numerous joints or cracks filled with deweylite, which are generally inclined to one another at angles of 60° and 120°. The crystals appear to be sections of an orthorhombic crystal, bounded by six prismatic planes, whose angle of intersection is 120°. In the polariscope, the mineral is seen to be doubly refracting, and is biaxial with a small optic-axial divergence (probably between 10° and 20°), the hyperboles being indistinct.

It has a strong pearly lustre, an eminent basal cleavage, almost micaceous, and is brittle. It has a hardness of 2·5, and specific gravity of 2·41. It is translucent, and by transmitted light is grayish or greenish yellow.

In the closed tube it gives off water and decrepitates slightly, becoming blackish gray or dark steel-colored. In the blow-pipe flame it blackens, then turns white, exfoliates slightly and fuses with boiling at 4·5 to a white bead. In the salt of phosphorus bead it dissolves completely to a clear glass which becomes milk-white in a cold saturated bead. With cobaltic nitrate on charcoal

[1] *v.* Further notes on inclusions in gems Isaac Lea, Proc. Acad. Nat. Sc. Phila., May, 1876.

it turns pink. It is decomposed by hydrochloric or sulphuric acid without gelatinization.

At the request of Professor Lewis, Mr. Reuben Haines had made an analysis of the mineral with the following results:—

SiO_2	43·63
MgO	39·71
FeO	0·78
Al_2O_3	2·23
H_2O	13·20
	99·55

Mr. Haines determined the specific gravity in a specific gravity bottle containing a thermometer, the weighing being done at 60° F.

From the composition as well as from its physical characters the mineral appears to be a true serpentine. Its optical characters show that it is crystallized, and not a mere pseudomorph. If so, the crystallization of serpentine is micaceous, as already surmised by Professor Dana.[1]

As the deweylite is the result of the alteration of feldspar, so the serpentine has been altered from mica (muscovite). The relative amount of muscovite in the adjoining graphic granite is about the same as that of the micaceous serpentine in the deweylite. Moreover in certain specimens of feldspathic deweylite, where the feldspar is not completely altered, there occur crystals of hydromuscovite (margarodite) in place of the micaceous serpentine.

Thus it is evident that the serpentine is changed from mica. Were it not for the ready cleavage and the special optical characters of the serpentine, it should be regarded merely as a pseudomorph. The occasional markings at angles of 120°, though scarce and imperfect, are in harmony with the same character belonging to several other micaceous species among the magnesian hydrous silicates, and indicate a close relationship between the serpentine group and the Vermiculite group of minerals.

It is interesting to find in the quartz, deweylite and serpentine, just described, such complete evidence that they have been derived from the direct alteration of graphic granite (pegmatite). While the albite and muscovite have changed into deweylite and serpentine respectively, the quartz has been broken up into cleavage fragments, and scattered through the deweylite. This fracturing of the quartz may, perhaps, give a clue to the method of alteration. As Hunt[2] has suggested, in an early period of geological history, when the earth's crust was hotter than now, and when a high temperature existed even at slight depths, thermal waters would abound and chemical changes would be rapid. Should such waters, highly charged with magnesian salts, come in contact with the heated

[1] System of Mineralogy, p. 465.

[2] Chem. and Geol. Essays, p. 306.

feldspathic rocks, there might result such a change as is here shown to have occurred. Certain facts which the speaker had observed in the serpentine deposits of Chester County, Penna., notably in Brinton's quarry, indicate that a change from a granitic dyke into serpentine is not an uncommon occurrence.

The two points of interest offered by the specimens here described are, 1. The crystallization of serpentine, as shown by its optical character; 2. The direct alteration of the feldspar and mica of graphic granite into the magnesian minerals, deweylite and serpentine, while the quartz has been fractured.

Contraction of Vegetable Tissues Under Frost.—At the last meeting of the Botanical Section, Mr. MEEHAN referred to a prevalent opinion that the liquid in vegetable tissues congealed as ordinary liquid does, and, expanding, often caused trees to burst with an explosive sound. Mr. Meehan made experiments with young and vigorous trees, varying from one foot to three feet in circumference. They were carefully measured in early winter when the thermometer was about 40°, and again after they had been exposed for many days to a temperature below freezing point, and, at the time of measurement, to 10° above zero.

In no case was there the slightest evidence of expansion, while in the case of a large maple (*Acer dasycarpum*), of 3 feet 11½ inches round, there appeared to be a contraction of ⅛ inch. This was the largest tree experimented with. In dead-wood soaked with water, there was an evident expansion; and the cleavage with explosion, noted in the case of forest trees in high northern regions, may result from the freezing of liquid in the centre or less vital parts of the trunks of trees.

In some hardy succulents, however, instead of expansion under frost, there was a marked contraction. The joints or sections of stem in *Opuntia Rafinesqui* and *O. Missouriensis*, shrink remarkably with the lowering of the temperature. As soon as the thermometer passes the freezing point, the shrinkage is so great that the whole surface has the wrinkled appearance presented by the face of some very aged person. A piece of *Opuntia Rafinesqui*, which in November measured 4 inches in length, is but 3½ now, and is not half the thickness it was in the autumn. In the winter when the thermometer was down to 10° above zero, the pen-knife penetrated the tissue just as easily as in summer, and no trace could be discovered of congelation in the juices of the plant. Other succulents exhibited more or less signs of shrinkage under extreme cold. *Mamillaria Nuttallii*, and *M. vivipara*, with *Echinocactus Simpsoni*, a mamillose form, drew the mammæ upwards, and had them appressed as closely as the spines would allow—and some species of *Sempervivum* did the same. This could only be accomplished by the contraction of the main axis from the apex downwards. *Sedum Hispanicum*, which has not a succulent axis, contracts its leaves into longitudinal wrinkles, presenting the appearance of being withered or dead. They expand again in a few days of temperature above the freezing point. Specimens of this *Sedum*, and of *Opuntia Missouriensis*, preserved just above freezing point under glass, did not shrivel—and a plant of *Echinocactus Simpsoni*. taken under cover, after the mammæ had been appressed by frost, expanded them to its summer condition in a short time afterwards.

Assuming from these facts that the liquids in plants which are known to endure frost without injury, did not congeal, it might be a question as to what power they owed this successful resistance. It was probably a vital power, for the sap of plants, after it was drawn from the tree, congealed easily. In the large maple tree already referred to, the juice not solidified in the tree, exudes from the wounded portions of branches and then freezes, hanging as icicles often six inches long from the trees.

MARCH 20.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

Note on a New Gold-purple.—Dr. GEORGE A. KÖNIG stated that while experimenting with a solution containing

$Ca_2H_2As_2O_8$ . . .	= 5·242
$CaSO_4$	= 2·983
$CaCl_2$	= 4·890
$MgCl_2$	= 2·736
$AuCl_3$	= 0·112
H_3AsO_4 . . .	= 10·290
	26·163 grains per liter,

he observed that upon adding to it very slowly a solution of one part of crystallized ferrous sulphate in ten parts of water, stirring vigorously after each drop, at first a white turbidity formed which gradually assumed a very rich purple color. The flocculent precipitate settles completely in twenty-four hours, but may be collected on a filter at once. Sometimes the purple color develops gradually, requiring several hours, the precipitate being white for some time. This result obtains, when less ferrous salt is added than required. One cub. cent., containing $\frac{7}{100}$ milligr. of gold, of the above solution with $\frac{1}{10}$ cub. cent. of ferrous solution, developed a very fine precipitate. Sometimes the purple does not develop at all; the precipitate turns bluish gray and remains so.

This purple substance can be dried at 100° C. without change of color. Heated to red heat the pieces assume a glazed appearance and turn black; but the fine powder again shows a blue-purple color. The purple obtained from 250 cub. cent. of the solution contained

As_2O_5 . .	= 0·0583	gram.
Fe_2O_3 . .	= 0·0340	"
Gold (Au) . .	= 0·0188	"
$CaSO_4$ . .	= 0·0060	"

The only gold-purple heretofore known was the Purple of Cassius, obtained by adding a mixture of stannic and stannous chlorides to a dilute gold solution. Authors are divided in their opinions as to whether the gold is contained therein in the metallic state and only mechanically admixed as a red allotropic modification, or chemically combined as gold dioxide. The speaker has inclined hitherto to the first view, and finds in this *ferric arseniate gold-purple*, physically so very analagous to the stannic gold-purple, a strong support to the mechanical hypothesis. Dilute hydrochloric acid decomposes this purple at once into brown gold, and arsenico-ferric solution.

A Flint Nodule from the Greensand of New Jersey.—Prof. LEIDY directed attention to a flint nodule, presented this evening, obtained from the greensand of Pemberton, N. J. It is discoid, about the size of a dollar, pitted and smooth, homogeneous and bluish black, and exhibits no trace of organic remains. He remarked that as flint nodules, regarded to be of organic origin, were so exceedingly abundant in the chalk formations of Europe, he had wondered that similar nodules were not of more frequent occurrence in the greensand deposits, of contemporary age, in our country. The nodule presented was the only one of the kind he had ever seen from the New Jersey marl.

MARCH 27.

MR. GEO. W. TRYON, JR., in the chair.

Forty-five persons present.

APRIL 3.

Rev. Dr. HENRY C. MCCOOK, Vice-President, in the chair.

Thirty-eight persons present.

A paper entitled "Aztec Music," by H. T. Cresson, was presented for publication.

The following was ordered to be printed:—

ON THE MUTUAL RELATIONS OF THE BUNOTHERIAN MAMMALIA.

BY E. D. COPE.

The name Bunotheria was proposed by me for a series of Mammalia which resemble in most technical characters the Edentata and the Rodentia. That is, they agree with these orders in having small, nearly smooth cerebral hemispheres, which leave the olfactory lobes and cerebellum entirely exposed, and in some instances the hemispheres do not cover the mesencephalum also. From the two orders in question, however, they are easily distinguished. Their enamel-covered teeth separate them from the Edentata, while the articulation of the lower jaw is different from that found in the Rodentia. It is a transverse ginglymus, with a postglenoid process in the *Bunotheria*, as distinguished from the longitudinal groove, permitting anteroposterior motion, of the Rodentia.

Such a group as is thus characterized will include two existing groups recognized as orders—the Prosimiæ and the Insectivora. The latter group has always been a crux to systematists, and when we consider the skeleton alone, as from the standpoint of the palæontologist, the difficulty is not diminished. Various extinct types discovered in latter years, chiefly in the Eocene formations, have been additions to this intermediate series of forms, giving even closer relations with the orders already adjacent; *i. e.*, the Edentata, the Rodentia, the Prosimiæ, and the Carnivora. As is known, the groups corresponding to these orders have been named respectively the Tæniodonta, Tillodonta, Mesodonta, and Creodonta. With great apparent diversity, these suborders show unmistakable gradations into each other and the two recent orders already mentioned. As such, I may mention *Psittacotherium*, which relates the Tæniodonta and Tillodonta; *Esthonyx*, which relates the Tillodonta with nearly all the other suborders; *Achænodon*, which connects Creodonta and Mesodonta, and *Cynodontomys*, which may be Mesodont or Prosimian. Then the existing *Chiromys* most certainly connects Tillodonta and Prosimiæ.

My original definitions of the suborders of the Mesodonta, given in vol. ii of the U. S. Geological Survey under Capt. G. M. Wheeler, p. 85, omitted the Prosimiæ, and embraced a number of characters whose significance must be reëxamined. Thus it is impossible to characterize the Creodonta as lacking a trochlear groove of the astragalus, in view of the form of that element in *Mesonyx* and *Mioclænus*, where the groove is more or less distinct. It is impossible to distinguish the Insectivora from the Creodonta by the deficiency of canine and large development of incisor teeth. In *Rhynchocyon* the canines are large, and the superior incisors wanting, while in *Centetes* the arrangement of these teeth is precisely as in the Creodonta. As to the large *Achænodon* and other *Arctocyonidæ*, I find no characters whatever to distinguish them from the generally small Mesodonta.

In view of these inconsistencies, I have reëxamined the subject, and find the following definitions to be more nearly coincident with the natural boundaries of the divisions of this large order. The importance of the character of the tritubercular superior molar has recently impressed me (see Proceedings of the Academy, 1883, p. 56), as it had previously done Prof. Gill. This zoologist has already distinguished two divisions of the Insectivora (without the *Galeopithecidæ*), by the forms of the superior molar teeth. The first possesses quadritubercular molars above, the second tritubercular. That these types represent important stages in the development of the molar dentition I have no doubt. These characters far outweigh in importance those expressing the forms of the skull, matters of proportion only, with which a few systematists unnecessarily overload their diagnoses. Such characters are of little more than specific value, and serve to obscure the mind of the inquirer for a true analysis. They may be used empirically, it is true, to determine relationships when the diagnostic parts are wanting.

I propose to transfer the Insectivora with tritubercular superior molars to the Creodonta, in spite of the fact that some of them (*Mythomys*, *Solenodon*, *Chrysochloris*) have but weakly developed canine teeth, and *Chrysochloris* has large incisors. As an extreme form, *Esthonyx* will follow, standing next the Tillodonta. It will then be necessary to transfer the Arctocyonidæ and all the Mesodonta to the Insectivora, where they will find affinity with the *Tupæidæ*. These have well-developed canines and small incisors, as in the extinct groups named. The *Chiromyidæ* must be distinguished from all of the other suborders, on account of its rodent-like incisors, combined with its lemur-like feet.

The characters of the six suborders will then be as follows:

I. Incisor teeth growing from persistent pulps:

Canines also growing from less persistent pulps, agreeing with external incisors in having molariform crowns; I. *Tæniodonta.*

Canines rudimental or wanting; hallux not opposable; II. *Tillodonta.*

Canines none; hallux opposable; III. *Daubentonioidea.*

II. Incisor teeth not growing from persistent pulps:

Superior true molars quadrituberculate; hallux opposable; IV. *Prosimiæ.*

Superior true molars quadrituberculate; hallux not opposable; V. *Insectivora.*

Superior true molars trituberculate or bituberculate;[1] hallux not opposable: VI. *Creodonta.*

While the above scheme defines the groups exactly, and, so far as can now be ascertained, naturally, I do not doubt but that future research among the extinct forms will add much necessary information which we do not now possess. It is possible that the group I called Mesodonta may yet be distinguished from the Insectivora by characters yet unknown. But I cannot admit any affinity between this group and any form of "Pachyderms," as suggested by Filhol, or of Suillines, as believed by Lyddeker.[2] Such suppositions are in direct opposition to what we know of the phylogeny of the Mammalia. These views are apparently suggested by the Bunodont type of teeth found in various Mesodonta, but that character gives little ground for systematic determination among Eocene Mammalia, and has deceived palæontologists from the days of Cuvier to the present time. The only connecting point where there may be doubt as to the ungulate or unguiculate type of a mammal is the family *Periptychidæ*, of the suborder *Condylarthra.* The suborder *Hyracoidea* may furnish another index of convergence.

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[1] The internal tubercle is wanting in the last two superior molars in *Hyænodon.* This genus, of which the osteology remains largely unknown, has been stated by Gervais to possess a brain of higher type than the Creodonta. Prof. Scott, of Princeton, is, however, of the opinion that this determination is erroneous, and that *Hyænodon* is a true Creodont in this and other respects. If so, the genus will perhaps enter the *Amblyctonidæ.*

[2] Memoirs Geological Survey India, Ser. x, 1883, p. 145.

The families included in these suborders will be the following:

TÆNIODONTA. *Calamodontidæ; Ectoganidæ.*

TILLODONTA. *Tillotheriidæ.*

DAUBENTONIOIDEA. *Chiromyidæ.*

PROSIMIÆ. *Tarsiidæ;* (?) *Anaptomorphidæ;* (?) *Mixodectidæ; Lemuridæ.*

INSECTIVORA. *Soricidæ; Erinaceidæ; Macroscelidæ; Tupæidæ; Adapidæ;*[1] *Arctocyonidæ.*

CREODONTA. *Talpidæ; Chrysochlorididæ; Esthonychidæ; Centetidæ* (= *Leptictidæ* olim); *Oxyænidæ; Miacidæ; Amblyctonidæ; Mesonychidæ.*

I at one time called this order by the name Insectivora, a course which some zoologists may prefer. But a name should as nearly as possible adhere to a group to which it was first applied, and whose definition has become currently associated with it. Such an application is correct in fact, and is a material aid to the memory. There are various precedents for the adoption of a new general term for a group composed of subordinate divisions which have themselves already received names.

In order to determine the number of internal tubercles in some of the *Insectivora*, so as to ascertain the affinities of some questionable genera, it is first necessary to examine the homologies of the cusps of the molar teeth. The opossums are characterized by the presence of three longitudinal series of tubercles on the superior molar. The homologies of these cusps are rendered clear by the character presented by the fourth superior premolar, where the anterior intermediate is wanting. The external cusps are really such, and are not developed from a cingulum external to the true external cusps, as appears at first sight to be the case with such animals as the *Talpidæ*. The intermediate cusps are really such, although the posterior looks like the apex of a V-shaped external cusp. In *Peratherium* the external cusps are smaller than in *Didelphys*, and the intermediate V's so much

[1] Two species of *Pelycodus* must be removed from this genus and family, and be placed in the Creodonta with *Mioclænus*. They are the *P. pelvidens* and *P. angulatus*, which have the posterior inner tubercle of the superior molars, a mere projection of the cingulum. I place them in a new genus which differs from *Mioclænus* in the possession of an internal cusp of the fourth inferior premolar, under the name of *Chriacus;* type *C. pelvidens*.

better developed, that the type is much like that of the *Talpidæ*, in whose neighborhood I originally referred it.

This leads to a consideration of the question of the homologies of the cusps in the genera of the old order of *Insectivora* proper, and of the *Creodonta*. Mr. St. George Mivart has briefly discussed the question, so far as relates to the former group.[1] He commences with the primitive quadrituberculate type presented by *Gymnura* and *Erinaceus*, and believes that the external cusps occupy a successively more and more internal position till they come to be represented by the apices of well developed V's, as in the ungulate types. The V's are well developed in several families, and in *Chrysochloris* the two V's are supposed to be united and to constitute almost the entire apex of the crown, while in *Centetes* the same kind of a V forms a still larger part of the crown.

I believe that these conclusions must be modified, in the light of the characters of various extinct genera, and of the genus *Didelphys*. In the first place there is an inherent improbability in the supposition that the external V's of the superior molars of the *Insectivora* have had the same origin as those of the *Ungulata*. The movements of the jaws in the two groups are different, the one being vertical, the other partially lateral. In the one, acute apices are demanded; in the other, grinding faces and edges. We have corresponding V's in the inferior dental series, and we regard those as produced by the connection of alternating cusps by oblique ridges. In homologizing the superior cusps, we have as elements, two external, two intermediate, and two internal cusps. The first are opposite the external roots, and the anterior internal is opposite the internal root.

First, as regards *Centetes* and *Chrysochloris*. Besides the strained character of the hypothesis that supposes the V-shaped summit of the crown to represent two V's fused together, there is good evidence obtainable in support of the belief that the triangle in question is the usual one presented by the *Creodonta*.

This clearly consists of the two external and the anterior internal cusps united by angular ridges. The form is quite the same as in *Leptictis* and *Ictops*, and nearly that of *Deltatherium*, where the external cusps are present. *Centetes* and *Chrysochloris* only differ from these in that the external cusps are wanting. In

[1] Journal of Anatomy and Physiology, ii, 138, figures.

addition, the latter genus presents a rudiment of the posterior inner tubercle, as is seen in *Deltatherium.* An explanation similar to this is admitted by Mr. Mivart to apply to the cusps of the inferior molar of *Centetes.* It remains to ascertain whether the cusp in this genus, *Chrysochloris*, etc., represents an intermediate or not.

Secondly, as regards the *Talpidæ* and *Soricidæ*, where the external V's are well marked. If we examine the external cusps in the genus *Didelphys*, we find that the posterior one becomes gradually more anterior in its position, until on the second true molar it stands largely above the interspace between the roots, instead of over the posterior root. It will also be seen that the anterior intermediate tubercle is distinct, and of insignificant proportions, while the posterior intermediate is large and is related to the posterior external, as is the apex of a V to its anterior base. In this arrangement I conceive that we have an explanation of the V's of the *Talpidæ* and *Soricidæ.* The first true molar of *Scalops* is a good deal like that of *Didelphys*, but the anterior cusp is larger and there is no anterior intermediate cusp, while the posterior external is of reduced size. The posterior V is better developed than in *Didelphys*, but is composed in the same way, of a posterior intermediate cusp, and a posterior external with a posterior heel. These are united by stronger ridges in *Scalops*, *Condylura* and *Blarina*, than in *Didelphys*. On the second true molar in *Scalops*, a V represents the anterior external cusp of the first true molar. Whether this V has a constitution like the posterior one, *i. e.*, is composed of external and intermediate cusps joined, is difficult to determine; but it is probably so constituted. It seems to be pretty clearly the case in *Blarina*, where the fourth premolar and first true molar may be compared, with a resulting demonstration of the correctness of this view. In *Condylura*, the V's have become more developed and the external cusps reduced, so that the analysis is more difficult.

This interpretation applied to *Urotrichus* and *Galeopithecus* gives them quadritubérculate molars, not tritubérculate, as determined by Mivart. *Mystomys* is tritubercular. The intermediate tubercles are present, but are imperfectly connected with the external, so that V's are not developed (*vide* figures of Mivart and Allman). This genus offers as much confirmation of the homology here proposed as do the opossums, but it differs from the latter in having the anterior intermediate tubercle the larger, instead of the posterior. *Mystomys* and *Solenodon* also confirm my determination of the homologies in *Centetes*.[1]

In conclusion I give the following synoptic view of the constitution of the superior molar teeth in various genera of the *Bunotheria*.

CUSPS PRESENT.

External. Intermediate. Two internal.	External. No intermediate. Two internal.	External. Intermediate One internal.	External. No intermediate. One internal.	No external. No intermediate. Two internal.	No external. No intermediate. One internal.
Adapidæ.	Gymnura.	Mystomyidæ	Mesonyx.	Chrysochloris (2d internal rudimentary)	Centetes.
Tupæidæ.	Erinaceus.	Mioclænus.	Leptictis.		
Galeopithecidæ	Macroscelididæ	Miacis.	Stypolophus.		
Soricidæ.		Talpidæ.	Oxyæna.	Solenodon. (do.)	
Urotrichus.		(Didelphys.)	Chriacus.		
		(Canis.)	Deltatherium		
			Esthonyx. (2nd internal rudimentary)		

[1] This view was first advanced by the writer in the Annual Report U. S. Geol. Survey Terrs., 1873 (74), p. 472.

APRIL 10.

Rev. H. C. McCOOK, D. D., Vice-President, in the chair.

Thirty-two persons present.

Notes on Echinocactus.—Mr. THOMAS MEEHAN announced, at the meeting of the Botanical Section, the discovery of sensitive stamens in *Echinocactus Whipplei.* This peculiarity had been long known in *Opuntia Rafinesqui* and allied species, as well as in *Portulaca*, which, though its natural order was regarded as very distinct in systems of classification, had much in common with *Cactaceæ.* The motion of the stamens when touched in this species of *Echinocactus* was not instantaneous. several seconds sometimes elapsing before the motion responded to the touch. The flowers of this species are unable to expand to any great extent, on account of their short tube, surrounded by long and stiff spines. If the flowers could expand as in *Opuntia*, and the stamens lie flat, as in that genus, Mr. Meehan suggested that the motion might be equal to that observed in *Opuntia.* The motion in *Opuntia* was not always up towards the pistil, but might be horizontal, to the right or to the left—there seemed to be no rule. That seemed to be the case also in the *Echinocactus.* The bending was from the base, as the filament retained a perfectly straight line during the movement.

Mr. Meehan further remarked that in descriptions of cactaceous plants, the relative length of the pistil to petals or stamens was often given. He had observed that in many species, about the period of the ejection of the pollen from the anther-cells, the stamens and style were of about equal length, the stellate stigma being just above the mass of anthers; but the style continued to grow after the maturity of the anthers, and, in *Echinocactus Whipplei*, would finally reach to near half an inch above. He had not been able to get any genera of *Cactaceæ* to fruit under culture except *Opuntia*, unless they were artificially pollinized. By the application of the flower's own pollen to the stigma, they sometimes perfected fruit.

Mr. Meehan also remarked that in botanical descriptions, *Echinocactus Whipplei* and *Echinocactus polyancistrus* were described as having greenish or yellow flowers. His plants had bright purple flowers, and he had no doubt were correc ly referred to the species named. They were from southern Utah.

Referring to *Echinocactus uncinatus*, he remarked that specimens collected in New Mexico by George Vasey, and blooming under culture, had the central spine double the length of the others, whereas in the figure in Pfeiffer they are all represented as uniform, and there were no green-edged sepals or bracts at the base of the flower, as in that figure, warranting the var. *Wrightii* Eng.

On the Relations of Heat to the Sexes of Flowers.—At the meeting of the Botanical Section on April 9, Mr. THOMAS MEEHAN referred to his past communications to the Academy, showing that in monœcious plants female flowers would remain at rest under a temperature which was sufficient to excite the male flowers to active development. Hence a few comparatively warm days in winter or early spring would bring the male flowers to maturity, while the female flowers remained to advance only under a higher and more constant temperature. In this manner the explanation was offered why such trees were often barren. The male flowers disappeared before the females opened, and hence the latter were unfertilized. He referred especially to some branches of *Corylus Avellana*, the English hazel-nut, which he exhibited before the Section last spring, in which the male flowers (catkins) were past maturity, the anthers having opened and discharged their pollen, and the catkins crumbling under a light touch, but there were no appearances of action in the female flower-buds. There were no nuts on this tree last season. The present season was one of unusually low temperature. There had not been spasmodic warmth enough to bring forward the particularly excitable maple-tree blossoms. The hazel-nut had not, therefore, had its male blossoms brought prematurely forward. He exhibited specimens from the same tree as last season, showing the catkins in a young condition of development, only half the flowers showing their anthers, while the female flower-buds had their pretty purple stigmas protruding from nearly all of them.

Mr. Meehan remarked that his observations the past few seasons had been so carefully made that he hardly regarded confirmation necessary, but believed the further exhibition of these specimens might at least serve to draw renewed attention to his former communications.

APRIL 17.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

Twenty-two persons present.

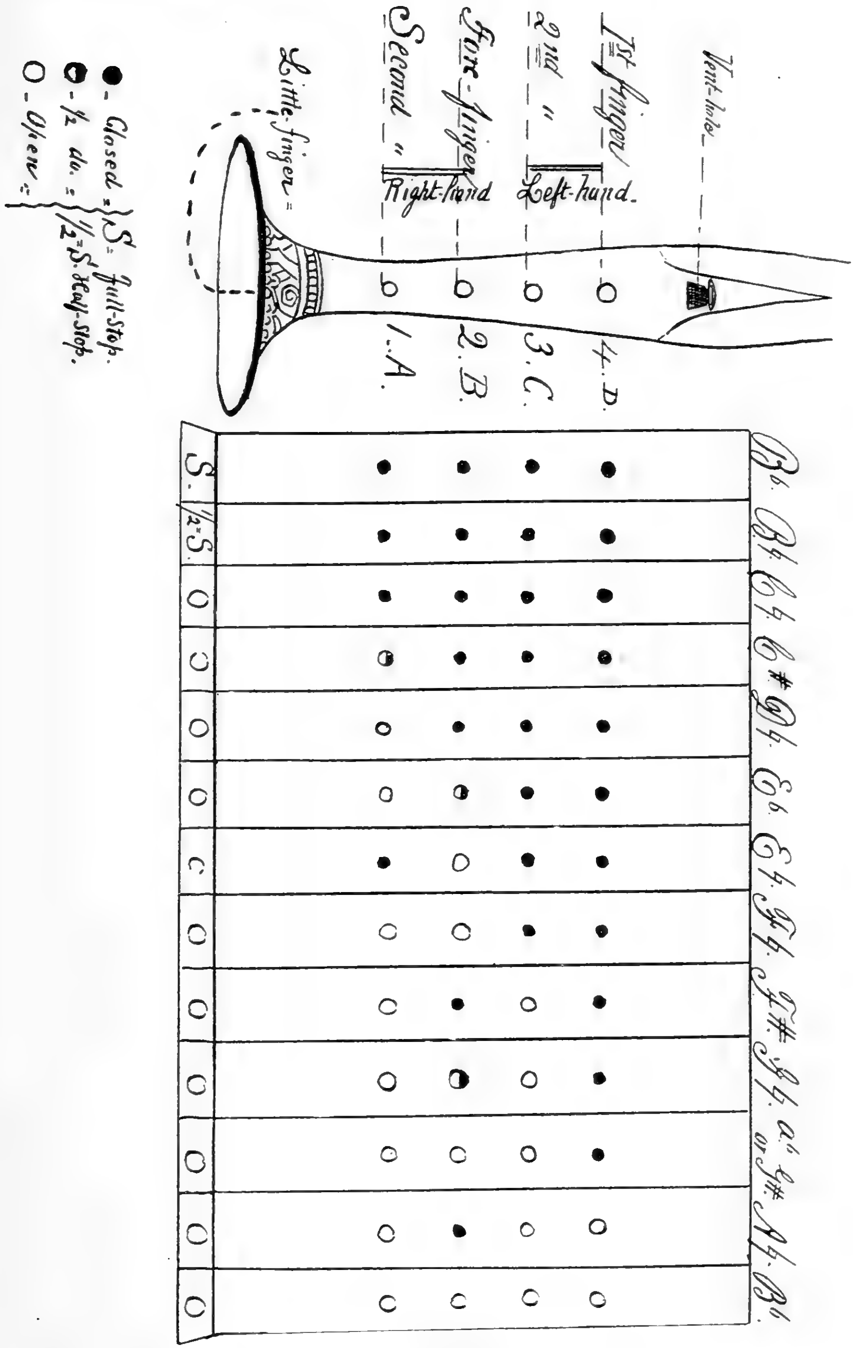
The following was ordered to be printed:—

AZTEC MUSIC.

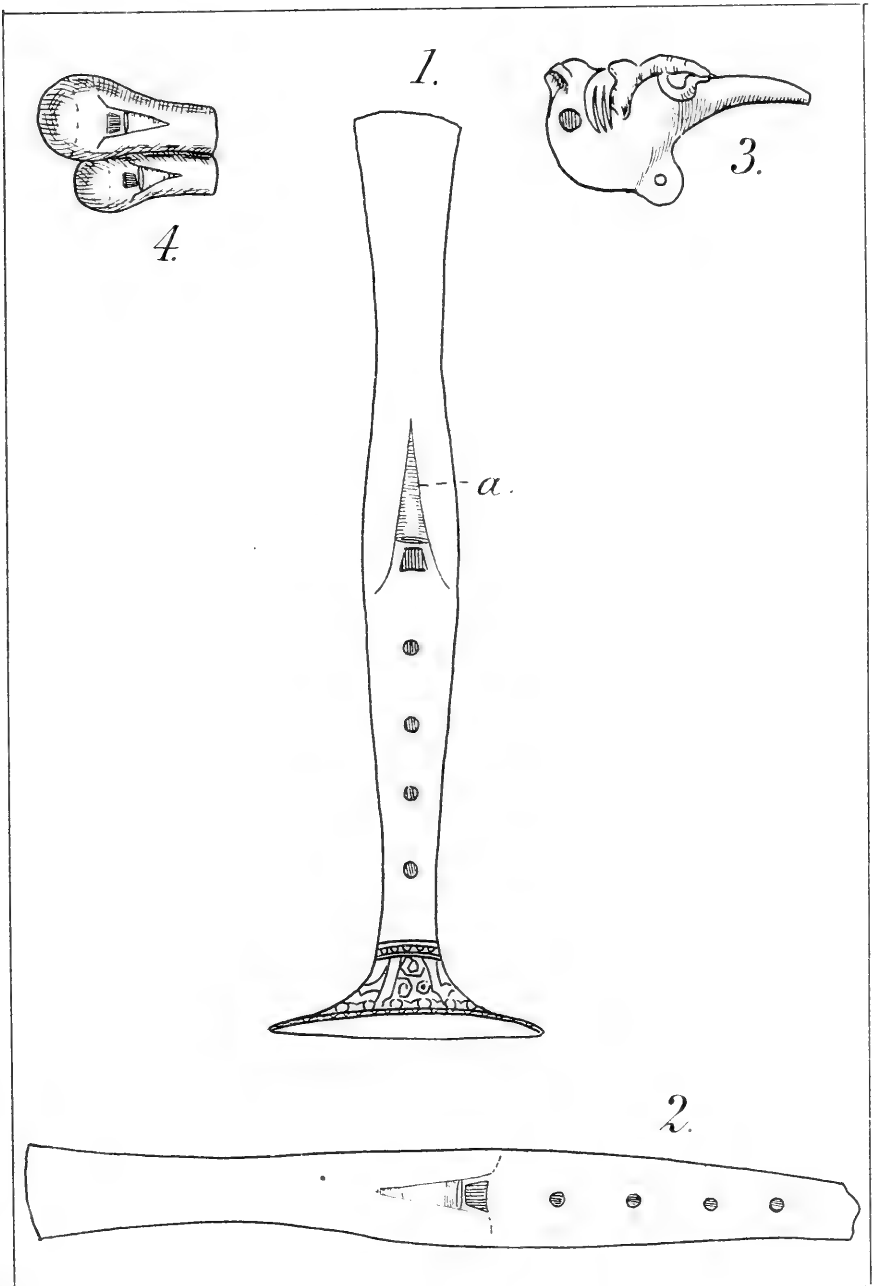
BY H. T. CRESSON.

Primitive music seems to have been limited to a few sounds, produced either by percussion or by means of rude instruments; these sounds or notes in most cases, as musical authorities unite in asserting, represented five tones of the diatonic scale, viz., the tonic or prime note, second, third, fifth and sixth. This would indicate that most barbarous nations were ignorant of the fourth and seventh tones of the scales as known to us. Among the Aztecs, whose remains show superior advancement in the arts, a more thorough appreciation of music evidently existed. To speak first of their percussive music, the huehuetl or large drum of the great temple, at the ancient pueblo of Tenochtitlan, was covered by the skins of serpents, and when beaten could be heard at a distance of several miles. They had clay balls or rattles placed inside of their grotesque clay images, also within the handles attached to their earthenware vessels, which are generally hollow, and contain pebbles or small pellets of clay.

The Poinsett collection possesses several objects among its interesting and valuable specimens of ancient Mexican art, which, unfortunately, are much injured or almost destroyed; these are in the form of a serpent's head, with protruding forked tongue, and have a ball of clay placed within the mouth. The first-named portion is attached to a handle of terra-cotta, to which, after an examination of several specimens, I am inclined to think, were joined large hollow cylinders of the same material. A portion of these still remain united to the handle, suggesting that they must have been concave. When shaken to and fro, the ball within the head of this terra-cotta serpent rebounds from side to side, thus producing a clear sound resembling that given by our American rattlesnake (*Crotalus horridus*) when irritated. A series of these instruments may have been used in their religious ceremonies, and were no doubt placed upon cylinders of large size, balanced so as to regain the perpendicular when set in motion, and in swaying from side to side produced a rattling sound, suggesting that of the serpent above named, which was esteemed a sacred animal by these people.



CRESSON ON AZTEC MUSIC.



CRESSON ON AZTEC MUSIC.

The desire to make imitations of objects by which they were surrounded emit musical tones, was no doubt suggested by the songs of birds and various sounds produced by animals. Gurney, in his admirable work entitled the "Power of Sound," page 143, states that the third note of the scale has had a natural charm for man as for the cuckoo; thus this well-known musical authority recognizes the fact that certain musical sounds or tones were agreeable to the ears of man; and hereafter, in a series of whistles or pitch-pipes, exhumed from the sepulchres of these Aztec people, I will endeavor to show that one of them is pitched almost precisely in the tones given by the Mexican *Hylodæ.* That musical sounds attract the attention of barbarians and savages, is well authenticated by travelers and those who have lived among them; it may therefore be supposed that these children of nature noticed and strove to reproduce sounds, which, however harsh and unmusical to us, to them were pleasing, because they recalled familiar objects. I am of the opinion that the chattering of macaws and parrots can be imitated upon several instruments I have denominated bird-calls, belonging to the Poinsett collection, in the Academy of Natural Sciences of Philadelphia; by short, quick blowing, they emit sounds very similar to those given by a flock of the above-mentioned birds.

Wind instruments were known to the Aztecs, as above indicated, by the bird-calls; they also possessed flutes, whistles made of sea-shells and flageolets of baked clay or terra-cotta.

There is a vase of this last-named material in the W. S. Vaux collection, now in the museum of the Academy of Natural Sciences of Philadelphia, upon which musical sounds may be produced, by applying the lips to certain parts. This unique specimen of a wind instrument was formerly in the possession of my friend Professor Leidy, and afterward came into that of the late W. S. Vaux, Esq. It is somewhat Roman in form, of a dark color, and ornamented by four grotesque masks, placed around the exterior edge or upper rim of the base, between which, and the interior of the vessel, there is a broad plane some two inches in width, that is perforated at intervals by small slits at each side, exactly opposite the masks. When covered by the lips and blown into, these slits emit certain musical sounds; by closing one of the eyes in the masks, which are hollow and connect by means of air-passages with the interior of the vase and slits upon the plane surface, some approach to a half-tone lower than that produced by leaving open the holes, can be obtained. The discovery of the musical powers of this vase is interesting, and I shall repeat the account of it given to me by Professor Leidy: "Having been attracted by its artistic form and decoration, I bought the vase, and some time afterward proceeded to clean the slits or elongated holes in the rim and eyes of the masks, these being filled with earth; in applying my lips to the slits, so as to blow out particles of dirt which remained therein, I found to my surprise that they emitted musical sounds."

Mr. E. A. Barber, in a valuable article upon "Indian Music," contributed to the *American Naturalist* of March, 1883, page 270, mentions a curious wind instrument of turtle-like form, which was procured on the island of Ometepec, by the late Dr. Berendt (during his recent excavations among the ruins and mounds of Central America), which, by certain manipulations, can be made to produce a number of airs. . . . . . "This unique relic is the first of the kind found among the remains of the old Nahuatl races which evinces any particular advancement in the art of music."

I must beg leave to differ from Mr. Barber in this last assertion, from the fact that in the Poinsett collection there exist Aztec flageolets capable of producing not only the fourth and seventh of the diatonic scale, but also the entire chromatic scale. A description of one of these flageolets will first be necessary, before explaining how the above-mentioned scales may be obtained. It measures nine inches in length, and the thickest portion is about three-quarters of an inch in width—being generally in the centre of the flageolet. The neck is considerably flattened, and measures seven-eighths of an inch in width, gradually contracting at the mouth-hole, and growing more cylindrical in form as it approaches the centre of the instrument. Viewed in profile a graceful curve from above downward joins the neck to the body. At the junction of these two parts may be seen protruding the portion which I have denominated the clay reed (Plate III, A); through this the current of air passes from the lungs of the performer into the body of the instrument, which is pierced by four finger-holes.[1] The

[1] After a careful search I am unable to find in the Poinsett collection of Mexican antiquities, any Aztec flageolets possessing five finger-holes, as stated by Mr. Barber in the *American Naturalist* of March,

terminal portion, or bell, is slightly concave exteriorly, of circular form, and decorated with designs of unique patterns, which have been stamped thereon while in a moist condition, by means of forms or dies; some of these, evidently used for a similar purpose, and made of baked clay, are to be seen in the Academy. The internal portion of this bell is hollow, becoming convex as it approaches the edges, and contracting at the point of connection with the tube or barrel, to a thickness of half an inch. Around this is formed a small cup-like cavity, which bears a most important part in performing upon the instrument. A careful examination and analysis of the construction of these instruments was made from a large number of fragments, some of which were splintered and broken in such a manner that the internal structure was clearly shown. It appeared that they must have been formed in four parts, the neck, clay-reed, body and foot or bell, which were afterwards united together while in a moist condition. Traces of the sutures, although in most cases concealed by the modeling, can be detected in many of the instruments.

It has been asserted in the beginning of this article, that the fourth and seventh tones of the diatonic scales could be produced upon these four-holed instruments (Plate III, fig. 1), and as this assertion is somewhat contradictory to most authorities who have hitherto written upon the subject, my method of proceeding shall be given in detail, with the result obtained. I propose to show—

I. That the fourth, seventh and octave tones of the diatonic scale as known to us exist in the Aztec instruments.

II. That the additional sounds or semi-tones, which constitute the chromatic scale, are likewise present.

That the *fourth* and *seventh* tones do exist in the scale of the ancient Mexicans or Aztecs, and can be produced upon their clay flageolets, will be hereinafter shown.

The objection may be raised, however, that although we, with our knowledge of music, which has only been gained by the experience and wisdom of centuries, can obtain all these tones, yet the Aztecs may have been ignorant of the ability of the

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1883, page 270; although the ancient Peruvians seem to have possessed flutes of this description, one of which is now in the cabinet of the American Philosophical Society of Philadelphia, and is mentioned by Mr. H. S. Phillips, Jr., their Corresponding Secretary, in his interesting report for 1882, p. 15.

instruments under consideration to produce them. In answer to this, I will simply state that such an objection would be against the evidence of historical and musical authorities, who have demonstrated that musical instruments of all nations, even of the most savage, have been constructed with a thorough knowledge of their full value and ability in the production of musical tones. This is shown, even in our day, by the savage tribes of Africa, and those of almost inaccessible regions in Asia, who thoroughly understand the instruments in use among them; and from these, we, with all our knowledge and musical comprehension, produce no other tones than can the natives themselves.

The flageolets, having been tested and compared with the flute and organ, were found to be pitched in the following keys: two of similar color and shape stand in the key of C natural, and one of like color in B natural; another, smaller in size, stands in F sharp, and the most perfect sounds emitted came from the flageolet of a dark brown color, which was pitched in the key of B flat; upon this instrument most of the experiments were conducted. It was found that by covering all four holes of the flageolet with the finger, C natural was produced with the bell open (Plate II), and by closing this last-named portion with the little finger, B flat could be obtained, thus lowering the instrument a tone and a half in sound. This action I have denominated finger-stopping, and it is a curious fact, that this same method has been practiced by musicians of our day with the hand upon the French horn. The fact having been demonstrated, that the cavity in the cup-shaped depression had been used for this purpose, it was necessary to find whether the finger-stopping could best be accomplished by the fourth finger of the right hand, or the little finger thereof. After repeated trials, the little finger was found best adapted to that purpose, which obliges the musician to hold the flageolet in the following manner: the body of the instrument rests between the ball of the thumb and the first or index finger of the left hand, covering 4 D (Plate II), thus supporting the instrument. Hole No. 3 C is covered by the second finger of the same hand, No. 2 B by the index finger of the right hand, and 1 A by the second finger; the little finger is used as stated—for the finger-stopping. The instrument being held as above described, the *fourth* of the scale or E flat can be obtained by half-closing the second hole or letter 2 B (Plate II), 3 C and 4 D remaining closed. The *seventh*, which is A natural, is obtained by closing 2 B, and leaving the other holes open. If these notes thus obtained be compared by a competent musician with any wind instrument of concert pitch, such as the flute, the truth of this assertion will be evident.

Musical authorities seem to have arrived at the somewhat hasty conclusion, that the Aztec people were only possessed of a knowledge of the so-called Pentatonic scale, but with all due deference to their opinion, I must beg leave to differ upon this point, as it is not probable that intervals which are so easily obtained, were unknown to artisans capable of manufacturing these flageolets of terra-cotta, pitched in different keys, and of determining the exact distance apart of the finger-holes. This superior knowledge of their artisans is still further shown by the ingenious and scientific arrangement of the finger-perforations made in their whistles, or pitch-pipes, described hereafter, which, when covered, reduce the tone exactly a fourth; equaling the dominant of the scale.

The more I study the musical instruments of these people, the firmer becomes my conviction that they must have possessed a full knowledge of the diatonic and chromatic scales; which can be produced upon the four-holed clay flageolets by any one capable of manipulating our modern flutes.

The instrument which stands in B flat, can be made to produce that note by closing all the holes and the bell (full finger-stop). B natural is more difficult to obtain, and is produced by a slight movement, with much care and precision, of the little finger outward from the centre of the cup-like cavity; from which fact, and the skill required to produce C sharp, E flat and G natural, I am inclined to believe that the Aztecs, like the ancient Peruvians, possessed musicians trained from early youth, who no doubt assisted in their religious ceremonies and festivals. C natural is produced with the four holes closed, and the cup-like cavity open.[1] C sharp, 1 A half open, 2 B, 3 C, 4 D closed; D natural, 1 A entirely open, 2 B, 3 C and 4 D closed. E flat, or the *fourth* of the scale, is produced by leaving 1 A open, 2 B, half-closed, 3 C and 4 D closed; E natural, 2 B open, 1 A, 3 C and 4 D closed; F natural, 1 A and 2 B open, 3 C and 4 D closed;

[1] It may be seen in the Plate, that where it is necessary to close the cup-like cavity in these flageolets, S is used to indicate entirely closed, half S for half-closed, or half finger-stop, and O for open bell.

F sharp, 1 A open, 2 B closed (see Plate), 3 C open and 4 D closed; G natural, 1 A open, 2 B half-closed, 3 C open, and 4 D closed; A flat or G sharp, 1 A, 2 B, 3 C open, and 4 D closed. A natural, the *seventh* of the scale, 1 A open, 2 B closed, 3 C and 4 D open. B flat, *octave*, is obtained by leaving all the holes and the bell open.[1] It becomes apparent by the above scales obtained upon these four-fingered clay flageolets, representing the keys of B flat, B natural, C natural and F sharp, that many interesting combinations could be obtained by their simultaneous use, such as concerted pieces, each flageolet sustaining a part.

Professor J. S. Cox says: "I cannot imagine what object they had in view for pitching their flageolets in different tones, unless each instrument was intended to perform a separate part, which when played together produced harmonious sounds; this method is used in our day by some of the fife and drum corps, there being three different kinds of fifes used in concert. . . . . . . They are too truthful in their various pitches (such as B natural, C natural, B flat, F sharp) for these to be accidental." These opinions of Professor Cox, whose reputation as a soloist upon the Boehm-flute is well known in America, cannot fail to impress the cautious observer that something more than mere accident is represented by these instruments standing in different keys.

The Aztec whistles, or pitch-pipes, in the collection of antiquities already mentioned, were ascertained to stand in the key of E flat, and together yield a full octave, so that four persons could play simple melodies upon them.[2] The fact that duplicates exist in several of the above-mentioned whistles and flageolets adds much probability to the theory already advanced, that these are not tones which happen to stand in the keys enumerated, but that

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[1] It has been suggested that it was possible to produce the entire scale (without closing the bell) by means of careful finger-manipulation upon any reed-formed instrument with four holes. Six notes can be obtained by careful fingering; an approach to the seventh (though very imperfect and flat in sound) can be produced by leaving all the holes open, and blowing strongly. After repeated trials, I am of the opinion that there is no way of producing the octave upon these four-holed Aztec instruments, except by means of finger-stopping.

[2] I have numbered these pipes from one to eight (tonic to octave). They, with their existing duplicates, may be seen in the museum of the Academy of Natural Sciences of Philadelphia.

they were made by artisans who thoroughly understood the principles of the scales as known to us; moreover, upon these whistles a ninth, eleventh and twelfth can be obtained (the tenth or G natural is missing), which gives, with this exception, an octave and a fourth.

Certain grotesque decorations upon these instruments may have some signification; the one which produces E flat, or the tonic of the scale, possessing no ornamentation, is an exception to most all the others, which are enveloped by frog-like appendages or legs, with feet attached. The bodies are tipped with an ornament resembling the tails of young sparrows, and the underneath portion thereof is furnished with an appendage or button, pierced by a hole, through which a cord was passed by which it was probably attached to the body of the performer. (Plate III, fig. 3.)

The ingenious way in which the Aztec whistles are modeled is well worthy of description, and must have occupied a great deal of time to accomplish it. They have no doubt been made in four parts, like the flageolets, and also possess a clay reed, which is enveloped by the neck, to which is attached the body, furnished with a vent-hole. This body is a circular form, something like the bulb of a retort (such as used in our laboratories), and was no doubt fashioned upon a ball-shaped or circular form, and then cut into two portions; one of these was joined to the neck, and the other piece fastened to it by careful modeling. An example of this can be seen in the double whistle (Plate III, fig. 4), where these two parts are shown somewhat separated; no doubt the effect of the action of the heat while in the kiln. The object of thus forming the body in two portions can readily be seen by an examination of these instruments, which are, with few exceptions, very carefully made, and the interior portion of the body quite smooth and regular within, as any imperfection would interfere with the regularity and fulness of the sound. A smooth round form of some material was chosen upon which to model or shape the body portion, which it would be necessary to divide in two, so as to release it therefrom, thus explaining the division of the above-named parts. The bodies of these whistles are each pierced by a stop-hole, which, if left unclosed when the instrument is blown, gives a clear piercing sound; by covering the same, a note one-fourth below that given while open, is produced. This hole is generally placed to the right side of a line drawn around the body from the centre of the vent. In playing the scale of E flat, all of the holes in these pipes are left open with the exception of that of pitch-pipe No. 2, which is closed, so as to produce F natural.

To recapitulate, it would appear: I. That upon the four-holed clay flageolets the chromatic and diatonic scales can be produced with a full octave. II. That the clay whistles or pitch-pipes, which may be manipulated in quartette, will produce an octave and a fourth. III. From the facts above shown, the Aztecs must have possessed a knowledge of the scales as known to us, which has been fully tested by comparison with the flute and organ.

These superior attainments in the science of music suggest that musicians of our day have arrived at a somewhat hasty decision in regard to the music of these ancient people having been confined within the narrow limits of a so-called pentatonic scale, as it is highly probable that they may have had melodies containing all the tones of the chromatic scale. Their ingenuity and skill in the production of these instruments may well claim the admiration of modern musicians and artisans. It is earnestly hoped that a much-neglected branch of American ethnology—the study of native American music—will hereafter receive the proper investigation due so important a subject. No doubt the researches now in progress, under the auspices of the Bureau of Ethnology at Washington, will develop many interesting facts in this connection.

APRIL 24.

The President, Dr. LEIDY, in the chair.

Thirty-nine members present.

The following papers were presented for publication:

"On the Structure of the Skull of the Hadrosauridæ," by Edward D. Cope.

"On some Vertebrate Forms from the Permian of Illinois," by Edward D. Cope.

A Social Heliozoan.—Prof. LEIDY exhibited drawings and made some remarks on a singular Heliozoan recently observed by him. His attention had been directed to it by Mr. Edward Potts, who discovered it, contained in considerable numbers in water, with vegetal debris, from Lake Hopatcong, N. J., where it had been obtained last autumn. The animal occurred mostly in groups composed of numerous individuals. One of these groups, of irregular, cylindroid shape, 0·84 mm. long by 0·36 mm. broad, was estimated to contain upwards of a hundred individuals. They reminded one of a mass of tangled burs. They remained nearly stationary even for twenty-four hours, and exhibited so little activity, that without careful scrutiny they might readily be taken for some inanimate structure. The individuals composing the groups appeared to be connected together only by mutual attachment of their innumerable rays, and none were observed to be associated by cords of protoplasm extending between the bodies of the animals, as seen in *Raphidiophrys elegans*. The individuals associated together were of two kinds: those which were active, and a smaller proportion which were in an encysted, quiescent condition.

The active individuals resembled the common sun-animalcule. The body was usually spherical or oval, but variable from contraction, colorless, granular and vesicular, with a large central nucleus more or less obscurely visible and variably granular, with three or four or more peripheral contractile vesicles. The body had a thick envelope of delicate protoplasm, with innumerable and immeasurably fine, straight spicules. The envelope with the spicules extended in numerous conical rays, from which proceeded numerous immeasurably fine granular rays. The encysted individuals presented the same essential constitution, except that the body was regularly spherical, enclosed by a structureless envelope or membrane, contained no contractile vesicles, and the enveloping protoplasm was devoid of granular rays. The body of the active individuals measured from 0·024 to 0·036 mm. in diameter; in the encysted individuals, usually about 0·02 mm. An active individual, with the body 0·033 mm. in diameter, with its envelope was 0·055 mm. in diameter. An encysted individual, with the body 0·02, with its envelope was 0·036 mm.

The active individuals were observed to feed on two species of minute monads, which were swallowed in the same manner as in *Actinophrys*. After some hours, a few individuals appear to have separated from the surface of one of the groups, but they were as stationary and sluggish as when in association with others.

The species is apparently distinct from others which have been previously noticed, and may be named *Raphidiophrys socialis*.

Daniel E. Hughes, M. D., and Edwin S. Balch were elected members.

MAY 1.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

MAY 8.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

Canadian Notes.—Mr. JOS. WILLCOX remarked that a noticeable feature in the Canadian landscape is the scarcity of springs of water and running streams. The latter, when they exist, are almost exclusively the outlets of lakes, which are very numerous in that country. The abundance of lakes there is a fortunate occurrence, as they store a large amount of water for use in supplying power to mills and drink for live stock during the dry summer and early autumn. By the action of the ancient glaciers a large portion of the soil of Canada has been carried away, the underlying rocks being usually near the surface, and in many cases visible above the ground. It is reasonable to conclude that the absence of springs of water is due to the prevailing scarcity of deep soil, the material necessary to soak up a large amount of rain and melting snow, from which springs are supplied, being deficient. His observations were confined to the country which lies north of Kingston and Brockville, in the Province of Ontario. In Jefferson and St. Lawrence Counties, in New York, small isolated areas of Potsdam sandstone occur, overlying the Laurentian granite and limestone. Sometimes they cover a space of only a few square yards. North of the St. Lawrence River, for a distance of more than one hundred miles, the Laurentian rocks are frequently covered with disconnected patches of calciferous sandstone and Trenton limestone. These remnants undoubtedly indicate the former existence of those rocks of great extent, overlying the Laurentian granite and limestone, the former having been subsequently removed by erosion. The ancient glaciers have probably performed a large share of this work, as their erosive action, which has torn and worn away the granite rocks to a considerable extent, would operate more rapidly on the softer limestones and sandstones.

The following were ordered to be printed:—

ON THE CHARACTERS OF THE SKULL IN THE HADROSAURIDÆ.

BY E. D. COPE.

In the year 1841, Professor Owen[1] distinguished the *Dinosauria* from other reptiles, as an order characterized by the structure of the sacrum, the limbs, and the articulations of the ribs with the vertebræ. The definition of the order remained without accession, until, in 1870, Prof. Huxley[2] determined the characters of the pelvis. This important addition to our knowledge placed the order on a firmer basis. No definitions were yet derived by either author from the skull, so that the relationships of the *Dinosauria* still remained obscure. In 1861 Professor Owen described part of the skull of a species of *Scelidosaurus* from the English Lias. On this imperfect basis I ventured in 1870[3] to determine whether the *Dinosauria* are monimostylicate or streptostylicate; and I added to the definition of the order, "attached quadrate;" and later[4] "os-quadratum articulated with its suspensorium by suture," thus placing these reptiles in the monimostylicate series. This character, if found to be general in the order, would distinguish it well from the *Lacertilia*, and give a point of affinity to the *Crocodilia*.

This order embraces a number of families. I at one time proposed to refer them to three suborders,[5] and Huxley concluded that they should be arranged in two suborders.[6] Professor Marsh, after showing that one of my three orders (*Symphypoda*) was established on characters erroneously ascribed to its type by previous writers, proposed to divide the *Dinosauria* into seven suborders. He later[7] regarded the *Dinosauria* as a subclass, and divided it into five orders, the fourth of which is composed of three suborders. The characters used by Marsh to define this supposed subclass, do not differ from those previously developed as above cited, excepting that a number are introduced which

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[1] British Fossil Reptiles.

[2] Quarterly Journal of the Geological Society, p. 33.

[3] American Naturalist, 1871, p. 508.

[4] Proceedings Amer. Assoc. Adv. Science, 1870 (1871), p. 233.

[5] Transactions American Philosophical Society, xiv, 1869, 90-99.

[6] Quarterly Jour. Geolog. Soc., London, 1870.

[7] Amer. Jour. Sci. Arts, 1882, p. 83.

cannot be used to distinguish a subclass, or in some instances an order. In like manner, the definitions of his orders and suborders embrace many characters which are not usually regarded as defining groups higher than families. Such, *e. g.*, are the numbers of toes; relative sizes of fore- and hind-limbs; solidity or non-solidity of bones; presence or absence of dermal armor. Much light was, however, thrown on the subject by Professor Marsh, by the numerous characters he brought to light, and the number of forms he defined.

The constitution of the pelvis is shown by Marsh to differ materially in the different members of the *Dinosauria*. As this region presents characters diagnostic of the order *Dinosauria* itself, its modifications within the order become of importance. The ungulate or unguiculate character of the feet must also not be neglected, although of less importance than in the mammalia. If the order is susceptible of division into suborders, it must be by means of the following definitions, which I select from Marsh's diagnoses:

Feet ungulate; pubes projecting and connected in front; no postpubes; *Opisthocœla*.

Feet ungulate; pubes projecting free in front; postpubes present; *Orthopoda*.

Feet unguiculate; pubes projecting downwards and coössified distally; calcaneum not produced; *Goniopoda*.

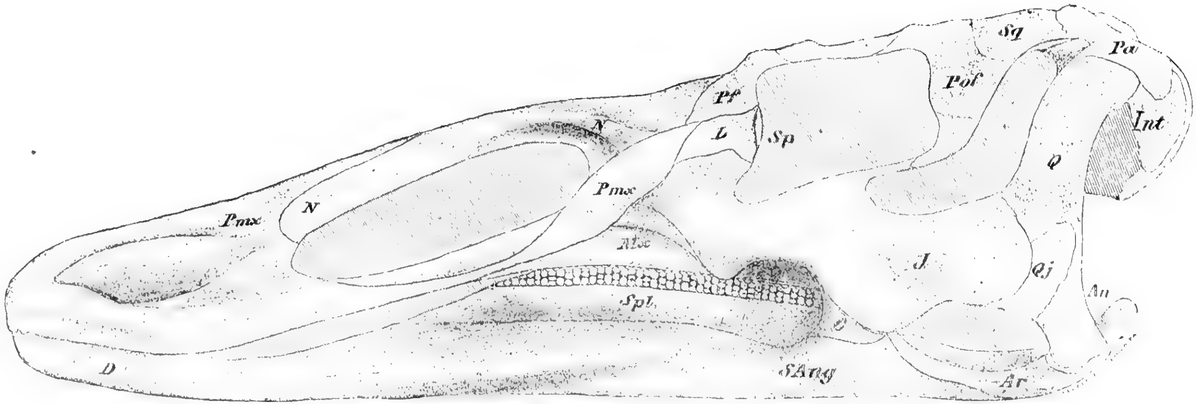
Feet unguiculate; calcaneum much produced backwards;.? pelvis; *Hallopoda*.

I have used for these orders the oldest names when the definitions first given were not erroneous, although they were inadequate. Thus I think the name *Opisthocœla* (Owen[1]) must take precedence of *Sauropoda* Marsh. I combine Marsh's two divisions, *Stegosauria* and *Ornithopoda*, into one, and use the name I gave in 1866 and redefined in 1869,[2] for the division thus remodeled. The name *Goniopoda*, given at the same time, I designed to embrace the carnivorous *Dinosauria*, but included in my definition some characters which are of less significance than I then attached to them.

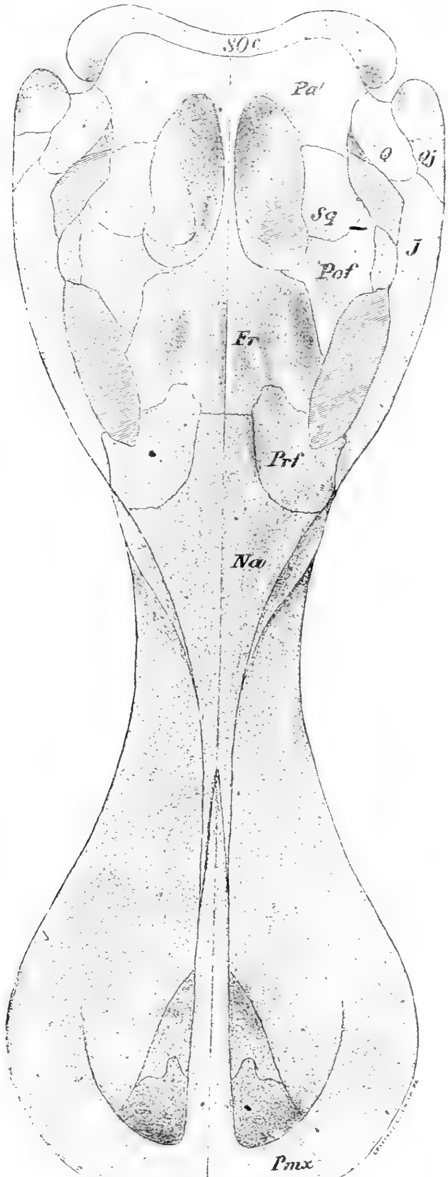
Prof. Huxley recognized three families: the *Scelidosauridæ* and

[1] Palæontology, 1860, p. 272.

[2] Transactions American Philos. Soc., xiv, p. 90. See American Naturalist, 1882, March.



DICLONIUS MIRABILIS 1/7.



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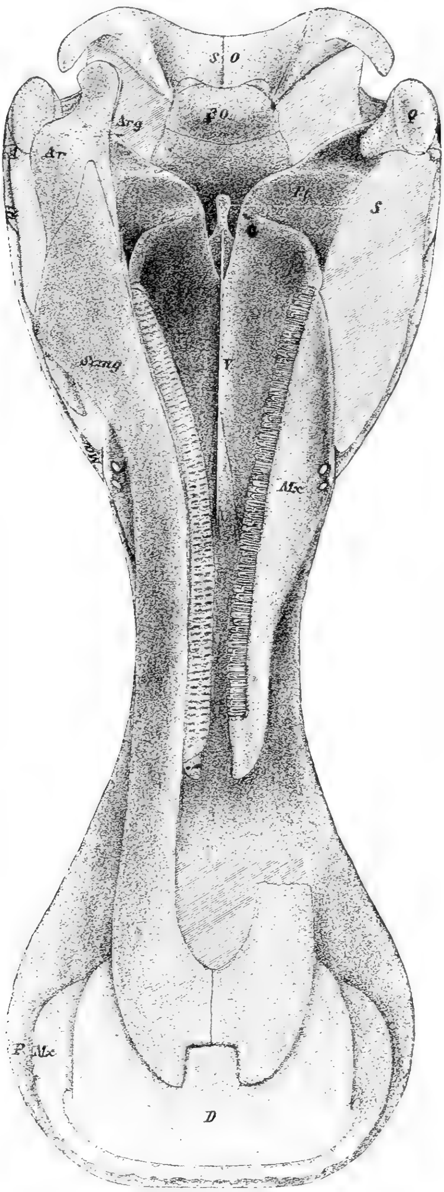

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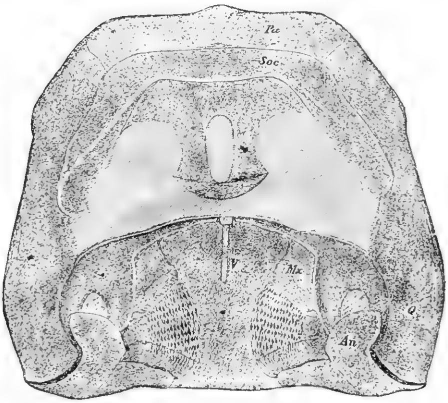

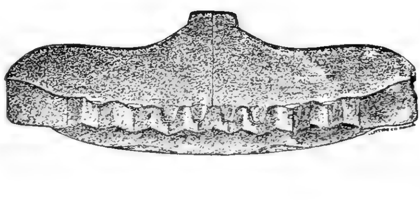

DICLONIUS MIRABILIS 1/7.

Iguanodontidæ, which belong to the *Orthopoda*, and the *Megalosauridæ*, which pertains to the *Goniopoda*. To the former, I added the family *Hadrosauridæ* in 1869, and in 1877 I defined the *Camarasauridæ*, of the suborder *Opisthocœla*.[1] To this family Marsh gave, in 1882, the name of *Atlantosauridæ*.[2] At the same time he proposed a number of families, some of which will be retained, while others are not sufficiently defined.

The *Hadrosauridæ* are, so far as known, confined to the upper cretaceous beds of North America, and continued, with their accompanying carnivorous genera, later in geological time than any other *Dinosauria*. Besides the genus *Hadrosaurus*, I have added the genera *Diclônius* and *Cionodon*, and it is possible that the genera *Monoclonius*, *Dysganus* and *Agathaumas* also belong to it. These types are all found in the Laramie formation, excepting *Hadrosaurus*, which is as yet only known from the older Fox Hills or Mæstrichtian, and Pierre epochs. From the latter formations, came also *Hypsibema*, possibly a member of the same family.

As the latest in time, the *Dinosauria* of the Laramie possess an especial interest. Having recently obtained a specimen of a species of the genus *Diclonius* Cope, I am in a position to give not only the characters of the family and suborder more definitely than heretofore, but also to furnish some cranial characters of the order, which have been hitherto little known or unknown. The species on which these observations are made is the *Diclonius mirabilis*,[3] of Leidy. It is represented by a nearly complete skeleton, including the skull, which was discovered by Messrs. Wortman and Hill in the Laramie beds of Dakota. At present, I only describe the general characters, and those chiefly cranial, leaving the complete description and iconography for my forthcoming volume on the Laramie vertebrate fauna.

The character which distinguishes this genus from *Hadrosaurus* is the attenuation of the astragalocalcaneum, and its coössification with the tibia. *Ornithotarsus* differs from *Diclonius* in the pro-

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[1] Proceedings American Philosophical Soc., 1877, p. 243.

[2] Amer. Jour. Sci. Arts, 1882, p. 83.

[3] This species is part of the one called by Leidy *Trachodon mirabilis*, who included in it a species of *Dysganus*. He did not characterize the genus *Trachodon*, and afterwards abandoned it. (Proceedings Academy, Phila., 1868, p. 199.)

duced calcaneum, which supports the extremity of the fibula. There are four digits of the anterior foot, and three of the posterior. The fore-limb is much shorter than the hind-limb, so that the attitude of the animal was kangaroo-like, as in *Hadrosaurus* and *Lælaps*. In this it differed from *Monoclonius*,[1] where the anterior limbs are as long as the posterior.

Ordinal Characters.—The quadrate bone is immovably articulated to the skull by three elements; the parietal, the quadratojugal, and the jugal. The intercalare occupies a position on the external edge of the exoccipital, and nearly approaches the proximal end of the quadrate at its posterior side. The postfrontals and prefontals are well developed, and the parietals, frontals, nasals and premaxillaries form the middle line of the skull above, as in other reptiles. The elements of the lower jaw belonging to reptiles are all present.

Subordinal and Family Characters.—The *parietal* is, as to its superior face, a T-shaped bone, of which the transverse portion rests on the supraoccipital bone, without interspace. The external extremities of the transverse branches are excavated below to receive the proximal end of the quadrate. These extensions of the parietal are stout, and represent the parietosquamosal arch of the *Lacertilia*. Resting as they do on the occipital, they present a character exactly intermediate between those presented by the *Crocodilia* and *Lacertilia*.

The *zygomatic arch* is complete, having the usual flexure observed in reptiles, and branching to a postorbital arch by the intervention of a postorbital bone. The postorbital part of the zygomatic arch forms the external border of the superior aspect of the skull, and encloses a crotaphite foramen. The portions of the frontal and parietal bones which separate the crotaphite foramina, form a narrow isthmus. The postorbital part of the zygoma consists chiefly of the squamosal. This element is rod-like, and does not reach or take part in the articulation with the quadrate. In this respect this genus differs materially from *Scelidosaurus*, where, according to Owen, the squamosal is more extended posteriorly, and articulates with the superior part of the quadrate by a fixed articulation. The external portions of the parietal are thus, in *Scelidosaurus*, correspondingly reduced.

The *malar* or *jugal* bone is of large size, while the quadrato-

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[1] Proceedings Phila. Academy, 1876, October.

jugal is rather small. Its articulation with the quadrate is squamosal. The maxillary is convex on its outer face, presenting the teeth inwards. The nasals are distinct, and much narrowed forwards to their junction with the spines of the premaxillaries. The latter bones are distinct. They form, when viewed from above, an anchor-shaped body, with the curved flanges extending outwards and backwards. These enclose, with the anterior apex of the maxillaries, the huge external nareal orifices, which were probably roofed over by membrane, as in the birds.

The *pterygoids* extend well posteriorly as broad plates, and are in close contact with the inferior part of the quadrates. They are separated for a short distance on the middle line posteriorly by a fissure, which, with the narrow space between the pterygoids and the presphenoids, gives exit to the transversely narrowed posterior nares. The occipital condyle looks downwards. The sphenoid is posteriorly horizontal, and overlaps the basioccipital with only a trace of lateral tuberosities; but in front it is curved abruptly downwards. At this point, an elongate, flattened, truncate process extends posteriorly, forming the median part of the roof of the fissure of the posterior nares. In front of this fissure the pterygoids are in contact, and extend a considerable distance anteriorly; at least to opposite to the border of the large anterior palatomaxillary foramen.

The *maxillary* bone is produced far posteriorly, so as to define the zygomatic foramen on the inner side. The palatine bone extends posteriorly between it and the pterygoid for a considerable distance, when the expanding pterygoid cuts it off, and extends to the posterior extremity of the maxillary, closing the space occupied in the *Lacertilia* by the posterior palatomaxillary foramen. I cannot distinguish whether the portion which extends to the maxillary bone is distinguished as an ectopterygoid. The posterior edge of this part of the pterygoid projects below the posterior part of the bone, which is nearly horizontal until it reaches the quadrate. It then ascends, forming a lamina on the inner side of that bone, reaching the process from the inner side of the condyle.

The *vomer* is a narrowed, horizontal lamina between the anterior parts of the maxillary bones, anterior to which point it does not appear to extend. It soon becomes a vertical lamina, spreading at the base, where it is in contact with the middle line of contact of the pterygoid bones (and perhaps of the palatines, but these are not visible at that point). From this point it is a deep attenuated keel, dividing the palate into two deep channels, and extends as far posteriorly as the nares. The posterior part is free beyond its base. The entire vomer is like that seen in various natatorial birds. The anterior maxillopalatine foramen separates the vomer from the maxillaries anteriorly. Posteriorly, the foramen is bounded by an ascending process of the maxillary bone, which is in contact with the palatines posteriorly.

The *premaxillary* is divided its whole length. At the middle line above, it passes between the nasal laminæ, while below it forms the roof of the muzzle part of the mouth, and the floor of the huge nareal fossa on each side of its spine. This part extends posteriorly as a thin lamina, each meeting that of the opposite side on the middle line, and recurving upwards, forming a median superior crest. The horizontal portion extends above the maxillary bone, between it and the descending postnareal part of the nasal, and extends over the anterior part of the lachrymal, intervening between the anterior extremity of the malar, and the posterior extremity of the nasal. Its posterior portion develops a rib-like projection, which descends downwards and forwards towards the anterior part of the maxillary bone, and disappears. This bone perhaps includes the *maxilloturbinal.*

The preorbital region includes a not unusual arrangement of the elements. The prefrontal bone descends as far as the middle of the anterior border of the orbit, and to the lachrymal. The orbital edge of the latter is interrupted by an element which presents a vertical edge outwards, and appears to be distinct from it, extending under it anteriorly, and separated from it by a vertical groove externally. It is, perhaps, the superciliary bone of Cuvier, which occupies a somewhat similar position in the *Varanidæ.* Below the lachrymal a small part of the orbit is bounded in front by the jugal. The latter sends forward a laminar prolongation over the maxillary, separating it externally from the posterior extension of the maxilloturbinal.

The *mandibular ramus* includes all the elements of the reptilian jaw. The arrangement posteriorly is a mixture of that of the crocodile and that of the lizard, while the remaining portion is peculiar. The angle is formed by about equal parts of the articular and angular, the former furnishing the external half, the latter the internal. There are a huge dental fossa and foramen, as in the

Lacertilia, and no perforations either external or internal, in agreement with the same type. The coronoid process is very large and elevated, and its base, which is crescentic in section, is embraced by the surangular, and is reached posteriorly by the anterior prolongation of the articular. Its posterior face is concave, and its apex is curved anteriorly, reaching the superior edge of the jugal bone at the inferior border of the orbit. The angular bone forms the internal border of the dental fossa, and extends to the posterior edge of the splenial above. Below, it sends a prolongation forwards. The greater part of the external and inferior faces of the ramus are formed by the surangular bone, which has an enormous extent, far exceeding in size that of any known reptile. It extends posteriorly to below the quadrate cotylus. Anteriorly it spreads laterally, and unites with its fellow of the opposite side, forming a short symphysis, and simulating a dentary. At the base of the internal side of the ramus, it is separated from the anterior prolongation of the angular by an open Meckelian groove, which shallows out near the middle of its length. In correspondence with this extent of the surangular, the splenial is enormously developed, and contains the great magazine of teeth which I have described as characteristic of this type.[1] Its internal wall is very thin, and adheres closely to the faces of the teeth, in the fossil, in its present condition. This development and dentition of the splenial bone distinguishes the *Hadrosauridæ* widely from the *Iguanodontidæ*. The dentary bone is a flat semicircular plate attached by suture to the extremities of the surangulars. There is no trace of symphysial suture, and the posterior border sends a median prolongation backwards, which is embraced by the surangulars. The edge of the dentary is flat, thin, and edentulous, and closes within the edge of the premaxillary.

The dentition is remarkable for its complexity, and for the difference in character presented by the superior and inferior series. Leidy pointed out the character of the latter[2] in the *Hadrosaurus foulkei*, and I have described the character of the superior dentition in the genera *Cionodon*[3] and *Diclonius*.[4] The teeth of both

[1] Bulletin U. S. Geol. Survey Territories, F. V. Hayden ; iii, p. 594–7. May, 1877.

[2] Cretaceous Reptiles North America, 1864, p. 83.

[3] Vertebrata of Cretaceous formations of the West, 1875, p. 59.

[4] Proceedings Philadelphia Academy, 1876, p. 250.

series succeed each other in columns of from five to eight teeth each, following an arc of a circle. The superior arc is convex externally; the inferior arc is convex internally, or towards the position of the tongue. It results that the opposed grinding surfaces of the two dental series are vertical. The cementum-plate of the tooth is, in both sets, on the convex side of the tooth, hence external and inferior in the superior teeth, and internal and superior in the inferior teeth. The teeth replace each other differently in the two jaws, or rather the replacement of the teeth does not partake of the general reversal of relations which the opposite series present in all other respects. The successional teeth rise in both jaws on the inner sides of the older teeth. From this it follows, that in the superior series the replacement is on the non-functional side of the tooth, or from the side which does not bear the cementum-plate. In the lower jaw, the successional teeth follow on the side that bears the cementum-plate, so that one tooth must be worn away before the apex of its successor can come into use. The arrangement of the superior series permits the successional to overlap the functional tooth far beyond the base of the enamel-plate, which in point of fact they do in the *Diclonius mirabilis*, though not to the same extent as in the *Cionodon arctatus*. The superior teeth are smaller and narrower in form than the inferior, and both have a keel on the median line of their cementum-face. There are no teeth on the anterior parts of the surangular bone nor on the dentary or premaxillary bones. The extremity of the muzzle is a flattened spatulate beak.

Dermal or corneous structures have left distinct traces in the soft matrix about the end of the beak-like muzzle. Laminæ of brown remnants of organic structures were exposed in removing the matrix. One of these extends as a broad vertical band round the sides, indicating a vertical rim to the lower jaw, like that which surrounds some tea trays, and which probably represents the tomia of the horny sheath of a bird's beak. At the front of the muzzle its face is sharply undulate, presenting the appearance of vertical columns with tooth-like apices. Corresponding tooth-like processes, of much smaller size, alternate with them from the upper jaw. These probably are the remains of a serration of the extremital part of the horny tomia, such as exist on the lateral portions in the lamellirostral birds.

Systematic Results.—The structure of the skull of this species adds some confirmation to the hypothesis of the avian affinities of the *Dinosauria*, which I first announced, as indicated by the hind-limbs, and which Professor Huxley soon after observed in the characters of the limbs and pelvis. The confirmation is, however, empirical rather than essential, and is confined to a few points. One of these is the form and position of the vomer, which much resembles that seen in lamellirostral birds. The large development of the premaxillary bone has a similar significance. So has the toothless character of that bone and the dentary.

Among reptiles, this skull combines, in an interesting way, the characters of the two orders *Crocodilia* and *Lacertilia*. The presence of the ethmoid above the maxillary and overlapping the lachrymal, is unique among vertebrata, so far as I am aware. The free exoccipito-intercalare hook is scarcely less remarkable.

Of mammalian affinity there is no trace to be found.

Specific Characters.—The general form and appearance of the skull, as seen in profile, is a good deal like that of a goose. From above it has more the form of a rather short-billed spoonbill (*Platalea*). For a reptile, the head is unusually elevated posteriorly, and remarkably contracted at the anterior part of the maxillaries. The flat, transverse expansion of the premaxillaries is absolutely unique. The posterior edges of the occipital bones are produced far backwards, forming a thin roof over the anterior part of the vertebral column. This roof is supported by two strong buttresses, one from each side of the foramen magnum. The latter is a vertical oval. The exoccipital (carrying the intercalare) descends on each side, forming a free hook-like process behind the superior half of the quadrate. The recurved process of the lateral branches of the parietal underruns the squamosal two-thirds the length of the latter. The quadrate is separated by a rather narrow, obliquely vertical fossa, from the postorbital arch, owing to the posterior position of the latter.

The orbit is posterior in position, and is a horizontal oblong in form. The superior (superciliary) border is flat, with slight rugosities at the positions of the pre- and postfrontal sutures. The frontal region is a little concave, and there is a convexity of the superior face of the prefrontal bone in front of the line of the orbit. The peculiar position of the teeth gives the side of the face, when the mandible is closed, a horizontally extended concavity. There are four and a half tooth-like colums on each side of the middle line of the end of the muzzle.

The extremital teeth of both series are smaller than the great majority, which are of equal size and similar form. Those of the superior series are rod-like, narrowed at the extremities, and flattened on one side. The edges of the cementum-plate are not serrate, and the other faces of the tooth are finely rugose with cementum-granules. In the inferior series, the cementum-faces are diamond-shaped, and the tooth may thus be distinguished into crown and root. The concealed surfaces are finely rugose; the edges of the cementum-plate are not serrate, and its surface is smooth. As compared with the *Hadrosaurus foulkei*, the dental magazine is much deeper, and contains a greater number of teeth in a vertical column, and probably a larger number in the aggregate. I find in each maxillary bone of the *Diclonius mirabilis* six hundred and thirty teeth, and in each splenial bone four hundred and six teeth. The total number is then two thousand and seventy-two.

According to Mr. Wortman, who, with Mr. Hill, dug the skeleton out, its total length is thirty-eight feet. The length of the skull is 1·180 meters.

Restoration.—This animal in life presented the kangaroo-like proportions ascribed by Leidy to the *Hadrosaurus foulkei.* The anterior limbs are small, and were doubtless used occasionally for support, and rarely for prehension. This is to be supposed from the fact that the ungual phalanges of the manus are hoof-like, and not claw-like, though less ungulate in their character than those of the posterior foot. The inferior presentation of the occipital condyle shows that the head was borne on the summit of a vertical neck, and at right-angles to it, in the manner of a bird. The head would be poised at right-angles to the neck when the animal rested on the anterior feet, by the aid of a U-like flexure of the cervical vertebræ. The general appearance of the head must have been much like that of a bird.

The nature of the beak and the dentition indicate, for this strange animal, a diet of soft vegetable matter. It could not have eaten the branches of trees, since any pressure sufficient for their comminution would have probably broken the slightly attached teeth of the lower jaw from their places, and have scattered them on the floor of the mouth. It is difficult to understand also how such a weak spatulate beak, could have collected or have broken off boughs of trees. By the aid of its dentate horny edge it may have scraped leaves from the ends of branches, but the appearances indicate softer and less tenacious food. Could we suppose that the waters of the great Laramie lakes had supplied abundant aquatic plants without woody tissue, we would have the condition appropriate to this curious structure. Nymphæas, Nuphars, Potamogetons, *Anacharis*, *Myriophyllum* and similar growths could have been easily gathered by this double-spoon-like bill, and have been tossed, by bird-like jerks of the head and neck, back to the mill of small and delicate teeth. In order to submit the food to the action of these vertical shears, the jaws must have been opened widely enough to permit their edges to clear each other, and a good deal of wide gaping must, therefore, have accompanied the act of mastication. This would be easy, as the mouth opens, as in reptiles and birds generally, to a point behind the line of the position of the eye. The eye was evidently of large size. On the other hand the indications are that the external ear was of very small size. There is a large tract that might have been devoted to the sense of smell, but whether it was so or not is not easily ascertained.

We can suppose that the huge hind-legs of this genus and of *Hadrosaurus* were especially useful in wading in the water that produced their food. When the bottom was not too soft, they could wade to a depth of ten or more feet, and, if necessary, drag aquatic plants from their hold below. Fishes might have been available as food when not too large, and not covered with bony scales. Most of the fishes of the Laramie period, are, however, of the latter kind (genus *Clastes*). The occurrence of several beds of lignite in the formation shows that vegetation was abundant.

EXPLANATION OF PLATES.

(All the figures are one-seventh of the natural size.)

Plate IV. Side view of skull of *Diclonius mirabilis*.
Plate V. The same viewed from above.
Plate VI. Inferior view of the same.
Plate VII. Fig. 1, View of occipital region of the same. Fig. 2, View of the extremity of the muzzle from the front.

The complete iconography of this species will appear in the third volume of the Report of the United States Geological Survey of the Territories, under F. V. Hayden and J. W. Powell, now in course of preparation.

ON SOME VERTEBRATA FROM THE PERMIAN OF ILLINOIS.

BY E. D. COPE..

The first notice of the existence of the Permian formation in Illinois was published in these Proceedings for 1876, p. 404, *et seq.* I then described the genera *Cricotus* and *Clepsydrops*, and a species of fish allied to *Ctenodus.* In the Proceedings of the American Philosophical Society for 1877 (commencing at p. 52), I added descriptions of other species, and in a second paper in the same volume, p. 182, I showed that the entire number known to that date was seventeen. Since then Mr. William Gurley, of Dansville, Ill., has sent me some additional specimens, which increase our knowledge of this interesting fauna.

A tooth in the collection is an incisor of a species of the *Diadectidæ*, a family not hitherto recognized in Illinois, although I have recorded it from Texas and New Mexico. It is more slender than the corresponding teeth of any of the species known to me. I do not know the incisors of the *Chilonyx rapidens.* I note here that the genus *Phanerosaurus* von Meyer, from the Permian of Germany, probably belongs to the *Diadectidæ* or the *Bolosauridæ.* The vertebræ are a good deal like those of *Empedias*,[1] but apparently lack the hyposphen.

Didymodus (?) **compressus** Newberry. *Diplodus* (?) *compressus* Newb. Cope, Proceeds. Amer. Philos. Soc., 1877, 53.

The name *Diplodus* was used by Rafinesque for a valid genus of fishes before it was employed by Agassiz for the present genus. I therefore propose to substitute for it the name *Didymodus.*

Thoracodus emydinus gen. et sp. nov.

Char. gen.—The form of the tooth or jaw on which this genus is proposed, reminds one of that of a *Diodon*, and also of one-half of that of a *Janassa.* It appears to be the half of a bilateral plate, which is divided on the middle line by suture. Its form is somewhat that of the anterior part of an episternal bone of a tortoise. It consists essentially of a smooth border, separated from the remainder of the tooth by a transverse groove. The interior

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[1] Mittheilungen a. d. Koeniglich. Mineral., Geolog. u. praehistor.-Museum, Dresden; V, Nachträge zur Dyas; Geinitz und Deichmüller, 1882, p. 10.

portion is, on the superior face (if the piece belong to the inferior jaw, and *vice versa*), transversely ridged and grooved, after the manner of the genus *Janassa.*

Char. specif.—The smooth border is wide above and below. Its edge is produced into a median projection, which is decurved. On the inferior surface it is marked by shallow grooves, which radiate from the groove which bounds it posteriorly, extending nearly to the free edge. Posterior to the bounding groove, the surface is smooth. The posterior surface above has its grooves concentric with the curved free margin. The ridges are narrow, and step-like in position, presenting their free edges backwards. There are no grooves other than these steps. They have an angular curve opposite to the angle of the free margin, and at the angle the groove which separates them is narrowed, while it widens at other points. Free edge of border thickened; surface everywhere smooth.

Measurements.	M.
Length of fragment transversely, . . .	·014
Length of fragment anteroposteriorly, . .	·011
Width of border area at median suture, . .	·005
Seven cross ridges, ...	·005
Thickness at suture at cross-ridges, . .	·002

Ctenodus heterolophus sp. nov.

This species is represented by a single broken tooth, which presents remarkable characters. It had apparently, when perfect, but three crests, which differ greatly in length, diminishing very rapidly from the first or marginal crest.

The crest just mentioned is not only longer, but *much more* elevated than the others, except at the base, where the second crest is the highest. But while the first rapidly rises, the second retains its elevation, and then descends, forming a convex edge, of which the distal part is obtusely serrate. The proximal part of the first crest is worn by friction with the opposing edge of the opposite jaw into a sharp edge, below which its base is covered by a thin layer of the shining cementum which invests the teeth and sides of the second crest. The amount of this shining layer is thus more extensive than in any other species of *Ctenodus* known to me. The third crest, judging by its base of continuity with the second, is very small.

Measurements.	M.
Elevation of first crest at middle, . .	·0095
Elevation of second crest at middle, . .	·0065
Length of a tooth of second crest, . .	·0020

The peculiarities of this tooth suggest that the genus *Gnathorhiza* Cope (Proceedings Amer. Philos. Soc., 1882, p. 629) is Dipnoan, and allied to *Ctenodus.*

Ctenodus vabasensis sp. nov.

This fine species is represented by an almost perfect tooth. It is allied to the *C. fossatus* Cope, but is wider, and the crests do not radiate so equally, but are chiefly directed in one direction as in most species of the genus. The *C. gurleianus* and *C. pusillus* are at once distinguished by the small number of crests, while the *C. periprion* and *C. dialophus* have a larger number of crests, and are otherwise different. *C. porrectus* differs less from it, but has only five $\frac{1}{1}$ crests, while the *C. vabasensis* has six $\frac{1}{1}$. The $\frac{1}{1}$ represents the small posterior (?) crest, which is double. This, with the next one, is directed slightly posteriorly; the fifth is at right-angles to the long axis, and the anterior four extend more or less forwards. They are serrate nearly to their bases, but the teeth are obsolete on their basal halves. The straight part of the internal edge extends as far forwards as the fourth crest, and is continued posteriorly as a short process. No fossæ at ends of crests. Superior face of tooth wide, and slightly concave. The anterior parts of the first and second crests are broken away, so that it is impossible to say whether they are produced as in *C. porrectus.*

Measurements.	M.
Length to marginal base of second crest, . .	·024
Width at marginal base of second crest, . .	·009
Width at fourth crest, inclusive of apex, . .	·015
Width of posterior side, ...	·010
Thickness at base of fifth crest, ...	·005

MAY 15.

The President, Dr. LEIDY, in the chair.

Twenty-five persons present.

The following were presented for publication:—

"Pinus Koraiensis," by Josiah Hoopes.

"On the Fishes of the Lakes of the Western Part of the Great Basin," by Edw. D. Cope.

Observations on Forsythia.—Mr. THOMAS MEEHAN, at the meeting of the Botanical Section, May 14, referred to his communication to the Academy (December 29, 1868), in which he suggested that notwithstanding the strong specific differences between *Forsythia viridissima* and *F. suspensa*, he believed they must have had a common origin. *F. suspensa* has short styles and long stamens, broad lobes to the corolla, broadly-ovate, thin, glaucous, sometimes trifoliate, deeply serrate leaves, and makes a shrub of some ten feet high, with numerous slender, pendulous branches. *F. viridissima* is a stiff, erect bush, but of not half the height, with narrowly lanceolate, thick, bright green, lightly serrate leaves; flowers with narrow lobes, and the style long and the stamens short. *F. suspensa*, in cultivation, often produces abortive capsules; *F. viridissima* rarely, if ever. In the paper cited above, an account is given of the production of seed-vessels on *F. viridissima*, by using the pollen of *F. suspensa*. Though the seeds were not wholly perfect, a winged seed of one species was produced among the wingless ones of the other. The resultant impression from those observations was that in spite of what would be regarded as good specific differences, they are but dimorphic forms, referable to sexual peculiarities.

Three years ago, the usually seedless capsules of *F. suspensa* produced a number of good seeds, which were sown. This season thirty-four flowered. The leaves and general habit of these plants present every shade of gradation between *F. suspensa* and *F. viridissima;* some of the leaves of the latter being even much more slender than those of the original species. The flowers also present in the larger number of cases the slender lobes of the *F. viridissima;* some with the lobes recurved laterally to such an extent as to seem much narrower than they are.

The most interesting fact in connection with this is the sexual characteristics. Of the thirty-four plants, raised from a parent having a short style and long stamens, only four have retained this parental character, but have assumed that belonging to the form *viridissima.*

Some interesting questions are suggested by these observations:

The fact that *F. suspensa* makes abortive capsules freely, and *F. viridissima* rarely, though it has the best developed pistil, indicates that fertility is dependent on the potency of the pollen; and this is confirmed by the production of capsules on *F. viridissima* when the pollen of *F. suspensa* was applied:

The fact that the speaker has had both forms growing on his grounds for many years, without any seed-vessel appearing on *F. viridissima*, except in the case cited, shows that it is not likely to be cross-fertilized through insect agency.

In the fully fertile case of *F. suspensa*, the plants of *F. viridissima* were fully four hundred feet away; and the suggestion of inter-crossing between these forms, considered in connection with the points previously made, seems to place hybridization out of the question.

We may conclude, therefore, that these two supposed species are but sexually dimorphic forms of one; and we have also the curious fact that, in this case, notwithstanding the presumable influence of the law of heredity, the strongly masculine tendency of the parent, as indicated by the highly developed stamens, the potency of its pollen on the *F. viridissima*. the power to almost perfect seeds in partially developed seed-vessels generally, and the actual perfection in one year, notwithstanding the imperfectly developed pistil, should have had to give way to the female tendency in the offspring to such a great degree as to leave only four out of thirty-four to represent the parent.

Influence of Circumstances on Heredity.—Mr. THOMAS MEEHAN referred to the fact that seed of the purple-leaved variety of *Berberis vulgaris*, collected from plants growing near Philadelphia, reproduced the purple-leaved peculiarity to an extent which it could not do more perfectly if the variety were a true species. In a bed of seedlings, containing on an estimate one thousand plants, there were only two reversions to the original green-leaved condition. Two years ago, he had been given, by Prof. C. S. Sargent, some seeds of ligneous plants, sent to him from some European Botanical Garden, and of thirty seedlings planted only two are dark purple as in the parent.

MAY 22.

Rev. Dr. H. C. McCOOK, Vice-President, in the chair.

Forty persons present.

A paper entitled "A Revision of the Species of Gerres found in American Waters," by B. W. Evermann and Seth E. Meek, was presented for publication.

May 29.

The President, Dr. Leidy, in the chair.

Forty persons present.

N. A. Randolph, M. D., J. Reed Conrad, M. D., and Spencer Trotter, M. D., were elected members.

Arnould Locard, of Lyons, Fred. W. Hutton, of Christchurch, N. Z., and C. E. Beddome, of Hobart Town, Tasmania, were elected correspondents.

The following were ordered to be printed :—

PINUS KORAIENSIS Sieb. & Zucc.

BY JOSIAH HOOPES.

Through the kindness of Chief Eng. G. W. Melville, U. S. N., I have enjoyed an opportunity of studying some excellent specimens of this interesting species of pine, collected by him during the late voyage of the unfortunate "Jeannette" to the Arctic regions. These specimens consist of a branch clothed with foliage, two immature cones, and a few mature seeds, and were collected in the District of Tuknansk, in Eastern Siberia. It was seen along the banks of the Lena, Yenisei and Obi Rivers, forming a tree about thirty feet in height, with a trunk about ten inches in diameter at base. The collector further states that it fruits abundantly, and "the edible seeds are used by the natives as food, and by travelers as nuts." It is interesting to note that this heretofore comparatively rare species has a wider habitat, and is more numerous than has generally been supposed, although reported as having been found up to the Amoor River, which takes its rise in the mountain range dividing the Lena from the Amoor; hence it was reasonable to suppose it was more generally distributed throughout Siberia and adjacent islands. Siebold found it in Kamtschatka; and various authors have described it in the list of Japanese Coniferæ, but only in the latter as an introduced species, where it is said to be quite rare.

Pinus Koraiensis is placed by Dr. Engelmann, in his recent revision of the genus *Pinus*, in the subsection Cembræ, of his first section, Strobus. It is distinguishable from the section Eustrobi by reason of the parenchymatous ducts, and with leaves sparingly serrulate, scarcely denticulate at tip. This nut-bearing pine is well marked throughout, and especially so in its cones and seeds, the latter being wingless, subangulate, flatly compressed, leaving on both sides of the scale when removed, remarkably deep impressions. The cones are very distinctive, with long reflexed scales, terminating in an abrupt mucro-like apex. The leaf-characters in the specimens before me coincide with the published description given by Dr. Engelmann, in relation to the absence (or nearly so) of hypoderm or strengthening-cells, as well as in other peculiar features of the Cembran group.

Murray, in his "Pines and Firs of Japan," records its height from ten to twelve feet, yet Parlatore, on the authority of Perfetti, gives it at "sometimes thirty to thirty-three feet." The latter is corroborated by Chief Eng. Melville, thus showing conclusively that it is a true northern species, attaining only its greatest size near the extreme limits of arboreal vegetation; and yet, like all other species of nut-pines, it never forms a large-sized tree.

This species will no doubt make a valuable addition to our list of ornamental Conifers, as its hardiness is unquestioned, and the foliage is as attractive as any other of the White Pine group, unless we except the *P. excelsa*. In England it has proven reliable, and with us the small plants show evidences of success.

A REVIEW OF THE SPECIES OF GERRES FOUND IN AMERICAN WATERS.

BY B. W. EVERMANN AND SETH E. MEEK.

Upon attempting to identify various specimens of *Gerres* from different points on our coast, and from Mexico and Central America, we were led to the thought that the species of this genus have been unduly multiplied.

Through the kindness of Prof. D. S. Jordan, to whom we here desire to acknowledge our indebtedness for the use of specimens and his library, and for many valuable suggestions, we had placed at our disposal his entire collection of specimens of *Gerres*, thus affording us a considerable amount of material for purposes of comparison.

In Jordan and Gilbert's Synopsis of Fishes of North America, six species of *Gerres* are given as found on the United States Coast; of these, *G. homonymus* appears to us to be identical with *G. gula* C. and V.; and *G. harengulus* Goode and Bean, with *Eucinostomus pseudogula* of Poey, and with *Diapterus gracilis* described from Cape San Lucas by Dr. Gill.

In the present paper it is desired to set forth the conclusions reached from a study of the material in hand. These conclusions are all to be considered as provisional, perhaps to be modified by the study of a greater number of specimens.

The synonymy given, however, appears to be fully justified by the evidence before us.

We have been kindly permitted to copy the synonymy of the Pacific Coast species from Profs. Jordan and Gilbert's MSS.

The different species of *Gerres* noticed in this paper may be readily separated by the following analysis:—

a. Preopercle and preorbital entire; body elongate, depth $2\frac{1}{3}$ to 4 in length.

b. Premaxillary groove naked.

c. Anal rays II–8; body very elongate, depth less than one-fourth its length. *lefroyi.* 1.

cc. Anal rays III–7.

d. Premaxillary groove linear.

e. Eye small, about $3\frac{1}{5}$ in head; depth nearly 3 in length. *gracilis.* 2.

ee. Eye large, less than 3 in head; depth about $2\frac{3}{5}$ in length. *dowi.* 3.

dd. Premaxillary groove not linear.

e. Body slender, depth 3 to $3\frac{1}{2}$ in length. *jonesi.* 4.

ee. Body somewhat elevated, depth about $2\frac{1}{2}$ in length.

f. Caudal fin moderate, shorter than head; second anal spine not very strong, shorter than third, $\frac{1}{4}$ to $\frac{1}{3}$ length of head; ventrals short, little more than half length of head, not reaching vent. Color bright silvery, darker above; snout and upper edge of caudal peduncle somewhat dusky; dark punctulations on body few or none; no trace of vertical bars; upper part of spinous dorsal becoming gradually blackish, other fins nearly plain; axil faintly dusky. *californiensis.* 5.

ff. Caudal fin about as long as head; second anal spine very strong, longer than third, one-third or more length of head; ventrals long, two-thirds length of head, reaching vent. Color in life, clear silvery, bluish above, sides with obsolete longitudinal streaks; back and sides with 8 or 9 bluish vertical bars, about as broad as the pupil; a dark blotch on upper edge of eye. *cinereus.* 6.

bb. Premaxillary groove scaled in front, forming a naked pit behind; depth about $2\frac{3}{5}$ in length. *gula.* 7.

aa. Preopercle serrate; premaxillary groove broad.

b. Preorbital entire.

c. Premaxillary groove naked.

d. Body ovate, the outline somewhat regularly elliptical, depth a little less than half length; spines rather slender and short, second dorsal spine half length of head, second anal spine less than half length of head. *aureolus.* 8.

dd. Body rhomboid, short and deep, with angular outlines, the depth usually more than half length; spines long and strong.

e. Anal rays III–8; second dorsal spine three-fourths or more length of head; second anal spine more than half length of head. *peruvianus.* 9.

ee. Anal rays II–9; second dorsal spine not nearly so long as head, and not half longer than second anal. *rhombeus.* 10.

cc. Premaxillary groove broad, rounded behind, with a median linear depression, its surface scaled; anal rays III–8; second dorsal spine about as long as head; pectorals nearly as long as head, reaching front of anal; teeth long, slender, and brush-like; depth 2 in length. *olisthostoma.* 11.

bb. Preorbital serrate; body with distinct dark stripes along the rows of scales; body rhomboidal, with angular outline; spines very strong.

c. Ventrals blackish. *ratao.* 12.

cc. Ventrals pale.

d. Second dorsal spine $\frac{2}{3}$ to $\frac{3}{4}$ length of head, and $\frac{2}{7}$ depth of body, which is 2 to $2\frac{2}{5}$ in its length.

e. Pectorals long, reaching about to front of anal; caudal longer than head; lateral stripes numerous; depth nearly 2 in length. *lineatus.*[1] 13.

ee. Pectorals short, barely reaching vent; caudal shorter than head; lateral stripes few; depth about $2\frac{2}{5}$ in length. *brevimanus.* 14.

dd. Second dorsal spine as long as head, and longer than longest anal spine; pectorals narrow, reaching past tips of ventrals to anal; lateral stripes about 12; depth 2 to $2\frac{1}{4}$ in length. *plumieri.* 16.

1. **Gerres lefroyi** (Goode) Günther.

Diapterus lefroyi Goode, Am. Jour. Sci. & Arts, 123, 1874.
Eucinostomus lefroyi Goode, Bull. U. S. Nat. Mus., No. 5, 39, 1876.
Eucinostomus productus Poey, Ann. Lyc., xi, 59, 1876.
Gerres lefroyi Günther, Voyage of Challenger, Fishes, i, 10, 1880. (Name only.)

Habitat.—Bermuda Islands.

2. **Gerres gracilis** (Gill) Jordan & Gilbert.

Diapterus gracilis Gill, Proc. Ac. Nat. Sci. Phila., 246, 1862. (Cape San Lucas.)
Gerres aprion Günther, iv, 255, 1862. (San Domingo; Jamaica; Bahia.)

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[1] The short description of *Gerres brasilianus* C. and V., vi, 458, contains no characteristics by which we are able to distinguish it from either *G. lineatus* or *G. brevimanus*, hence we do not include it in the Key.

Eucinostomus pseudogula Poey, Anal. Soc. Esp., iv, 124 & 125, 1875. (Cuba.)

Eucinostomus harengulus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 132. (Western Florida.)

Diapterus harengulus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 339. (Clear Water Harbor, Florida.)

Gerres gracilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas); and Bull. U. S. Fish Comm., 1881, 329 (Guaymas; Mazatlan; Panama); *ibid.*, 1882, 108 (Mazatlan; Panama).

Gerres harengulus Jordan & Gilbert, Syn. Fish. N. A., 584, 1883. (Pensacola, Florida.)

Body elliptical, compressed, tapering regularly each way from the spinous dorsal; anterior profile almost straight and not steep; angle at front of breast little marked. Mouth small, maxillary reaching vertically from front of orbit or slightly past it. Teeth rather strong, in broad patches. Exposed portion of maxillary ovate, about twice as broad as long. Preorbital entire, very narrow, its narrowest part about half width of maxillary. Eye not very large, its diameter about equal to length of snout, or the interorbital space, and is about $3\frac{1}{5}$ in head. Furrow for the base of the premaxillaries a narrow naked groove, its length about three-fifths of the eye, and more than three times its own breadth, measured from the anterior limit of the scales along its sides. Preopercle entire. Dorsal spines weak and flexible, the last two or three proportionally stronger than the others. Longest dorsal spine about twice in head, more than two-fifths greatest depth of body, and nearly twice length of second anal spine. Anal spines short, the second somewhat stronger than the third, but shorter, its length $3\frac{3}{4}$ to $4\frac{1}{2}$ in head. Third spine shorter than soft rays. Ventrals short, three-fifths length of head, reaching about half-way to anal, but not nearly to vent. Pectorals slender, about as long as head, reaching about to vent. Caudal not very long, the inner margins of the lobes convex, the middle rays about one-fourth length of outer ones, which are a little shorter than head. Scaly sheath at base of fins moderate, the last rays of the anal hidden by it. Ventrals and caudal mostly covered with small scales; other fins naked.

Color in life, silvery, greenish above. Snout and upper part of caudal peduncle dusky. Spinous dorsal, in a male specimen, dusky, punctate at base, abruptly black at tip, the dark areas separated by a transparent, horizontal bar; in a female specimen, the dorsal grows gradually darker at tip. Soft dorsal punctate.

Caudal with a faint dusky margin. Ventrals very slightly dusky on the middle in the male, plain in the female.

Head $3\frac{3}{10}$; depth $2\frac{9}{10}$; D. IX–10; A. III–7; lat. line 5-45-9.

It seems probable that the habitat of the various species of *Gerres* will be found to be much more extended than has hitherto been supposed. Specimens of the present species have been obtained in the West Indies, on the coast of Florida, and at several points on the Pacific coasts of Central America and Mexico. Prof. Chas. H. Gilbert reports it as abundant at Mazatlan, where it is found in shallow waters near the shore. It reaches a length of six inches or more, and is known to the fishermen as *Mojarra cantileña.*

3. **Gerres dowi** (Gill) Günther.

Diapterus dowi Gill, Proc. Ac. Nat. Sci. Phila., 162, 1863. (Panama.)

Gerres dowi Günther, Fish. Centr. Amer., 448, 1866 (Description taken from Gill); Steindachner, Ichth. Beiträge, iv, 13, 1875 (No description). (Callao, Peru; Galapagos Islands).

Gerres dowi Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 329 (Panama); *ibid.*, 1882, 111 (Panama); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 377 (Panama).

Gerres aprion Günther, Fish. Centr. Amer., 391, 1866. (Name only.) (Panama.)

Habitat.—Panama to Peru. Very abundant on the coasts of the Galapagos Islands. (Steindachner.)

4. **Gerres jonesi** Günther.

Gerres jonesi Günther, Ann. and Mag. Nat. Hist., 1879, iii, 150, 389; Voyage Challenger, Fishes, i, 10, 1880 (Bermuda).

Habitat.—Bermuda Islands.

5. **Gerres californiensis** (Gill) Jordan & Gilbert.

Diapterus californiensis Gill, Proc. Acad. Nat. Sci. Phila., 1862, 245. (Cape San Lucas.)

Gerres californiensis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 319 (Guaymas; Mazatlan); *ibid.*, 1882, 108 (Mazatlan).

? *Gerres gula* Steindachner, Ichth. Beiträge, iii, 60, 1875. (Name only; *nec* Cuv. & Val.) (Magdalena Bay.)

Habitat.—Pacific coast of Mexico. (Mazatlan; Guaymas; Cape San Lucas.)

6. **Gerres cinereus** (Walbaum) Jordan & Gilbert.

Turdus cinereus peltatus Catesby, pl. ii, fig. 2, 1750.

Mugil cinereus Walbaum, Arte di Piscium, 228, 1792. (After Catesby.)

Gerres aprion Cuv. & Val., vi, 461, 1830 (Martinique; San Domingo; Montevideo; East Coast of Mexico). (Not of Günther = *Eucinostomus pseudogula* Poey); Poey, Rep. Fis. Cuba, i, 316, 1865.

Diapterus aprion Poey, Syn. Pisc. Cuba, 321, 1868. (Cuba.)

Gerres zebra Müller & Troschel, Schomburgk Hist. Barbadoes, 668, 1848 (Barbadoes); Günther, i, 343, 1859, and iv, 254, 1862 (Copied); Steindachner, Ichthyol. Notizen, iv, 11, 1867 (Surinam); Steindachner, Zur Fisch-Fauna des Magdelenen-Stromes, 9, 1878 (Rio Magdalena, identified with *G. squamipinnis*); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 329 (Mazatlan).

Gerres squamipinnis Günther, i, 349, 1859, and iv, 254, 1862 (Jamaica; Gautemala); Günther, Fish. Centr. Amer., 391, 1869 (No description) (Jamaica; Chiapam; Panama); Steindachner, Ichthyol. Notizen, iv, 12, 1867 (Surinam).

Gerres cinereus Jordan & Gilbert, Bull. U. S. Comm., 1882, 108 (Mazatlan); and Syn. Fish. N. A., 935, 1883.

Habitat.—Both coasts of Tropical America (Mazatlan; Chiapam; Panama; Bahamas; Barbadoes).

7. **Gerres gula** Cuvier & Valenciennes.

Gerres gula Cuv. & Val., vi, 464, 1830 (Martinique; Brazil); Jenyns, Zoöl. Beagle, Fishes, 58, 1842; Günther, i, 346, 1859, and iv, 255, 1862 (Atlantic Coasts of Tropical America); Poey, Rep. Fis. Cuba, i, 316, 1865.

Eucinostomus argenteus Baird & Girard, Ninth Smith. Report, 345, 1855; Baird & Girard, Mex. Bd. Survey, 17, pl. 9, figs. 9–12, 1859.

?*Gerres argenteus* Günther, iv, 256, 1862. (Atlantic Coasts of N.A.)

Eucinostomus gulula Poey, Anal. Soc. Esp., iv, 128, pl. vi, 1875.

Diapterus homonymus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 340. (Clear Water Harbor, Fla.)

Gerres gula Jordan & Gilbert, Syn. Fish. N. A., 934, 1883. (West Indies, north to Cape Cod.)

Body elliptical, compressed, dorsal profile tapering regularly each way from beginning of spinous dorsal; anterior profile nearly straight, posterior slightly more convex. Line from angle at front of breast to vent nearly straight. Mouth small, slightly oblique (when not protruded), maxillary reaching just beyond vertical at front of eye, exposed part triangular, about twice as long as broad. Premaxillaries very protractile; premaxillary groove longer than broad, scaled in front, with a naked pit behind; these scales, however, are not very distinct in young specimens, and are apt to be rubbed off in poorly preserved ones.

Villiform teeth on both jaws; no canines, incisors, or molars; no teeth on vomer or palatines. Preopercle entire; gill-rakers short, about seven below angle. Eye large, 3 in head, its diameter a little greater than its distance from snout, and about equal to the interorbital space.

Scales moderate, as in other species. Lateral line follows curve of back, being most arched beneath fifth and sixth spines.

Spinous dorsal as long as soft, second dorsal spine nearly $1\frac{3}{4}$ in second anal spine, which is stronger than the third, but equals it in length; posterior ends of anal and dorsal fins opposite, soft parts of these two fins depressible into a scaly sheath. Pectorals nearly as long as head, reaching to vent. Ventrals short, not reaching quite to vent. Caudal deeply forked.

Color, in alcohol, silvery, palest below, no lines or bars except sometimes in young, but the scales are minutely punctate with dark, thickest on dorsal region. A black spot at top of spinous dorsal.

Head $3\frac{1}{4}$ in length; depth, $2\frac{3}{5}$. D. IX–10; A. III–7 or 8; Lat. line about 5–45-9.

We append averages of the measurements of thirteen specimens, viz.:—1 from Bermuda; 2 from Beaufort, N. C.; 2 from Charleston, S. C.; 7 from Pensacola, Fla.; 1 from Aspinwall.

From a comparison of these specimens and of some seven others which we have examined, we are convinced that the synonymy of this species should stand as given above.

TABLE OF MEASUREMENTS.

Number of specimens measured	1	2	2	7	1	
Specimens from	Bermuda.	Beaufort, N. C.	Charleston, S. C.	Pensacola, Fla.	Aspinwall.	Total average.
Greatest depth in length	2.77	2.81	2.67	2.61	2.67	2.66
Head in length	3.31	3.18	3.33	3.23	3.08	3.23
Distance from snout to spinous dorsal in length	2.71	2.50	2.51	2.42	2.39	2.46
Second anal spine in second dorsal spine	1.76	2.00	1.70	1.72	....	1.74
Eye in head	3.05	3.02	3.00	3.00	3.00	3.01
Depth of deepest specimen in length	2.77	2.77	2.63	2.33	2.67	....
Depth of most slender specimen in length	2.77	2.86	2.70	2.86	2.67	....
Shortest 2d anal in 2d dorsal spine	1.76	2.00	1.70	2.09	....	....
Longest 2d anal in 2d dorsal spine	1.76	....	1.70	1.54	....	....

8. **Gerres aureolus** Jordan & Gilbert.

Gerres aureolus Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 328 (Panama); *ibid.*, 1882, 111 (Panama).

Habitat.—Bay of Panama.

9. **Gerres peruvianus** Cuvier & Valenciennes. *Moharra, China.*

Gerres peruvianus Cuv. & Val., Hist. Nat Poiss., vi, 467, 1830 (Payta, Northern Peru); Lesson, Voyage Coquille, Poiss., 180, 1828; Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 330 (Mazatlan; Panama); *ibid.*, 1882, 111, 108, 112 (Panama; Mazatlan; Punta Arenas); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 382 (Panama).

Gerres rhombeus Günther, Fish. Centr. Amer., 391, 1866 (Name only; *nec* Cuv. & Val.) (Chiapam); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Salina Cruz).

Habitat.—West Coast of Tropical America (Mazatlan; Salina Cruz; Panama; Chiapam; Peru).

10. **Gerres rhombeus** Cuvier & Valenciennes.

Gerres rhombeus Cuv. & Val., vi, 459, 1830 (Martinique and San Domingo); Günther, iv, 253, 1862 (In part; apparently confounded with *G. olisthostoma* Goode & Bean) (Cuba; Jamaica; Puerto Cabello); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 382 (Aspinwall).

Habitat.—West Indies.

11. **Gerres olisthostoma** Goode & Bean. *Irish Pompano; Hog Fish.*

Gerres rhombeus Poey, Syn. Pisc Cuba, 32, 1858 (Not *G. rhombeus* of Cuv. & Val., vi, 459); Poey, Rep. Fis. Cuba, i, 316, 1865.

Mojarra rhombea Poey, Anal. Soc. Esp., Hist. Nat., x, 327, 1881.

Gerres olisthostoma Goode & Bean, Proc. U. S. Nat. Mus., 1882, 423 (Indian River, Florida); Jordan & Gilbert, Syn. Fish. N. A., 934, 1883 (West Indies, north to Southern Florida).

Habitat.—West Indies, north to Southern Florida.

12. **Gerres patao** Poey.

Gerres patao Poey, Mem. Cub., ii, 192, 1860; *ibid.*, Syn. Pisc. Cub., 320, 1868; Günther, iv, 253, 1862 (Cuba).

Habitat.—West Indies.

13. **Gerres lineatus** (Humboldt) Cuvier & Valenciennes.

Smaris lineatus Humboldt, Observ. Zoöl., ii, 185, pl. 46, 1807–1834. (Acapulco.)

Gerres lineatus Cuv. & Val., Hist. Nat. Poiss., vi, 470, 1830 (Description from Humboldt); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 330 (Mazatlan; San Blas); *ibid.*, 1882, 108 (Mazatlan); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 377 (Fresh-water lake at Acapulco).

Gerres axillaris Günther, Proc. Zoöl. Soc. Lond., 102, 1864; Günther, Fish. Centr. Amer., 448, 1866 (Chiapam); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Name only). (San Blas.)

Habitat.—West Coast of Mexico.

14. **Gerres brevimanus** Günther.

Gerres brevimanus Günther, Proc. Zoöl. Soc. Lond., 152, 1864; Günther, Fish. Centr. Amer., 448, 1869 (Chiapam).

Habitat.—Pacific Coast of Central America.

15. **Gerres brasilianus** Cuvier & Valenciennes.

Gerres brasilianus Cuv. and Val., vi, 458, 1830 (Brazil); Poey, Rep. Fis. Cuba, i, 315, 1865.

Habitat.—West Indies, south to coast of South America.

16. **Gerres plumieri** Cuvier & Valenciennes.

Gerres plumieri Cuv. & Val., vi, 452, 1830 (Antilles); Günther, iv, 253, 1862 (Atlantic Coasts of Tropical America); Jordan & Gilbert, Syn. Fish. N. A., 583, 1883 (West Indies, north to Eastern Florida); Poey, Rep. Fis. Cuba, i, 315, 1865.

Habitat.—West Indies; Aspinwall; Indian River, Fla.

Profs. Jordan & Gilbert's collection contains specimens from each of the two places last named.

JUNE 5.

The Rev. H. C. McCOOK, Vice-President, in the chair.

Twenty-five persons present.

A paper entitled "On the Genus Hyliota," by Graceanna Lewis, was presented for publication.

The death of Dr. W. Lehman Wells, a member, was announced.

Observations on Actinosphærium eichornii.—A communication from Miss S. G. FOULKE on *Actinosphærium eichornii* was read by Prof. H. Carvill Lewis.

It was stated that while observing Actinosphæria, four individuals were seen to become fused, as it were, into one mass.

At the end of an hour, this mass had separated into three Actinosphæria, two of the original four remaining fused into one.

This double one then became constricted, a little to one side of the middle, apparently being about to separate. In a few minutes the *Actinosphærium* began to eject, at the point of constriction, a thin protoplasmic substance containing transparent granulated globules and free granules. By a waving motion of the rays, the masses of ejected matter were broken up, and the globules set free in the water.

These globules developed from one side an extremely long ray of finely granular protoplasm, slightly elongating at the same time, thus taking an oval shape. No trace of the axial threads peculiar to the rays of adult Actinosphæria could be discovered. The average length of these globules, including the ray, was ·1422 mm.; without the ray, ·0127 mm.

The next act of the globules was the sending out another ray from a point opposite to the first. Minute vacuoles appeared and ranged themselves close to the surface of the globule. Other rays were developed at various intervals of time. The appearance of the young Actinosphæria gradually became more perfect in resemblance to the parent. The growth was very slow, the perfect form not being attained for a period varying from one to two weeks, and the size was even then small.

The external layer of vacuoles of the *Actinosphærium* from which the globules had been ejected, contained numbers of granules in active motion. In the different vacuoles the number varied from ten to about one hundred, as nearly as could be counted. They were usually congregated at one point and seemed to be trying to force a way out.

Sometimes a globular mass of protoplasm was seen to run out upon a ray, and then, instead of returning to the body as usual, drop off into the water, and develop into a perfect *Actino-*

sphærium, in the same manner as those ejected in a mass from the body.

Several free cells, having rays, were observed, upon touching a ray of the *Actinosphærium*, to glide down it in the manner usual to captured prey, and be re-absorbed into the body.

One globule of protoplasm, running out towards the point of a ray, stopped, and while motionless sent out a long ray at right-angles to that supporting the globule. Another smaller globule ran out on this secondary ray and, in its turn, sent out a third ray at right-angles to the secondary ray, but parallel to the primary ray. It has been stated that the rays of the *Actinosphærium* never branched, but the observer thought that the above phenomenon could be truly called branching, as all the protoplasm returned to the main ray, and thence to the body.

To ascertain whether any globules of protoplasm *artificially* freed from the body of the *Actinosphærium* would develop in the same manner as those above described, an *Actinosphærium* was crushed in the livebox so violently as to completely disintegrate it. The vacuoles were broken up, and the internal mass of protoplasm mixed with the water, only two or three small masses of the external vacuoles remaining intact. On removing the pressure, all the fluid protoplasm was seen to gather itself up into globules, of sizes varying from ·0507 mm. to ·253 mm.

These globules contained vacuoles, the size and number of the vacuoles varying with the size of the globules. The water became free from protoplasm, though a large number of the granules, which had been contained in the external vacuoles previous to the crushing of the *Actinosphærium*, remained swimming actively about in every direction.

The globules remained quiet for some minutes, and then began to extend pseudopodial rays. The vacuoles increased in number and arranged themselves close to the exterior of the globules, those of the largest size pushing out the thin protoplasmic covering, so as to produce a strong resemblance to the perfect *Actinosphærium.* The resemblance of each globule to the original *Actinosphærium* became more and more perfect. The few masses of the original vacuoles also protruded rays, thus conclusively showing that the rays of Actinosphæria are not necessarily dependent upon the central mass of protoplasm. The vacuole masses developed into perfect Actinosphæria much more quickly than the globules formed of the central protoplasm, an hour or two being sufficient to perfect the development. The rays of all the immature Actinosphæria were irregular and flattened and in many cases lacked the axial thread.

The Actinosphæria moved their pseudopodial rays freely in all directions, the ray being bent close to the peripheral layer of vacuoles.

From an original colony of eight individuals, a small bottleful was manufactured in the manner above described, the time needed for development being in proportion to the size of the fragments into which the Actinosphæria were divided. The above experiments were tried on many individuals, the only difference of result, in the various instances, being in the degree of completeness with which the protoplasm separated itself from the water. It was argued from the above facts, that the power of any part of an *Actinosphærium* to develop into a perfect individual was inherent, and not dependent upon any peculiar condition of the animalcule.

Fig. 8, Pl. XLI of Leidy's Rhizopods of North America, which he doubtfully refers to the Actinosphæria, exactly resembles a medium stage in the development of the globules ejected from the body of the *Actinosphærium.*

The observer stated that the rays of *Actinosphærium*, when irritated by being compressed, would be retracted completely on all sides, and would again appear on the cessation of the disturbance.

The length of time needed for the development of the Actinosphæria, in the reproduction by natural means, was from seven to fourteen days; that needed for the development, in the reproduction by artificial means, was from one to two days.

In the latter case this length of time was needed only in cases when the crushing was carried to extremes, as, when the *Actinosphærium* was simply divided into small pieces, a few hours were all that was needed to complete the development of the fragments.

JUNE 12.

Mr. JOHN H. REDFIELD in the chair.

Twenty-three persons present.

Cutaneous Nerves in Mammals.—Dr. HARRISON ALLEN, in continuation of his remarks on the trophic value of the cutaneous nerves spoke of the distribution of the larger setæ-bearing hair-follicles in mammals as exposed after depilation. He described the oral, the mental, the supra-orbital and the proximo-carpal groups as well as those placed on the lateral aspects of the limbs. He had succeeded in tracing nerve-filaments to the follicles in all instances and held that they bore close analogies to the pteryls of the birds. In specimens in which the follicles were rudimentary he had observed failure of the nerve also, and he was thus induced to believe that a close relation existed between the setæ-bearing follicles and the nerves themselves.

The following was ordered to be printed:—

ON THE GENUS HYLIOTA.

BY GRACEANNA LEWIS.

By a letter of inquiry from Prof. G. Hartlaub, M.D., of Bremen, Germany, concerning some rare African birds of the genus *Hyliota*, attention has been drawn to the specimens now in this Academy, of which there are three, all of them being male birds.

The question at issue is whether there are two distinct species or only one; and as distinguished authorities differ on this point, it seems proper to offer to ornithologists the testimony which these specimens afford.

The genus was first characterized by Swainson, who described the species *H. flavigastra.* The bird was at first supposed to belong to India, but was subsequently found to inhabit N. E. Africa and Senegambia, and was for a long time the only known species of the genus. Our specimen agrees moderately well with Swainson's description, but is, no doubt, an immature male, the wings are brownish and are not edged with glossy purple, but instead with a dull grayish white. The two external pairs of tail feathers are edged more or less with white, as in the female. The band of white on the wing is formed largely by the middle and greater coverts, and beginning nearly at the outer edge of the wing, continues obliquely across the roots of the primaries, secondaries and tertials, meeting on the back with the white of the rump so as to form a deep curve over the folded wings and back. The white on the wing is even more extensive than is apparent. On lifting the overlying dark plumage this color is seen to involve nearly all of the upper portion of the wing, the internal surface of which as well as the axillaries are white. The outer greater coverts are white at the base but are black glossed with green on their margins; on the external feather, the black is so reduced as to leave only a border on a white ground. The whole upper plumage of the head and back as far as the rump is of deep blue-black with glossy steel-blue reflections.

In 1851, J. and E. Verreaux described in the Rev. et Mag. de Zool., p. 308, a second species, *Muscicapa (?) violacea.* In the same year, H. E. Strickland brought home from the River Gaboon a specimen which he described in Jardine's Contributions to Ornithology, 1851, p. 132, under the name of *Hyliota violacea*, after having had the opportunity of consulting the manuscript of Verreaux, to which he refers. He remarks as follows: "This bird is interesting as affording a second species of a genus of which one specimen only, the *H. flavigastra*, Swains., of Senegal, was hitherto known. It much resembles *H. flavigastra*, but differs in its broader beak, and the less extent of white on the wing. Whole upper parts black with a steel-blue gloss, of a rather more purple hue than in *flavigastra*. Three or four of the greater wing coverts next the body are white (in *flavigastra* the whole of the middle, and the basal half of the greater coverts are white). Lower parts pale cream-color.

Total length $\dot{5}$; beak to front $\ddot{5}$; to gape $\ddot{7}$; broad $\ddot{2}\frac{1}{2}$; wing $\dot{3}$; medial retrices $\dot{1}$ and $\ddot{9}$; external $\ddot{2}$; tarsus $\ddot{7}$."

Of *Hyliota violacea*, as above described, the Academy possesses two specimens. One is the identical bird on which the species was founded by Verreaux, and its characters agree with the description of that author, as well as with that of Strickland, and also with that to be found in Hartlaub's Ornithologie Westafricas, Bremen, 1857, p. 98.

The second specimen in possession of the Academy, belongs to the Du Chaillu 1st Coll., and is also from the River Gaboon. This bird is mentioned in Cassin's Catalogue, Proc. Acad. of Nat. Sciences, 1869, p. 51, but no description is given. Essentially its characters are the same as the type specimen of Verreaux.

In this species, the only white to be seen on the whole wing is on one single feather belonging to the *inner* portion of the greater coverts. There are really about five feathers belonging to the series of ornamental coverts, but they overlie each other, and are so disposed that in the closed wing only one of them is visible.

The rump in both species is covered with long, loose, silky feathers, of a white or grayish white color, from the base to near the tip, when the feather suddenly becomes dark and at the same time pennaceous in structure. The only difference between the two species appears to be in the depth of the dark margin, or its entire absence in mature specimens of *flavigastra*. In Swainson's description of the type, the rump is given as pure white, but it is not so in our specimen. The pennaceous dark border is nearly as deep as in *violacea*, so that this character cannot be relied upon as a distinction between the two species.

In his Ornithology of Angola, p. 190, Prof. Barboza du Bocage acknowledges the receipt from M. Anchieta, of one specimen of *H. violacea*. The description is that of a bird with a large amount of white on the wing. This description does not resemble the type specimen of Verreaux, but is much more nearly like *flavigastra* Swains.

Depending on this description, R. Bowdler Sharpe gives it in his Catalogue of the Birds in the Collection of the British Museum, instead of that of Verreaux, and, in consequence, considers *H. violacea* as a doubtful species.

With the privilege of examination of the type, and of comparing this with the Du Chaillu specimen, and the descriptions of Verreaux, Strickland and Hartlaub, it seems impossible to suppose that the specimen sent by M. Anchieta to Prof. Bocage, was that of a true *violacea*, but was either *H. flavigastra*, or a form intermediate between the two.

The striking differences between the two species, are the blue-black plumage in the upper parts in *flavigastra*, and the violet-black of *violacea;* the broad bands of white on the wing of the former, and the concentrated spot on that of the latter; the darker shade of the under parts in *flavigastra;* and the white thighs of the one and the black of the other, together with the larger size of *violacea.* They also inhabit different regions, *flavigastra* belonging to the N. E. of Africa and Senegambia, while *violacea* is found southward from the Gaboon to Benguela in West Africa.

Swainson points out the general resemblance of *Hyliota* to the African todies of the genus *Platystira*, and to the Old World fly-catchers of *Muscicapa*, with a bill so much lengthened and compressed on the sides that at first sight it might be mistaken for a *Sylvia.*

It also agrees with *Muscicapa* and *Cryptolopha* in having the base of the bill broad and depressed as far as the nostrils, and then compressed to the extremity, the bill being so much lengthened in *Hyliota* that it becomes the tenuirostral form of the group to which it belongs.

The glossy blue-black plumage, white wings and buff throat are in unison with related fly-catchers. By the rump feathers Swainson detects an analogy with the caterpillar-catchers of the Ceblepyrinæ.

In *Hyliota* the sexes differ remarkably in color, as they do also in *Platystira*, such difference not being the rule in the family of the *Muscicapidæ.* *Hyliota* agrees with the fly-catchers in general by its small and weak feet and its syndactyle toes, the outer being connected with the middle as far as the first joints. The wings and tail are those of *Muscicapa*, in which group *Hyliota* is placed by ornithologists.

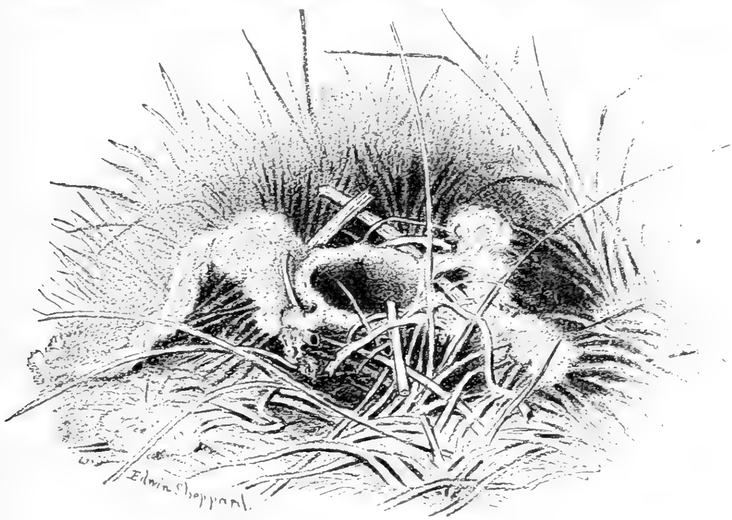
June 19.

The Rev. H. C. McCook, Vice-President, in the chair.

Twenty-nine persons present.

The death of J. B. Gassies, a correspondent, was announced.

Note on the Intelligence of the American Turret Spider.—The Rev. Dr. H. C. McCook exhibited nests of *Tarentula arenicola* Scudder, a species of ground-spider, of the family Lycosidæ, popularly known as the Turret Spider. These nests, in natural site, are surmounted by structures which quite closely resemble miniature old-fashioned chimneys, composed of mud and crossed



Nest of Turret Spider, lined with cotton.

sticks, as seen in the log cabins of pioneer settlers. From half an inch to one inch of the tube projects above ground, while it extends straight downwards twelve or more inches into the earth. The projecting portion or turret is in the form of a pentagon, more or less regular, and is built up of bits of grass, stalks of straw, small twigs, etc., laid across each other at the corners. The upper and projecting parts have a thin lining of silk. Taking its position just inside the watch-tower, the spider leaps out and captures such insects as may come in its way. The speaker has found nests of the species at the base of the Allegheny Mountains near Altoona, and in New Jersey on the seashore. In the latter location the animal had availed itself of the building material at hand, by forming the foundation of its watch-tower of little quartz pebbles, sometimes producing a structure of considerable beauty. In this sandy site, the tube is preserved intact by a delicate secretion of silk, to which the particles of sand adhere. This secretion scarcely presents the character of a web-lining, but has sufficient consistency to hold aloft a frail cylinder of sand and silk, when the sand is carefully scooped away from the site of the nest.

A nest recently obtained from Vineland, N. J., furnished an interesting illustration of the power of these araneads to intelligently adapt themselves to varying surroundings and to take advantage of circumstances with which they certainly could not have been previously familiar. In order to preserve the nest, with a view to study the life-history of its occupant, the sod containing the tube had been carefully dug up and the upper and lower openings plugged with cotton. Upon the arrival of the nest in Philadelphia, the plug guarding the entrance had been removed, but the other had been forgotten and allowed to remain. The spider, which still inhabited the tube, immediately began removing the cotton at the lower portion, and cast some of it out. But guided apparently by its sense of touch to the knowledge that the soft fibres of the cotton would be an excellent material with which to line its tube, she speedily began putting it to that use, and had soon spread a soft, smooth layer over the inner surface and around the opening. The nest, in this condition, was exhibited and showed the interior to be padded for about four inches from the summit of the tower. Dr. McCook pointed out the very manifest inference that the spider must for the first time have come in contact with such a material as cotton, and had immediately utilized its new experience by substituting the soft fibre for the ordinary silken lining; or, rather, adding it thereto. This nest with the cotton wadding is figured on p. 131.

JUNE 26.

Dr. W. S. W. RUSCHENBERGER, in the chair.

Twenty-three persons present.

The Fishes of the Batsto River, N. J.—Prof. COPE gave an account of the results of fishing in the confined waters of a broken dam on the Batsto River, New Jersey. The species obtained were the following. Percidæ: *Pœcilichthys erochrous* Cope; *Enneacanthus simulans* Cope; *Mesogonistius chætodon* Baird; Aphododeridæ: *Aphododerus sayanus* Gill.; Umbridæ: *Umbra limi* Kirtl.; Esocidæ: *Esox umbrosus* Kirt.; *Esox reticulatus* Les.; Cyprinidæ: *Cliola chalybæa* Cope; Catostomidæ: *Erimyzon sucetta* Lac.; Siluridæ: AMIURUS PROSTHISTIUS Cope, sp. nov.; Anguillidæ: *Anguilla rostrata* Les. Prof. Cope remarked that these fishes represent the fish fauna of the Carolinian district of the Nearctic realm, only three of the above, *Esox reticulatus*, *Erimyzon sucetta* and *Anguilla rostrata*, extending into the Alleghanian district. Of the remaining eight species, four are restricted to New Jersey, and in the case of two of them, *Pœcilichthys erochrous* and *Mesogonistius chætodon*, the corresponding parts of Delaware; the other two species being *Cliola chalybæa* and *Amiurus prosthistius*. *Pœcilichthys erochrous* is the only Etheostomine perch which inhabits muddy waters, though it is not confined to such bottom, living as well in the gravelly but dark brown-stained streams of the New Jersey pines. The *Amiurus* is new to science, which is quite unexpected in the case of so large a fish. Its characters are as follows:—

Caudal fin rounded when expanded, not straight or slightly concave, the marginal rays being shortened. Anal fin long, one specimen with 27 rays, two with 25, and one with 24 rays. Anterior dorsal fin a good deal nearer the end of the muzzle than to the adipose fin. Length of head 2·66 times in length without caudal fin; depth at first anal ray 4·25 times in same. Greatest width of head just equal to depth of body at first anal ray. Eyes small, the space between them five times their long diameter. Pectoral spines a little larger than dorsal spines, with posterior points only, which are stronger than those of the dorsal. Maxillary barbel to near the middle of pectoral spine; humeral process little roughened, extending a little beyond middle of spine. Radii D. I. 6; C. + 18 +; V. 8; P. I. 8. Color generally black; the under surface of the head silvery white, fading on the belly to dull white and posteriorly pink, as far as base of anal fin. Fins black, pectorals and ventrals pale at base. Total length m. 0·208; from end of muzzle to base of dorsal spine, ·042; to posterior base of adipose fin ·149; to base of caudal fin (end of hæmapophysis) ·170. Depth at first anal ray ·039. Total length of a larger specimen ·233.

When first seen the specimens of this species were supposed to be unusually dark-colored examples of the common *Amiurus nebulosus*. A critical examination soon showed that they differ in the important characters of the considerably more anterior position of the dorsal fin, 4 to 7 more anal radii, and more rounded outline of the caudal fin. He had compared it with the *A. nebulosus* from Lake George, N. Y., and from the Hudson and Delaware Rivers. In fact its characters ally it to the western *A. natalis*, from which it differs by its more slender form and more rounded caudal fin.

The following was ordered to be printed:—

ON THE FISHES OF THE RECENT AND PLIOCENE LAKES OF THE WESTERN PART OF THE GREAT BASIN, AND OF THE IDAHO PLIOCENE LAKE.

BY E. D. COPE.

Preliminary Observations.

The numerous lakes of the northwestern part of the Great Basin present many points of interest to the geologist and biologist. The region which they occupy is one of comparatively recent geological disturbance, so that their topographical features may be regarded as of relatively modern origin. Their former greater extent and intercommunication in groups has been clearly pointed out by the geologists of the U. S. Survey of the Fortieth Parallel; and the species of fishes found in the pliocene and post-pliocene deposits of the adjacent regions have been shown by myself[1] to be nearly allied to those now living in the present lakes.

The geologists of the fortieth parallel have shown that a large part of the present Territory of Utah was, during late tertiary time, occupied by a large body of water, of which Salt Lake, Utah Lake and Sevier Lake are the present representatives. To this ancient sea they have given the name of Lake Bonneville. They have also shown that the existing lakes of the western region of Nevada were formerly united into an extensive body of water, to which they have given the name of Lake Lahontan. It included the existing Walker's, Carson, Humboldt, Pyramid and Winnemucca Lakes. It is exceedingly probable that it will be shown that a third lake existed in Oregon, north of the supposed northern boundary of Lake Lahontan, which is now represented by the Warner Lakes, Abert's Lake, Summer Lake and Silver Lake, and probably by Harney's and Malheur Lakes on the eastern side of the Oregon desert. As will be shown later, the larger species of fishes found in such of these lakes as contain them, are identical, and different from those of the lakes of the Bonneville series. One species, the *Catostomus tahoensis*, is common to this area and that of the true Lahontan Lakes (Tahoe and Pyramid), and this Oregon lake may have been continuous with that of Nevada, at a point some distance east of the mountains. Goose Lake, the Klamath Lakes, and doubtless Rhett and Clear Lakes,

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[1] Proceedings American Philosophical Society, Nov. 1870 and Dec. 1877.

form another series, characterized by several points of resemblance in their fish faunæ. Whether they were connected, forming a single body, at an earlier geological period, is not yet known. Some of them are connected by rivers and creeks at the present time, and the Klamath River discharges the contents of the lakes of the same name into the Pacific Ocean.

Still another late tertiary lake existed in Eastern Oregon and Western and Southern Idaho. No body of water represents it at the present time, and the remains of fishes found in its sediments belong to species different from those of the Oregon basin, both recent and extinct. It is to be supposed that this lake was separate from all of the others, and of earlier age, although one of the pliocene series. It may be called Lake Idaho, and its sediment, the Idaho formation. A list of its species will be given after the consideration of the characters of the faunæ of the Lahontan and Klamath Lakes.

The cause of the desiccation of the Great Basin and other interior regions of our continent, has not been satisfactorily explained. It is usually ascribed to the intervention of the Sierra Nevada and Rocky Mountain ranges, which precipitate the clouds from the Pacific Ocean, and thus deprive the regions eastward of rain. This would at first appear to be a sufficient explanation, but the facts of geological history contradict it. The existence of extensive lakes throughout the now dry region, in pliocene and postpliocene time, has been already referred to. But the Sierra Nevada was no less elevated then than now. Furthermore, great lakes or seas occupied the centre of the continent during miocene time, when the ranges were still higher. Vast forests of vegetation, and a rich population of animal life, point to a humid climate during the entire period that has elapsed since the great elevation of the Rocky Mountains in the beginning of the eocene epoch, to within comparatively recent times. Yet the mountains have been steadily diminishing by erosion throughout that period.

Of course the comparatively low elevation of the Great Basin would accelerate its desiccation, other conditions being equal. Mr. J. D. Clayton,[1] of Salt Lake City, discovered immense faults along the western slope of the Wasatch Mountains, and proposed the hypothesis that the entire area of the Great Basin had de-

[1] Published, I believe, in a number of the Salt Lake *Herald*, which I cannot at present lay my hands on.

scended several thousand feet during tertiary times. Mr. C. King[1] states that the fault along the eastern edge of the basin amounts to 30,000 feet, and that along the western border, from 3000 to 10,000 feet. The elevation of Pyramid Lake above the sea level is now, according to King,[2] 3890 feet. That of the Great Salt Lake is, according to Emmons, 4200 feet.[3] The depression, according to King, took place on the eastern side during early eocene times, and may have been nearly simultaneous on the western border. As a consequence of it, the Manti and Amyzon beds were deposited, representing the eocene period west of the Wasatch Mountains.

I. The Lahontan and Klamath Lakes.

The lakes of the Great Basin in Nevada and Oregon diminish in alkalinity as we approach the Sierra Nevada Mountains. While desiccation has concentrated the salts in all of them, those near the mountains have been maintained in a more or less fresh condition by the constant influx of the pure water of the mountain streams. The lakes most remote from the mountains are not habitable by fishes, their only animal population being crustacea and the larvæ of insects. Such are Summer and Christmas Lakes of Oregon; and the Malheur and Harney Lakes are said to have the same character. That of Pyramid Lake, although receiving the fresh waters of the Truckee River, is too alkaline to be potable. The following analysis is given in Mr. King's II Vol. of the Survey of the 40th Parallel (p. 824), as made by Prof. O. D. Allen, of Yale College:

Magnesia,	0·1292
Sodium,	0·8999
Soda,	0·4234
Chlorine,	1·3870
Sulphuric Acid,	0·1400
Carbonate of Lime,	0·0178
Carbonic Acid,	0·2392
	3·2365

in 1000 parts of the water.

[1] Survey of the 40th Parallel, i, p. 744.

[2] Loc. cit., iii, p. 822.

[3] Loc. cit., ii, p. 466.

The water of the Upper Klamath Lake is slightly alkaline to the taste, and less so than that of Pyramid Lake. The waters of Goose and Silver Lakes are similar to it, while that of Warner's Lake is rather more alkaline. All of these lakes abound in fishes. Summer Lake, Christmas Lake, and others, are intensely alkaline to the taste.

The locality which has furnished the greatest number of fossil remains of the pliocene or postpliocene ages, is known as Fossil Lake. It is twenty miles east of Silver Lake, in the western part of the Oregon Desert. It is a shallow depression of perhaps a hundred acres in extent, where drinkable water may be obtained by digging. The soil is a mixture of sand and clay, which supports a more or less luxuriant growth of Artemisia. Bones of extinct and recent species of vertebrata, thoroughly fossilized, mixed with worked flints,[1] and shells of *Carinifex newberryi* bleached snow-white, lie in profusion in this light material. Within a short distance of this locality the soil becomes sandy, and a few miles northeastward the surface of the country consists of sand-dunes, which rise to a height of one hundred feet. The sand is constantly moving to the northeast under the influence of the prevailing southwest wind, creeping up the long southwest slope of the dunes, and falling in a fine shower over the apex of the vertical northeast face. This tract is perhaps twenty miles in diameter.[2] A smaller tract of a similar character lies at the northern end of Summer Lake, where the sand is piled up against the basaltic hills that bound its valley on the east. I have given lists of the vertebrate fossils of this region, as cited in the accompanying foot-notes.

As described by Emmons,[3] Pyramid Lake is thirty miles long, by twelve wide. It is surrounded by mountains of eruptive granite, trachyte and basalt. According to King, the level of this lake rose, between 1867 and 1871, nine feet, while that of the connected lake, Winnemucca, rose twenty-two feet. This lake is exceedingly rich in life, as will be pointed out by and by. Messrs. Jordan and Bean[4] have catalogued several species of fishes as

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[1] See *American Naturalist*, 1878, p. 125.

[2] See Bulletin of the U. S. Geol. Survey of the Territories, F. V. Hayden, iv, p. 389 ; v, p. 48.

[3] Survey of the 40th Parallel, i, p. 506.

[4] Rept. of the Chief of Engineers, U. S. A. Expl. and Surv. W. of 100th Mer., G. M. Wheeler, 8vo, 1878, p. 187.

found in it, and I enumerate several additional ones in the present article.

The Mud Lakes in the neighborhood south of Fort Bidwell lie in a monoclinal valley of moderately inclined beds of a plutonic outflow. The strata dip towards the Sierra Nevadas, westwards. A high divide on the north separates these lake basins from that of the Warner Lakes. As already remarked, it is possible that they may have been connected by water, which occupied lower lands to the eastward, but this point remains as yet unsolved.

The four Warner Lakes occupy a long valley, which trends north and south. They are connected by a stream which flows through a succession of swamps of *Typha latifolia.* They abound in fishes and fishing-birds. The valley is apparently a fractured anticlinal, the strata dipping away from the lake on both the east and the west sides. The rocks are a dark-colored basalt. At the first and second lakes the western bluff is the higher, reaching, to judge by the eye, nearly a thousand feet elevation at the lower part of the third lake. At the northern part of the latter, at Wilson's Ranch, the eastern bluff is the higher, reaching the grand proportions of two thousand feet, estimated measurement.

Summer Lake is eighteen miles long and six or seven miles wide. The hills and bluffs of the western side probably reach a thousand feet in elevation. Those of the eastern side are much less elevated, and are separated from the water by a wide slope of sand and alkaline earth and mud. The western range is basaltic. At one point where the escarpment is especially steep, the brown basalt is overlaid by a deposit of white pumice or siliceous dust, which is worn into a picturesque sculpture by the weather.

I did not get a near view of Abert Lake, but it lies between high basaltic bluffs, of which the eastern is the more elevated, rising to a great height above the water. It is supplied with water by the Chewaucan River, which is a large creek with a fine flow of pure water. It abounds in fishes, especially the trout, *Salmo purpuratus.*

Silver Lake also lies in a valley with eastern and western walls of basalt. The strata of which the walls are composed, dip away from each other here, as at Warner's Lake, producing the impression that the lake occupies a fracture in an anticlinal. A range of hills, terminating at its eastern extremity in a bluff, extends along the north side of the lake. The rock of which it is composed differs from those of the principal ranges, in being a finely bedded volcanic conglomerate mud. The same material forms bluffs forty-five miles eastward in the desert. During the season of 1882 the waters of Silver Lake rose higher than had been previously known. It is probable that these lakes are rising, as is the case with Pyramid Lake. A comparatively small elevation would connect the waters of Silver Lake with Summer Lake, eighteen miles distant, and those of Summer Lake with the Chewaucan River, seven miles distant. This would convert the Chewaucan Swamp into a lake, and connect the Abert Lake with the series.

Goose Lake is thirty miles in length and about ten miles in width. It is bounded on the east and west by eruptive mountains of no great elevation near the lake, but which rise gradually to a considerable height, especially to the eastward. To the north and south the valley of the lake continues for several miles. It is cut off to the north by the watershed of the Chewaucan, and to the south by that of Pitt River. The scenery of its banks is tame as compared with that of some of the other lakes, but presents nevertheless many elements of beauty. It is shallow for a long distance from its northern and eastern shores. It abounds in fishes and water-birds. I fished for a day with hook and line without success, but procured a good collection of fishes by another method. I found numerous specimens both fresh and dry, which had been dropped by fishing-birds on or near the shore.

The great or Upper Klamath Lake is thirty-two miles long, and of irregular width, and is said to be twelve miles across its widest part. Its western shore is the base of the Cascade Mountains, and its eastern shore is bordered by a low range of eruptive hills. Both shores are wooded; and the scenery, though it lacks the rugged grandeur of that of Warner's and Abert's Lakes, is highly picturesque. The symmetrical proportions of Mount Pitt are ever visible on its eastern shore, while the more central peaks of the Cascades are in view from its northern extremity. It is fed by several streams, the most important of which is the Williamson's River, which enters it from the east. This has a considerable flow of water. The Link River, which connects the Upper and Lower Klamath Lakes with the Klamath River, is a wide and rapid stream containing much water.

The Upper Klamath Lake is more prolific in animal life than any body of water known to me. The proportion of alkali which it contains appears most favorable to the development of life. Its waters are full of vegetable impurities, living and dead, and mollusca and crustacea abound everywhere. These sustain a great population of fishes, which, though not numerous in species, is so in individuals. Swarms of fishing-birds employ themselves in catching them living from the lake. The most abundant mollusca are the *Planorbis* (*Carinifex*) *newberryi* Lea, and a *Lymnæa.* A probably hydroid polyp is found attached to the bark of submerged trees in large numbers. Its creeping yellowish stems are imbedded in sarcode, forming a continuous mass. Each zoöid is of an elongate oval form, sessile, and with six rays of equal size, each one-half as long as the body. These zoöids are translucent, but with two oval bodies in the lower half of the body-cavity, of a yellow color. The masses are as large as the fist. The length of each zoöid is one millimetre. They did not extend themselves beyond this length, neither did the rays elongate to beyond half the same, so long as I observed them. They retracted themselves on being irritated. They do not possess any fringes like the arms of the Polyzoa. As the possession of a cœnœcium distinguishes this genus from all the fresh-water hydroids, I propose to characterize this remarkable form as the type of a new genus, with the name of *Rhizohydra*, and the species, by the name of *flavitincta.*[1]

The following mollusca which I obtained were identified by Mr. Tryon, to whom my acknowledgments are due :—

Ancylus newberryi Lea.
Limnæa stagnalis Lea.
Physa gyrina Say.
Pompholyx effusa Lea.
Planorbis corpulentus Say.
Carinifex newberryi Lea.
Anodonta wahlamatensis Lea.

In my explorations of these lakes, I was greatly aided by Col. Whipple, in command at Fort Klamath, and Col. Barnard, in command at Fort Bidwell, and Dr. George Kober, surgeon at the

[1] My attempts to preserve some of the masses of this animal in alcohol were not successful.

latter post. To these gentlemen I wish to express my thanks. My especial thanks are also due to General W. T. Sherman, commander-in-chief of the army, from whom I have received many favors, on this and other occasions.

Synopsis of the Fishes.

ISOSPONDYLI.

Salmo purpuratus Pallas.

Pyramid Lake; Chewaucan River; Silver Creek (tributary of Silver Lake); Klamath Lake, and Williamson's River.

As Jordan remarks, this fish varies as to its color-shades, and is hence imagined by fishermen to include several species. A specimen from Link River (the part of Klamath River connecting the Klamath Lakes) is nearly silver-white. Specimens from Williamson's River are of darker color. I examined a large number of individuals from that stream, and found the following variations in some of them. One specimen Br. XI; Anal $10\frac{1}{1}$; one, Br. XII, A. $9\frac{1}{1}$; six, Br. XII, A. $10\frac{1}{1}$; three, Br. XIII, A. $10\frac{1}{1}$; one, Br. XIII, A. $11\frac{1}{1}$; one, Br. XIII, A. $12\frac{1}{1}$.

An important food fish, sometimes reaching ten pounds in Klamath Lake.

Salvelinus malma Walb.

Seven-mile Creek, which enters Lake Klamath from the northwest.

PLECTOSPONDYLI.

APOCOPE Cope.

Apocope ventricosa Cope. Jordan, l. c., p. 211.

Abundant in the small streams near Fort Bidwell, N. E. California.

Apocope vulnerata Cope. Jordan, l. c., p. 210.

Abundant in streams near Fort Bidwell, and in those tributary to Warner's Lake and Abert's Lake.

AGOSIA Gird.

This genus is stated by Jordan to agree with *Apocope*, excepting in the possession of a complete lateral line.

Agosia novemradiata Cope, sp. nov.

Scales 11–60–11; radii, dorsal I. 9; anal I. 7. The head is rather elongate, especially the muzzle, which projects a little beyond the mouth. Eye 4·5 times in length of head; 1·5 times in length of muzzle, and in interorbital width. Head four times in length without caudal fin; depth at ventral fin, five times in the same. Dorsal fin originating behind line of last ventral ray; radii always I. 9. Caudal peduncle rather deep.

Measurements.	M.
Total length (with caudal fin),	·107
Length to edge of operculum,	·010
Length to first ventral ray (outside),	·044
Length to first dorsal ray (outside),	·047
Length to first anal ray (outside),	·060
Length to base of caudal fin,	·085
Depth at occipital region,	·013
Depth at first dorsal ray,	·018
Depth at first anal ray,	·016
Depth of caudal peduncle,	·009

Color silvery, dusted with smoky, to below the lateral line, and marked on the sides and back with several rows of dusky spots. Bases of inferior fins and upper lip red.

This species differs from the species of *Apocope*, which it generally resembles, in having a perfect lateral line. It agrees with the *A. henshavi* in having nine dorsal rays, but has a longer muzzle and larger scales. The latter has the following scale formula, 16–67–12. It is possible that some of the specimens referred by Jordan to the *A. henshavi* belong here. Abundant in Weber River at Echo, Utah.

CLIOLA Gird.

Hybopsis "Agass." Cope and others.

Cliola angustarca Cope. Proceeds. Amer. Philos. Society, 1877, p. 230.

Well distinguished from the allied fossil species by its narrower pharyngeal bones, and its teeth 4–4. Fossil Lake, Oregon.

MYLOLEUCUS Cope.

Annual Report U. S. Geol. Survey Terrs., 1871, p. 475. Jordan, Synopsis Fishes North America, 1883, p. 887.

This genus differs from *Leucus* Heck. in its dental formula, 5–4 instead of 5–5. It is characteristic of the streams and lakes of the Great Basin, and of those waters of Oregon and California which lie nearest to them. Most of the lakes of southwestern Oregon contain them, and their variations are such as to render their specific characters somewhat difficult to unravel. Teeth of species of this genus occur in the pliocene lake deposits of the Great Basin.

Myloleucus gibbarcus Cope. *Alburnops gibbarcus* Cope, Proceeds. Amer. Phil. s. Society, 1877, p. 230. *Anchybopsis breviarcus* Cope. l. c., p. 229.

The presence of four teeth on the right pharyngeal bone of specimens referred to *Alburnops*, as above, is not established ; and the other characters point to the specific identity of the individuals included under the two names cited. It was abundant in a fossil state at Fossil Lake, Oregon, whence I have obtained about twenty pharyngeal bones of both sides. First discovered by Chas. M. Sternberg.

The recent species may be distinguished as follows :—

Scales 11-12—51-5—6-7 ; anal rays I. 8 ; head 3·5 ; depth 3·5 to 4 times in length. *M. formosus.*

Scales 10—47-50—5 ; anal rays I. 8 ; head 3·5 ; depth 4 times in length. *M. parovanus.*

Scales 9–46–4 ; anal rays I. 9 ; head 3·75 ; depth 4·5 times in length. *M. thallassinus.*

Myloleucus formosus Girard. Jordan, Synopsis Fishes N.A., p. xxi. *Leucus formosus* Jordan, Report Capt. G. M. Wheeler, Expl. W. 100th Mer., 8vo, 1878, p. 193.

Specimens of this fish from Silver Lake represent a form of the species allied to the *M. obesus*, in the greater depth of the body than those found in the Chewaucan River and the Warner Lakes. In the first named, the depth enters the length 3·5 times ; in the last two, four times. The Silver Lake specimens diverge from the types in having the scales a little larger. They are thus counted in the three sets of specimens :—

Silver Lake 11—51-3—8 ; Chewaucan 11–55-7 ; Warner Lake 12—54-5—7. The largest specimen is from Warner's Lake and measures 8½ inches in length.

Myloleucus parovanus Cope. Zoology Wheeler's Expl. Surv. W. 100th Mer., p. 669.

This species was originally described by me from the Beaver River of Utah. It now appears that is the most abundant cyprinoid of Goose and Klamath Lakes. It reaches a length of 10 to 12 inches, and forms a large part of the food of the great flocks of various species of fishing-birds which live at those lakes. Its specific characters are constant in a large number of individuals. Prof. Jordan identified this species with the *M. bicolor* of Girard, but he gives the scale formula of that species as 8–50–5, and the anal rays as 7—characters quite inconsistent with the *M. parovanus.*

Myloleucus thalassinus sp. nov.

This species rests on a single specimen which I obtained at Goose Lake, Oregon. It is a more slender fish than the *M. parovanus*, and its color when fresh is light, translucent green, quite different from the more or less heavy olivaceous color of the latter. Its proportions are expressed in the key above given, as well as the smaller number of longitudinal rows of scales, and the additional ray of the anal fin.

Measurements.	M.
Total length (with caudal fin),	·143
Length to edge of opercle,	·031
Length to base of dorsal on lateral line,	·059
Length to base of ventral on lateral line,	·061
Length to base of anal on lateral line,	·0805
Length to base of caudal on lateral line,	·114
Depth at first dorsal ray,	·026
Depth at first anal ray,	·022
Depth of caudal peduncle,	·014
Width of interorbital region,	·010
Width of orbit,	·007

LEUCUS Heckel.

Fische Syriens, 1843, p. 48. *Anchybopsis* Cope, Proceed. Amer. Philos. Society, 1870, p. 543.

I found recent species of this genus in Pyramid Lake, Nevada, only. Some extinct species occur in the pliocene beds of Oregon and Idaho.[1] The two species from Pyramid Lake differ as follows:

Scales 13-14—56-9—7-8; anal rays I. 8; head 3·66 in length; depth 4 (3·75); eye in head 5 times. *L. olivaceus.*

Scales 14-15—63-6—8; anal rays I. 8; head 4 times in length; depth 4·5 times; eye 3·5 in head. *L. dimidiatus.*

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[1] *Leucus latus; Anchybopsis latus* Cope, Proceeds. Amer. Philos. Soc., l. c., Idaho; size large. *Leucus altarcus; Anchybopsis altarcus* Cope, loc. cit., 1877, p. 229. From Oregon; small.

Leucus olivaceus sp. nov.

The largest cyprinoid of the Pyramid Lake, and very abundant. The shape is a regularly compressed fusiform. The head narrows to the muzzle, and the mouth opens obliquely forwards and upwards. The end of the maxillary bone, when the mouth is closed, is concealed in a sheath, and extends a little beyond the anterior margin of the eye. The latter enters the length of the muzzle (without the chin) 1·33 times; and the interorbital space 1·60 times. Middle of front a flat longitudinal surface, bounded on each side by an angle, from which the surface slopes to the superciliary border. In the *Myloleucus parovanus*, a fish of similar size, the frontal is flat roof-shaped, there being a median longitudinal angle. In specimens from Klamath Lake, however, the lateral angles are more distinct than in those from Goose Lake. This fish is everywhere a dusky olive, except on the belly, which is silvery. No lateral band. Fins dusky.

Measurements.	M.
Total length, with caudal fin,	·283
Length to edge of opercle,	·064
Length to base of dorsal, on lateral line,	·122
Length to base of ventral, on lateral line,	·131
Length to base of anal, on lateral line,	·173
Length to base of caudal, on lateral line,	·235
Depth at first dorsal ray,	·060
Depth at first anal ray,	·043
Depth at caudal peduncle,	·027
Width of interorbital region,	·020
Width of orbit,	·0126

This and the smaller *L. dimidiatus* swim in schools in the lake, and may be seen from the elevated road along the rocky shores, rippling the surface like a gust of wind. At this signal, the pelicans, gulls and terns quickly congregate, and are soon actively employed in fishing.

Leucus dimidiatus Cope, sp. nov.

This very abundant fish is much smaller than the adult *L. olivaceus*, and has a more slender form, smaller scales, and a different coloration. The eye nearly equals the interorbital width and a little exceeds the length of the muzzle. The mouth slopes upwards, and the extremity of the maxillary bone reaches to the anterior edge of the orbit. The ventral fin originates behind the point below the first dorsal ray by the width of a ray. The fins are all rather small, except the caudal. The sides and belly are a pure silver-white up to the eighth row of scales below the dorsal fin. Above that line the sides and back are a light brown, becoming lead-colored along the border of the white. In some specimens this lead-color forms an obscure band.

Measurements.	M.
Total length with caudal fin,	·104
Length to edge of opercle,	·021
Length to first dorsal ray on lateral line,	·042
Length to first ventral ray on lateral line,	·043
Length to first anal ray on lateral line,	·060
Length to caudal fin on lateral line,	·084
Depth at first dorsal ray,	·019
Depth at first anal ray,	·0148
Depth at first caudal peduncle,	.009
Width of interorbital space,	·007
Width of orbit,	·006

This species exists in immense numbers in Pyramid Lake, where it doubtless furnishes much food for the trout, *Salmo purpuratus*.

Leucus altarcus Cope. *Anchybopsis altarcus* Cope, Proceeds. Amer. Philosoph. Soc., 1877, p. 229.

Extinct; from Fossil Lake, Oregon, only. Represented by pharyngeal bones and teeth.

SIPHATELES Cope.

Gen. Nov. Char.—Pharyngeal teeth 5–5, with well developed grinding surfaces. Ventral fins beneath the anterior part of the dorsal. Lateral line very imperfectly developed.

This genus is *Leucus*, with undeveloped lateral line. The only species does not resemble any of the others here described.

Siphateles vittatus sp. nov.

Scales 11–55–5; radii D. I. 8; A. I. 8. Head 4 times in length without caudal fin; depth of body 4·5 times in the same. Eye one-third of length of head, and a very little less than interorbital width. Mouth opening obliquely upwards, the maxillary not quite reaching the anterior edge of the eye.

Measurements.	M.
Total length with caudal fin,	·077
Length to edge of operculum,	·016
Length to line of dorsal fin on lateral line,	·0323
Length to line of ventral fin on lateral line,	·0328
Length to line of anal fin on lateral line,	·045
Length to base of caudal on lateral line,	·061
Depth at first dorsal ray,	.0133
Depth at first anal ray,	·0105
Depth of caudal peduncle,	·0068
Diameter of interorbital space,	·045
Diameter of eye,	·0445

Belly and sides silvery; a straight lead-colored lateral band; above this, pale reddish (in spirits). The leaden band is interrupted at the base of the caudal fin by a vertical band of straw-yellow, which has a dark posterior edge.

In the species of *Leucus* from the same locality (Pyramid Lake), there are 23 or 24 longitudinal rows of scales; in this one there are only 17.

SQUALIUS Bonap.

Jordan, Synopsis Fishes N. America, p. 230.

The species of this genus, as defined by Jordan, that I have observed in the Oregon Lakes, are two, which differ as follows:

Scales 13–63–7; dorsal rays I. 9; head 3·75 to 4 times in length; depth in do. 4 times; eyes in head 4·25 times; teeth 2·5–5·2. *S. cœruleus.*

Scales 12–60–5; dorsal rays I. 8; head 4 times in length; depth in do. 4·25 times; eye in head 3 times; teeth 1·4–5·1. *S. galtiæ.*

Squalius cœruleus Girard. Jordan, l. c., p. 241.

Abundant in Klamath Lake. The specimens differ among themselves somewhat; thus, the depth enters the length 3·60 times in some; 4 times in others. The dorsal fin originates above the ventral in some; a little behind in others. The teeth all have the grinding surface distinct, and the dorsal fin always has I. 9 rays. Length of the longest specimen, $5\frac{1}{8}$ inches.

Squalius galtiæ sp. nov.

This species belongs to the group *Clinostomus*, where the dorsal fin originates a little behind the line of the front of the ventrals, and the teeth have no grinding surface. The lateral line is, on the other hand, but little decurved, and there are but eight anal rays (in one specimen nine). The muzzle is short and the mouth oblique, without prominent chin, and with the extremity of the maxillary bone extending a little beyond the line of the anterior rim of the orbit. The interorbital region is gently and regularly convex, and is as wide as the diameter of the orbit.

The color is olive above, as far laterally as a plumbeous band which extends from the superior angle of the operculum to the middle of the base of the caudal fin. Below this line, the sides and belly are silver, except a broad band of crimson, which extends from the branchial fissure, to the line of the first anal ray. Side of head with a dusky band. This is the only species I have seen in this region which displays brilliant colors.

Measurements.	M.
Total length with caudal fin, ...	·067
Length to edge of opercle, ...	·014
Length to first dorsal ray on side, . . .	·0298
Length to first ventral ray on side, . . .	·0282
Length to first anal ray on side, . . .	·0385
Length to base of caudal fin, ...	·056
Depth at first dorsal ray, ...	·014
Depth at first anal ray,.	·0103
Depth of caudal peduncle, ...	·006
Interorbital width, ...	·0043

This pretty species is quite abundant in Pyramid Lake.

CHASMISTES Jordan.

This curious genus is confined to the lakes of the Great Basin. One species, the *C. liorus* J. and G., is very abundant in the Utah Lake, while the others occur on the western side of the same zoölogical area. Two of them I discovered in Lake Klamath in 1879, and I now add a fourth from Pyramid Lake. These fishes are the largest that inhabit the waters of the Great Basin. They are essentially Catostomi in which the fleshy lips are wanting, the mouth having the characters of the majority of the Cyprinidæ.

Chasmistes cujus sp. nov.

I procured but one specimen of this fish from Pyramid Lake, where it is difficult to obtain. The size is large; the specimen I procured measured eighteen inches in length. The head is wide and flat, the width of the interorbital space being more than half the length. The upper lip is very thin; the lower lip is represented by folds on each side, which do not connect round the symphysis. Scales 13–65–11. Dorsal rays 12; anal I. 8. The eye enters the length of the head 8·5 times, and the interorbital width 4·5 times. The swim-bladder has but two cells. The colors are pale olive.

The pharyngeal teeth of this species are much like those of the *C. liorus* in their triangular section; they are, nevertheless, of delicate construction. The head of this species is relatively larger and wider than in any of the others, which gives it a heavy and clumsy appearance.

This fish is said by the fishermen to inhabit the deepest water, and to be seen in numbers only at the time of breeding. Its habits in this respect agree with what is said of the *C. luxatus* of the Klamath Lake. The Indian name of the *Chasmistes cujus* is "Couia."

Chasmistes brevirostris Cope. American Naturalist, 1879, p. 785. Jordan, Fishes N. Amer., p. 132, 1883.

This fish does not exceed 14 to 16 inches in length, and has a differently formed head and muzzle from the *C. luxatus*. They are shorter, especially the muzzle, and the latter is without the hump produced by the protuberant premaxillary spines. Parietal fontanelle small. The lower lip-fold is only present at the sides of the mandible. Both lips are smooth. Eye round, its diameter entering the length of the head six and two-thirds times, of which three times enters the muzzle. Interorbital region flat, its width entering the length of the head two and one-eighth times. Body nearly cylindric. Scales 12–74–11; radii D. 11, A. 9. Color dusky above, silvery below; fins colorless. This fish is abundant in Klamath Lake, but I was informed by a Klamath chief, that it does not ascend Williamson's River in spring with the *C. luxatus* and *Catostomus labiatus*. Klamath name, "Xoöptu."

Chasmistes luxatus Cope, American Naturalist, 1879, p. 785. Jordan, l. c., p. 132.

Form elongate; head long, flat above, and with a large fontanelle. Mouth terminal, the spines of the premaxillary bones projecting so as to form a hump on the top of the snout. Lower lip a very thin dermal fold, extending entirely around the chin. Both upper and lower lips delicately tubercular. Eye oval, the axis longitudinal, and contained seven times in the length of the head, of which three and a-half times are contained in the muzzle. Interorbital region flat, one-third as wide as the head is long. Scales 12–80–9; radii D. 11, A. 9. Color clouded above with black punctulations; below paler, with red shades in some specimens; fins uncolored. It attains a length of nearly three feet. It ascends the streams tributary to Lake Klamath in thousands in the spring, and is taken and dried in great numbers by the Klamath and Modoc Indians. The former call it "Tswam."

The character of the lips, the oval eye, and the less interorbital width distinguish this species from the *C. brevirostris*, as well as the longer muzzle and superior size adduced in my original description.

On this species and the *C. brevirostris* I proposed the genus *Lipomyzon*, on the supposition that the pharyngeal bones and teeth of *C. liorus* were like those of the genus *Catostomus*, from which those of these species differ in their greater attenuation. During the summer of 1882, I obtained a number of specimens of *C. liorus*, and find that while its pharyngeal bones are less attenuated than those of *C. luxatus*, they are more so than in some species of *Catostomus*, so that I cannot distinguish, generically, the species of Klamath Lake. The pharyngeals of *C. brevirostris* are not more attenuated than those of *C. liorus*.

CATOSTOMUS Les.

Catostomus labiatus Ayres. Cope, American Naturalist, 1879, p. 785.

This species abounds in Klamath and Goose Lakes, but I did not observe it in any of the lakes to the eastward of these. The formulæ are:—

Klamath Lake: scales, 10–74–11; radii D. I. 11; V.10; head 4·5 times in length; eye 5·5 times in head.

Goose Lake: scales 12-13—75—11; radii; D. I. 11; V. 10; eye 6; head 4·5 times in length.

The largest specimens measure twelve inches in length. Remains of species of this family are abundant in the pliocene sands of Oregon, but do not represent many species. Pharyngeal bones and teeth indicate that the species are true Catostomi.

Crania and other bones of one of the species have been found abundantly at Fossil Lake. In some of the specimens the pharyngeal bones and teeth are preserved. I cannot distinguish the specimens from corresponding parts of the common sucker of Lake Klamath, named by Ayres as above. They, however, present considerable variations among themselves. These may be stated as follows :

I. Ethmoid and front convex transversely.
  a. Parietal fontanelle small. Two specimens.
  aa. Parietal fontanelle large. Three specimens ; two of them lent me by Prof. Thos. Condon, of Eugene, Or.
II. Ethmoid and front a little convex ; fontanelle large ; in both points resembling the typical specimens from Lake Klamath. One specimen.
III. Ethmoid and front plane, the latter a little concave in profile. Fontanelle large. One specimen.

There are numerous other skulls in my collection, but they are not yet sufficiently cleared of matrix to display their characters.

Catostomus batrachops sp. nov.

This sucker is characterized by the short, wide and depressed form of the cranium. The ethmoid bone is considerably more than twice as wide as long (minus the spine), while in *C. labiatus* it is only half as long as wide. The interorbital width is equal to the length of the skull, minus the ethmoid bone and epiotic spine ; in *C. labiatus* this width is a good deal less than the dimension mentioned. The ethmoid and frontal bones are less convex than is the case in the more common fossil variety of *C. labiatus*. Although the bridge separating the temporal and pterotic fossæ is wide in *C. labiatus*, it is wider in the *C. batrachops*, and has a concave superior surface, which is not separated by ridge or angle from that of the superior plate of the parietal bone. There is no frontal keel, and the fontanelle is well developed.

Measurements.	M.
Length from epiotic spine to ethmoid spine, inclus.,	·084
Length of ethmoid, minus spine,	·018
Length of frontal bone (median),	·032
Length of parietal bone (median),	·015
Interorbital width,	·056
Width at pterotics, about	·062
Width between apices of epiotics,	·032
Width of ethmoid,	·042

This species appears to have been about eighteen inches in length. The only skull which represents it was found by Charles H. Sternberg, near Silver Lake, Oregon.

Catostomus tahoensis Gill and Jordan. Synopsis Fishes N. Amer., 127.

This is the common species of the lakes which represent the Lahontan Basin. I found it in Pyramid Lake and the third Warner Lake. The formulæ are as follows:

Pyramid Lake: scales 14–89–14; radii D. I. 11; V. 9; head 4·5 times in length.

Warner Lake: scales 16–83–15; radii D. I. 11; V. 9; head 4 times in length.

PERCOMORPHI.

URANIDEA Dekay.

Uranidea minuta Pallas. Jordan Synopsis, p. 698.

Abundant in Klamath Lake; not seen elsewhere.

General Remarks.

The species noticed in the preceding pages may be enumerated with reference to their geographical distribution, in the following lists:—

I. Pyramid Lake.

Salmo purpuratus henshavi Jord.
Leucus olivaceus Cope.
Leucus dimidiatus Cope.
Siphateles lineatus Cope.
Squalius galtiæ Cope.
Chasmistes cujus Cope.
Catostomus tahoensis G. & J.

II. Fort Bidwell.

Apocope vulnerata Cope.
Apocope ventricosa Cope.

III. Warner's Lake.

Apocope vulnerata Cope.
Myloleucus formosus Gird.
Catostomus tahoensis G. & J.

IV. Goose Lake.

Myloleucus parovanus Cope.
Myloleucus thalassinus Cope.
Catostomus labiatus Ayres.

V. Klamath Lake.

Salmo purpuratus Pall.
Salvelinus malma Walb.
Myloleucus parovanus Cope.
Squalius cœruleus Gird.
Squalius bicolor Gird.
Chasmistes brevirostris Cope.
Chasmistes luxatus Cope.
Catostomus labiatus Ayres.
Uranidea minuta Pall.

VI. Silver Lake.

Salmo purpuratus Pall. *Myloleucus formosus* Gird.

VII. Abert's Lake.

Salmo purpuratus Pall. *Myloleucus formosus* Gird.
Apocope vulnerata Cope.

VIII. Weber River, Utah.

Rhinichthys transmontanus Cope. *Squalius montanus* Cope.
Agosia novemradiata Cope. *Pantosteus platyrhynchus* Cope.

IX. Fossil Lake, Oregon. (Fossil.)

Leucus altarcus Cope. *Catostomus labiatus* Ayres.
Myloleucus gibbarcus Cope. *Catostomus batrachops* Cope.
Cliola angustarca Cope.

Examination of the preceding lists discloses the following facts: (1). The species of *Leucus* replace in Pyramid Lake the *Myloleucus* of the other lakes. (2). All the species of Pyramid Lake are peculiar to it, excepting the *Catostomus tahoensis*, which is found in the third (and probably other) Warner Lakes, one hundred and fifty miles north of it. (3). The *Myloleucus formosus* inhabits the eastern line of lakes—Warner's, Abert's and Silver Lakes; while the *M. parovanus* is confined to the more western lakes, the Goose and Klamath. (4). The distribution of the Catostomi is similar; the *C. tahoensis* being the eastern, in Pyramid and Warner's Lakes, and the *C. labiatus* in the Goose and Klamath Lakes.

The distribution of the other species is not sufficiently known to enable us to draw any conclusions regarding them.

II. The Fauna of the Idaho Lake.

RAIIDÆ.

Raia pentagona Leidy. *Oncobatis pentagonus* Leidy, Proceeds. Phila. Academy, 1870, p. 70.

A species said to have been found in the beds of this deposit. It is referred to a new genus by Leidy, who, however, does not characterize it.

CYPRINIDÆ.

This family predominates over all others in the number of species and individuals. Typical carnivorous forms (*Squalius*) were not rare, but the greater number of genera are carnivorous with the teeth less (*Leucus*, *Myloleucus*) or more (*Mylocyprinus*) adapted for crushing hard substances. The food of such species was probably mollusca. There were but few herbivorous forms, and these (*Diastichus* sp.) not typical, but related to the adjacent carnivorous genera. Especial interest attaches to the present distribution of some of the genera. *Diastichus* is the only one which is extinct, so far as known, though its characters approach those of existing genera so nearly, that it may be found at any time in the recent fauna. *Mylocyprinus* has a living species in China. *Leucus* is found in Europe and Asia. *Myloleucus* is American, and is confined to the lakes of the Great Basin and California; two species occurring in Utah and two in Oregon. *Cliola* is found in North America east of the Sierra Nevada. *Squalius* is generally North American and European.

MYLOCYPRINUS, Leidy.

Proceedings Academy Phila., 1870, 70. Cope, Proceeds. Amer. Philos. Society, 1870, 543. *Mylopharyngodon* Peters, Monatsberichte Berlin Academy, 1880, 925.

I am acquainted with three species of this genus; two extinct from Idaho, and one, the *Mylocyprinus æthiops* Basilewsky, (*Mylopharyngodon* Peters) recent, in China. The pharyngeal bones of these species may be distinguished as follows. I know those of the *M. æthiops* from a figure given by Prof. Peters.

I. Teeth commencing near the symphysis; curvature of pharyngeal very abrupt; apex shorter than tooth-row; *M. inflexus.*

II. Teeth commencing at a distance from symphysis, leaving a style; curvature gradual.

Style and apex each shorter than tooth-row; *M. robustus.*

Style and apex each longer than tooth-row; *M. æthiops.*

Mylocyprinus inflexus Cope, sp. nov.

Established on two pharyngeal bones of the left side, one of which indicates a fish of perhaps two pounds weight, and the other one of half the size. Its form is peculiar in the very abrupt curve of the external border, the great abbreviation of the style, and the shortness of the tooth series. The proximal and distal extremities of the bone are connected across the concavity by a thin expansion of the inner border, not seen in *M. robustus.* The first tooth is small, but larger than the corresponding one sometimes seen in *M. robustus*, so that I would be inclined to think it a permanent character, were it not wanting from the smaller specimen.

The second tooth is broadly molar. Two foramina perhaps indicate the position of two teeth of an internal row. The toothless apex of the bone is longer and flatter than in *M. robustus.* The entire bone is flatter than in that species. The first tooth stands on the edge of the symphysis.

Measurements.	M.
Total length on tooth row,	·025
Length of base of tooth row,	·018
Length of apex,	·016
Width at middle,	·018

Near Sinker's Creek, Idaho. J. L. Wortman.

Mylocyprinus robustus Leidy. Loc. cit. Report U. S. Geol. Survey Terrs., i, p 262, Pl. XVII, figs, 11–17.

This is the most abundant fish of the Idaho beds, and is represented by a great many pharyngeal bones with teeth, in my collection. These present a great many variations, and I have proposed in a former paper to recognize three species: *M. kingi*, *M. robustus* and *M. longidens.* Study of my material shows that these forms intergrade, and that if they represent distinct species, two others must be admitted. I incline to look upon the differences as due in part to age, and in part as subspecific variations. I tabulate them as follows:

I. Small; style more slender, five teeth in outer row, the upper very small and subprehensile; the lower small, conic.

II. Like the last, but the style stouter.

III. Like I, but only four teeth; the inferior tooth wanting.

IV. Like I, but four teeth; the superior larger and obtuse; *M. longidens.*

V. Larger; four teeth, the last obtuse but much smaller than the others; style stout; *M. robustus.*

VI. Larger; style stout; four teeth, the superior nearly as large as the others, which are equal; *M. kingi.*

The slenderness or stoutness of style is not coincident with the other characters, but the latter condition is always found in large specimens. In these the convex border is also much thickened. The small, partly hooked form of the superior tooth is only found in small fishes, and is probably a character of youth. It indicates that the genus is descended from more purely carnivorous types.

The minute first tooth is generally found in small specimens, but not always. It lingers in some to middle size. This species has not been found in the Oregon basin. The settlers call the pharyngeal bones "baby-jaws."

LEUCUS Heckel.

Fische Syriens, 1843, p. 48. *Anchybopsis* Cope, Proceed. Amer. Philos. Soc., 1870, p. 543.

Leucus latus Cope. *Anchybopsis latus* Cope, l. c.

Much the largest species of the genus, as yet only represented by two pharyngeal bones of opposite sides. Southern Idaho.

Leucus condonianus Cope, sp. nov.

This fish is represented by four pharyngeal bones, two of each side, which have the dental formula 2·5–5·2; the presence of the two inner teeth being doubtful on one of those of the right side. They indicate a smaller fish than the *L. altarcus*, and one about the size of the *Ceratichthys biguttatus*. The teeth display but little grinding surface, and have swollen subconic crowns, which are less expanded transversely than those of the *L. altarcus*. The style is moderately long and not much recurved. The external aliform border is rather full, and expands gradually from the style, not abruptly, as in *L. altarcus*. It is especially full opposite the superior extremity of the tooth series, where it is contracted in *L. latus*.

Measurements of Medium Size.	M.
Length on tooth line,	·014
Length of tooth line,	·007
Length of apex from tooth line,	·005
Width at middle,	·005

Dedicated to Professor Thos. Condon, of Eugene, Oregon, who first discovered and explored in part, the fossiliferous formations of the Oregon and Idaho basins.

SQUALIUS Bonap.

Jordan emend. *Ptychochilus* Agass. *Clinostomus* Girard. *Oligobelus* Cope, Proceeds. Amer. Philosoph. Soc., 1870, p. 540.

The American species generally differ from the type in the reduced number of teeth in the right pharyngeal series. The dental formula is 2·5–4·2, in our extinct and recent species. In the pliocene species here noticed, the teeth have acute, slightly incurved, apices. They differ from each other as follows:

I. Inner face just above superior tooth much narrower than anterior or posterior faces.

a. An external marginal expansion.

Width at fourth tooth equal length of bases of superior three teeth; an external bevel below first tooth; large; *S. posticus.*

Width at fourth tooth considerably less than length of bases of superior three teeth; a bevel below base of first tooth causing ala to be more distinct; large; *S. laminatus.*

Ala not projecting; width less than length of bases of superior three teeth; no bevel below first tooth; smaller; *S. reddingi.*

aa. No external ala.

Bone very narrow; teeth spaced; larger; *S. bairdi.*

II. Inner face just above superior tooth deep, equaling anterior and posterior faces.

No external ala; bone narrow; *S. arciferus.*

Squalius posticus Cope. *Semotilus posticus* Cope, Proceeds. Amer. Philos. Society, 1870, p. 541.

The original specimen is from Idaho. Only a fragment of two others are known.

Squalius laminatus Cope. *Oligobelus laminatus* Cope, loc., cit., 1870, p. 541.

Originally founded on a single fragmentary pharyngeal bone. A complete right-hand bone with all the teeth, found by Mr. Wortman, shows that this is as large a species as the *G. postica*, but of more slender proportions.

Squalius reddingi Cope, sp. nov.

This species is founded on pharyngeal bones of individuals of smaller size than those which represent the others mentioned in this list. They represent a fish of the average dimensions of the *Pogonichthys inæquilobus* of California. The five teeth occupy as much length as the style, and the apex is as long as the bases of four teeth and an interspace. The apex is flat, and its inner face is convex, and as deep at the base as one-half the width. The external alar expansion is slight but distinct, and originates opposite the third tooth from below. The style is not recurved.

Measurements.	M.
Length on tooth series, ...	·026
Length of tooth series, ...	·012
Length of apex from teeth, ...	·011
Width of bone at middle, ...	·005

One right and two left pharyngeal bones of this species were found by Mr. Wortman in Southern Idaho. It is named for my friend, the late Mr. B. B. Redding of San Francisco, Vice-President of the California Academy of Sciences.

Squalius bairdi Cope. *Semotilus bairdi* Cope, loc. cit., p. 542.

This species was established on a right pharyngeal bone which supported four teeth in the principal row. My original reference of it to the genus *Semotilus*, was based on supposition that the left pharyngeal bone would be found to support five teeth in the principal row. This is shown to be the case by such a bone discovered by Mr. Wortman. It belonged to a smaller individual than the typical one, and shows the very narrow basis of a probably shorter style than those seen in the other species here mentioned.

Squalius arciferus Cope. *Oligobelus arciferus* Cope, loc. cit., p. 541.

The most robust species, represented by parts of two pharyngeal bones.

DIASTICHUS Cope.

Proceedings Amer. Philos. Society, 1870, p. 539.

An entire pharyngeal bone of the typical species of this genus has five teeth in a single series. The opposite bone of another species presents also five teeth, so that the formula is probably 5–5. The teeth are compressed and short, and somewhat expanded transversely to the direction of the bone. They display an oblique grinding surface on use. They might then be referred to the genus *Leucus*, but the apical branch of the bone is much more elongate and is truncate at the extremity. This character is best seen in *D. macrodon*, where there appears to have been a superior as well as an inferior symphysis. The direction of the tooth series is at right-angles to this apical portion, as in other genera.

Diastichus macrodon Cope. Loc. cit., p. 539.

A specimen of pharyngeal bone, found by M. Wortman, is not more than half the linear dimensions of those obtained by Mr. King from the same part of Idaho.

Diastichus parvidens Cope. Loc. cit., p. 540.

No additional material.

Diastichus strangulatus sp. nov.

Represented by two pharyngeal bones from Southern Idaho.

One of these lacks the style, and the other the apical portion. The species differs from the *D. macrodon* in the flatter apical ramus, which is devoid of the marginal tuberosity and distal recurvature, seen in that species. It is straight and forms an acute angle with the axis of the tooth series. The style is short, stout, and somewhat recurved. The marginal ala is rather abruptly given off opposite the second tooth from below. The necks of the pharyngeal teeth are contracted, so that the internal and external outlines of the crown are convex. The grinding surface is quite oblique.

Measurements.	M.
Length of tooth line, ...	·014
Length of apical ramus, ...	·013
Width of bone at middle, ...	·010
Width of crown of tooth, ...	·005

This species was about the size of the gold-fish. From Southern Idaho, J. L. Wortman.

CATOSTOMIDÆ.

Catostomus shoshonensis sp. nov.

Of this fish I have two crania from the Idaho basin, one obtained by Mr. Wortman and the other by Mr. Clarence King. Two other crania, collected by the same gentlemen, represent a variety, or possibly another species.

The bones of the skull are relatively more elongate than those of the *C. labiatus.* The width of the superior surface of the parietal bones between the lateral angles is equal to two-thirds the length of the superior surface of the ethmoid bone posterior to the base of its anterior spine. The two measurements are equal in the *C. labiatus.* The ethmoid has three median longitudinal concavities and raised borders in the *C. shoshonensis*, but is regularly convex in the *C. labiatus.* The temporal fossa is separated by a narrow raised band from the pterotic fossa in the former, but by a very wide band in the latter. The supratemporal crests are not raised and sink gradually to the level opposite the posterior part of the supraorbital border. There is a slight median frontal keel which extends forwards from the same point. The frontoparietal fontanelle is well defined, elongate, and rather narrow. It commences at the base of the supraoccipital spine and extends to opposite the anterior foramen of the postfrontal bone. The bones of the skull are smooth.

Measurements.	M.
Length from apex of epiotic to end of ethmoid spine, inclusive,	·075
Length of ethmoid without spine (median),	·018
Length of frontal bone (median),	·030
Length of parietal (median),	·0105
Interorbital width,	·028
Width at pterotics,	·040
Width between apices of epiotics,	·0245
Width of parasphenoid at middle of orbits,	·0070
Diameter (long) of hyomandibular cotylus of pterotic,	·0070.

The above measurements equal those of the largest size of the *Catostomus teres* of our waters. It will be desirable to compare its skull with that of *C. macrochilus* Gird., which comes from the Columbia River. Girard says that it is of more elongate proportions than that of the *C. labiatus*.

Catostomus cristatus sp. nov.

This species is known to me from a skull, of which only the cranium posterior to the anterior orbital region remains. It belongs to the same elongate type as the *C. reddingi*, and differs from that species as follows:—

The lateral casts of the frontal bone are more elevated, and are carried farther forwards. Instead of gradually disappearing anteriorly, they descend abruptly to their termination, enclosing a groove with the supraorbital plate of the frontal. The fontanelle is wide, and extends farther into the frontal bone. The low median frontal ridge commences at its anterior border. The bridge between the temporal and pterotic fossæ is narrow. There is a transverse ridge on each half of the supraoccipital bone; in *C. reddingi* this ridge is oblique, descending towards the middle line.

Measurements.	M.
Length of parietal bone (median),	·014
Length of frontoparietal fontanelle,	·023
Width at pterotics,	·046
Width between frontal crests at anterior extremities,	·014
Width between apices of epiotics,	·024
Diameter (long) of hyomandibular cotylus,	·008

Found by J. L. Wortman in S. W. Idaho. One specimen only.

COBITIDÆ.

A species of this family left remains in the Idaho Lake basin. I have reached this conclusion by the discovery, among the specimens submitted to me by the Smithsonian Institution, of the inferior element of the three modified anterior vertebræ,[1] which are so characteristic of certain families of the Physostomous fishes. This portion, moreover, is that which occupies the position among the Cobitidæ only. Among them, it consists of a longitudinal plate terminating posteriorly in a bladder-like chamber on each side, each of which is closed below by a transverse process of the inferior plate; an angular fissure extends around the ends of these, and at the angle sends a short continuation upwards. This is quite similar to what is observed in *Cobitis.*

This occurrence of *Cobitidæ* is, perhaps, the most interesting fact brought to light by the examination of these extinct fishes. All of the numerous existing species of this family are found in the Eastern Hemisphere, and the great majority in tropical Asia, a few only occurring in Europe and South Africa. Extinct species are found in the miocene of Oeningen. We have then, in this form, another example of the occurrence of Asiatic types in North America prior to the glacial epoch; and as in a fresh-water fish, more strongly demonstrative of continuity of territory of the two continents, than can be with any other type of animal.

SALMONIDÆ.

RHABDOFARIO Cope.

Proceeds. Amer. Philosoph. Society, Nov., 1870.

A genus represented by skulls, in which the maxillary bone is cylindrical and rod-like, thus differing from *Salmo.*

Rhabdofario lacustris Cope, l. c.

A species with a head as large as that of the *Salmo salar*, which was not uncommon in the Idaho Lake. In addition to the type obtained by Mr. King, Mr. Wortman found parts of several individuals.

SILURIDÆ.

AMIURUS Raf.

? Amiurus sp.

Represented by pectoral spines. These do not differ from those of some recent species, but differ from those of the species of

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[1] The pharyngeal bones referred to this family by me as above cited, belong to the Cyprinidæ in the restricted sense. See genus *Diastichus.*

Rhineastes from our eocene beds, except perhaps the *R. arcuatus*, in the possession of but one row of teeth. The surface is delicately striate. The anterior edge is smooth and acute, and the posterior edge has two rows of serræ separated by the usual groove.

COTTIDÆ.

COTTUS L.

I refer to this genus four species from the Idaho beds. They may belong to *Uranidea*, but as I can only identify them as yet by the preopercula, I cannot determine this point. The parts in question are not rare, showing that this type was well represented in this region.

The preopercular bones are furnished with three or four acute spines of no great length. In this they differ from the living American species of *Uranidea*, which have only one or two spines, excepting the *U. spilota*, which has (*fide* Jordan) four spines, three of which are inferior. The four species of the present collection differ in their prominent features, as follows:—

a. Foramina on inner side of preoperculum.

Four spines; angular spine directed backwards; inferior ones forwards; smaller; *C. divaricatus.*

Angular spine directed backwards; posterior inferior downwards; inner side with two faces separated by an angle; larger; *C. pontifex.*

aa. Foramina on the posterior edge of preopercle.

Angular spine directed backwards; two strong similar inferior spines turned forwards; larger; *C. cryptotremus.*

aaa. No foramina.

Angular spine directed downwards; inferior spines forwards; the anterior inferior flattened; large; *C. hypoceras.*

Cottus divaricatus sp. nov.

Represented by two preopercula. These indicate the smallest of the four species, and one about equal to the *C. richardsoni*, Ag. The preoperculum is flatter and thinner than in the other species, and the foramina are all on the inner side of the branches. These are: one large one above base of superior spine, one small one between bases of superior and angular spines, one do. between bases of angular and posterior inferior, and one at anterior base of posterior inferior. The two inferior spines are smaller than the others, and are incurved. The superior posterior is the largest and is curved upwards, and compressed at the base. Both external and internal faces are flat.

Measurements.	M.
Length from base of superior to base of exterior inferior spines, inclusive, ...	·008
Length of superior spine above, ...	·003

From Willow Creek, Oregon. J. L. Wortman.

Cottus pontifex sp. nov.

The preopercular bone of this species is robust, especially in the transverse diameter. Instead of being flat as in *C. divaricatus*, it presents two faces on the side which is perforated by foramina, which are separated by a vertical angle. The anteroexterior face is flat, while the posteroexternal is somewhat irregular. The foramina which pierce it are larger than in any other species, especially the one between the second and third spines. The foramina communicate below the surface, the canal thus formed being spanned by a narrow bridge from the base of each spine. The opposite side of the preoperculum is a little concave, and plane at the base of the spines. The bases of the superior and the angular spines are closer together than in any other species, being absolutely in contact.

Measurements.	M.
Length of three upper spines on bases, incl., .	·008
Length of joined bases of two upper spines, .	·005

It is not possible to be certain whether there is any anterior inferior spine. One specimen was obtained by Mr. Wortman, probably from Willow Creek, Oregon.

Cottus cryptotremus sp. nov.

A larger species, very different from the last, and nearer the *C. divaricatus*. Three preopercula are in my collection. In all the specimens the superior limb is broken off, so that it is impossible to state the character of the superior spine. The angular spine has a round section and is directed backwards, and in line with the inferior border. The two inferior spines are at a little distance from its base, and are well developed, acute, and of equal size. They are directed forwards and inwards. The external face of the inferior limb is divided by a prominent obtuse angle on its entire length. There is a small foramen at the posterior base of each inferior spine, and a large one at the anterior extremity of the inferior branch, looking partially outwards.

Measurements.	M.
Length of base of three inferior spines, incl., .	·0085
Length of inferior spines, inclusive, . . .	·0055
Length of anterior inferior spines, . . .	·0045
Length of inferior branch of bone, . . .	·0140

Discovered by Mr. J. L. Wortman, Castle Creek, Idaho.

Cottus hypoceras sp. nov.

The preoperculum of this species differs widely from those of the three already described. Although it has four spines, they are distributed differently, three being inferior and one posterior, instead of two posterior and two inferior. The base of the posterior spine is less compressed than in the others, and looks as though the apex is directed posteriorly instead of superiorly as in *C. divaricatus*, and *C. pontifex*. It is opposite the inferior branch instead of above it as in the species named. The angular spine is round at the base; the first inferior is compressed at the base, and the anterior is compressed to the rounded apex, its superior edge being acute, the inferior rounded. This spine therefore differs from that of any of the other species.

The external face is gently rounded, and is smooth. The internal face has the usual excavation with bordering rim, and is roughened. There are no foramina except two above the base of the anterior inferior spine. In size this species is about like the *C. pontifex*.

Measurements.	M.
Length of base of four spines, inclusive, in a straight line, ...	·011
Length of bases of anterior two inferior spines inclusive, ...	·007
Length of angular spine, ...	·004
Elevation of vertical limb of preoperculum, . .	·012

One specimen; obtained by Mr. J. L. Wortman, probably at Willow Creek, Oregon.

PERCIDÆ.

The spines of the dorsal fin of a species of this family are not rare in the formation, but I have not yet been able to fix them generically or specifically.

General Observations.

In the preceding pages there are described from the Idaho pliocene formation the following species :—

Percidæ,	1	species.
Cottidæ,	4	"
Salmonidæ,	1	"
Cyprinidæ,	11	"
Catostomidæ,	2	"
Cobitidæ.	1	"
Siluridæ,	1	"
Raiidæ,	1	"
Total,	22	species.

Of the above, all differ from existing species so far as known, but three of the species which represent the *Percidæ*, the *Cobitidæ* and the *Siluridæ* respectively, have not been exactly determined. All the species differ from those of the Oregon Lake (or Lake Lahontan as it may prove to be). Of the families, all are existing and all are represented on the North American Continent excepting the *Cobitidæ*, which are now confined to Eur-Asia. But of these eight families four are not now found in the American waters which empty into the Pacific Ocean, viz., the *Percidæ*, *Siluridæ*, *Cobitidæ*, and *Raiidæ*, excepting that there is one species of the Percidæ in California. Five of the seven families have not yet been found in the Oregon fossil lake basin, but as two of them (*Salmonidæ*, *Cottidæ*), are found in the existing lakes of that region, they will probably be found in that deposit.

The above evidence is sufficient to prove that the Idaho pliocene formation is distinct from any formation previously known. It is older than the Oregon lake deposit.

In addition to the fishes, three species of craw-fishes were discovered in this formation by Capt. Clarence King. These I named *Astacus subgrundialis*, *A. chenoderma*, and *A. breviforceps*.[1] The mollusks of this formation have been described by F. B. Meek, and they, like the fishes, determined it to be lacustrine and fresh, as already stated by Prof. Newberry. The species are stated by Meek[2] to be distinct specifically, and in some cases

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[1] Proceedings Amer. Philos. Society, 1870, p. 605. Loc. cit., Nov. 1870.

[2] Proceedings Acad. Nat. Sci., Phila., 1870, 56.

generically, from all others hitherto described from the West. Leidy observes,[1] that mammalian remains received from Capt. King's expedition include portions of *Mastodon* and *Equus excelsus*. Mr. Wortman obtained teeth and bones of the latter, and a cannon-bone of an undetermined ruminant of the size of the *Cervus elaphus*. The ungual phalange of an edentate allied to *Megalonyx* was obtained from the same horizon and locality.

The map of the adjacent parts of Oregon, Nevada and California, showing the lakes, is copied from the map issued by the War Department of the United States, Brig. Gen. A. A. Humphreys, Chief of Engineers.

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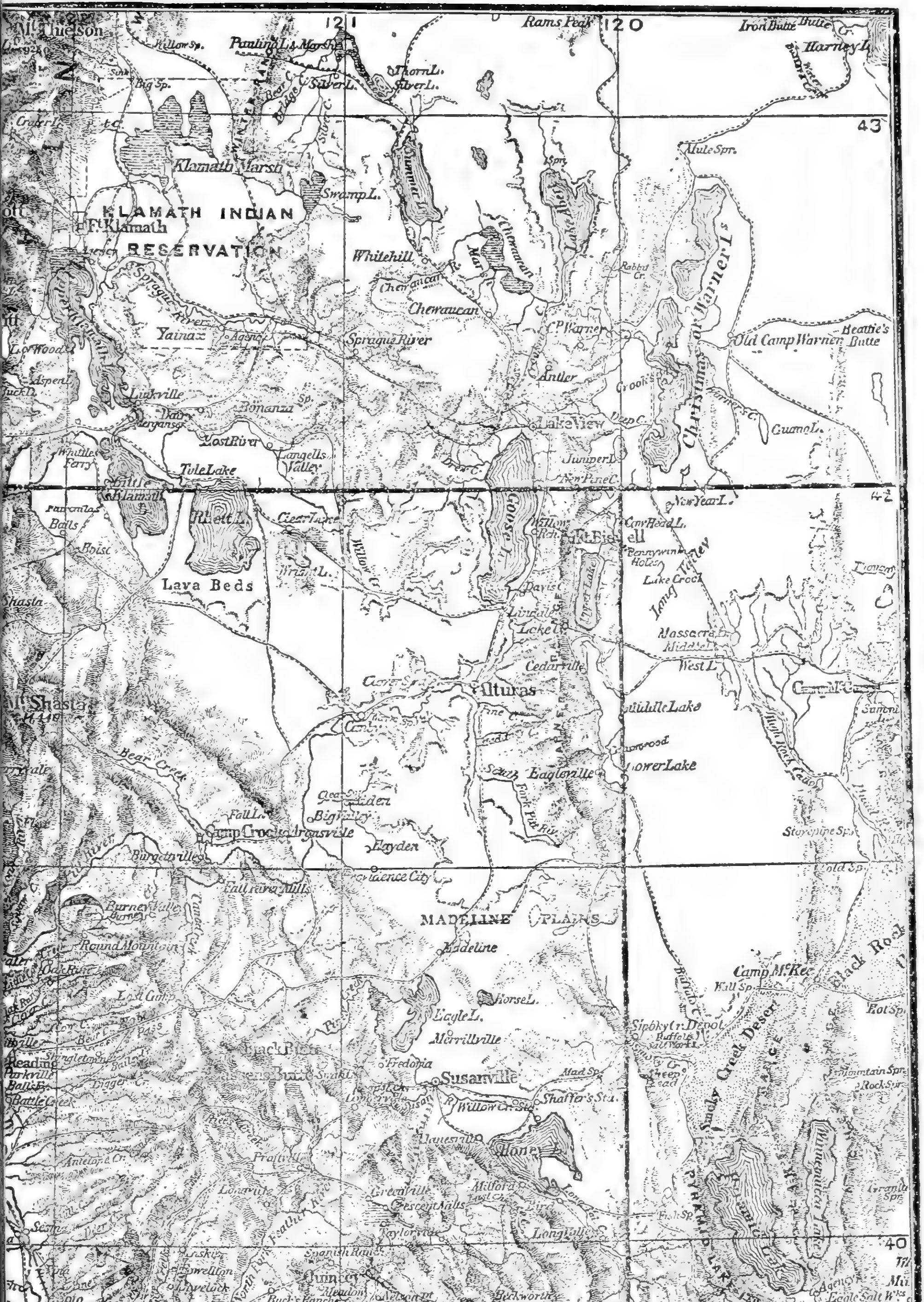
[1] L. c., 1870, 67. On Cretaceous and Tertiary Reptilia and Fishes, by Prof. E. D. Cope, November, 1870.


121
120
43
42
40
Rams Peak
Iron Butte
Harney L.
Willow Sp.
Paulina L. & Marsh
Big Sp.
Thorn L.
Silver L.
Klamath Marsh
Swamp L.
KLAMATH INDIAN
RESERVATION
Ft. Klamath
Whitehill
Chewaucan
Yainax
Agency
Sprague River
C.P. Warner
Antler
Old Camp Warner
Beattie's Butte
Christmas or Warner L's
Mule Spr.
Rabbit Cr.
Linkville
Bonanza
Lost River
Langells Valley
Lake View
Deep C.
Juniper L.
Guano L.
Tule Lake
Little Klamath
Rhett L.
Clear Lake
Whittles Ferry
Lava Beds
Goose L.
Ft. Bidwell
Camp Head L.
New Year L.
Long Valley
Lake Crock
Davis
Lindale
Lake City
Massacre L.
Middle L.
West L.
Cedarville
Alturas
Canby
Middle Lake
Lower Lake
Eagleville
South Fork Pit Riv.
Camp McGarry
High Rock Cañon
Shasta
Mt. Shasta
Bear Creek
Fall L.
Camp Crook
Big Valley
Hayden
Burgettville
Fall River Mills
Providence City
Stovepipe Sp.
MADELINE PLAINS
Madeline
Burney Valley
Burney
Round Mountain
Oak Run
Horse L.
Eagle L.
Merrillville
Camp McKee
Black Rock
Hot Sp.
Smoke Creek Desert
Reading
Parkville
Battle Creek
Fredonia
Susanville
Shaffer's Sta.
Willow Cr. Sta.
Honey L.
Prattville
Greenville
Crescent Mills
Taylorville
Long Valley
Milford
Pyramid Lake
Winnemucca Lake
Fish Sp.
Spanish Ranch
Quincy
Buck's Ranch
Meadow
Buckworth
Summit
North Fork Feather R.
Sierra Valley
La Porte
Gibsonville
Eureka
Yankee Hill
Agency
Eagle Salt W'ks
Deep Wells

JULY 3.

Prof. EDW. D. COPE in the chair.

Seventeen persons present.

A paper entitled "Description of a New Hydrobiinoid Gasteropod from the mountain lakes of the Sierra Nevada, with remarks on allied species and the physiographical features of said region," by R. E. C. Stearns, was presented for publication.

The death of Isaac T. Coates, a member, was announced.

On some Fossils of the Puerco Formation.—Prof. COPE stated that he had recently received from the Puerco beds of New Mexico remains of a number of individuals of the extinct mammal he had named *Periptychus ditrigonus.*[1] Besides jaws and teeth with permanent and temporary dentition in good preservation, the pelvis, femur and tibia are included in the specimens. These show that the species must be referred to the genus *Conoryctes* Cope, and render it very probable that the genus belongs to the family of the Periptychidæ. The absence of ungual phalanges prevents absolute certainty. The genus is near *Periptychus*, but differs in the one root and simple conic crown of the second true molar in both jaws, and the presence of cingular cusps of the superior molars, exterior to the external tubercles. *Conoryctes ditrigonus* has the molars of both jaws larger than those of the *C. comma*, and there is less difference in size between the posterior and anterior teeth than in that species.

The following new species accompanied the above:

PERIPTYCHUS COARCTATUS. This species represented by teeth of the lower jaw, viz.: one incisor, three premolars, and two molars, two of the latter imperfect. The characters of the species are well marked in the premolar and molar teeth. The former lack the anterior and internal ledges of the *P. carinidens* and *P. rhabdodon*, having only a prominent ledge-shaped heel, besides the principal conical cusp. The true molars lack the small tubercle which is between the pair of threes which compose the crown. The adjacent cusps of the threes are connected by low longitudinal ridges instead of oblique ones. The cusps themselves are closer together than in the other species, especially those of the anterior three, which are closely approximated. The anterior one is small and low. The enamel is grooved as in the other species.

Diameters of crown of fourth premolar: anteroposterior, ·0115; transverse, ·0115; elevation (worn), ·010. Diameters of crown

[1] Proc. American Philos. Society, 1882, p. 465.

of second true molar: anteroposterior, ·011; transverse, ·009. From the Lower Puerco beds. D. Baldwin.

PANTOLAMBDA CAVIRICTUS sp. nov. Represented by a nearly entire mandibular ramus with all the teeth represented excepting the crowns of the incisors. The characters are seen, first in the large size, the teeth having twice the linear dimensions of those of the *P. bathmodon;* and second, in the lateral prominence of the inferior edge of the ramus, which produces a concavity of the side of the jaw posterior to the canine teeth. It is the largest mammal known from the Puerco formation.

The inferior canines are strongly curved, so that the crown is directed upwards and a little backwards. Both root and crown have a round section, but the apex of the crown cannot be described, as it is greatly worn by use in the specimen. The incisive border is regularly convex, and the three incisors are not of large size, the first being least, and the third largest. The premolars and molars have the form of those of the *P. bathmodon*. The latter present two V's, the anterior narrower and more elevated. In the former the posterior V is represented by a short crest. The last molar is produced into a heel, which supports the posterior branch of the posterior V, and no cusp. The first premolar is one-rooted, and is separated from the second premolar by a moderate diastema. The symphysis is not long, is regularly curved upwards, and has a flat inferoanterior face. The canine alveoli create a marked prominence on each side.

Measurements.—Depth of ramus at diastema, m. ·045; do. at third premolar, ·056; width of ramus below third premolar, ·021; length of bases of three incisors, ·023; diameters of canine at base: anteroposterior, ·018; transverse, ·018; diameters third premolar: anteroposterior, ·012; transverse, ·011; diameters first true molar: anteroposterior, ·077; transverse, ·014; diameters third true molar: anteroposterior, ·022; transverse, ·014.

The jaw of this species is about the length of that of a large tapir, but is deeper and more robust. The flare of the inferior edge in front is suggestive of the structure seen in the *Dinocerata*, and of the probability that the Taligrada (to which *Pantolambda* belongs) are the ancestors of that suborder as well as of the Pantodonta. The flare is related to the flange of *Uintatherium*, exactly as the similar ridge in *Nimravus* is to the flange in *Machærodus*.

ZETODON GRACILIS, gen. et sp. nov. *Char. Gen.*—This genus and species are founded on a broken lower jaw which contains the second and part of the first true molars, and the fourth premolar. The teeth are of very peculiar character. True molars consisting of narrow crescents in two pairs, which are both concave towards each other, embracing a fossa. The posterior crescents soon unite on attrition, closing the fossa, while the anterior are well separated, and only unite by their anterior apices. Each molar has a small columnar heel. Fourth premolar with the posterior pair of crescents only, which soon unite. The anterior pair is represented by a part of the external one, which forms a narrow lobe. The heel is larger than in the true molar.

The position of this genus it is impossible to determine from the specimens in my possession. It may be Marsupial or Condylarthrous, and if the latter, one of the *Meniscotheriidæ*; but if not of these groups, its position is not likely to be in any known order of the tertiary periods.

Char. Specif.—Crowns compressed, deeply grooved at the points of junction of the crescents. This is effected by a narrow lamina from the anterior inner to the posterior outer; the anterior outer being free posteriorly, excepting after considerable wear. A groove on the external side of the crown distinguishes the heel, which sinks into the crown below. It is larger on the first than on the second molar. The heel of the fourth premolar is elevated on its posterior edge. No cingula except a weak one at the exterior base of the posterior lobe of the true molars, and at the anterior base of the anterior lobe of the fourth premolar. Ramus compressed; but little of it preserved. Diameters of p. m. iv.: anteroposterior, ·0055; transverse, ·0020; of second true molar: anteroposterior, ·0045; transverse, ·002. From the lower red bed of the Upper Puerco epoch. D. Baldwin discoverer.

JULY 10.

Mr. CHARLES MORRIS in the chair.

Twenty-eight persons present.

A paper entitled "Preliminary Observations on the Brain of Amphiuma," by Henry F. Osborn, was presented for publication.

JULY 17.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

Sixty-two persons present.

JULY 24.

Mr. JOHN H. REDFIELD in the chair.

Fourteen persons present.

JULY 31.

Mr. J. H. REDFIELD in the chair.

Eleven persons present.

The following were ordered to be printed:

DESCRIPTION OF A NEW HYDROBIINOID GASTEROPOD FROM THE MOUNTAIN LAKES OF THE SIERRA NEVADA, WITH REMARKS ON ALLIED SPECIES AND THE PHYSIOGRAPHICAL FEATURES OF SAID REGION

BY ROBERT E. C. STEARNS.

The interesting form herein described was first brought to my notice through the kindness of Mr. Xenos Clark, son of the lamented Prof. Henry James Clark, in 1879. Owing to ill-health and other causes, it has remained undescribed until this time. Recently I have been stimulated to inquire into its characters and relationship, by the reception of a letter and further specimens from Prof. R. Ellsworth Call, who, while believing it to be undescribed, thought possibly it had been made known by some of our West Coast naturalists, and wrote to me for information.

While it appears to have certain analogies with *Lioplax* of the Viviparidæ on the one side (see *L. subcarinata* Say), and with the Strepomatidæ (see the carinated Goniobases like *G. torulosa* [1] Anthony), on the other, yet the sum of its characters, inclusive of faunal and geographical relationship, seems to me to point rather in the direction of the fresh-water Rissoids. The late Dr. Stimpson's genus *Tryonia* applies only to shells with a "surface longitudinally ribbed or plicated," as distinct from the usual smooth-surfaced shells of the various groups embraced in his "Researches, etc." [2] He includes, however, the little group *Pyrgula* of Cristoforo and Jan, and arranges it directly preceding *Tryonia*, which my judgment confirms as being its proper place.

Woodward [3] included this genus (*Pyrgula*) in his synonymy of *Melania;* he also placed *Amnicola* as a subgenus of the foregoing. H. and A. Adams [4] place *Pyrgula* with the Melanians, but *Amnicola* is grouped by them with the Rissoidæ. They further include

[1] L. and F. W. Shells of N. A. Part IV, p. 229, S. T. Miss. Coll., 253. See also Meek and Hayden's Tertiary *Goniobasis tenuicarinata,* Proc. Phila. Acad. Nat. Sci., 1857, p. 124, and *G. nebrascensis,* id., 1856, p. 124. Also Wheeler's Report. Palæontology, vol. iv, and Hayden's Inv. Palæontology, vol. ix.

[2] Researches upon the Hydrobiinæ and allied forms. Smiths'n Misc. Coll., 201.

[3] Recent and Fossil Shells, 2d ed., pp. 246, 247.

[4] Adams' Genera, pp. 306–308, vol. i.

the genus *Tricula* of Benson with the Melaniidæ, an arrangement which has been followed by Chenu.[1]

Benson's *Tricula* is based upon a small fluviatile form which the Adams say "somewhat resembles *Paludomus;* * * * * the only species known is an inhabitant of the River Kamaan in India." The specific name *montana* implies a station similar to those inhabited by the various species of *Pyrgula* herein quoted. The figure of *Tricula* as given by the Adams and Chenu, together with the totality of testimony furnished by said authors, leads me to suspect that the Indian species should be removed from the Melaniidæ to the Hydrobiinæ and near to *Pyrgula.*

It is not without some little hesitation that I place the Sierra Nevada shell in the genus *Pyrgula.* Its principal characteristics, however, indicate said group as well as the environmental features. Stimpson's generic description of *Tryonia* applies only to shells longitudinally sculptured ("ribbed or plicated"), a too restricted limitation for a generic standard in this case, because if literally applied it would exclude ninety-five per cent. of the individuals which form the mass of which Stimpson's[2] species is but a rare varietal aspect. Upon this point he wrote: "In company with the Tryoniæ, Mr. Blake found a small cancellated shell, which has been described as *Melania exigua* by Conrad, and as *Amnicola protea* by Gould. In view of the character of the surface, I think it scarcely possible that this species can belong to the Hydrobiinæ. It will, perhaps, be found to be allied to *Bittium.* The occurrence of this marine or brackish-water genus in the Desert would not be surprising, since *Gnathodon* was found in the same basin at a point somewhat nearer the Gulf." It is quite evident to my mind that Stimpson could not have had a very large number of specimens as they are usually found; if so, they would have included not only his *T. clathrata*, as well as Conrad's and Gould's types, but intermediate and connecting varieties, sufficient to have caused him to expand his generic diagnosis, and either to have made him hesitate before investing the variety before him with specific dignity, or else to have included Conrad's and Gould's forms as species of *Tryonia.* He was not aware of the countless millions of these tiny shells, that are scattered over a vast area, or of the depth of the fresh-water sedimentary deposit throughout which

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[1] Manuel de Conchyliologie, etc., p. 294, vol. i.

[2] Researches, etc., etc., *id.*, p. 48, *et seq.*

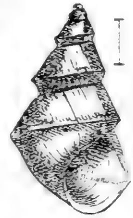
they are distributed. At Walter's Station, on the Southern Pacific Railroad, the perpendicular section exhibited by the digging of a well to the depth of forty-seven feet, contained these shells from the surface of the desert to the bottom of the well.[1] Again, in suggesting relations between Conrad's and Gould's forms with *Bittium*, a genus belonging to the brackish-water division or subfamily (Potamidinæ) of the Cerithiidæ, he seems to have overlooked the fact that the longitudinally plicated sculpture of his species is a character common also to the brackish-water genus *Cerithidea*, which belongs as well as *Bittium* to the Potamidinæ.[2]

Had Stimpson's generic definition of *Tryonia* been more ample I should have been tempted to have given the shell herein discussed a place in said group rather than *Pyrgula*, which latter, as figured by the Adams and Chenu, shows an angular termination to the aperture at the base of the columella, indicative of a more pronounced feature in the soft parts (siphonal) at this point than the rounded aperture of *Tryonia* and *Tricula* (as figured), and the form before me presents. This, however, is a somewhat variable feature as between individuals of the same species, and still more so between forms of one species as compared with forms of another.

With the concurrence of Prof. Call, I have described the shells received from him and Mr. Clark as follows:

Genus **PYRGULA** Cristoforo and Jan.

Pyrgula Nevadensis, n. s.



Shell small, elongated, ovate-conic, turreted; number of whorls five to six (5–6), with a conspicuous keel following spirally the periphery of each and terminating near the middle of the outer edge of the continuous peritreme, which is otherwise simple, ovate and slightly effuse, and appressed (to the whorl) above; in some specimens somewhat produced on its inner side and suggesting a faint umbilicus. Shell white or nearly so; smooth and glossy, with a slight epidermis on

[1] For further information on this point, see my remarks on the "Fossil Shells from the Colorado Desert," in Am. Naturalist, March, 1879.

[2] The connection of the marine Cerithiidæ with the fresh-water Melaniidæ through the brackish-water Potamidinæ, seems natural and logical. In this connection the remarks of Swainson in his "Treatise on Malacology," are well worth perusing.

some specimens. Dimensions as follows, being the measurement of ten (10) specimens, all adult:

Longitude	·14,	Latitude	·08	inch.
"	·15,	"	·08	"
"	·16,	"	·09	"
"	·17,	"	·09	"
"	·17,	"	·09	"
"	·18,	"	·10	"
"	·18,	"	·10	"
"	·22,	"	·10	"
"	·22,	"	·11	"
"	·21,	"	·12	"

The mean of the above measurements is eighteen-hundredths of an inch in length by ninety-six-thousandths of an inch in breadth, or very nearly two to one. The largest specimen measured ·23 by ·13 inch. Aperture about one-third the length of the shell, being as forty-one to one hundred and twenty ($\frac{41}{120}$). Of the sixteen specimens examined[1] *nine* are from Pyramid Lake (Clark), and *seven* from Walker's Lake (Call).

The Pyramid Lake lot, from Mr. Clark, were accompanied by specimens of the flat-spired form of *Pompholyx effusa*, to which Dr. Dall has given the name of "*var. solida.*"[2]

The several specimens of *Pyrgula Nevadensis* exhibit similar differentiation as *Tryonia* in size of mouth, variability in coil, robustness or attenuation; and many of the specimens from the alkaline deposit of the lake bottom are discolored, varying from light ashen slate to dark slate, approaching black.

In connection with the above, I have to thank Professor Call for the following notes:

"I have it as collected by the U. S. Geological Survey the past

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[1] Subsequently thirty-two specimens, adolescent and mature, from the dredging "(1)" Pyramid Lake; and about the same number, young and adult, from "(2)" North Shore, Pyramid Lake, were received from Prof. Call and examined with care.

[2] Annals of Lyceum of Nat. History of N. Y., March, 1870, p. 334. The locality here given, through some misapprehension, is "Clear Lake," which is in California; it should read "White Pine, Eastern Nevada." Dall, in *Science*, vol. i, No. 7, page 202 (March 23, 1883), refers to the occurrence of *Pompholyx effusa* in a calcareous deposit in Pyramid Lake, and remarks on its variations.

summer. Where known, I give the name of the collector as authority for locality. (1) From dredgings of Pyramid Lake bottom; *Russell* (I. C.); August 30, 1882. (2) North side of Pyramid Lake, Nevada; *Russell* (I. C.). (3) In tufa, shore of Walker's Lake, Nevada; *Russell* (I. C.), and also loose. This is the locality represented by the shells sent to you.

"Pyramid Lake,[1] although it receives the fresh water of the Truckee River, the outlet of that gem of lakes, Tahoe, is very strongly alkaline, and the water is not good for human use, although it can be used for a short period without much inconvenience."

The elevation of Pyramid Lake is 4890 feet, as stated in Gannett's[2] List, etc., and Walker's Lake, according to the same authority, has an altitude of 3840 feet. The water of this lake is probably similar to that of Pyramid; it is brackish, as I have been informed by Prof. Joseph LeConte.

These lakes are the remnants of the great tertiary lake which covered this general region, and are the pockets or deeper depressions in the floor of the ancient lake; the bitterness of their waters being the result of the accumulated alkaline and saline sediments, or dregs, of centuries.

Assuming that I have placed the above form in its proper position, much greater interest attaches to it than that of the addition of a new species to the fauna of the general region within which it is found, or that of adding a peculiar type to the living molluscan fauna of the North American continent.

The species of *Pyrgula* heretofore described,[3] are the type, *P. helvetica*, from Switzerland; *P. bicarinata*, France; *P. pyrenaica*, from the Pyrenees; and *P. andicola*, from the Andes of Bolivia.

Its distribution hitherto, it will be seen, is Europe and South America; inhabiting, as Stimpson observed, "fresh waters in mountainous regions," and as he further remarked, "It is interesting to notice that all the species of the genus as yet described are severally reported to occur in mountainous districts; an instance of correlation of form to external conditions."

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[1] Lieut. Symons, in Lieut. Wheeler's Report Geog. Survey, etc., 1878, p. 114.

[2] U. S. Geol. Survey. Hayden, Misc. Pub., No. 1. Fourth Ed.

[3] *Vide* Stimpson, *ibid.*

These facts tend to give this new species[1] its chief importance, and point to further interesting discoveries.

Specimens of *Pyrgula Nevadensis* have been distributed to the Museum of the Acad. Nat. Sci. Phila.; the U. S. National Museum, Washington; the Museums of the University of California and California Acad. of Sciences; and are contained in the cabinets of Professor A. E. Call and my own.

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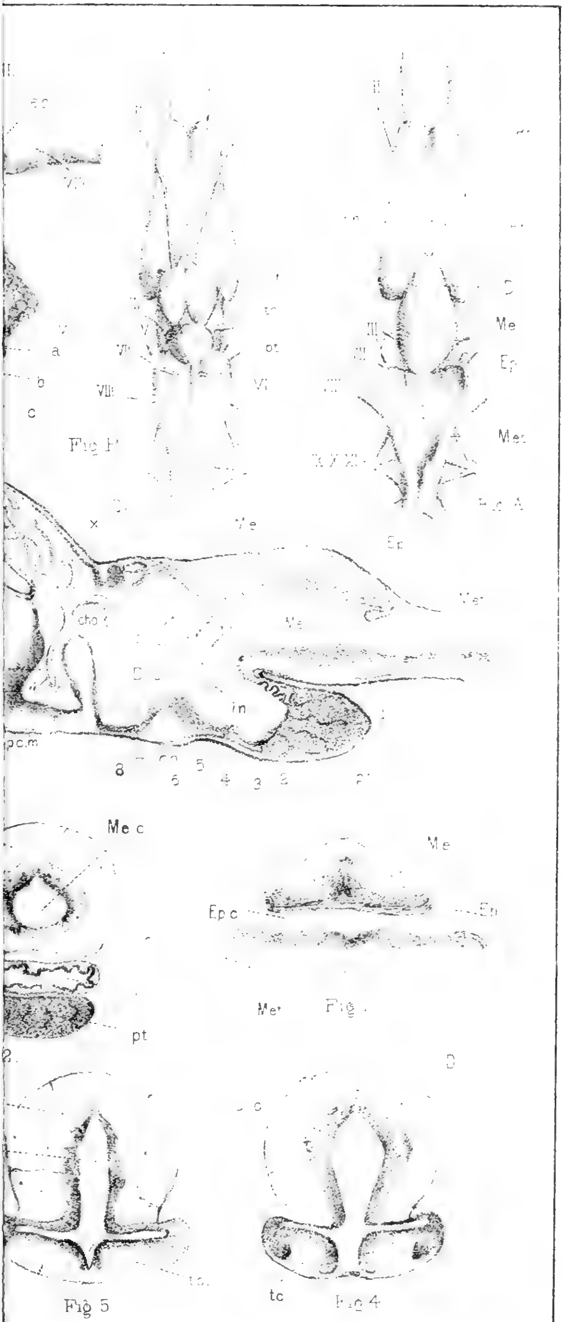
[1] Mr. John Wolf has described *Pyrgula scalariformis* from the post-pliocene of Tazewell, Illinois River. *Vide* Tryon, in Proc. Acad. Nat. Sci. Phila., May 1, 1873.



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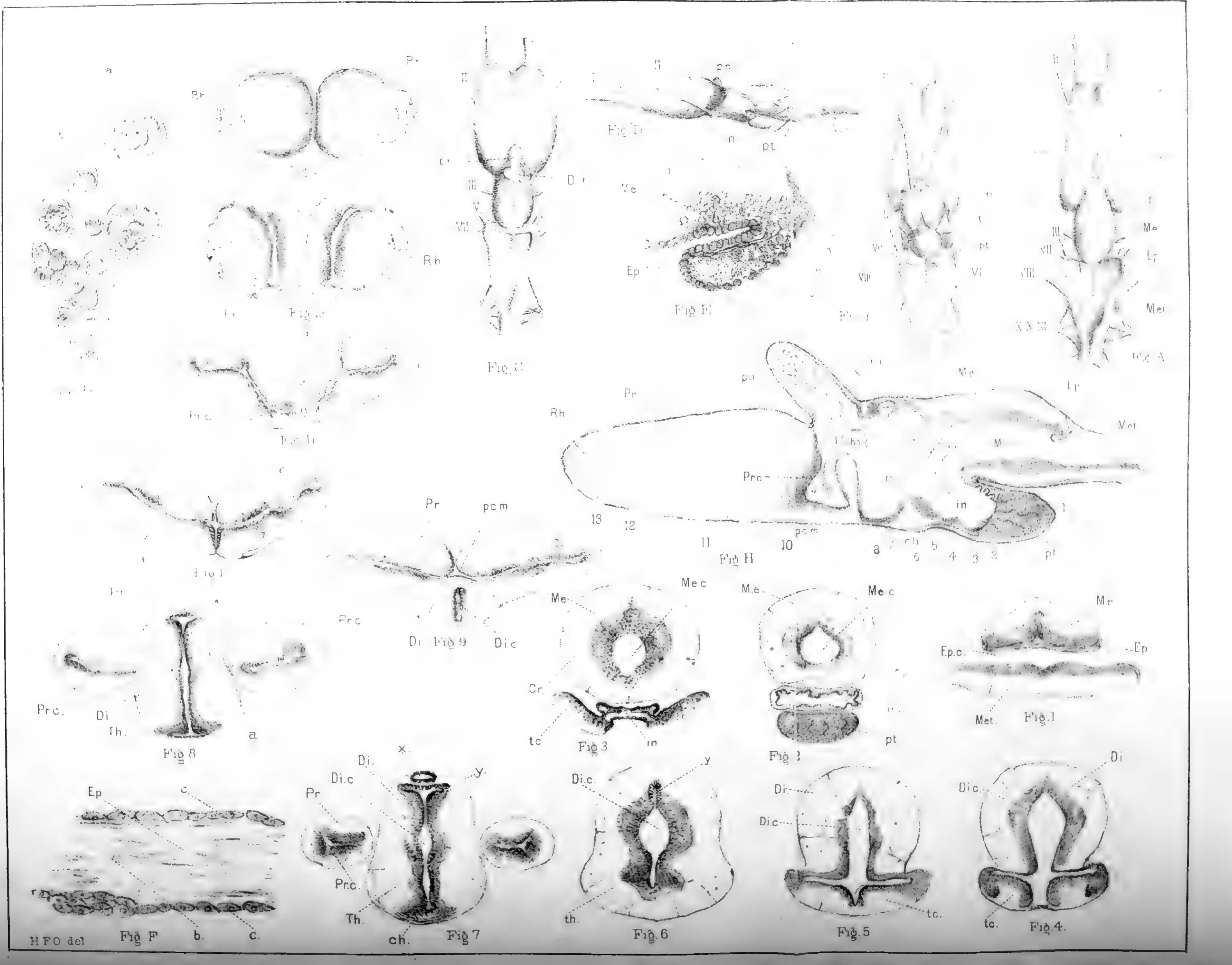
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PRELIMINARY OBSERVATIONS UPON THE BRAIN OF AMPHIUMA.

BY HENRY F. OSBORN, SC. D.

The North American Urodela, embracing a wide variety of forms which can readily be obtained, offer an attractive field for the comparative study of the amphibian brain. The work upon the subject hitherto has been chiefly in Germany, but many members of this large group have barely been touched upon, so that a systematic research into the whole subject would form a valuable contribution to Comparative Morphology.

In the hope of extending my study later I have recently been investigating the brain of *Amphiuma*,[1] having procured a quantity of live specimens from New Orleans. This paper contains a preliminary account of this investigation.

Among the more important studies upon the amphibian brain are those of Wyman,[2] Fischer,[3] Stieda[4] and Wilder.[5] Stieda's work is principally upon the microscopic structure of the brains of the Frog and Axolotl; Wilder, in his study of the Frog and Menobranchus, has directed attention largely to parts of the brain which have been less studied hitherto, namely to the cavities and the thinner portions of the brain parietes surrounding them, as well as to the brain membranes. I am indebted to the writings of both of these authors for light upon this subject, although I have not as yet so fully consulted either as I would like to do.

In the general description the usual terminology of different portions of the brain is employed, but in referring to the various segments of the brain tube and to the ventricles they enclose I largely employ the terms partly adopted and partly introduced by Wilder. His system of nomenclature, which is chiefly founded upon the embryonic divisions of the brain, is admirably clear and

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[1] I employ this title as it is the family name (*Amphiumidæ*), and is more generally known, although *Murænopsis*, the three-toed genus, is the one which I studied.

[2] Smithsonian Contributions to Knowledge, Washington, 1853.

[3] Amphibiorum Nudorum Neuroglia ; also, Anat. Abhandlungen über die Perennibranchiaten und Derotremen.

[4] Zeitschrift für wiss. Zoologie, Band xx, xxv.

[5] Anatomical Technology, Wilder and Gage, 1883.

consistent, although objections may be raised to the author's means of indicating position and direction.[1]

My method of study was: (1) A careful examination of the external features of the brain. (2) A series of very thin transverse and longitudinal sections of the brain, the sections after staining being carefully mounted in serial order. These series naturally supplement each other and give a very accurate idea of the gross and minute structure.

The technical process of preparing the brains was as follows: They were hardened, after removal from the skull, in a saturated solution of bichromate of potash, the acid being subsequently removed with alcohol of different densities. The brains were then embedded in an egg-mass prepared by shaking the white and yolk of egg together, with three drops of glycerine to each egg. This mass was first stiffened around the brain by placing in a vapor of alcohol, then hardened in absolute alcohol until ready for cutting. Its advantages are that it closely embraces the brain, holding all the parts together and becoming transparent in oil of cloves. The section cutting was done with one of the large instruments manufactured by Jung, of Heidelberg, which is far superior to any other instrument of its kind now in use.

External Structure. The brain of *Amphiuma* (Plate VIII, figs. A and B) resembles that of *Menopoma* (figs. C and D) more closely than that of any of the remaining Urodela. Its most striking feature is that the component parts are, in the main, little differentiated from each other, giving the exterior very much the simple character of an embryonic brain. This is especially true of the Di-, Mes- and Epencephala. The vertical longitudinal section (fig. H) shows that the construction of the interior is equally simple. The brain flexure is apparently slight. The brain is also extremely small in proportion to the body, and has a narrow, elongated form; a remarkable feature is the diminutive

[1] The following are some of the terms employed and their synonyms: *Rhinencephalon*, olfactory lobes; *Prosencephalon*, including the cerebral hemispheres and their cavities (*procœliæ*); *Diencephalon*, including the thalami optici, the infundibulum, the pineal gland, etc., and the *diacœlia* or third ventricle; *Mesencephalon*, including the optic lobes, the crura cerebri and *mesocœlia* or iter; the *valvula*, or valve of Vieussens; *Epencephalon* or cerebellum; *Metencephalon*, medulla oblongata, and roof of fourth ventricle.

size of the cerebellum. This general simplicity corresponds to the partial blindness and to the degenerate structure and habits of *Amphiuma*.

The *Metencephalon* is very broad and shallow, with its upper surface divided longitudinally by a central and two slight lateral furrows, and with its borders turning bluntly inwards anteriorly, apparently to enter the cerebellum. On its lower surface the medulla is divided by the central furrow, a continuation of the anterior fissure of the spinal cord. As in other Amphibia, the medulla passes without clear demarkation into the crura cerebri.

The *Epencephalon*. The cerebellum is a narrow, band-like structure, arching across the wide medulla. It is unusually small, and was actually overhung by the optic lobe in my specimens, so as not to be seen in the median line, although this point may require confirmation. The valvula is therefore out of sight, in the dorsal aspect of the brain, but may be seen in the longitudinal sections.

The *Mesencephalon*. The optic lobe has no longitudinal furrow, but forms a single, narrow, unpaired body, passing forward into the roof of the Diencephalon without demarkation. These divisions of the brain cannot be distinguished upon the dorsal surface, but can be seen in side view by noting the position of the infundibulum below. The *Crura* (pars peduncularis) form a broad base for the posterior half of the Mesencephalon, which, by an oversight, is not represented in the drawings. As they pass forward, however, they cannot be distinguished from the optic lobe nor from each other, so that this division of the brain forms a cylindrical tube, the component parts of which can only be detected in the microscopic structure.

The *Diencephalon*. The roof of this portion of the brain terminates anteriorly in the large pineal gland; its median surface is marked, in *Menopoma*, by two circular thickenings which were not noticed in *Amphiuma*. These may correspond to several structures in the brain roof, which are apparent in the sections. The sides of the Diencephalon form the thalami, but the prominent feature of this portion of the brain is the production of the floor into the long, backward-directed infundibulum, which is best seen in side view. At the base of this process is the large pituitary body. At the sides of the infundibulum are two thickenings which converge to enter the thalami; their relations are clearly shown in the sections. In front of the infundibular region the Diencephalon as a whole becomes higher and narrower. There is quite a space between the infundibulum and optic chiasma; the latter has no clear decussation of fibres as in the frog; on the other hand, the nerves are given off as two slender fibres on either side of a slightly raised whitish plate.

The *Prosencephalon.* The cerebral hemispheres are very long, flattened-oval bodies, narrowing forwards; they are in close contact, but there is no structural union, except for a short distance in front of the lamina terminalis. The *Rhinencephala* arise from the outer anterior third of the hemispheres and give off on the lower surface of the brain, the large olfactory nerves.

Internal and Microscopic Structure.

The internal structure of the brain, so far as studied, has many interesting features, which may here be considered in connection with the various divisions of the brain tube, concluding with some observations upon the general distribution of the gray and white matter. It must here be said that the minute histology has not been so carefully studied as to afford conclusive data.

Fig. H represents a longitudinal vertical section of the brain of *Amphiuma*, magnified four diameters, the shaded portions showing the gray or cellular matter. The vertical lines indicate, approximately, the position of twelve of the thirteen transverse sections which are figured. Fig. 9 passes through the anterior commissure and the forward portion of the diacœlia, not quite agreeing with any vertical line that could be drawn through fig. H. Much enlarged longitudinal and transverse views of the cerebellum are given in E and F. Fig. G gives an imperfect idea of some of the cells found in the crura.

The *Epencephalon* is the only division of the brain which has a complete investment of gray matter; this statement needs the reservation that the cells surrounding the cerebellum *may* be of epithelial origin, although this doubt is apparently disproved by the close similarity and continuity of their structure with those of the optic lobe. If this be admitted, the cerebellum is composed of three parts: (1) A continuous band of fibres arching from side to side of the medulla. (2) A fine layer of fibres which have an antero-posterior direction. (3) An investing layer of cells one or two rows deep. These parts are represented in fig. E, *b*, *a* and *c;* also in fig. F, *b* and *c*.

(1) The *transverse band* of fibres (fig. 1) form the greater part of the cerebellum; they appear to arise from columns of fibres in the lateral portions of the medulla, so that they correspond partially to the inferior peduncles of the mammalian cerebellum arising from the restiform bodies. (2) The fine layer of fibres have a direction at right-angles to these, and are three or four deep, seeming to terminate in the lateral portions of the cerebellum, in some cells lying between the cerebellum and the optic lobe. This layer, owing to the peculiar position of the cerebellum beneath the optic lobe, is dorsal to the main transverse band; if the cerebellum were turned backwards, this layer would be ventral to it. (3) The cells composing the cortex of the cerebellum are of an elongated-oval shape, usually one row, in some places two rows deep. Their greatest diameter is arranged parallel to the main band of transverse fibres. Here, as in other portions of the brain, it was difficult to ascertain whether or no these cells were continued into fibre processes. No such processes were discovered.

The above account differs widely from that given by Stieda[1] of the frog's cerebellum; although the latter is somewhat difficult to understand owing to the lack of figures.

The *Mesencephalon.* Posteriorly, the mesocœlia is broad and low, and the brain tube has a subpyramidal section; anteriorly, it becomes more circular and is surrounded by a shield-shaped mass of cells (figs. 2 and 3), surrounded in turn by the mass of longitudinal fibres, the whole constituting the optic lobe and crura. According to Stieda,[2] the brain of axolotl has a similar structure in this region.

The *Diencephalon* is the most interesting division of the brain; its deep but narrow cavity (diacœlia) is filled with the large choroid plexus; it has a very thin roof and floor, but broad lower sides. The *infundibulum* is formed by the thrusting downward of the posterior portion of the floor. Its walls are much convoluted; they are composed chiefly of white matter, with here and there a scattering of nerve-cells, which in some places form a continuous layer. The base of the infundibulum is closely reflected over the pituitary body as a thin lamina. The pituitary body has therefore no communication with the brain cavity, as has

[1] Zeitschrift für wiss. Zoologie, Band xx.

[2] Same Journal, Band xxv.

been observed in some animals. It is composed of a solid mass of granular cells, traversed by numerous blood-vessels, and resembles in structure, although more compact, one of the ordinary lymphatic glands.

The lumen of the infundibulum becomes narrower before it communicates with the diacœlia, and the lateral walls become thickened into two solid oval masses, largely composed of nerve-cells. These bodies resemble the *lobi inferiores* of the Teleosts, and, according to Stieda,[1] correspond in position with the tuber cinereum of the mammalia; anteriorly they gradually converge (figs. 4 and 5), finally entering the thalami. At this point the diacœlia has a cruciform shape, the lateral cavities separating the tuber cinereum from the walls of the Diencephalon above. In front of this is the thickening of the optic chiasma, and around the upper portion of the ventricle is a row of compact cells which resemble columnar epithelium. Anteriorly the latter flatten out, covering a lateral expansion of the ventricle. Above this is a small hollow sphere formed of a single layer of cells (fig. 7, *x*); the meaning of this structure is not known, and no mention of it has been found by the writer elsewhere. It corresponds in position with the external markings noticed upon the dorsal surface of the Menopoma brain at this point (see fig. C, *Di. t.*). Immediately below this point is a transverse band of nerve-fibres which probably belong to the optic chiasma.

The roof of the Diencephalon is of irregular thickness; forward it is carried as a very thin lamina over the *pineal gland.* The structure of this body is nothing more than a rich plexus of blood-vessels produced from the choroid; in the apex are numerous fine nuclei, resembling those of connective tissue, certainly not of nerve-tissue. There is no evidence that the latter is present.

It will thus be seen that the pineal body is a simple vascular structure, properly speaking, in communication with the brain cavity, since it is apparently surrounded by the brain parietes. The pituitary body, on the other hand, is a compact glandular structure, not in apparent communication with the brain cavity, except by an improbable process of osmosis through the attached cells.

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[1] Stud. über d. centrale Nervensystem d. Knochenfischer. Zeits. für wiss. Zoologie, Band xviii.

The sections are imperfect in the forward portion of the root of the Diencephalon *(diatela)*; they do not show the *postcommissura*, described by Stieda and Wilder. The *præcommissura*[1] has its usual shape and position.

The relations of the Diencephalon to the *Prosencephalon* are shown in figs. 7, 8 and 9. The procœliæ extend back into the posterior sections of the hemispheres. Anterior to this the hemispheres fuse with the thalami below, receiving from the upper portion of the Diencephalon a conspicuous band of fibres (fig. 8, *a*). The relations of the dia- to the procœliæ are best obtained by means of horizontal longitudinal sections; these have not been made as yet, so that the nature of these cavities is somewhat doubtful. It appears that the procœliæ communicate with each other some distance anterior to the lamina terminalis.

The hemispheres have a great lateral extent, containing extensive cavities. Their posterior halves are partly fused together; anteriorly, however, they are quite separate and distinct, becoming more cylindrical in section in the region of the Rhinencephalon. A peculiar feature of each procœlia is the formation of a short superior median cornu (fig. 11, *a*); corresponding to this is an extension of the gray matter lining the cœlia to the cortex of the hemisphere. Forwards the cœliæ have a vertical and more internal position. The *Rhinencephala* arise in masses of gray cells in the anterior third of the lateral portions of the hemispheres: they do not contain any cavity, but are continued forward into the solid olfactory nerve.

The structure and distribution of the nerve-fibres and cells have not been closely studied; the following are some preliminary notes:

The cavities of the brain are throughout lined with masses of nerve-cells of varying thickness. Nerve-cells are also found scattered among the fibres, but these are somewhat rare. The gray substance lining the hemispheres corresponds to the *central gray*, the Höhlengrau of Meynert. At a few points it is found upon the brain cortex; these are: (1) the lateral bodies of the infundibulum (fig. 3); (2) the upper surface of the central portion of the hemispheres (fig. 11); (3) and the inner sides and front of the foremost portion of the same (fig. 12); (4) the cerebellum.

[1] Anterior and posterior commissures.

None of these cortical exposures of the central gray can be considered to correspond to the *cortical gray* (Rindengrau) of the mammalian brain. The gray substance is, therefore, chiefly central.

The scattered nerve-cells above referred to are principally found in the substance of the hemispheres above the cavities, internal to fig. 11, *a*. Here they are numerous.

The nerve-cells are chiefly small, oval and nucleated bodies, very compactly placed; among these at some points, as in the crura, much larger cells enveloped in loose capsules were discovered. No processes were found leading out of these cells, in fact no unmistakably branched cells were found at any point; this may have been the fault of the preparation methods, for Stieda has found that the branched nerve-cells are very numerous in the frog, while Wyman, employing simpler histological methods, failed to find them.

This is as far as the sections have been studied, although they offer very tempting opportunities for making out the nerve-tracts.

The following is a resumé of the results thus far obtained:

In external characters, *Amphiuma* differs widely from the frog type in the simpler differentiation of its parts, the mid-region of the brain being a rounded tube with no separation of its optic lobes and thalami indicated above. The cavities of the brain are equally simple, the meta-, meso- and diacœliæ forming a uniform cavity, forking into the procœliæ in front. The infundibulum has the large size which is so characteristic of it in the fishes, and its lateral bodies recall the *lobi inferiores* in the Teleosts, although passing forwards they form the tuber cinereum. The pineal and pituitary bodies are constructed upon clearly different principles, one being within, the other without the brain walls, the former a vascular plexus, the latter a gland. In the roof of the Diencephalon is a small spherical body whose meaning is not known, but which may prove to be of some morphological significance. The cerebellum has a cellular investment and consists of two sets of fibres with a transverse and fore and aft direction. The gray matter of the brain lines the cavities throughout, as the "central gray;" continuations of it extend in some places to the cortex, but the "cortical gray," if present at all, is very limited in distribution.

EXPLANATION OF PLATE VIII.

Illustrating the Brains of Amphiuma and Menopoma.

Lettering and Abbreviations.

Rh.—Rhinencephalon; *Pr.* and *Pro. c.*—Prosencephalon and Procœlia; *Di.*, *Di. t.* and *Di. c.*—Diencephalon, Diatela (roof of Diencephalon), and Diacœlia; *Me.* and *Me. c.*—Mesencephalon and Mesocœlia; *Ep.* and *Ep. c.*—Epencephalon and Epicœlia; *Met.*—Metencephalon.

Tc.—Tuber cinereum; *ch.*—optic chiasma; *pt.*—pituitary body; *pn.*—pineal gland; *in.*—infundibulum; *cho.*—choroid plexus; *cr.*—crura cerebri; *p. cm.*—præcommissura (anterior commissure); *th.*—optic thalamus.

I.—Optic; II.—Olfactory; III.—Oculo-Motor; V.—Trigeminis; VI.—Abducens; VII.—Facial; VIII.—Auditory; IX, X, XI.—Vagus Group. N. B.—The identification of the nerves was by noting their origin; the distribution of the nerves has not been worked out.

Special References in Figures.

Figures A–D, twice natural size. Figs. H and 1–13, eight times natural size.

Figure A. Dorsal view of the brain of *Amphiuma*.

Figure B. Ventral view of the same.

Figure C. Dorsal view of the brain of *Menopoma*.

Figure D. Lateral view of the same. Dit. corresponds to vertical line 7, fig. H.

Figure E. Enlarged view (about 30 diameters) of a longitudinal section of the cerebellum and a portion of the optic lobe, taken at one side of the median line. The valvula, *v*, is broader in the median line; *d*, white, *e*, gray portion of Mesencephalon; *a*, fine longitudinal fibres; *b*, transverse band of fibres; *c*, cortical layer of cells.

Figure F. Transverse section of the cerebellum, lettering as in fig. E.

Figure G. *a*, large, *b*, small cells found in crura cerebri (30 diameters).

Figure H. Longitudinal section of the brain of *Amphiuma*, taken to the left of the median line. Vertical lines, 1 to 13, correspond to transverse sections represented by figs. 1 to 13. Black line represents the pia mater; the roof of the metacœlia (fourth ventricle) is omitted in the drawing.

Figure 1. Vertical transverse section through cerebellum, showing it as a transverse band passing beneath Mesencephalon.

Figure 2. Ditto through pituitary body and infundibulum, showing crura cerebri and optic lobe unpaired.

Figure 3. Showing sides of infundibulum thickening into tuber cinereum.

Figure 4. Through posterior portion of the Diencephalon.

Figure 5. Through the median portion of the Diencephalon.

Figure 6. Slightly anterior to fig. 5. *y*, a constriction of the upper portion of the diacœlia.

FIGURE 7. Forward portion of Diencephalon. *y* corresponds to *y* in fig. 6; *x*, see *x* in fig. H.

FIGURE 8. Forward portion of Diencephalon. *a*, bands of fibres passing downwards into the hemispheres.

FIGURE 9. Forward lower portion of Diencephalon (*Di. c.*), showing præcommissura and procœlia.

FIGURE 10. Through the hemispheres slightly anterior to the lamina terminalis.

FIGURE 11. Median portion of hemispheres; *a*, gray matter extending to cortex.

FIGURE 12. Anterior third of hemispheres; showing the beginning of the Rhinencephalon.

FIGURE 13. Section near the tips of the hemispheres.

AUGUST 7.

Mr. CHARLES MORRIS in the chair.

Six persons present.

AUGUST 14.

Mr. CHARLES MORRIS in the chair.

Nine persons present.

AUGUST 21.

Mr. CHARLES MORRIS in the chair.

Six persons present.

AUGUST 28.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fifteen persons present.

Some Evidences of Great Modern Geological Changes in Alaska.—Mr. THOMAS MEEHAN exhibited a piece of wood taken from a prostrate tree, in what appeared to have been a sunken forest in Alaska. It was in Hood's Bay, as marked on some charts, on a peninsula formed by the junction of Glacier Bay and Lynn Channel, and facing Cross Sound, in lat. 58° 30′. The arboreal vegetation generally prevailing in this section consists of *Abies Sitkensis* (*A. Menziesii* of many botanists); *Abies Mertensiana*, the western hemlock spruce; and *Thuja gigantea*, called here "cedar" and "white cedar." *Thujopsis borealis* is said to "abound" in these districts by some authors, but Mr. Meehan remarked that though looking for it through many hundred miles along the shores of the inland seas in southeastern Alaska, he did not see one specimen. The trees in the forest are of all ages, from young seedlings to aged decaying and dead ones. But in sailing into Hood's Bay he noted that the forests all had a comparatively young look—few of the trees appearing over fifty years old. The shores were high—at the point where he landed not less than fifty feet above tide-water—and the soil was sand, or of glacial production. Across from here to Lynn Channel the distance might be about twelve miles, and, so far as could be judged, the soil and trees across were of the same character; and it appeared the same up and down the peninsula for miles. Along the shore he found numerous prostrate trees, and upright stumps which had been ground off a few feet above the surface. The stumps could be seen extending down below low-water mark, and they extended up to the bottom of the highland at high-water mark, where the mud in which they had grown was covered by the glacial deposit already referred to. The wood exhibited was part of one of these prostrate trunks, and is evidently the same species as that now existing on the land, *Abies Sitkensis.* It is quite sound, and exhibits no evidence of great age since it became covered with the drift. The shores are strewn with rocks and stones of various classes, as usual in cases of glacial deposits. On one of the prostrate trunks—the one from which the piece of wood exhibited was taken—there lies a block of granite which, by measurement, was found to contain 2214 cubic feet. This trunk was partially bent in the middle by the weight of the huge block of stone, showing that the block had fallen on it, while the ground beneath the trunk was comparatively soft. Near this, but so far as could be seen not on any trunk, was a much larger mass of granite, comprising 3888 cubic feet. The whole of the circumstances pointed to the almost certainty that there had been a sudden subsidence of the land, and that with the subsidence there was a flow of water with icebergs on which were these huge rocks, and which crushed the trees and tore off those which were strong enough to resist; and that subsequently to the destruction of the forest, the whole surface became covered to a great depth with drift. Since that time there must have been an elevation of the land, and the remains of the trees are again brought to their original surface, but with a deep bed of earth above them. Mr. Meehan believed that the botanical facts might afford a clue to an approximation to the time when these events occurred. The youth of the living forest indicated that, at the farthest, it could not have been more than a few hundred years since the elevation occurred. As already noted, the trees in the immediate vicinity appeared to be but about fifty years since germination; but unless the original parent trees which furnished the seed for the uplifted land were near by, it might take some years for the seed to scatter from bearing trees, grow to maturity, again seed, and in this way travel to where we now find them. But as original forests were evidently not so very far distant, two or three hundred years ought to cover all the time required. The Rev. Mr. Corlies, a missionary at Juneau, or Harrisburg as it is marked on some charts, informed the speaker that an Indian chief had told him that about seven or eight generations ago, as tradition told them, there had been a sudden and terrible flood in that land, and only a few Indians had escaped in a large canoe. The probable identity of the sunken trees with the present species, and the freshness of the wood, would indicate no very great date backwards at which the original subsidence occurred.

In connection with the subject of the comparative recentness of great geological changes as indicated by botanical evidence, Mr. Meehan referred to an exposure of the remains of a large forest near the Muir glacier, one of five huge ones which form the head of Glacier Bay, between lat. 59° and 60°. This glacier is at least two miles wide at the mouth, and has an average depth of ice at this spot of perhaps five hundred feet. At the present time there is not a vestige of arboreal vegetation to be seen anywhere, except some willows on the hillsides, some miles from huge hills of drift piled up everywhere around. The river which flows under the glacier, and which has a volume equal to the Schuylkill at Philadelphia, does not flow into the bay from under the ice at the face, but rushes out in a mighty torrent on the northwest side, a few miles above the mouth, and has cut its way through mountains of drift, the gorge being many hundred feet in width, and the sides from two hundred to five hundred feet high. The torrent through the bed is now comparatively level, carrying with it an immense quantity of heavy stones, some of which must have comprised masses of six or eight cubic feet. Along the sides of this gorge were the exposed trunks, all standing perfectly erect, and cut off at about the same level. Some were but a few feet high, and others as much as fifteen—the difference arising from the slope of the ground on which the trees grew. These trunks were of mature trees in the main, and were evidently of *Abies Sitkensis*, with a few of either *Thuja gigantea* or *Juniperus*, perhaps *Occidentalis*, the uncertainty arising from the imperfection of the bark—what there was of this indicating the former, while an eccentricity of outline of the wood, not uncommon in *Juniperus*, favoring the latter view. These trees must have been filled in tightly by drift to the height of fifteen feet before being cut off, or the trunks now standing would have been split down on the side opposite to that which received the blow, and the grinding off could not have been many years after, or the dead trees would have lost their bark, as they always do when under varying conditions of heat and moisture. The facts seemed to him to indicate that the many feet of drift which had buried part of the trees in the first instance was the work of a single season, and that the subsequent total destruction of every vestige of these great forests was the work of another one soon following. As in the case of the facts noted in Hood's Bay, Mr. Meehan believed that the conclusion was justified that the total destruction of the forests here, the covering of their site by hundreds of feet of drift, and the subsequent exposal to view of their remains, were all the work of but a very few hundred years.

Mr. Charles Peabody was elected a member.

September 4.

Mr. Thos. Meehan, Vice-President, in the chair.

Sixteen persons present.

The death of John C. Dawson, a member, was announced.

Exudation from Flowers in Relation to Honey-dew.—Mr. Thos. Meehan remarked that our standard literature yet continued to teach that the sweet varnish-like covering often found over every leaf on large trees, as well as on comparatively small bushes, was the work of insects, notably Aphides. So far as he knew, Dr. Hoffman, of Giessen, who in 1876 published a paper on the subject, is the only scientific man of note who takes ground against this view. He met with a camelia without blossoms, and wholly free from insects, and yet the leaves were coated with "honey-dew," as it is generally known. He found this substance to consist of a sticky colorless liquid, having a sweetish taste, and principally gum. Mr. Meehan said he had often met with cases where no insects could be found, as well as others where insects were numerous, and where in the latter case, the attending circumstances were strongly in favor of the conclusion that the liquid covering was the work of insects.

He said he believed that few scientific men had any knowledge of the enormous amount of liquid exuded by flowers at the time of opening, and he had seen cases where the leaves were as completely covered by the liquid from the flowers, as if it had exuded from the leaves, as he believed Dr. Hoffman had good grounds for believing is often the case. He had already brought to the attention of the Academy cases where large quantities of liquid had dropped from the flowers to the leaves below, of which *Yucca*, *Mahonia* and some others had been recorded in the Proceedings of the Academy. *Akebia* had been noted by Mr. Wm. M. Canby to drop from the leaves at certain times, and Sach notes in his Textbook the moisture which fills the small flowers of *Thuja*. In connection with the last case, the exudation from Coniferæ, he met with a remarkable case during his recent journey through the northwest coast. While collecting plants along the east shore of the Columbia River he noticed a plant of *Alnus Oregana*, covered with honey-dew. The woolly Aphis, so well known for its preference for alder, also abounded. Little drops of liquid were in many cases attached to the apex of the abdomen, and the conclusion was reached that in this case at least, the probabilities favored the insect origin of the liquid on the leaves. Proceeding a few feet further, towards the trunk of a large spreading Sitka spruce (*Abies Sitkensis*), and then on the other side, a bush of *Pyrus rivularis* was observed also covered, but not a sign of an insect anywhere about it. This caused a reëxamination of the whole case, when it was noticed that stones under the spruce tree, forming the shore of the river, and many feet outside of the circle formed by the branches of the Pyrus and Alder, were quite black with a gummy coat, which most probably had fallen from the spruce, the branches of which overshadowed the two bushes already named, as well as the stones. The branches of the spruce hanging towards the river were covered with young cones of probably one-half their full size, and the scales were found to be filled with sweet liquid. Taking the cone as it hung on the tree and stripping it down as one would milk a cow, a drop as large as a pea gathered in the hand from a single cone. There could be no doubt but that the viscid covering on the leaves of the two shrubs below, as well as on the unprotected stones, came from the cones of the spruce tree. He had seen, two years ago, the glossy covering over the leaves of the *Liriodendron* at flowering time, and found the opening flowers with a large quantity of liquid at the base, and had intended especially to give the matter minute attention the past summer and then report to the Academy; but his long journey had diverted him. Recently the subject had been again brought to his attention during some experiments in relation to pollinization and cross-fertilization in *Platycodon grandiflora* not yet concluded. Cutting open very carefully a corolla just about to expand, the whole inner surface was found to be coated with minute drops of moisture, which, as they gathered in size, streamed down toward the base of the pistil. This liquid was not sweet, but had the taste of lettuce. In the case of the moisture which exuded from the divisions of the perianth in *Yucca gloriosa* and *Yucca angustifolia* before reported, the taste was rather bitter than sweet. He said there was reason for the belief that much of the moisture found at the base of flowers was not the product of "nectariferous glands," which were sometimes guessed at rather than always detected, but was rather the collection from exudation from the petals; and if so it was a confirmation of Dr. Hoffman's idea of the origin of honey-dew through the surface of the leaf, as we might reasonably suppose a modified leaf like the petal of a flower to have some functions in common with the primary leaves from which they sprung.

What is the object of this abundant exudation of sweet liquid and liquid of other character from leaves and flowers? The speaker said we were so accustomed to read of nectar and nectaries in connection with the cross-fertilization of flowers, that there might seem to be no room for any other suggestion. But plants like the *Thuja* and *Abies* were anemophilous, and having their pollen carried freely by the wind, had no need of these extraordinary exudations from any point of view connected with the visits of insects to flowers. In the case of *Thuja*, Sach had suggested another use: "The pollen-grains which happen to fall on the micropyle of the ovules are retained by an exuding drop of fluid, which about this time fills the canal of the micropyle, but afterwards dries up, and thus draws the captured pollen-grains to the nucleus, where they immediately emit their pollen-tubes into the spongy tissue. In *Cupressineæ*, *Taxineæ* and *Podocarpeæ* this contrivance is sufficient, since the mycropyles project outwardly; in the *Abietineæ*, where they are more concealed among the scales and bracts, these themselves form, at the time of pollination, canals and channels for this purpose, through which the pollen-grains arrive at the micropyles filled with fluid" (STRASBERGER).[1] Mr. Meehan said that in his former observations on liquid exudations in *Thuja* and other plants he was inclined to adopt the suggestion of Sach as to the purpose of the liquid supply; but as it was here in *Abies* so long after fertilization must have taken place, and as it was held up in the deep recesses of the scales of the pendent cone, where it could hardly be possible the wind could draw up the pollen; and as, moreover, the extract shows that these eminent botanists believe *Abietineæ* does not need the moisture they did not know existed in this abundance, we must look for other reasons, which, however, do not yet seem to be apparent.

SEPTEMBER 11.

Mr. MEEHAN, Vice-President, in the chair.

Sixteen persons present.

The death of the Curator-in-charge, Charles F. Parker, on the 7th inst., was announced.

Irritability in the Flowers of Centaureas and Thistles.—Mr. THOMAS MEEHAN called attention to some flowers of various compositæ on the table, sent by Miss Mary E. Powel, of Newport, Rhode Island, who has observed a singular motion in the florets of *Centaurea Americana.* This motion had long been known to German botanists, and a reference to some features of it may be found in Sach's Text-book of Botany, and there was an illustrated paper by Cohn in *Zeitschrift für wis. Zoologie*, vol. xii, showing the mechanism of the contraction of the anthers. As, however, the motion had failed to attract the attention of American observers, or at least he knew of no reference to it in any American work at his command, he believed it might do good service to place on record an independent statement of the phenomena as exhibited by the specimens before us.

Besides the motion in *Centaurea Americana*, observed by Miss Powel, Mr. Meehan said that he found a similar motion in the following plants growing in his garden: *Centaurea alba*, *Centaurea*

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[1] Sach, Text-book of Botany, Oxford edition, p. 449. The various ways of spelling micropyle in the same paragraph, are of course retained in the quotation.

nigra, *C. ochroleuca*, *C. rutifolia*, *Cirsium serrulatum*, *C. discolor*, and *C. lanceolatum*. The motion seems most active when the anthers are ready to shed their pollen, and, as pollen-gathering insects anticipate the observer, it is best to cut the flowers and place them in water in a room. Endeavoring to observe the motion of *Cirsium discolor* in the growing plant almost failed from this cause, but on drawing a light substance over the whole head, some of the florets were found to move.

In the *Centaurea* flowers on the table, the best period for observing the motion is when the anthers which cover the apex of the pistil seem about to allow the pistil to protrude. If then touched, the pollen is seen to issue from the mouth of the united stamens, and the whole crown of anthers to decline. Cohn, above cited, gives the exact measurement of this contraction, and explains the mechanism by which the contraction is accomplished. At the same time, if the motive power be very active, the whole upper portion of the floret, moves in some direction, apparently without order or system. Sometimes it is in a lateral direction, at other times upwards or downwards, and sometimes describing a circle round its own axis. In some cases the motion is communicated to other florets—two and sometimes three moving to the touch of a single one. In ten minutes after the exhibition of irritation, it is ready for another fit, and goes through the motions, though less actively than before. Mr. Meehan had failed to get any motion three times from the same floret, and not always two. Touching the pistil had no effect unless the force was sufficient to press one side against the anther. The irritation seemed to be confined to the stamens, and through these probably down by their nervous connections through the achenium, and in this way communicating with the nerves which run up through neighboring achenes to the stamens which they support.

Since the above communication was made to the Academy, Mr. J. H. Redfield believes that the neutral ray florets in *Centaurea Americana*, which have neither stamens nor pistil, also possess the power of motion, and Miss Powell, without knowledge of Mr. Redfield's observation, notes a similar experience.

SEPTEMBER 18.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Thirty-one persons present.

The death of John C. Trautwine, a member, was announced.

Notes on the Sequoia gigantea.—Mr. MEEHAN remarked that so much had been written about the mammoth trees, that there seemed little room for more; but to one of the fullest accounts given, namely, that by Mr. Muir in the Proceedings of the Meeting of the American Association for the Advancement of Science, at Buffalo, 1876, he believed he might add a few additional facts, drawn from or suggested by a visit made to a few of the groves during the past summer. He could confirm the statement of Mr. Muir that there were comparatively few young plants growing among the old ones in the Calaveras or Mariposa groves. In the latter spot a few might be found in swampy places. Many of the large trees were also growing in swampy ground, while some were found where the ground would be pronounced quite dry. Mr. Muir gave 5000 feet as about the elevation of the trees in these—the northern part of the belt occupied by them. On the southern part of the belt Mr. Muir found them at about 8000 feet, and there numerous young trees formed the great mass of the undergrowth, and furnished an abundance for a perfect succession of forest trees. Here Mr. Muir found them in ground not swampy, as well as in situations as swampy as possible, and he concludes that the *Sequoia gigantea* is a tree which has the power of growing in dryer and wetter soil than most other species. He adds: "It is constantly asserted in a vague way, that the Sierra (in past times) was vastly wetter than now, and that the increasing drouth will of itself extinguish *Sequoia*, leaving its ground to other trees supposed capable of flourishing in a dryer climate. But that *Sequoia* can and does grow on as dry ground as any of its present rivals, is manifest in a thousand places. 'Why, then,' it will be asked, 'is *Sequoia* always found in greatest abundance in well-watered places where streams are exceptionally abundant?' Simply because a growth of sequoias always creates these streams. * * * Drain the water, if possible, and the trees will remain; but cut off the trees, and the streams will vanish." He has seen a fallen trunk make a dam of 200 feet long, and similar bogs made by roots and fallen trunks damming the earth, are familiar features in the more luxuriant sequoia forests. On this bare suggestion Mr. Muir builds as if it were a demonstration, and proceeds to say: "Since the extra moisture found in connection with the denser growths is an effect of their presence, instead of a cause of their presence, then notions, * * * based upon its supposed dependence on greater moisture, are shown to be erroneous."

In the light of these views, Mr. Meehan said he had carefully examined the trees in the groups scattered from the Fresno to Calaveras, and could say that in these localities the sequoias possessed no more power of making the ground swampy than any other tree which might form the leading forests in heavy wooded districts. The huge specimens of *Pinus Lambertiana*, *Pinus ponderosa*, and the thick groves of *Libocedrus*—huge, though averaging at best but two-thirds the diameter of the mammoth sequoias—did not make the ground swampy in the slightest degree. Mr. Muir's supposition—for it surely cannot be regarded as such a demonstration as science requires—would give us small swamps, at least, for the smaller trees.

Experience of forest growths in the eastern states gave abundance of facts, which were quite sufficient to explain the existing state of things, on grounds very different from those assumed by Mr. Muir. Observers knew that there were trees which loved moisture, and trees which preferred dry ground. Swamp-lovers would grow in dry places almost as well as in wet ones, but the dry-lovers would not grow in wet places. The swamp magnolia, swamp willow, swamp azalea, the bald cypress, the swamp maple, the sweet gum—every swamp tree that can be named—do just as well, and in many cases better, in dry ground. This is so well known to every intelligent cultivator of trees, that its correctness is beyond dispute. Here in the east, the largest red maples, willows, cypresses, and other swamp trees, are the occasional specimens which by accident find themselves on dry ground. On the other hand, the dry-land species of pine, oak, maple, and other trees, can under no circumstances be made to grow in wet places; and, therefore, if Mr. Muir's suggestion that the *Sequoia* was once a dry-land plant, and made the land swampy through its own growth, should by any possibility be found correct, it would probably be an exceptional case in the vegetable kingdom. It had been shown by himself, the speaker said, in past communications to the Academy, printed in its Proceedings, that trees only grow in swamps from a provision of nature that their seeds shall only germinate in wet places. It seems like a determination of nature that some trees shall grow in swamps, whether they prefer it or not. Though these trees grow better and fruit freely in dry ground, the trees cannot spread, because there is not the moisture required for the seed to grow.

Mr. Muir mistakes the argument. It is not that sequoias will not grow in dry ground, but that the seed will not germinate to any extent except under highly humid conditions. Ground need not be absolutely wet. The cultivator raises swamp ferns on bricks, and the swamp rhododendron is often found on rocky ledges, but this is only where a humid atmosphere keeps the seed from drying till it grows. The atmospheric humidity at 8000 feet would be more likely to help *Sequoia* at 8000 feet than at 5000. In concluding this branch of the topic he said the facts spoke for themselves. The seed did not grow now—there were no seedlings—though seeds were abundant. They grew in former times or the trees would not exist. There must be some change in the conditions necessary to make seeds grow since the forest was started. We know from outside observations that seed of swamp-loving trees will not grow under arid conditions. We see that the *Sequoia* is a swamp-lover. Is not this getting to as close an explanation as science rarely reaches? May we not say that *Sequoia* does not spread because the humid conditions are not as they once were when the forests were founded? This was certainly his conclusion from the facts as they presented themselves to his observation.

If this be incontrovertible, it opens up an interesting question as to the cause of the desiccation in the vicinity of the big trees. The ratio of disintegration in a mountain peak, by the frost, rains, and elements generally, and the descent of the loose mass to the lower lands by the simple law of gravity alone, would depend on the width of the peak, as well as the nature of the material. In the process of ages, peaks covered with snow would be lowered till they were no longer snow-capped in summer, and thus lower regions in the vicinity, covered perchance with *Sequoia*, would be under dryer atmospheric conditions. To a greater or less extent this must be the case in all mountain changes, but whether this could have been going on to any appreciable extent in the few thousand years during which these trees have occupied the spot, is a question for geologists to determine. However, Mr. Muir himself gives good reasons for the belief that these trees followed from the west, eastwardly, in the close wake of retreating glaciers, and when the atmospheric moisture, as well as that of the earth contiguous, must have been more moist than now.

In regard to the age of the trees, Mr. Meehan said doubts had been expressed whether the *Sequoia* might not make more than one annual circle of wood a year, and thus render the count by these annual circles unsafe. He had given close attention to this point on the ground, by measuring the height of thrifty young trees, and estimating by the growth per year the probable age. A tree of say thirty, forty or fifty feet, would be seen to be about that many years old. The diameter of the trunk would then be taken and found to correspond with the one annual ring per year in the sections of the larger trees, as per actual count. There would be no question but the larger trees were over 2000 years old.

He found that when about three or four hundred years old, the trees ceased to increase in height to any appreciable degree, the effort of the tree being more in a lateral direction, and the nutritient matter necessary to the building up of the trunk was mainly the work of the side branches. The height of one called "Haverford," after our sister college, he found, by a rough triangulation, to be about 249 feet.

SEPTEMBER 25.

Rev. Dr. H. C. McCook, Vice-President, in the chair.

Thirty-seven persons present.

The death of Alexis T. Cope, a member, was announced.

Restoration of Limbs in Tarantula.—Rev. Dr. McCook remarked that the tarantula exhibited had been kept in confinement nearly a year, fed during winter on raw beef and in summer on grasshoppers. In the spring it cast its skin, by a laborious process, which was described to the Academy, in the course of which it lost one foot and two entire legs. This summer again, during the latter part of August, the animal moulted; the moult as exhibited is a perfect cast of the large spider—skin, spines, claws, the most delicate hairs all showing, and their corresponding originals appearing bright and clean upon the spider. The moulting occurred during Dr. McCook's absence, but was just finished when he returned. When the cast-off skin was removed it showed, as might be supposed, the dissevered members to be lacking. But on looking at the spider itself, it was seen that new limbs had appeared, perfect in shape but somewhat smaller than the corresponding ones on the opposite side of the body. The dissevered foot was also restored. The loss of the opportunity to see the manner in which the legs were restored during moult was greatly regretted; but we have some clue from the careful and interesting studies of Mr. Blackwall. Several spiders whose members had been previously amputated, were killed and dissected immediately before moulting. In one of these the leg which was reproduced was found to have its tarsal and metatarsal joints folded in the undetached half of the integument of the old tibia. Another like experiment was made with an example of *Tegenaria civilis*. The reproduced leg was found complete in its organization, although an inch in length, and was curiously folded in the integument of the old coxa, which measured only one-twenty-fourth of an inch in length. Dr. McCook's tarantula had lost both legs close up to the coxæ, and in the moult the hard skin formed upon the amputated trunks was wholly unbroken, showing that the skin had been cast before the new leg appeared. We risk nothing in inferring that, as in the case of Blackwall's *Tegenaria*, the rudimentary legs were folded up within the coxæ, and appeared at once after the moulting, rapidly filling out in a manner somewhat analogous to the expansion of the wings in insects after emerging.

Messrs. Henry F. Claghorn and Emanuele Fronani were elected members.

OCTOBER 2.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Twenty-eight persons present.

The death of Charles Magarge, a member, was announced.

The Synchronism of Geological Formations.—Professor ANGELO HEILPRIN, referring to one of the many vexed problems which from time to time engross the attention of geologists and naturalists, namely, the contemporaneity of geological formations, stated that the order of deposit of the various formations, from the oldest to the newest, was constant the world over, and that nowhere, except where there may have been a reversal of the strata themselves, was there evidence of a reversed position. Corresponding strata, as indicated by the contained fossils, had therefore been supposed to belong to the same age, although occurring in widely separated regions. This view, for a long time maintained undisturbed by the earlier geologists and palæontologists, had, however, been dissented from by Edward Forbes, Huxley, and other advocates of the doctrine of faunal dispersion from localized areas or centres of distribution (opponents of independent creation), on the obvious ground, that faunas starting from a given point of origination could only spread by migration, and that such migration must consume time, proportional to the distance traveled and the physical and physiographical facilities afforded for traveling. Hence it was argued that widely separated formations showing an equivalent faunal facies, as, for example, the Silurian of America and the Silurian of Europe or eastern Asia, or the Cretaceous of Europe and South America, could not be of identical age, and, with a fair show of probability, not even approximately so. In support of this position it has been urged that during the present age of the world the faunas of the several continents are widely distinct, and could, under geological conditions, be considered as indicating different zoological (geological) eras. In conformity with this view, Professor Huxley had proposed (Anniversary Address, Geol. Soc., 1862. Q. J. Geol. Soc., xviii, p. xlvi) the term "homotaxis," indicating similarity of arrangement, in place of synchrony, to describe the relations of distant areas of the same formation.

Pushing his conclusion to what appeared to be its furthest legitimate point, Professor Huxley deduced therefrom two important considerations:

I. That formations exhibiting the same faunal facies may belong to two or more very distinct periods of the geological scale as now recognized; and conversely, formations whose faunal elements are quite distinct, may be absolutely contemporaneous; *e. g.:* "For anything that geology or palæontology is able to show to the contrary, a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa" (*loc. cit.*).

II. That, granting this disparity of age between closely related faunas, all evidence as to the uniformity of physical conditions over the surface of the earth during the same geological period (*i. e.*, the periods of the geological scale), as would appear to be indicated by the similarity of the fossil remains belonging to that period, falls to the ground. "Geographical provinces and zones may have been as distinctly marked in the Palæozoic epoch as at present, and those seemingly sudden appearances of new genera and species, which we ascribe to new creation, may be simple results of migration."

These views, enunciated by Prof. Huxley, were still largely held, Prof. Heilprin maintained, by a very large body of geologists. But it can readily be shown by a logical deduction that at least one of the conclusions arrived at (I) is, in almost certainty, erroneous; and that the second, based upon this one, derives no confirmation from the supposed facts. If, as is contended, several distinct faunas—*i. e.*, faunas characteristic of distinct geological epochs—may have existed contemporaneously, then evidences of inversion in the order of deposit ought to be common, or, at any rate, they ought to be indicated somewhere, since it can scarcely be conceived that animals everywhere would have observed the same order or direction in their migrations. Given the possible equivalency in age, as claimed, of the Silurian fauna of North America with the Devonian of the British Isles and the Carboniferous of Africa, or any similar arrangement, why has it never happened that when migration, necessitated by alterations in the physical conditions of the environs, commenced, a fauna with an earlier facies has been imposed upon a later one, as the Devonian of Great Britain upon the Carboniferous of Africa, or the American Silurian upon the Devonian of Britain? Or for that matter, the American Silurian may have just as well been made to succeed the African Carboniferous. Why has it just so happened that a fauna characteristic of a given period has *invariably* succeeded one which, when the two are in superposition, all over the world (as far as we are aware), indicates precedence in creation or origination, and *never* one that can be shown to be of later birth? Surely these peculiar circumstances cannot be accounted for on the doctrine of a fortuitous migration. Nor can it be claimed that, through the interaction of the evolutionary forces, a migrating fauna with an early-life facies will in each case at the point of its arrest have assumed the character of the later-day fauna which belongs to that position. Therefore it appears inexplicable that a very great period of time could have intervened between the deposition of the fauna of one great geological epoch at one locality, and that of the same or similar fauna at another locality distantly removed from the first. In other words, the migrations, for such must undoubtedly have been the means of the distant propagation of identical or very closely related life-forms (unless we admit the seemingly untenable hypothesis that equivalent life-forms may have been *very* largely developed from independent and very dissimilar lines of ancestry), must have been much more rapidly performed than has generally been admitted by naturalists. (*Sic* Huxley: "All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question, Were the British Cretaceous rocks deposited at the same time as those of India, or are they a million of years younger or a million of years older?")

But what applies to the broader divisions of the geological scale also applies to the minor divisions. Thus the subordinate groups of a formation are almost as definitely marked off in the same order, the world over, as are the formations themselves. After breaks in formations the appearance of characteristic fossils is largely the same; whereas, on the theory of synchronism of distinct faunas, such a succession of forms would certainly not be constant. After deducing further evidence from the lithological characters of the rock-masses of the various geological formations, the speaker maintained that the views entertained on the subject by the older geologists were more probably the correct ones, namely: that formations characterized by the same or very nearly related faunas in widely separated regions belonged, in very moderate limits, to approximately the same actual age, and were, to all intents and purposes, synchronous or contemporaneous.

Longevity of Trees.—At the meeting of the Botanical Section, October 8, Mr. Thomas Meehan remarked that there was nothing phenomenal in the great age of the mammoth sequoias, as other trees on the Pacific coast exhibited great age. In order to ascertain whether more than one annual circle of wood is formed in each year, he tested the matter in various ways. For instance, a pine or spruce would be found to make an average growth of a foot a year up to fifteen years old; from that to about thirty years, nine inches; from that on, six inches; after that a stage was reached where the erect growth ceased to any considerable extent, and the growth force seemed turned toward the lateral branches. In the pine forests of the Pacific coast, there was no danger of error in fixing the age of the average tree of sixty feet high, at about fifty years. Wherever such a tree was cut down, and an opportunity afforded to count the circles, they would be found to correspond so nearly with the calculated age, as to prove that it was quite safe to assume a single circle for a single year. Then there was a remarkable degree of uniformity in the diameter of these annual growths in most trees, so that when once we had the number of the circular lines to an inch, and the diameter of the tree, we could tell its age near enough for general purposes. In some pine trees growing on very rich soil, he had found as few as about four circles to an inch. For instance, a section of a *Pinus Lambertiana* (in Mariposa), four feet across, had but 189 circles; but here the increased size of the trees corresponds with the larger annual circles. Trees of this species of pine here were not uncommon, measuring thirty, and a few thirty-three feet around. No matter, however, how vigorous may be the growth of trees under fifty or one hundred years, they decrease with age, and we may safely allow six rings to an inch in these older sugar pines, which would make the thirty-three feet tree 396 years old. The outer growths of sequoia were very narrow. He counted as many as eighteen to the inch, while the rings in the interior of cross-sections would show about six to the inch. Allowing twelve as the average per annum, a tree of thirty-three feet diameter would give 2376 years old, which is about the same as given by an actual count of rings. At Harrisburg or Juneau, in lat. 58°, a Sitka spruce (*Abies Sitkensis*) cut down, gave 149 rings from centre to circumference—298 lines, in a trunk three feet across. This gave an average of about eight to an inch in this 149 years old, three feet tree. At Wrangel, lat. 56°30′, a tree of the western hemlock (*Abies Mertensiana*) which had been blown down, and afterwards divided by a cross-cut saw at four feet from its base, gave eighteen lines to an inch, and the annual growths seemed very regular almost to the centre of the tree. It was six feet in diameter, and must have been a grand old tree in its day. It had evidently been broken off years before it was blown down, but the length of this trunk up to where it had been broken was 132 feet, and four feet in diameter at that height. But allowing as much as twelve to an inch, it would give for the point cut across, six feet, an age of 432 years. At Kaigan Harbor, lat. 55°, the Sitka spruces were very large, and of great height. He measured two of the largest, which were twenty-one feet in circumference each. Allowing eight to the inch, as in the tree of the same species at Harrisburg, it gives 336 years as the age of the tree; so far as appearances went, these trees were in the height of vigor, and there seemed no reason, judging from experience in other cases, why these trees might not flourish for a hundred years yet. Mr. Meehan had no doubt that these trees in these latitudes in Alaska, would easily have a life of 500 years.

Turning now to the Atlantic States, we find 200 years as the full average term of life for its forest trees, with the exception, perhaps, of the plane, *Platanus occidentalis*, which is the longest lived of all. Trees famous for longevity in Europe are comparatively short-lived here. In the old Bartram Garden, near Philadelphia, where the trees can be little more than 150 years old, nearly all are past their best. The English oak, *Quercus Robur*, which in England is said to live for a thousand years, has grown to full size and wholly died away in this garden, and the foreign spruces are on the down grade. The great cypress, *Taxodium distichum*, which must have made an average growth of four lines a year, has also begun to show signs of deterioration. Silver firs, *Abies pectinata*, in the vicinity of Philadelphia, known to be planted in 1800, are decaying. This is the general experience.

In seeking for the cause of this difference, we are accustomed to look at the relative humidity of the atmospheres of Great Britain and the Atlantic United States. Evergreens like *Cerasus Laurocerasus*, *Laurus nobilis*, and *Viburnum tinus*, which will endure a temperature of 25° below freezing point in Great Britain, are killed by 10° in Philadelphia; and it is believed by the dryer atmosphere causing a heavier drain for moisture on the vital powers of the plant to supply. A strain which will wholly destroy plants in some instances, must have an enervating influence where it does not wholly destroy, and this would naturally be exhibited in shortening the life of the tree.

The climate of Alaska had the same favoring influences we found in Great Britain. The warm sea of Japan flowed against its southeastern face, along which the trees referred to were found. The atmosphere was always moist, and severe weather almost unknown. At Sitka, in lat. 57°, as much as 100 inches of rain had fallen in a single year. The harbor was rarely frozen; boats came in and went out at all times of the year. There were some winters when no ice of any consequence was seen. These were circumstances favorable to longevity in trees.

Mr. Meehan concluded by remarking that Dr. Lindley had said somewhere that his researches had failed to show that there was any period of duration of life set for any tree, and that if circumstances favored there seemed no reason why trees might not live for an indefinite period, and, therefore, arguments offered in connection with the "wearing out of varieties," based on what is called the "natural life of a tree," had little force. Mr. Meehan believed his observations on the longevity of trees on the Pacific confirmed Dr. Lindley's views. At any rate, there seemed nothing phenomenal in the age of the *Sequoia gigantea*, as other species partook of similar longevity to a great extent.

Prof. Angelo Heilprin was elected Curator, to fill the vacancy caused by the death of Charles F. Parker.

October 9.

The President, Dr. Leidy, in the chair.

Thirty-two persons present.

The Council reported the appointment of Prof. Angelo Heilprin as Actuary to the Curators, or Curator-in-charge.

Mineralogical Notes.—Dr. Leidy exhibited a large crystal of topaz, from Mursinsk, Siberia. It is pale blue, with perfect termination, and weighs three pounds three ounces. He also exhibited large cut specimens of white topaz and rich green beryl, which had met with a curious accident. The two, in unpacking, had been violently struck together, and the former had been broken through the middle so as to exhibit a perfect cleavage.

October 16.

Mr. Thos. Meehan, Vice-President, in the chair.

Thirty-seven persons present.

OCTOBER 23.

Mr. CHARLES MORRIS in the chair.

Six persons present.

The deaths of Joachim Barrande, Oswald Heer and W. Kowalewsky, correspondents, were announced.

OCTOBER 30.

The President, Dr. LEIDY, in the chair.

Forty-five persons present.

The following were presented for publication:

"Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences of Philadelphia, from January 23, 1882, to November 26, 1883."

"On the Anatomy of Ancylus lacustris and Ancylus fluviatilis," by Dr. Benj. Sharp.

"Note on a Collection of Fossils from the Hamilton (Devonian) Group, of Pike Co., Pa.," by Prof. Angelo Heilprin.

"Manayunkia speciosa," by Prof. Jos. Leidy.

"On the Evidences of Glacial Action in Northern New York and Canada," by Jos. Willcox.

"Obituary Notice of Charles F. Parker," by Isaac C. Martindale.

The death of J. Lawrence Smith, a correspondent, was announced.

Francis A. Cunningham and S. Mason McCollin, M. D., were elected members.

Eugene A. Rau, of Bethlehem, Pa., was elected a correspondent.

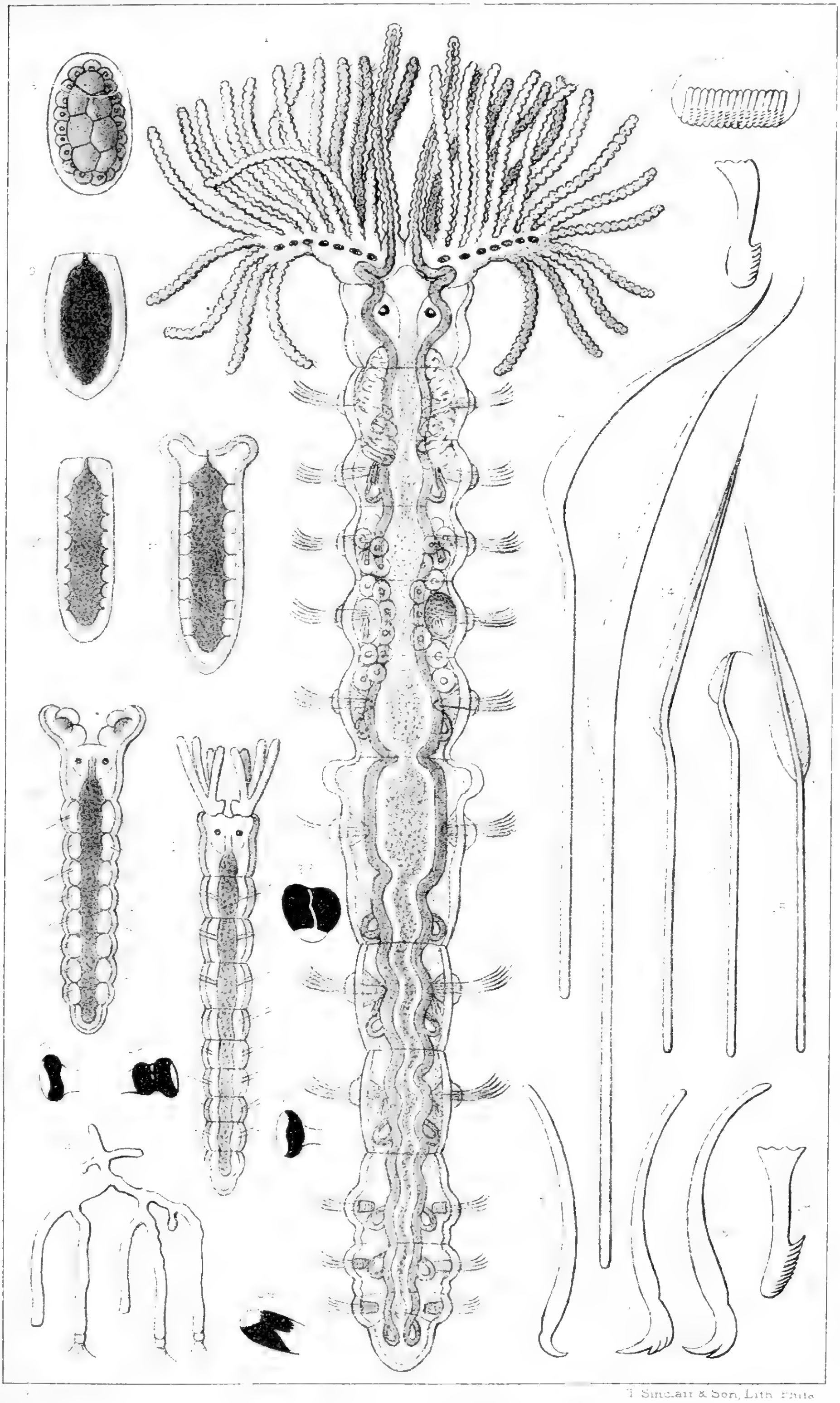
The following were ordered to be published:

MANAYUNKIA SPECIOSA.

BY PROF. JOS. LEIDY.

At the time of the discovery of the pretty polyzoan, *Urnatella gracilis*, of which a description is now in course of publication in the Journal of the Academy, I found an equally interesting little annelide, of which I gave a brief notice in 1858, published in the Proceedings for that year, page 90, under the name of *Manayunkia speciosa.* The two were found in company together, attached to the same stones, in the Schuylkill River, at Fairmount, Philadelphia. They seem fitting associates, for while *Urnatella* is nearly related with the marine *Pedicellina*, *Manayunkia* is closely related with the marine annelide *Fabricia.* *Manayunkia* has proved to be less frequent than *Urnatella*, nor have I found it elsewhere than in the locality named. Recently, several specimens were submitted to my examination by our fellow-member, Mr. Edward Potts, who found them attached to a fragment of pine-bark, in Egg Harbor River, New Jersey. Independent of the interest of finding the worm in a new locality, the specimens have enabled me to complete an investigation of the animal so far as to prepare the following description, though I have to regret that the material has been insufficient to allow me to clear up several important points. I have had the opportunity of comparing *Manayunkia* with a species of *Fabricia* living on our coast, and have found the two to be so nearly alike, that I am prepared to hear it questioned whether the former should be regarded as generically distinct from the latter.

Manayunkia forms a tube of mud, which it occupies. The tube is composed of the finest particles, aglutinated by a mucoid secretion of the worm. It is cylindrical, straight or bent, mostly even or slightly uneven on the outside, and sometimes feebly annulated. It is attached partly along its length to fixed objects, with the greater part free, directed downward and pendant. Most specimens observed were single, but several were found in which two or three tubes were conjoined, and in one instance five tubes with remains of others were given off, in a candelabra-like manner, from a common stem, as represented in fig. 2, Plate IX. From the open mouth of the tube, the worm protrudes its head and spreads its crown of ciliated tentacles, in the same manner as in



T. Sinclair & Son, Lith. Phila.

MANAYUNKIA SPECIOSA

most tubicolous annelides. The simple tubes range from two to four lines in length by the one-fifth to the one-fourth of a line in width.

Manayunkia is very sensitive, and on disturbance withdraws deeply into its tube, so that half the length of the latter may be removed before reaching the worm. The little creature clings tightly to the inside of its habitation, apparently mainly by means of the minute podal hooks of the posterior segments of the body.

The mature worm (fig. 1) is from three to four millimetres in length by about one-fourth of a millimetre in breadth, and is divided into twelve segments, including the head. The color is translucent olive-green, with the cephalic tentacles of a slightly brownish hue. As the worm shortens, the segments become more bulging laterally and the constrictions deeper; in elongation, the segments become more cylindrical and the constrictions less marked. When the worm is elongated, it is of nearly uniform width for about three-fourths of the length, and then slightly tapers to the end, or is a little widened again in the two segments before the last. The head is about as broad as it is long, and is surmounted by a pair of lateral lophophores supporting the tentacles. Its border above projects dorsally into a short rounded process. The succeeding four segments of the body are about as broad as they are long, and nearly of uniform size; the next one is somewhat longer than those in advance. The seventh segment, in all the mature worms observed, greatly exceeded any of the others. It was usually twice the length, and differed from them in having an abrupt expansion at the fore-part, which suggested the production of a head prior to division of the worm; a process, however, if it occurs in *Manayunkia*, I had not the opportunity of observing. The succeeding segments, smaller than the anterior ones, differ little in size, except the last two. The terminal segment abruptly tapers from above its middle in an obtusely rounded extremity. When the worm protrudes from its tube, the lophophores are reflected from the head, and they exhibit a double row of tentacles extending forward. The number of tentacles varies with the age of the worm, but at maturity there are usually eighteen for each lophophore. They are of moderate length, and of uniform extent, and measure about half a millimetre. Two of them internally, one for each lophophore, are rather longer and larger than the others, and are rendered conspicuous by a large vessel filled with bright green blood. The tentacles are invested with ciliated epithelium, with actively moving cilia, and in all respects bear a close resemblance to those of the polyzoa. In the allies of *Manayunkia*, they are regarded as branchial appendages, and usually named cirri; and although this is unquestionably correct, as in the case of the corresponding organs of the polyzoa, they perform a varied function, and may, with equal correctness, be called tentacles.

When *Manayunkia* is about to withdraw into its tube, the lophophores approach, and together with the tentacles form a close longitudinal fascicle. Along the lophophores, at the base of the tentacles, there is a row of half a dozen or more brownish pigment spots, resembling eyes, but not having the usual constitution of such organs. The segments of the body of *Manayunkia*, succeeding the head, are furnished on each side with a fascicle of locomotive setæ, which is divided into two portions, one usually consisting of shorter setæ than the other. The fascicles, when most protruded, project from a papilla, which disappears with the partial retraction of the former. They are projected directly outward or in a slanting manner either forward or backward, and are moved in the same manner and by the same arrangement of muscles as in other chætopods. The number of podal setæ is from four to ten in each fascicle. In several mature individuals the numbers in the different segments were as follows: 8 to 10 setæ in the first to the sixth segment; 6 to 7 in the three succeeding ones; 4 or 5 in the tenth, and 3 or 4 in the last segment.

The setæ, figs. 3, 4, of the anterior segments are longest, and range from about 0·15 to 0·25 mm. in length. They consist of a long, straight rod, with a linear-lanceolate blade tapering into a long filament. The rod varies little in length in the different setæ; but the blade varies considerably in this respect. The blade is more or less bent from the rod, and is longest in the longer setæ.

Except the head and the first setigerous segments, the others are provided on each side with a fascicle of podal hooks, which are situated ventrally behind the bottom of the podal setæ. The hooks are 4 or 5 in each fascicle in the setigerous segments from the second to the eighth inclusive, and are very different from those of the succeeding segments. The podal hooks, fig. 5, of the anterior segments, are about 0·05 to 0·06 mm. long, and consist of a long curved handle, ending in a small recurved hook.

The podal hooks of the posterior three setigerous segments form close transverse rows, fig. 6, of variable number, from 9 to 24 in each row. The hooks are minute, and measure from 0·025 0·03 mm. long. They consist of a broad handle, ending in a lateral comb-like extremity, as represented in figure 7.

The number of podal setæ and podal hooks is more or less variable in the corresponding segments of different individuals, and frequently also on the two sides of the segments of the same individual. The difference is due sometimes to the accidental loss of some of the appendages; sometimes probably to circumstances interfering with their development. In several specimens the following differences were observed:

SPECIMEN 1.

First segment, 6 and 8 setæ.

Second to fourth segment, inclusive, 8 to 10 setæ and 4 to 5 hooks.

Fifth to eighth segment, inclusive, 6 to 8 setæ and 4 to 5 hooks.

Ninth segment, 6 setæ and 9 and 22 hooks.

Tenth segment, 4 setæ and 12 and 18 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 2.

First segment, 8 setæ on each side.

Second to sixth segment, inclusive, 8 setæ and 4 hooks on each side.

Seventh and eighth segments, 6 or 7 setæ and 4 hooks, except on one side of the eighth segment, in which another fascicle of 6 setæ substituted the usual fascicle of hooks.

Ninth segment, 6 setæ on each side and 9 and 20 hooks.

Tenth segment, 4 and 5 setæ and 13 and 16 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 3.

First segment, 8 setæ each side.

Seven succeeding segments, 6 to 10 setæ and 3 to 4 hooks each side.

Ninth segment, 7 setæ and 24 hooks each side.

Tenth segment, 3 setæ and 18 hooks, but on one side the latter were all imperfect, mostly with the comb undeveloped.

Eleventh segment, 2 setæ and 14 hooks each side.

In the last specimen the rows of 24 hooks in the ninth segment measured 0·08 mm. wide; the rows of 18 hooks of the tenth segment 0·072 mm. wide; and the rows of 14 hooks of the last segment 0·06 mm. wide. The height of the rows corresponding with the length of the hooks was 0·025 mm.

The intestinal canal of *Manayunkia* is of extreme simplicity, consisting of a median tube alternately dilated within the segments and contracted in the intervals of the latter, without any other conspicuous division into more distinct portions. The widest expansions are within the fourth to the seventh segment, inclusive, but are also variable in these. Afterwards the intestine becomes narrower to the anus, which opens ventrally in the last segment. The mouth is funnel-like, capacious, and without armature of any kind. Along the intermediate two-thirds of the canal the walls are of a yellowish brown hue. Within the intestine in the seventh segment, and within the terminal portion, active ciliary motion was observed. The intestine, as usual in other annelides, is connected by thin diaphragms to the wall of the body-cavity in the intervals of the segments. The intervals are occupied with liquid with multitudes of floating corpuscles.

The ovaries, with ova in different stages, occupy the fourth to the sixth segment inclusive. Within the lower part of the head, extending thence into the third segment on each side, there is a large elliptical organ, which I have suspected to be the testicle, though I did not examine its structure.

I was greatly puzzled in the attempt to ascertain the arrangement of the vascular system of *Manayunkia*, and am in doubt as to the following explanation I give of it. The blood is of a bright green color, and in many positions serves clearly to define the course of the larger vessels. As represented in figure 1, the chief blood-vessels appear to be a large one on each side of the intestinal canal, closely following the course of this so as to seem to form a green coat to it. In each segment of the body the vessel gives off a pair of lateral branches apparently uniting in a loop. In the head the two main vessels leave the sides of the intestine, and after forming a close flexure or a sinus at the base of each lophophore, proceed onward through the interior of the larger pair of tentacles. In viewing the worm in any direction, the two main vessels so constantly appeared at the sides of the intestine, that I at first took them for the walls of the latter itself. The condition I did not comprehend until I found an explanation in the following paragraph in Claparede's Recherches sur la structure des Annelides Sedentaires, Geneva, 1873, page 76: "M. de Quatrefages has discovered that in certain Serpuliens," to which family *Fabricia* and *Manayunkia* belong, "the intestinal canal is enclosed in a lacuna or rather a veritable sheath taking the place of a dorsal vessel." Claparede adds from his own observations the statement "that a number of the sedentary annelides present the same peculiarity of having the intestine included in a vascular sheath playing the part of a dorsal vessel." In this view the two chief vessels, in figure 1, at the sides of the intestine, are to be regarded as sections of the vascular sheath enclosing the latter. The principal movement observed in the vessels of *Manayunkia*, consisted in an incessant pumping of blood into those of the two larger tentacles alternating with contraction and partial expulsion of blood from the same.

The nervous system of *Manayunkia* I did not attempt to investigate. A well-developed eye occupied the head at the side of the gullet. It exhibited a clear vitreous humor in a choroid cup. No trace of eyes was to be detected in the terminal segment of the body, such as exist in *Fabricia*.

In several instances in which I have extracted *Manayunkia* from its tube, a number of young ones, about half a dozen, have been liberated, from which it appears that the eggs are laid within the tube, there hatched, and the young then retained under the care of the parent until sufficiently developed to be able to care for themselves.

Figures 8–13, Pl. IX, represent an ovum and a series of young in different stages of development, which were obtained together with others in the same condition from three tubes.

The ovum, fig. 8, about 0·2 mm. long, obtained with several similar ones from a tube, exhibits a central mass of large yolk-cells enclosed by a layer of smaller ones. Fig. 9 represents an embryo, which accompanied the former. It was motionless and devoid of cilia. The yolk-cells appear to have been resolved into a stomachal cavity. The embryo was about the same size as the ovum. Fig. 10 represents a more advanced embryo, from the same tube. It measured 0·265 mm. in length. The intestine indicates a division into eight segments. Fig. 11 is a more advanced stage of development of the worm from another tube.

It measured one-third of a millimetre in length. The body-wall and intestine are quite distinct, the latter exhibiting eight segments. The tentacular lobes have commenced development. Fig. 12 represents an individual further developed, from the same tube as the former. It measured half a millimetre long. The body is distinctly divided into nine segments, of which eight bear a pair of setæ on each side. The tentacular lobes exhibit each the rudiments of four tentacles. Eyes also have made their appearance. Fig. 13 represents a young worm, from another tube, the only one accompanying its parent. It measured 0·72 mm. long. The body is divided into the same number of segments as in the former. The tentacular lobes have developed each four tentacles with the rudiment of a fifth. Podal hooks could be detected in none of the segments except the last, in which there were three comb-hooks on each side. Another young individual observed, from another tube, about the same size of the preceding, had five tentacles on each side, but was otherwise exactly similar. Another individual three-fourths of a millimetre long, with five tentacles on each side, had one more setigerous segment than in the others.

The species of *Fabricia* to which I referred in the beginning of the present communication, and which I examined with particular interest on account of the near relationship of *Manayunkia* to it, is the same as that described by Prof. Verrill, as being common from New Haven to Vineyard Sound and at Casco Bay (see Report on the Sea Fisheries of New England, Washington, 1873, p. 619). I first noticed the worm at Newport, Rhode Island, in 1858, and found it abundantly at Bass Rocks, Gloucester, Mass., in 1882. It occurred on rocks between tides, under a luxuriant growth of *Fucus vesiculosus*, with its tubes projecting from among the mud and sand firmly fixed together with multitudes of little mussels about the roots of the sea-weed.

The worm is three or four millimetres long and of a yellowish or yellowish brown hue, with more or less reddish. The body is compressed cylindrical and slightly tapering behind, and is divided into twelve segments, including the head. This is prolonged dorsally in a half elliptical process or upper lip. The vertex supports on each side a trifurcate lophophore, each fork of which is provided with a double row of narrow cylindrical tentacles invested with cilia.

The segments succeeding the head are furnished with lateral fascicles of podal setæ, and, except the first one, are provided with fascicles of podal hooks, all of which have the same general arrangement and form as those described in *Manayunkia*. The fascicles of podal setæ, from the first to the eighth segments, usually contain six or seven setæ; those of the ninth and tenth segments, three or four setæ; and those of the eleventh segment two or three setæ. The longer setæ, figs. 14, 15, resemble those of *Manayunkia*, consisting of a straight rod with a feather-like vane ending in a long point and bent at an obtuse angle from the rod. The stouter setæ, fig. 16, have the same form, but differ in the variably much shorter proportion of the vane. The setæ range from 0·12 to 0·25 mm. long.

The first setigerous segment possesses no podal hooks, as in the case of *Manayunkia*. The fascicles in the succeeding segments to the fourth contain each eight or nine hooks, and those following to the eighth, inclusive, six or seven hooks. The hooks of the remaining three segments, as in *Manayunkia*, are very different from those of the anterior segments, and are arranged in close transverse semicircular rows of from 20 to 28 in each row.

The anterior podal hooks consist of a curved handle ending in a short robust hook, like those of *Manayunkia*, but differing in the hook being furcate, or even divided three or four times on the dorsum, as represented in figs. 17, 18. These podal hooks usually measure about 0·08 mm. long.

The posterior podal hooks resemble the corresponding ones of *Manayunkia* as represented in fig. 19. They measure from 0·035 to 0·04 mm. long.

The intestinal canal of *Fabricia* has the same simple character as that described in *Manayunkia*. The mouth has a pair of palp-like appendages, situated between the lophophores. The vascular system appears to exhibit the same arrangement as in *Manayunkia*, but the blood is of a red color.

Fabricia is remarkable for being furnished with a pair of eyes to the terminal segment of the body as well as to the head. The eyes are of simple character, but equally well developed at both extremities of the body. They consist of a black pigment cup, including a spheroidal vitreous body. In several instances I observed a curious variation of the eyes in different individuals and on the different sides of the same individual. Fig. 20 represents the usual form of the cephalic eye. Figs. 21 and 22 represent the two eyes of the same individual, the right eye apparently double. Fig. 23 represents another double eye, but with the lens directed backward. Fig. 24 represents a caudal eye.

The tube of *Fabricia* is composed of exceedingly fine particles of quartzose sand and indefinite particles of mud.

I observed no specimens of this genus, exhibiting the reproductive organs in the condition usual in mature ones of *Manayunkia.*

In several instances I observed a few free eggs and young worms of 0·12 mm. in length within tubes in company with the parent, but did not have the opportunity of investigating them.

Manayunkia mainly differs from *Fabricia* in having a pair of simple or undivided tentacular lophophores instead of having them trilobate; in the possession of an inner pair of larger tentacles which receive a continuation of the main trunks of the vascular system; and in having no eyes to the terminal segment of the body.

EXPLANATION OF THE FIGURES OF PLATE IX.

FIG. 1. MANAYUNKIA SPECIOSA. Magnified about 50 diameters. The worm in the ordinary condition of extension, with its tentacles spread.

FIG. 2. A stock of five tubes. Magnified about 4 diameters.

FIG. 3. One of the longer podal setæ from the second setigerous segment of the body. 666 diameters.

FIG. 4. One of the shorter podal setæ, from the same. 666 diameters.

FIG. 5. A podal hook, from the same. 666 diameters.

FIG. 6. A row of podal hooks, from the last segment of the body. 250 diameters.

FIG. 7. A podal hook from the same row. 666 diameters.

FIG. 8–13. Egg and different degrees of development of the young of *Manayunkia.* 100 diameters.

FIG. 14–16. Podal setæ of *Fabricia Leidyii*, Verrill. 500 diameters.

FIG. 17, 18. Podal hooks of anterior segments. 500 diameters.

FIG. 19. Podal hook of posterior segment. 666 diameters.

FIG. 20–24. Eyes of *Fabricia.* 250 diameters.

FIG. 20. A cephalic eye of the usual form.

FIG. 21, 22. Right and left cephalic eyes of the same individual.

FIG. 23. A double cephalic eye.

FIG. 24. A caudal eye.

NOTE ON A COLLECTION OF FOSSILS FROM THE HAMILTON (DEVONIAN) GROUP OF PIKE CO., PA.

BY PROF. ANGELO HEILPRIN.

Among a small collection of invertebrate fossils obtained from the Hamilton rocks of the vicinity of Dingman's Ferry, Pike Co., by Drs. E. C. Hine and J. Holt of this city, and now in their possession, I have been able to identify the following species and genera. Most of these are probably not new to the State, but inasmuch as the palæontology of Pennsylvania has been but very imperfectly (indeed, one might say, not at all) worked up, and the fossils there occurring, although known in some part to amateur collectors, but very sparingly recorded, it has appeared to the writer that the publication of the present list, as well as of others of a similar character to follow, may not prove entirely useless, tending toward a more complete knowledge of the extinct fauna of the State.

ACTINOZOA.

Heliophyllum Halli.

MOLLUSCA.

Fenestella, sp. indet.
Crania Hamiltoniæ.
Spirifer mucronatus.
Spirifer granuliferus.
Spirifer medialis?
Streptorhynchus Chemungensis.
Orthis, sp. indet.
Chonetes, sp. *setigera?*
Aviculopecten duplicatus? or *A. scabridus?*
Limoptera macroptera.
Paracyclas lirata.
Grammysia bisulcata.
Orthoceras (impression).
Nautilus or *Goniatites* (septal lines too imperfectly preserved for generic determination).

CRUSTACEA.

Phacops bufo, a complete specimen and several tail-pieces.
Homalonotus Dekayi, several well-preserved fragments unquestionably belonging to this species.

Crinoid stems or impressions belonging to several distinct species are common in the rock-masses. It may be noted that Prof. I. C. White, during his survey of Pike and Monroe counties, was unable to discover any traces of trilobites in the rocks of this series. "Not a single specimen of a *Trilobite* was observed in all this thickness of rock at the many localities where it is exposed for observation within the district" (Second Geological Survey of Pennsylvania, Report of Progress, G 6, p. 112, 1881).

ON THE ANATOMY OF ANCYLUS FLUVIATILIS O. F. Müller AND ANCYLUS LACUSTRIS Geoffroy.

BY BENJAMIN SHARP, M. D., PH. D.

This paper first was written in German, and served as an inaugural dissertation for the Philosophical faculty at the University of Würzburg, in Bavaria. In rewriting it I have merely omitted a few unimportant details, and made one or two slight changes.

INTRODUCTION.

The position of these little animals in the system of classification was long a subject of dispute. At first they were placed by Linnæus[1] in the genus *Patella*, but in the same year (1767) Geoffroy[2] formed an especial genus for them, which he called *Ancylus*, on account of the resemblance of the shell to a Phygean cap (Α'γχνδος).

The specimens of *fluviatilis*, which I had for examination, were obtained in the Main near Würzburg, and in a branch of the same near Gemünden—the only place in which the other species could be had was in a small pond near Aschaffenburg.

The work was carried on in the laboratory of Prof. C. Semper, at Würzburg, and I here take the opportunity of expressing my sincere thanks to him for his kindly advice and assistance.

Ferussac placed this genus, in 1837, among the Pulmonata, to which order it undoubtedly belongs.

Moquin-Tandon[3] believed that *Ancylus* was amphibian in its habits. I do not believe that the animal under natural and healthy conditions ever approaches the surface of the water. He says: "Does the animal breathe free air or that air dissolved in water?" Ferussac[4] said positively that the animal was compelled to come to the surface to breathe. L. Agassiz,[5] Depuy, and others, were of the same opinion. To prove this, Moquin-Tandon[6] made the following experiments :—

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[1] Linnæus, Syst. Nat., 1767.

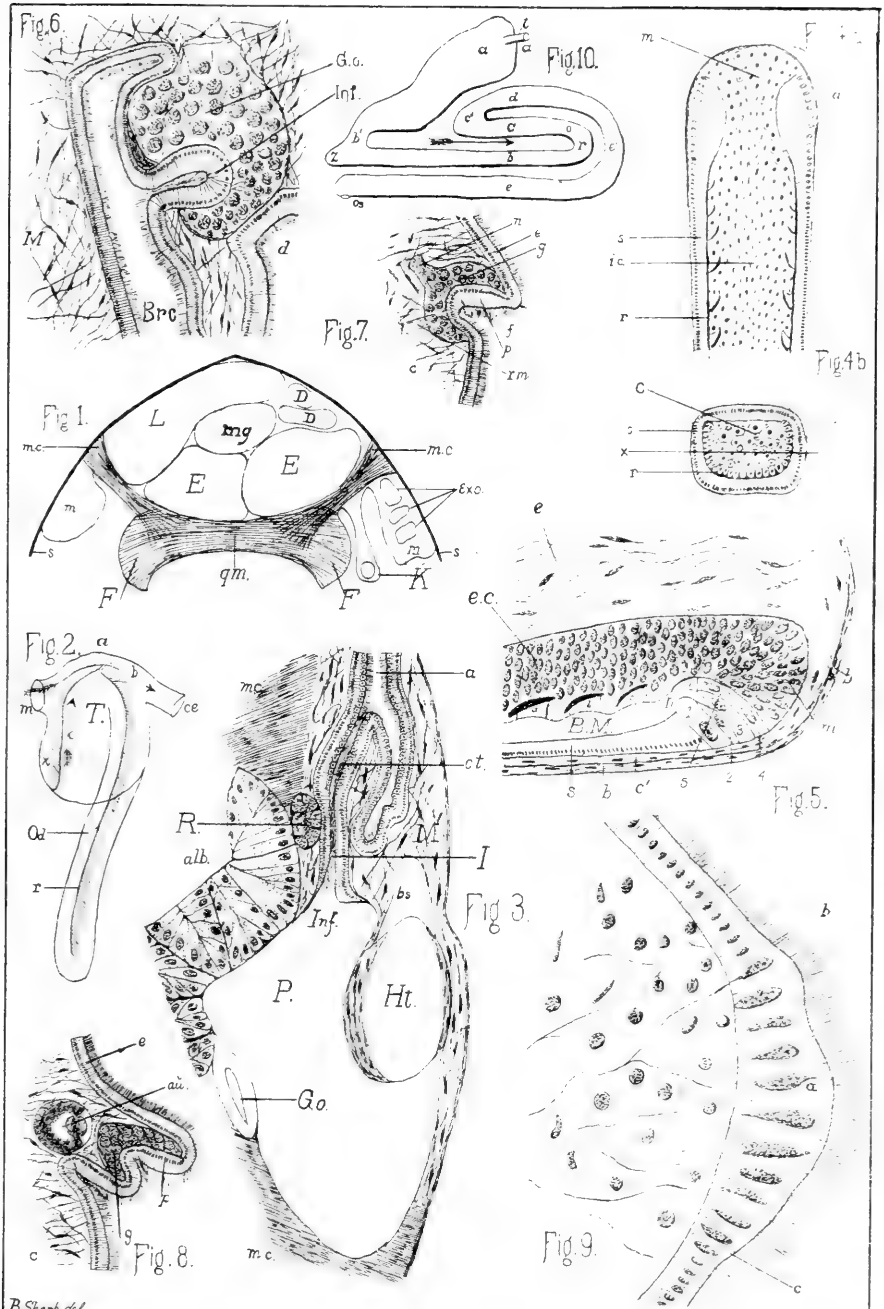
[2] Geoffroy, Trait. somm. d. Coquil fluv. et terres., etc., Paris, 1767.

[3] Moquin-Tandon, Recher. anatomico-physiol. sur l'Ancyle fluviatile (*Ancylus fluviatilis*), Journal de Conchyliologie, Tome iii, 1852, p. 124.

[4] Ferussac, Dict. class. d. Hist. Nat., Tome i, 1822.

[5] L. Agassiz, Act. Helvit., 1841.

[6] Recher. anat. physiol. s. l'Ancyle, etc., pp. 124–126.



SHARP ON ANCYLUS.

Many animals were placed in a vessel of water, and the following facts were observed:

1. That not all the animals found the need of coming to the surface to breathe, and that many stayed at the bottom of the vessel.
2. That the need of air did not seem very strong, as they came slowly to the surface.
3. That certain individuals remained in the upper portion of the fluid.
4. That many went only partially out of the water.
5. That others left the water entirely, but remained in the neighborhood of it.

These and other facts show that they breathe air and are not water animals. Further on he says:—

1. Seven animals were placed in tall champagne-glasses, which were filled with water; in the middle of the glass was placed a partition, so that the animals could not come to the surface; the water, however, could freely circulate. The animals lived three days, at which time they were taken out.
2. Three individuals were placed in 45 cu. mm. of well-water, and these lived only eight hours.
3. Six *Ancyli* were placed for three days in 25, 30 and 50 cu. mm. of river-water; all remained living and some deposited eggs.

This last experiment seems to prove that they are not amphibious.

I made essentially the same experiments with the same results, and further found that when the *Ancyli* were placed in aquaria, in which there was running water, they never came to the surface; if, however, the water was not fresh, they would invariably come to the surface of the water. I think, therefore, that the apparent amphibian habits are due to the fact that the water was not sufficiently aërated. Probably the cause of such rapid death in the case of the animals that were placed in the well-water, was the presence in it of such a small percentage of air.

I will first take up the anatomy of both species in general, and describe the differences between them, and then consider the special part, which consists in:—

1. Formation of the radula.
2. Observations on the nervous system.
3. The anatomy of the excretory organ.

General Anatomy.

In the following description I will first consider the anatomy of *A. fluviatilis* as a basis, for the anatomy of this is tolerably well known from the papers of Carl Vogt [1] and Moquin-Tandon.[2] The first paper is short and incomplete, containing at the same time many mistakes, while the latter, unfortunately, is without plates. On *A. lacustris* no paper has as yet appeared, as far as I know.

The shell of *A. fluviatilis* is much larger than that of *A. lacustris.* In both species the form is that of a depressed cone and of a dirty brown color. In *A. fluviatilis* it is said [3] that the shell is wound to the left. I have never as yet seen a shell of *A. fluviatilis* which was in the least unsymmetrical, for the apex of all the specimens that I have examined lay in the median line, only rolled a little backwards.

In *A. lacustris*, however, the apex of the shell is wound slightly to the right, and this character has been considered sufficient to place this form in a separate genus, that of *Acroloxus* (Beck, 1837), or *Vellitia* (Gray, 1840), which, however, is not generally accepted.

The opening of the shell (*apertura*) is oval in both species; in *A. lacustris*, however, it is a much longer oval than in *A. fluviatilis.*

The shell contains such a quantity of conchyolin, that if it be thrown into an acid and left there until all the carbonate of lime be dissolved away, the organic framework of conchyolin remains perfect and the form unchanged.

If a piece of this be placed under the microscope a large number of the siliceous cases of diatomes are seen. This is easily explained: the diatomes are found in large quantities on the objects on which the *Ancyli* are found, and as they are so small, they can easily pass between the mantle and the shell and then become covered by a layer of mother-of-pearl or nacre which is secreted by the external surface of the mantle and by which the shell grows in thickness. This process of imbedding diatomes in nature is similar to that effected artificially by the Chinese, when they place their little leaden images between the mantle and the

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[1] Bemerkungen über den Bau der *Ancylus fluviatilis.* Archiv für Anat. und Physiol. (Müller), 1841.

[2] Recher. anat. physiol. s. l'Ancyle, etc.

[3] C. Claus, Grundzüge d. Zoologie, Marburg, 1880–82, and others.

shells of bivalves, and allow them to become coated with mother-of-pearl.[1]

The mantle.—If the shell be carefully removed from the animal, the form of the body is found to be like that of the shell, namely, a depressed cone, and covered with a thin white membrane, the mantle. The base of the mantle, or that part which comes in contact with the aperture of the shell, is thickened and separated from the body, so that a deep groove is found running around the foot bounded externally by the internal surface of the mantle. The deepest point of this groove is at that point where the mantle and foot join. From this point, or the base of the groove (looking at the animal from below), hangs the gill, between the foot and the mantle, on the left side in *A. fluviatilis*, and on the right in *A. lacustris*. The inferior portion of the external surface of the mantle has a deposit of black pigment; this band of black pigment is not present in *A. lacustris*.

Organ of locomotion.—The only organ of locomotion is the foot, which is an oval muscular disk. The shape is like that of the aperture of the shell to which it belongs. The foot is formed of muscular fibres which run in four different directions, and between which the lacunæ or blood-spaces are found. One system of muscular fibres passes from before backward (longitudinal fibres); another, perpendicular to these, passes from side to side (transverse fibres). The other two systems are continuations of the muscle that binds the body to the shell. These latter fibres pass perpendicularly from the shell, and entering the foot, spread out fan-like into it, so that some of the fibres are almost horizontal and others almost perpendicular to the sole of the foot; these may be called lateral fibres. The animal holds itself to objects on which it creeps, by the foot, which acts like a sucker. If the animal be disturbed it draws the shell tightly downwards so that the soft parts are completely covered by the shell and thus protected. The movement of *Ancylus* is very slow. It never swims, as does, for example, *Limnæus*, on the surface of the water, as Gray and

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[1] An interesting account of this process may be found in F. Hague, Ueber d. natürliche u. künstliche Bildung der Perlen; and C. Th. von Siebold, Ueber d. Perlenbildung chinesischer Süsswasser-Muscheln, als Zusatz z. d. vorhergehenden Aufsatz. Zeitschr. f. wiss. Zool., Bd. viii, 1857.

Turton[1] observed. Moquin-Tandon[2] states that he had never observed the animal creeping or swimming on the surface of the water.

The shell of the animal is fastened to the body by a muscle, which, as already said, passes perpendicularly from the shell and enters the foot obliquely, and with which it coalesces, forming with the foot the sides and floor of the visceral cavity respectively. In the figure (Pl. X, fig. 1) we have a cross-section of the animal about the middle, drawn with a camera lucida, and to which I have added the lines *s*, which represent a cross-section of the shell. The letters *m c* represent the musculus cochlearis, which enters the sides of the foot; *q m* are the transverse fibres. The longitudinal fibres are not represented, as they are transversely cut and only appear as points.

In the musculus cochlearis of the left side in *A. fluviatilis* and on the right of *A. lacustris* a cavity is found in which the heart is situated. The walls of this cavity form the pericardium.

The gill.—In the space between the foot and the mantle in *A. fluviatilis* on the left side is found a broad, leaf-like fold of the integument, the gill. This fold or gill reaches down as far as the lower border of the mantle. In the figure (Pl. X, fig. 1) the gill (*k*) is represented on the right side of the section, although really on the left side of the animal, and we must imagine that we are looking at the animal from the front. The gill is one-third as long as the whole animal and lies in the middle third of the body. In the living animal it is of a lighter color than the surrounding tissues and the surface of it is smooth. Although the gill of *A. lacustris* is on the right side of the animal, its relative position is the same as in *A. fluviatilis.* The space between the foot and the mantle, into which the gill hangs, may be called the branchial chamber.

I believe that the organ which Moquin-Tandon[3] speaks of as the lobe auriforme is what I prefer to call the gill. It is physiologically one, as we will presently see.

The whole surface of the gill is covered with ciliated epithelium, and the internal part is formed of cutis, consisting of loose connective-tissue fibres which run in all directions and between

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[1] Manual of Shells, ed. ii, 1840.

[2] Recher. anat. physiol. s. l'Ancyle, etc., p. 35.

[3] Recher. anat. physiol. s. l'Ancyle, etc., p. 12.

which the blood-spaces (lacunæ) are found. A long continuous one runs the whole length of the inferior border of the gill, and is in connection with the mantle-vein. The nuclei of the connective-tissue fibres are very distinct; the rectum passes perpendicularly through the tissues of the middle of the gill, and opens at the anus, situated on the external surface.

Several organs open into the branchial chamber; in the middle of the external surface of the gill, as said, opens the anus. In *A. lacustris*, when the gill is on the right side the rectum and anus also are on that side. Close behind the base of the left tentacle in *A. fluviatilis*, is found the male genital pore or opening, and close behind this the female; as with the anus, these openings are on the right side of *A. lacustris;* in *A. fluviatilis*, on the internal surface of the left mantle, is found the minute opening of the excretory organ, the kidney, which lies embedded in the tissues of the mantle; in *A. lacustris* the kidney is on the right side; thus we see that four organs open into the branchial chamber, the ♂ and ♀ genital openings, the anus, and the kidney.

The alimentary canal.—The mouth, which opens on the inferior surface of the body, is surrounded by three lips; the two anterior lips are placed together so that they form an inverted V (Λ); the open part of the V is closed by the under lip, which is the extreme anterior end of the sole of the foot.

The mouth leads into a small tube, which passes perpendicularly upwards, opening on the floor of the buccal mass (Plate X, fig. 2 *m*). About half-way between the mouth and the buccal mass is situated the horseshoe-shaped jaw, which is placed in the anterior wall of the tube. The jaw consists of a single membrane of conchyolin, upon which are situated numerous little teeth or denticles. Moquin-Tandon says, however, that "*Ancylus* possesses three jaws, disposed as those in *Limnæus*—a transverse one above, and two vertical ones on the sides, * * * the borders of which are formed of a series of little denticles."[1] I do not find this to be exactly the case, but agree with Keferstein, who says: "In *Ancylus* we see, instead of the simple jaw, a large number of long pieces, which are tolerably symmetrically arranged, and encircle

[1] *L'Ancyle* possède trois mâchoires, disposées comme celles des *Limnées*, une transversale, en haut et deux verticle, sur le côtés * * * celles des bords forment comme une serie de petites denticules: Reche. anat. physiol. s. l'Ancyle, etc., p. 16.

the upper (anterior) side of the cavity of the mouth."[1] These long pieces are the denticles.

The buccal mass, which is of a spheroidal form, lies in the head, between the two tentacles. Immediately over the mouth is found the opening of the œsophagus, and in the middle between these two openings projects the tongue, which is covered by the radula. The odontophore is in *Ancylus* exceptionally long, and reaches from the buccal mass to the middle of the body. The opening of the odontophore lies in the superior part of the buccal mass: the first part of the odontophore itself lies sunken in a groove of the buccal mass, so that seen from the side it appears to spring from the posterior wall.

The diagramatic figure (Pl. X, fig. 2) represents a longitudinal section of the odontophore (*od*), which opens into the spheroidal buccal mass. In the figure the odontophore is relatively much shorter than it is in reality.

After the odontophore leaves the buccal mass it passes backwards, lying directly under the œsophagus and parallel with it; then it passes in *A. fluviatilis* to the right, and in *A. lacustris* to the left side. The œsophagus and odontophore are at the position of insertion in the buccal mass, separated from one another by the commissure of the buccal ganglia. Soon after leaving this commissure the odontophore passes to the side and then upwards and over the œsophagus, so that in the latter part of its course it lies above it.

The alimentary canal has in both species nearly the same form, except that the windings are different. The œsophagus arises in the middle of the superior and anterior angle of the buccal mass, directly over the position where the mouth enters from below (Pl. X, fig. 2 *oe*).

The salivary glands open by a very short duct into the œsophagus, immediately behind the position of its exit from the buccal mass. These glands are two in number, and lie on the side of the œsophagus.

The stomach is of a good size and spheroidal in form, the walls are thick and muscular. It is embedded in the liver, which lies

[1] Bei *Ancylus* sehen wir an die Stelle der einfachen Kiefers ein grosse Menge kleiner länglicher Stücke treten, welche ziemlich symmetrisch angeordnet, die Oberseite der Mundhöhle umgürten. Bronn's Klass. u. Ord. d. Thierreichs, Bd. iii, 2 Abth., 1862–1866, p. 1190.

beneath, behind and, in *A. fluviatilis*, on the right side; the left side being covered by the albuminous gland. In *A. lacustris* the relation is only reversed, so that the liver lies on the left side of the stomach and the albuminous gland on the right.

The intestine passes from the stomach at about the middle of its superior wall and then passes into the liver, forming a loop, which is clearly visible when the shell is removed in *A. fluviatilis*, but difficult to be seen in *A. lacustris*. After a few turns it passes to the left side of *A. fluviatilis* and to the right in *A. lacustris*, and proceeds downwards, entering the gill and opening on the external surface of the same.

I will here call attention to a peculiar ring of long cylindrical epithelial cells which lies in the walls of the rectum in *A. fluviatilis*. It is in the middle of that part of the rectum which lies in the gill. These cells are ciliated, as are indeed the epithelial cells of the whole intestine.

The physiological significance of the cells forming the ring I have in no way been able to determine.

In both species the liver is large and fills up the greater part of the body-cavity. It consists of a number of follicles; each follicle is formed of an external tunica propria and an internal layer of large cells. These cells secrete the bile, which is led into the intestine, close behind its exit from the stomach, by means of three ciliated ducts.

The vascular system.—As the vascular system of *Ancylus* differs so little from that of mollusca in general, it is not necessary to go into details. The heart, which is an arterial one, is formed of two parts, an auricle and a ventricle. In *A. fluviatilis* it lies on the left side of the body above the gill and in advance of the rectum. The auricle, the smaller of the two parts, is divided from the ventricle by a contraction, and at this point a valve is found opening into the ventricle. From the end of the ventricle arises the aorta, which soon divides into two branches; one of these passes to the head (*Arteria cephalica*) and the other supplies the viscera. These two branches divide into smaller ones, and finally open into the body-cavity, where they pour out their blood. The blood, which can freely circulate in this cavity, is collected into the lacunæ of the foot which open in the floor of the body-cavity. One of these lacunæ, which can almost receive the name of vein, passes from the foot into the mantle and becomes connected with another large lacuna, the mantle-vein, which lies above the tubular part of the kidney. It then sends a branch downwards into the gill, and after passing through this, again becomes joined to the mantle-vein, so that both pass into the auricle together.

The heart lies in a closed sack, the pericardium, on the external walls of which it is fastened (Pl. X, fig. 3 *Ht*). The external wall of the pericardium is only separated from the shell by the mantle, while the other parts lie in contact with the musculus cochlearis. The wall of the pericardium consists of a tunica of connective tissue, in which, here and there, the nuclei can be distinctly seen. The lobe auriforme of Moquin-Tandon[1] is intimately connected with the vascular system, and seems to aërate the blood, and physiologically is a gill.

The generative organs.—Ancylus, as is well-known, is hermaphroditic. The hermaphroditic gland or ovitestis, in which sperma as well as ova are formed, lies in the superior and posterior part of the body, immediately below the apex of the shell. In *A. fluviatilis* it lies in the median line, while in *A. lacustris*, where the apex of the shell is wound to the right, the ovitestis also is on the right side of the median.

When the shell is removed from the animal, the ovitestis is easily seen by its having a much lighter color than the surrounding parts.

The larger part of the genitals in *A. fluviatilis* is on the left side of the body, and in *A. lacustris* on the right side. Stephanoff[2] believes that albumen is secreted by the epithelial cells of the ovitestis. I cannot indorse this belief, as I never observed albumen in the ovitestis, and, further, there is a well-developed albumen-secreting gland present which opens into the oviduct. This albuminous gland has been described by C. Vogt[3] and Moquin-Tandon.[4]

I do not consider it necessary to enter into a detailed account of the genitals, as they have been completely described by

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 12.

[2] Ueber d. Geschlechtsorgane u. Entwickl. v. Ancylus fluviatilis. Mem. de l'Acad. d. Science d. St. Petersbourg, Tome X, No. 8, 1866, p. 2.

[3] Bemerk. ü. d. Bau d. Ancylus fluv., etc.

[4] Recher. anat. physiol. s. l'Ancyle, etc., p. 540.

Moquin-Tandon [1]; suffice to say that Stephanoff,[2] in his description of these organs, made many blunders, and at the same time did not seem to have known of the existence of Moquin-Tandon's work.

I.—The Formation of the Radula.

The radula is formed in the odontophore. This consists of four parts, which can be best understood by a reference to the figures. Fig. 4 *a* (Pl. X) represents a horizontal section through the posterior portion of the odontophore. Fig. 4 *b* (Pl. X) is a transverse section of the same. Both figures serve to illustrate the four parts making up the odontophore.

First, we have to distinguish the tongue-papilla (Pl. X, fig. 4 *ac*), which fills up the interior of the odontophore; this is surrounded, as is seen in the drawing, by the radula (*r*). External to the radula is the epithelium of the radula. If we make a transverse section through the odontophore (fig. 4 *b*), we find that the radula (*r*) has the form of the letter U, and consequently does not entirely surround the papilla, while the epithelium of the radula (*s*) encircles its external surface. At the open part of the letter U, where the radula is wanting, the epithelium passes gradually into the papilla.

The line *x* in the transverse section (fig. 4 *b*, Pl. X) represents the position of the horizontal section (fig. 4 *a*).

The only part not mentioned now is the fourth and most important of all. I propose to describe it in *Helix aperta*, as the parts in this form are larger and more distinct than in *Ancylus*.

Fig. 5 (Pl. X) represents the posterior part of the odontophore, drawn by a camera lucida. It represents that part of the odontophore which is enclosed by the bracket (*a*) in fig. 4 *a*.

In the drawing we see at that point where the tongue-papilla coalesces with the epithelium of the radula, five large, sharply defined cells (*1*, *2*, *3*, *4* and *5*), which I propose calling the matrix of the radula—thus differing from other writers on the subject, who have not seen these cells, and who call the matrix that part to which I have given the name of tongue-papilla.

Before I pass to the formation of the radula I will first take up the histology of the separate parts of the odontophore in *Helix aperta*.

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 337.

[2] U. d. Geschlectsorg. u. d. Entwick. von Anc., etc.

As has already been described by Semper,[1] the tongue-papilla consists of two layers. The internal layer is formed of loose connective tissue, the fibres of which run in every direction, and in which can be distinctly seen the large fusiform nuclei; most of these nuclei are bipolar, although here and there a tripolar one can be seen.

The external layer of the tongue-papilla is made up of cells which possess a large nucleus, and the cell-wall, if seen at all, is very faintly evident; this layer seems more to be a homogeneous mass of protoplasm, in which are embedded large numbers of nuclei; here and there fine lines may be seen, which may be regarded as the cell-walls (Pl. X, fig. 5 *m*). This layer comes in close contact with the radula and its teeth. The axes of these oval nuclei seem to have a definite direction. In the posterior part they are all directed to the point where the radula begins, while those further forward become perpendicular to the radula itself.

When the object is well stained the difference between these two parts of the tongue-papilla is distinctly seen; the loose internal part being of a light color, while the external part, rich in nuclei, takes a very dark shade.

In *Ancylus* the demarkation between these two parts is not so pronounced as in *Helix*. The peripheral part of the tongue-papilla, rich in nuclei, passes gradually into the loose, pale, internal part (Pl. X, fig. 5 *a*).

The epithelium of the radula, *s* (Pl. X, fig. 5), is composed of a single layer of long cylindrical epithelial cells, with well-defined nuclei and distinct cell-walls. These cells are much longer at the posterior part of this layer, *i. e.*, at the point where they lie in contact with the matrix of the radula, than those nearer the mouth. The larger cells rest obliquely on the tunica and parallel to the large cells of the matrix; as they become shorter they become more and more perpendicular, as is seen in the figure (Pl. X, fig. 5 *s*). The nuclei are small, although with a high power they can be distinctly seen. When thus examined they have the same general appearance of nuclei, and are placed in that part of the cell nearest to the tunica.

Between these long cylindrical cells of the epithelium of the radula and the posterior part of the odontophore are seen five

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[1] Zum feinern Bau der Mollusken-Zunge. Zeitschr. f. wiss. Zool., Bd. ix, 1858.

very large cylindrical cells (Pl. X, fig. 5, *1*, *2*, *3*, *4* and *5*), to which I have given the name of matrix. When a horizontal section is examined these cells are very striking and easily distinguished by their having a much lighter color than the surrounding parts; each one of these five cells has a peculiar and characteristic form. The cell marked *1* stands obliquely to the tunica, and that end farthest from the tunica is rounded or dome-shaped; all the other of these five cells, with the exception of *4*, are pointed at the corresponding extremity, and also placed obliquely to the tunica. In *4* this condition is reversed, the pointed extremity being nearest to, but not touching, the tunica. The blunt end of this cell is in contact with the radula, and the point is inserted between cells *3* and *5*.

The protoplasm of these five cells of the matrix is quite clear, taking only a slight reddish tinge with borax (Grenacher's) carmine. There is not the slightest trace of a granulated structure to be found. The nuclei of these cells are very large and oval in form; their size is about twice that of the nuclei that are found in the neighboring tongue-papilla (Pl. X, fig. 5 *m*). The structure of these nuclei differs somewhat among themselves; some contain only one nucleolus, in others it is more or less broken up, and others still have a granular appearance.

The cells *1*, *2* and *3* form the basal membrane (Pl. X, *B. M.*) and cell *4* the bases of the teeth. The convex end of cell *1* secretes a mass of conchyolin, which is the beginning of the basal membrane. The posterior part of this membrane, namely, that part which lies against cell *1* in the figure (fig. 5), has the appearance of a hook, the point of which lies between cells *1* and *3*, just overlapping the tip of the point of *2*. These three cells are those which take part in the formation of the basal membrane of the radula, the cell *3* forming the upper, and cell *1* the lower face of this so-called hook, and cell *2* probably adds a little to the point. This hook-like appearance is only present in longitudinal sections. In reality, naturally, this part of the basal membrane is not a hook, but a sharp edge, which is curled over and fits into a groove formed by two rows of cells; cells like cell *1* (fig. 5) forming the anterior, and cells like cell *2* forming the posterior wall.

The formation of the teeth is carried on by the cell marked *4*. This is triangular in shape with the base abutting the posterior face of the tooth, *d* (Pl. X, fig. 5). I believe that this cell *4* is formed by division from cell *5*, and dies when the tooth is fully formed, and the remains of this cell are carried forward between the teeth as the radula advances. This can be the only way, for if the cell remained living and continued to secrete conchyolin instead of a series of teeth, we would have simply a solid layer formed on the top of the basal membrane. By a continuous secretion of the cells *1* and *3*, the basal membrane moves or is pushed forward, and thus carries the tooth (*d*) along with it; after this has proceeded for a short distance (viz., the distance of the space between the teeth), a new cell, which has been formed from cell *5*, is ready to commence secreting again, and a new tooth or transverse row of teeth begins to form, and thus the process continues.

The caps of the teeth are shaded darkly in the figure (Pl. X, fig. 5), and are formed after the base of this is completed by cell *4*. The caps are formed by the cells that make up the external layer of the tongue-papilla. If the preparation has been colored with picro- or borax-carmine the basal membrane and bases of the teeth do not color, or only take a slight tinge, while the caps of the teeth are colored darkly. This shows, I should think, that the basal membrane with the bases of the teeth and the caps are of two different formations.

The covering of the odontophore, which may be called the sheath, consists of two layers. The internal, *c′* (Pl. X, fig. 5), which is made up of a simple layer of connective-tissue cells, passes directly into the internal or loose part of the tongue-papilla (*e*), and it seems that this layer is merely a continuation of this part of the papilla. The external layer of the sheath, which covers the whole of the odontophore and is continuous with that which covers the buccal mass, consists of a more compact layer of connective-tissue fibres, in which, as in the internal layer, distinct nuclei may be seen.

In the odontophore the teeth of the radula are directed backward. The radula passes from the posterior part of the odontophore and extends to the opening in the buccal mass, over the tongue, where it makes a bend and returns on the under surface of the tongue; the teeth are placed reverse to those on the upper surface, which are directed backwards, while those on the under surface are directed forwards. In fig. 2 (Pl. X), I have given a diagramatical longitudinal section of the buccal mass and the odontophore, in order to show the direction of the teeth on the radula (r). The arrow (c) in the same diagram shows the direction in which the radula moves when the animal is rasping the food.

As regards the disappearance of the worn-out and useless teeth, Semper says: "There are only two ways possible, since the view that each tooth continually grows is not to be considered at all. Once we thought, as did Troschel, Claparède and others, that the radula gradually moved forward, and that the forward teeth that were worn out were thus gradually replaced; or there must be a periodical shedding of the radula. This latter view seems to me the most natural."[1]

Above it was shown that the epithelium of the radula had no connection whatever with the formation of the radula. On the other hand it was observed that the radula as well as the teeth, *a*, *b*, *c*, *d*, etc. (Pl. X, fig. 5), with the exception of the caps, grew from behind, that is, from the cells of the matrix *1–5* (Pl. X, fig. 5).

From this we see that the radula grows at the posterior end of the odontophore and must gradually be shoved forward, and that the teeth that are used up at the mouth are gradually being replaced from behind. The view of a renewal of the radula by a periodical shedding, as Semper thought most probable, is consequently excluded. In many sagittal sections it is easy to see the anterior part of the radula breaking away at the point, x (Pl. X, fig. 2). At this point separate teeth and parts of the radula could be seen, and they would have been cast out at the mouth.

Trinchese[2] gives in his paper on *Spurilla Neapolitana* a short notice on the development of the radula in this species. He speaks of from five to seven cells which go to form the teeth, and also the cells forming the layer which I have called the epithe-

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[1] "Hier sind nur zwei Fälle möglich, da die Annahme, dass jeder Zahn fortwährend wachse, nicht weiter zu berücksichtigen ist. Einmal könnte man nun annehmen, dass, wie es auch Troschel, Claparède u. A. thun, die Reibmembran allmählig vorrücke und dadurch sowohl die vordern untauglichen Zähne ersetzt würden, als auch eine Grossenzunahme der Zähne ermöglicht sei, oder man müsste eine von Zeit zu Zeit stattfindende Häutung annehmen; die letzten Annahme scheint mir die natürlichste." Zum fein. Bau d. Molluskenzunge, p. 277.

[2] Anat. e fisiol. della *Spurilla Neapolitana*. Estrat. d. Serie III, Tomo IX, d. Mem. dell' Acad. delle Scienze dell' Instituto di Bologna, 2 Febbriao 1878.

lium of the radula. These cells do not form the basal membrane directly. It is formed from the many-layered epithelium of the radula. It is not formed, as one would suppose, by a cuticular secretion of the cells, but at the cost of the cells themselves. The upper layers of the epithelium of the radula coalesce, and thus form the basal membrane. In this manner the epithelium gradually decreases in thickness as it passes forward. Trinchese says, regarding the formation of the radula, that: "The superior part of the body of each shell is divided into many small rods, which are very small at first and which gradually lengthen as they proceed downwards. These small rods are the denticles. The inferior part of the cell, which takes no part in the formation of the tooth, forms with the similar part of the neighboring cell, the tooth-mass or the true body of the tooth. Finally the boundary between the different cells disappears. The nuclei of the tooth-forming cells which remain under the tooth undergo division and give origin to a very compact layer of nuclei, which become more and more pointed as the tooth is shoved forward, are gradually formed in the matrix. When the teeth are so far protruded from the sheath (odontophore), the inferior part of the tooth forms, by means of the layer of nuclei, a very resisting cuticle. This cuticle thickens as the tooth advances, while the nuclei or cell-layer gradually diminish in thickness." [1]

The little rods that he speaks of are not to be found in *Helix aperta*. As the form of the tongue and the radula is as different in *Helix*, and further as the tongue-papilla, in the true sense of

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[1] "La parte superiore del corpo di ogni cellula, si divide in tanti piccoli bastoncelli, i quali, molto costi in principio, si allungano man mano manzandosi verso il nucleo il quali viene spinto in basso: questi bastoncelli sono i dentini. La porzione inferiore della cellula che non prende parti alla formazione dei dentini, concorre colla porzione omologa delle cellule vicine a formare il corpo del dente. In fine il limito delle diverse cellule scomparisce ed il dente è così formato. I nuclei delle cellule odontogene rimasti sotto il dente, si segmentano e danno origine ad uno stratodi nuclei molto spesso, il quale si va assottigliando a secunda che ildente viene spinto in avanti dagli altri chi si formans via via nella matrice. Quando i denti sono per uscire dalla guaina, in comincia a formarsi sotte di ossi, per l' atturtà dello strato nucleare, una cuticola molto resistente, la quale li fissa solidamente sul margine della rotella. Questa cuticola, a seconda che il dente si spinge in avanti, divene sempre più spessa, mentre lo strato sottostante si assottiglia e si esaurice.

the term, is wanting in *Spurilla*, it is hardly to be supposed that the formation of the radula is exactly the same.

The cells of the matrix lie, in his figure (Tab. VIII, fig. 2 *b*), behind one another, and only the most anterior one comes in contact with the tooth and takes part in its formation. As is easily seen, these relations are very different from the state of affairs in *Helix*.

Rücker,[1] who does not seem to have known of the paper by Trinchese, calls these teeth the ontoginous teeth. He shows five cells to be present, but not arranged in *Helix pomatia* as I have found to be the case with *H. aperta*. His cell *a* takes the place of my *4* and *5*. Over his cell *d* is formed the future tooth. Then "the part of the cell that lies on cell *d*, the future hook, is raised from its bed, and the tooth passes through the arc of a quadrant in order to assume the normal position."[2]

How or by what means the tooth is raised he does not say. I believe, however, that, as I have shown, the death of cell *4* (Pl. X, fig. 5), after the tooth is formed, is a much more plausible explanation.

II.—Observations on the Nervous System.

The nervous system of *Ancylus fluviatilis* was first described by C. Vogt, in 1841, while that of *A. lacustris*, as far as I know, has never yet been especially described. It is, however, formed on the same plan as that of the former species; the difference in the two being merely one of position. Vogt described the œsophageal ring in the following manner: The œsophageal ring consists of two superior, two lateral, and one inferior ganglia.[3] This description is not correct. The part was better described by Moquin-Tandon[4] in the year 1852.

Moquin-Tandon[4] found that the œsophageal ring consisted of seven ganglia: two superior, which he called the cerebral ganglia

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[1] Ueber die Bildung der Radula bei Helix pomatia. Besond. Abdruck aus d. xxii. Bericht d. Oberh. Ges. f. Natur- und Heilkunde, 1883.

[2] Dann "hebt sich der Zelle *d* aufliegende Theil der Zahner, der zukünftige Haken desselben von seiner Unterlage ab, der Zahn beginnt eine vierteldielung, um allmählig aus der übergekippten in die nomaler Stellung überzugehen." Ueb. d. Bildung d. Radula, etc., p. 217.

[3] "Der Schlundring besteht aus zwei obern, zwei seitlichen und einem untern Knoten." Bemerk. u. d. Bau d. Ancylus, etc., p. 29.

[4] Recher. anat. physiol. s. l'Ancyle, etc., p. 129, *et seq.*

(*g. cérébroides*), and five inferior (*g. sous-œsophagiens*). Of these latter, two lie laterally (*g. supérieurs*), and two lie below the œsophagus (*g. antero-inferieurs.*) The fifth is an odd one, and is placed between the lateral and the inferior ganglion of the left side, and was called the supplementary ganglion (*g. supplementaire*).

The lateral ganglia are now generally known as the pleural or visceral ganglia, and the inferior the pedal ganglia. In *A. lacustris* the supplementary ganglion lies between the visceral and pedal ganglion of the right side. The reason of this difference of position of the supplementary ganglion is probably that in *A. fluviatilis* the genitals, which are in part supplied by this ganglion, lie on the left side; while in the other form, where the genitals are on the right side, the supplementary ganglion is also on that side.

Further, Moquin-Tandon [1] speaks of two small ganglia, which are joined by *connectives* [2] with the cerebral ganglia, and which he calls the buccal ganglia.

According to Moquin-Tandon, then, the nervous system of *Ancylus* consists of nine ganglia. There exist, however, other ganglia, which Moquin-Tandon did not find. Two of these lie in the tissue of the left mantle of *A. fluviatilis* and in the right of *A. lacustris*. The other two form a pair, and lie in the cephalic portion, at the base of the tentacles, near the position of the eyes.

First we will consider the two ganglia that are situated in the substance of the mantle. They lie in the upper part of the same between one of the windings of the kidney and the musculus cochlearis. These two ganglia are best seen in a horizontal section. They are very small, so that it would be hardly possible to demonstrate their existence by dissection. They are connected by a bundle of nerve-fibres; besides this, there comes a bundle of nerve-fibres from the body to the posterior of these two ganglia. Although I was unable to demonstrate the connection of this

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 129, *et seq.*

[2] I use the expression "*connective*," employed by Lacaze-Duthiers (Du Système Nerveux d. Mollus. gastrop. pulmon. aquat. etc. Archiv. d. Zoologie Exp. et Gén., Tome i, 1872), for those bundles of nerve-fibres which join ganglia of the same side, in opposition to the term "*commissure*," which is only employed to denote those nerve-fibres that join ganglia of opposite sides.

posterior ganglion with the œsophageal ring, I have no doubt of the existence of such a connection.

We will first consider the anterior and largest of these two ganglia. From the form, position and structure I conclude that this is the so-called ganglion olfactorium. The existence of this ganglion was first pointed out by Lacaze-Duthiers[1] in the Pulmonata, but he did not suspect it to be the organ of smell. He supposed it to be the ganglion that provided for respiration, and at the same time regulated the large quantity of mucus which is secreted in the region of the respiratory orifice, the moment the animal is irritated at this point. Spengel,[2] in his researches on this organ in the Prosobranchia, believed it to be the seat of smell, and gave it the name of the ganglion olfactorium.

In *Ancylus* this ganglion lies on that side of the mantle which forms the external wall of the branchial chamber, and almost at the highest point of the chamber, namely, where the gill and mantle join.

The ganglion consists of cells with larger nuclei which are so large that they almost fill out the whole cell. These nuclei take a dark color when stained in picro-carmine, and are filled with a large number of fine granules. No nucleolus was to be seen. The whole ganglion is enveloped in a fine tunica, made up of connective tissue, which is continuous with the tunica that covers the bundle of nerve-fibres connecting the two ganglia.

The form of this ganglion olfactorium is in general spherical. At that point where it comes in contact with the internal surface of the mantle we find an invagination (Pl. X, fig. 6 *inf.*), so that the whole ganglion has a cup-like form. This invagination I call the infundibulum, because it has the form of a funnel. The walls of the infundibulum are lined with cylindrical, cilated epithelium, which seems to be identical to that which covers the inner surface of the mantle, save that the cells and cilia of the infundibulum seem to be a little longer than those of the mantle.

The cells stand perpendicular to the internal surface of the infundibulum, and are separated from the cells of the ganglia by an almost imperceptible tunica of very fine connective tissue. I was unable to determine positively whether there was direct nervous

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[1] Du Syst. New d. Moll. gast., etc.

[2] Die Geruchsorgane und das Nervensystem der Mollusken. Zeitschr. f. wiss. Zoologie, Bd. xxxv, 1881.

connection between the cells of the infundibulum and the ganglion cells, although one undoubtedly exists.

The nerve which connects these two ganglia consists of parallel fibres which are connected with the poles of the ganglion cells. It takes little or no color with picro-carmine, and is quite pale when compared with the surrounding tissues.

The posterior and smaller of these two ganglia I am inclined to believe is the supra-intestinal ganglion, which, according to Spengel,[1] lies in connection with the ganglion olfactorium. It is about one-half the size of this latter ganglion, and lies in the same plane with it, so that a horizontal section through one takes in the other. On one side it lies in contact with the anterior wall of the pericardium; on the other it touches the internal portion of the same part of the kidney which touches the internal portion of the ganglion olfactorium.

This ganglion receives a branch from the body, which is the one probably connecting it with the œsophageal ring. It sends also a branch posteriorly.

The form and structure of this ganglion are similar to that of the ganglion olfactorium, save that there is no funnel-like invagination. This ganglion has all the points that characterize the supra-intestinal ganglion: first, a branch which connects it with the pleural or visceral ganglion; secondly, a branch that connects it with the abdominal ganglion, and thirdly, a connection with the ganglion olfactorium.

The tentacular ganglia.—Besides the ganglia already described as belonging to the central nervous system, together with the ganglion olfactorium, there is a pair of ganglia which do not belong to the central nervous system proper, and may be considered as belonging to the peripheral nervous system. These ganglia have already been pointed out by P. B. Sarasin,[2] as existing in the fresh-water Pulmonata. Sarasin agrees with Lacaze-Duthiers,[3] that this pair of ganglia are homologous to those found in the end of the tentacles of *Helix*. They are situated behind the position of the eye, and in close contact with the

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[1] D. Geruchsorg. u. d. Nervensyst. d. Moll., etc.

[2] Drei Sinnesorgane und die Fussdrüse einiger Gastropoden. Arbeit aus dem Zool. Zootom. Instit. zu Würzburg, Bd. vi, 1883.

[3] Die Syst. Nerv. d. Moll. gast., etc.

epidermis. When the eyes are retracted (for they can be retracted in these animals) they lie close to this pair of ganglia.

In *A. fluviatilis* the eyes and ganglia are seen in the same transverse sections (Pl. X, fig. 8). This is not the case in *A. lacustris*, as the ganglia lie a little posterior to the retracted eyes. Each ganglion of this pair lies at the base of a tentacle, and each is ovoid in shape, the longer axis being antero-posteriorly situated. They are covered with a fine tunica of connective tissue. The nerve that supplies them comes from the cerebral ganglia and enters this ganglion on its inner surface. The nerve-cells which make up the ganglia are in every respect similar to those already described for other ganglia.

The tissue of the ganglia is pierced by a bundle of muscular fibres (Pl. X, fig. 7 *rm*), which comes from the buccal mass, pierces each ganglion and is inserted in that part of the epidermis which is covered by the ganglion. This muscle was not observed by Sarasin.[1] When this muscle contracts, the epidermis, together with the ganglion, is drawn inward.

The figures 7 and 8 (Pl. X) represent two transverse sections through the ganglion of the left side of *A. fluviatilis*. In fig. 7 we see this most anterior of the two sections representing the retractor muscle. Fig. 8 shows the relation of the ganglion to the eye. In these two sections we see that the ganglion has a deep groove on its external surface, so that in fig. 7 we have a figure somewhat resembling that of the ganglion olfactorium (Pl. X, fig. 6 *Go*).

This groove, *f* (Pl. X, fig. 7), is caused by the contraction of the retractor muscle. This groove was always present in sections.

In the figure 7, the nerve (*n*) which comes from the cerebral ganglion is seen entering the ganglion in question. At that point where the ganglion comes in contact with the cells of the epidermis (*p*), they seem to be somewhat longer than those surrounding this part. When the surface of this part is viewed from the exterior a pale patch is seen, which is made up of these lengthened epidermal cells. The external surface of these cells is covered with cilia which are a trifle longer than those found on the adjoining epithelium. Sarasin[2] considers this pair of ganglia as a special organ of sense; I am inclined to believe that we have here an

[1] Drei Sinnesorgane, etc.

[2] Ueber drei Sinnesorgane, etc.

organ similar to the side line, or side organ, that has been found in the annelides by Eisig[1] and Meyer.[2] The ganglion olfactorium may be one of a pair which would represent another segment, the mate of which has been lost by the disturbance of the bilateral symmetry. This so-called ganglion olfactorium is paired in the lowest Gastropoda, as *Patella*, *Haliotis*, etc., when the bilateral symmetry is not as disturbed as in the higher forms of Gastropoda.

The organ of touch.—Moqu n-Tandon makes the following observation: "*Ancylus* does not possess an especial organ of touch. The foot, which is large, flexible and capable of being exactly applied to solid bodies, and embraces them in part, it is true, receives and transmits tract le impressions, but the animal rarely uses it for this purpose.

"Blainville has proved that the tentacles of the Gastropoda never serve as organs of touch, in spite of their sensibility; he has merely confirmed the opinion of many earlier naturalists.

"This is not the case with the anterior part of the head, with which the mollusk at times touches different bodies with the appearance of smelling them. I have seen two individuals, which were about to copulate, which had the air of feeling and caressing themselves with the mouth.[3]"

Moquin-Tandon was wrong when he said that no especial organ of touch was present in *Ancylus*, for I have found one without any difficulty. It is probable that Moquin-Tandon was unable to find it, as he did not make any sections of the animal. As would be supposed from the citation, the organ lies in the anterior part of

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[1] Die Seitenorgane und becherförmige Organe der Capitelliden. Mittheil. a. d. Zool. Stat. zu Neapel, Bd. i, 1879.

[2] Zur Anatomie und Histologie von *Polyopthalmus pictus*. Clap., Archiv f. Microscop. Anat., Bd. xxi, 1882.

[3] "L'Ancyle ne possède pas d'organe spécial pour le *toucher active.* Son pied, qui est large, souple et susceptible de s'appliques exactement contre les corps solids, même de les embrasser en partie peut, il est vrai, recevoir et transmettre de impressions tractiles mais l'animal l'emploie rarement à cet usage.

"Blainville à prouvé que les tentacles des gastrop des ne servaient jamais á l'exploration du tact, malgré leur sensibilité; il n'a fait que confirmer l opinion de plusieurs anciens naturalistes. Il n'est pas de même du chaperon et du moufle, avec lesquel le Mollusque touche quelquefois les divers corps et semble les flaiver j'ai ou doux individus disposé à s'accoupler, qui avaient l'air de se palper et de se carresser avec la bouche." – Recher. anat. physiol. s. l'Ancyle, etc, p. 131.

the upper lip, exactly in that part which, according to Moquin-Tandon, was used for feeling.

The position and presence of this organ can best be demonstrated in longitudinal sections of *A. lacustris* (Pl. X, fig. 9), as in this species it is better developed than in *A. fluviatilis.*

This organ is made up of a certain number of specialized epithelial cells, which are connected with the cerebral ganglion by fine nerves; there are two organs which make a pair, and form a patch on each side of the median line of the upper lip, and each is connected with the cerebral ganglion of its own side.

The cells which make up this organ differ principally from the surrounding epidermal cells in their great size (Pl. X, fig. 9 *b-c*). These specialized cells are not all of the same size, those in the centre of the patch being the longer; and as we approach the periphery, they grow smaller and smaller, until they pass imperceptibly into the surrounding epidermis. This can be seen in the drawing (Pl. X, fig. 9), which represents a longitudinal section through the upper lip of *A. lacustris.*

The external or free surface of these cells is covered with long cilia, which thus differ from the cilia of the surrounding epithelium. The nuclei of these cylindrical cells differ from those found in the neighboring epithelium in form as well as in size. When the object is colored in picro-carmine, the nuclei take a deep color, and stand out sharply from the rest of the cell. Although these nuclei are somewhat different among themselves, they are, in general, fusiform. In this respect they differ from the regular, oval-shaped nuclei of the epidermis. Some of these nuclei appear bent, while others are straight. In fig. 9 (Pl. X) we see that some of the nuclei are pointed only at one end, and others at the other, while only one is pointed at both. In reality, all the nuclei are pointed at both ends, and the reason that they are not so in the drawing is that the nuclei have been cut in two, the knife not happening to pass from one point to the other, but to have taken an oblique course. In consequence of this, some represent the one half, and others the other half, of the nucleus. The bending of the nuclei is due, I believe, to action of the re-agents used in preparing the specimen.

The substance of the nuclei is granular, as the other epidermal nuclei, and I could not find the existence of a nucleolus.

The nerve-endings, which enter the cells of this organ, are the terminal branches of that nerve which arises in the cerebral ganglia, and are distributed to this region of the head. They enter, as near as I could determine, the posterior end of the cell, and become joined to the posterior end of the nucleus. The opposite point of the nucleus approaches the free surface of the cell, and probably is connected in some way with the cilia (Pl. X, fig. 9 *a*). In this figure, the muscular and connective-tissue fibres are intentionally omitted, as it would be difficult to distinguish the nerve-fibres, were they drawn in.

The other organs of special sense in *Ancylus* are so little different from those in other Pulmonata, that I do not consider it necessary to give a description of them here.

III.—The Anatomy of the Excretory Organ.

As yet, no one has completely described the excretory organ of *Ancylus*. This organ has only been known in part, and described under various names. C. Vogt,[1] in the year 1841, spoke of an organ imbedded in the mantle which he called the "sulphur-yellow body" (Schwefelgelber Körper), and supposed that the so-called reticulated portion was the lung.

Moquin-Tandon also considered this organ an organ of respiration, and said: "The breathing organ of *Ancylus* is neither a tube nor an external gill, it is an internal pouch. I am convinced of this, after numerous dissections. This pouch is small, oblong, straight and situated in the left side of the mollusk, toward the border of the mantle, and in advance of the rectum."[2]

Blainville[3] is of the same opinion, and considers that the orifice of this respiratory organ is closed by an opercular appendage (appendice operculaire). This appendage is what I have shown to be the gill.

Moquin-Tandon adds that the orifice is very small. He further speaks of a gland that surrounds the heart, concerning which he says: "The pericardial gland surrounds the heart and the breathing organ, as is the case with most Gastropoda; it occupies

[1] Bemerk. ü. d. Bau d. Ancylus, etc., p. 28.

[2] *L'organe respiratoire* de *l'Ancyle* n'est, ni un tube trachéiform, ni une branchie externe; c'est une poche intérieure; je m'en suis assuré, après de nombreuses dissections, cette poche est petit, oblongue, etroit, et située à la partie gauche du Mollusque vers le bord du manteau, en avant du rectum. Recher. anat. physiol. s. l'Ancyle, etc, p. 123.

[3] Manuel de malacologie et de conchylogie. Paris, 1825, p. 504.

the left and posterior part of the pulmobranchial pouch, and extends transversely and expands behind the auricle and the ventricle. Its color is yellowish, and opens without doubt at the side of the respiratory orifice."[1] He says further on: "The pericardial gland produces a very large amount of mucus, I have never found calcareous granules in it; these I have only found in the thick part of the mantle, principally near the margin; they were very large, a little irregular and transparent."[2] Although I have diligently searched for the reticulated part described by C. Vogt, I have been unable to find it. It appears to me that he had reference to what I have called the sacular part of the kidney, later to be considered, which lies close to the pericardium, the walls of which have not a reticulated appearance, but are thrown into longitudinal folds. C. Vogt regarded this part of the organ as the lung, while Moquin-Tandon, on the other hand, called it the pericardial gland.

When the animal is laid upon its back, and the mantle and foot separated, an S-shaped yellow body is seen through the thin walls of the mantle.

In *A. fluviatilis* this organ lies in the left, and in *A. lacustris* in the right lobe of the mantle; this is the organ of excretion, or the kidney. Were this organ to be dissected out and measured, it would be found to be about twice the length of the animal to which it belonged; thus in an animal measuring 7·4 mm., the kidney was found to measure 14·4 mm.

In fig. 10 (Pl. X) I have endeavored to give a diagramatical drawing of the course of the kidney. To the largest part I have given the name of the sacular portion; it lies in contact with the

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[1] L'orifice respiratoire est très petit et perce dans un epaississement de la peu, un peu plus pâle que la reste du tissue * * *. La glande pericardiale est accolée comme dans la plupart des Gastropodes, au cœur et à l'organe de la respiration; elle occupe les parties glauches et posterieures de la poche pulmobranche, et s'etend transversalement, en se renflent, derrière l'oreillette et le ventricle. Sa coleur est jaunâtre, s'ouvre sans doute, a côté de l'orifice respiratoire. Recher. anat. physiol. s. l'Ancyle, etc., p. 128.

[2] La glande pericardiale produit une assez grande quantité de mucus. Je n'y ai jamais trouvé de grains calcaires. J'en ai observé seulment dans l'epaisseur du manteau particuliement vero sa marge; ils etaient assez gros, un peu irreguliers et transparents. Recher. anat. physiol. s. l'Ancyle, etc., p. 128.

posterior wall of the pericardium. The folds that I have referred to above are not represented here, as they do not affect the general form of the organ. At the point *b'* the sacular portion passes into the tubular portion. *Os* represents the opening of the organ into the branchial chamber. The arrow is given to show the position of the animal as regards the kidney, the arrow pointing toward the head. The kidney is drawn as if the observer were viewing it through the external wall of the branchial chamber. The little canal (*t*) which is seen in the anterior part of sacular portion is the communication between the kidney and the pericardium. The diagram (Pl. X, fig. 10 *a*) is drawn from a complete series of transverse sections, by first drawing each section and then projecting it by measurement to surveyor's paper.

The organ may be divided into two parts, which are in form entirely different from one another. The first part—that is, that part which lies next to the pericardium—I call the pericardial or sacular portion (Pl. X, fig. 10 *a*); it is the largest and most active portion of the kidney; it is flattened from the side, so that the greatest diameter is perpendicular to the animal. The walls, as above stated, are thrown into longitudinal folds, which are much deeper at the pericardial end than at the end where this part joins the others; at this point, in fact, it may be said not to exist, as they gradually grow fainter until they disappear altogether. The anterior end of this portion is very broad, and covers nearly the whole posterior wall of the pericardium. This part, which runs obliquely backwards and downwards, has an oval form on transverse section which gradually becomes more circular as the folds disappear and we approach the tubular portion. The length of this first portion, in an average sized animal, is about 2·8 mm.;[1] the greatest diameter, 1·0 mm.; and breadth, 0·3 mm.

In the posterior wall of the pericardium is seen a small funnel-shaped opening (Pl. X, fig. 3 *inf*), which is lined with long cilia; this opening leads into a fine tube; this tube lies in contact with the internal wall of the sacular portion of the kidney for a short distance, and then opens into it. Here we have, without doubt, a direct communication between the pericardium and the kidney.

This small tube may be divided into two parts, histologically different from one another, and the point where this division takes

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[1] All measurements are taken from an animal of average size, which measured 7·4 mm. in length.

place is where the rectum, which is on its way perpendicularly through this part of the animal to the gill, comes in contact with the tube. The anterior part of this canal I call the prærectal, and the posterior portion the postrectal.

This little canal has nearly the same calibre throughout; the walls of the prærectal part are composed of cylindrical epithelial cells, which lie on a fine tunica propria, and on the free ends of which are found cilia. The cilia are longest at the pericardial opening of this tube. The lumen of the postrectal part is nearly the same as that of the prærectal part; the walls of the former, however, are somewhat thicker.

The internal surface of the excretory organ is also ciliated, and consists of a layer of cylinder epithelium. In the walls are found those concretions so characteristic of the gastropod kidney. These concretions are not found in the walls all over the kidney, but seem confined to a certain part. It is my opinion that the concretions are identical to those small granulations referred to by Moquin-Tandon (see p. 237) in the mucus of this region.

The sacular portion of the kidney does not pass gradually into the tubular portion, but at a sharp angle, as is seen in the diagram (Pl. X, fig. 10), where a little blind sac is formed (Pl. X, fig. 10 *z*). The diameter of this part of the sacular portion is 0·2 mm.

The second part of the kidney, or the tubular portion, is much longer than the pericardial or sacular portion, but has a much smaller diameter than the latter, and is convoluted. At the beginning it runs parallel with the inferior border of the mantle, and bending at *r* (Pl. X, fig. 10) it returns on its course; at *c′* (fig. 10), it makes another bend and passes for a short distance forward again; then forming a slight curve it passes to its most inferior position, and then running parallel with the lower border of the mantle it opens at *os*, at a position about opposite the posterior part of the gill. In the diagram (fig. 10) I have represented the convolutions as if they were all in one plane; this is, however, not the case, as in a horizontal section we often see two convolutions.

In *A. lacustris* the kidney has essentially the same form, lying in the right mantle, save that the folds of the sacular portion are not so marked.

As to the disposition of the concretion, I can say that they are found in the postrectal and sacular portions, thickly embedded in the walls; the tubular portion, which may be looked upon as the duct to the glandular or sacular portion, also has them in the first part of its course, as far as *o* (Pl. X, fig. 10); they then become scattered and rarer until we get to *c*, when they have entirely disappeared. The whole interior portion of the organ is ciliated.

EXPLANATION OF PLATE X.

FIG. 1. Transverse section, about the middle of *A. fluviatilis*; *s*, shell; *m*, mantle; *mc*, musculus cochlearis; *F*, foot; *qm*, transverse muscular fibres; *L*, liver; *mg*, stomach; *E*, albuminous gland; *D*, intestinal canal; *K*, gill; *exo*, excretory organ or kidney.

FIG. 2. Diagram of buccal mass and odontophore; *m*, mouth; *b*, curved arrow showing direction the food takes to (*oe*) œsophagus; *a*, anterior wall; *c*, arrow showing direction of movement of radula when licking (for *x*, see text); *Od*, odontophore; *r*, radula.

FIG. 3. Part of horizontal section of *A. fluviatilis*; *Inf*, infundibulum; *I* and *ct*, tube connecting kidney (*a*) to pericardium (*P*); *Ht*, heart; *bs*, blood-space; *m*, mantle; *R*, rectum; *mc*, musculus cochlearis; *alb*, albuminous gland; *Go*, parts of genital organs.

FIG. 4 *a*. Horizontal section of odontophore of *A. fluviatilis*.

FIG. 4 *b*. Transverse section of same.

FIG. 5. Posterior part of a longitudinal section of odontophore of *Helix aperta*.

For explanation of the letters of the last three figures, see text.

All the figures, with the exception of fig. 2 and fig. 10 have been drawn by means of a camera lucida

FIG. 6. Transverse section of the ganglion olfactorium (*Go*); *Inf*, infundibulum; *m*, mantle; *d*, kidney; *Brc*, branchial chamber.

FIG. 7 and 8. Two transverse sections of the tentacular ganglion of left side of *A. fluviatilis*; *n*, nerve; *e*, epidermis; *g*, ganglion; *p*, enlarged epidermal cells; *f*, groove; *c*, cutis; *rm*, retractor muscle; *au*, eye.

FIG. 9. Longitudinal section of upper lip of *A. lacustris*. For *a*, see text.

FIG. 10. Diagram of kidney of *A. fluviatilis*. For letters, see text.

The following, received through the Mineralogical and Geological Section, was also ordered to be printed :—

NOTES ON THE GEOLOGY OF CHESTER VALLEY AND VICINITY.

BY THEO. D. RAND.

In a recent reply to criticisms by Dr. Frazer of statements in regard to the serpentine outcrops, etc., described in Vol. C 6 of the Second Geol. Survey of Pennsylvania, I stated that I would exhibit before the Academy specimens from the outcrops in question. Dr. Frazer stated (*Am. Nat.*, Sept., 1883, p. 525) : "At the same time it must not be forgotten that what one observer would regard as evidence of a serpentine outcrop, another would not. * * * It would seem to be only thus that such wide divergencies as are here noted are explicable."

I have here specimens from the serpentine outcrops which I had stated were overlooked in C 6, and specimens from two outcrops represented in C 6 to be serpentine, which I questioned. I think they speak for themselves, but if any member has any doubt or question, I trust the matter may be so discussed as to elicit the truth.

I desire also to call attention to certain statements in the survey of Chester Co., C 4, recently published, statements with which my observations do not agree.

1. The non-existence of Potsdam sandstone, or a sandstone very closely resembling Potsdam, south of Chester Valley.

C 4 says, pp. 34, 124 : "The quartzite failed altogether on the southern side of the valley." "No Potsdam sandstone has been detected anywhere along the southern edge of the limestone area."

I have here specimens from Samuel Tyson's, on north flank of South Valley Hill, near King of Prussia station, Chester Valley, and from three localities in Cream Valley (between the South Valley Hill and the Radnor syenitic gneiss range), one, on the Brooks farm, about 100 yards west of the line dividing Delaware county from Montgomery and 300 yards northeast of the southwest corner of Upper Merion township; another, one-half mile west of this, near and south of the limestone on Stacker's place, and the third the Pennsylvania Railroad cut northwest of Wayne station, just north of the trap, in which cut Dr. Frazer, p. 283, speaks of finding sandy gneiss[1] with a hard serpentine-like mineral. I have also the eurite of Barren Hill for comparison.

It will be seen that the correspondence is exact—the micaceous partings, the rhomboidal cleavage, the minute tourmalines—all agree.

I have also a specimen of the trap of the Conshohocken dyke which crosses this cut about 100 feet southeast of the eurite. I could find no serpentine-like rock there, nor any other hard rock; the rocks are much decomposed, but the gneiss of Rogers' altered primal is there unmistakably.

2. I have also specimens (loose in the soil) from immediately south of the eastern end of the serpentine, stated, on p. 87, to be bounded both south and north by talcose slate. The rock is Rogers' altered primal.

3. On page 87 it is stated: "It is evident that even a synclinal belt of serpentine 2000 feet wide, or even 400 feet wide, can mean nothing else than a great thickness of the talc mica schist formation, metamorphosed more or less completely into serpentine, and a good cause for such alteration is present in an extensive outburst of trap close beyond."

"Everybody familiar with the surface of Delaware and Chester counties knows how *almost invariably* its trap and serpentine appear together."

If this is true, how can it be explained that a few miles further east, what seems to be admitted (p. 282) to be the same serpentine belt is wholly within the gneisses of C 6 (Rogers' altered primal), over 1000 feet south of the trap, with gneiss, hornblende schist, steatite and limestone intervening, and that the trap passes eastward for some five or six miles, at least, from Wayne station, P. R. R., to a point far east of Conshohocken, through the hydromica schists of the South Valley Hill to Bethel Hill without a trace of serpentine.

At what locality in Delaware county, among its numerous serpentine outcrops, does trap, properly so-called, occur?

It does not appear at Lenni, Media, Blue Hill, Marple, Newtown, nor at any of the numerous outcrops of the Lafayette belt, nor of that of the steatite belt on the south, nor of the Radnor belt in Radnor. In Easttown they do appear together, but can

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[1] This quotation is erroneous; in place of "sandy gneiss" it should be "a decomposed friable white gneissoid rock."

this possibly be construed to be more than that converging lines must meet?

4. P. 84: "The southern edge of the South Valley Hill belt of talc mica slates is defined upon the map by a chain of dots and stripes of two colors, representing outcrops of serpentine, and outcrops of crystalline limestone. Were these outcrops ranged in more than one line, the task of explaining their appearance would be far easier. * * * It looks as if the serpentine might be a subsequent modification of the limestone. No case is recorded of the serpentine and crystalline limestone of our line being seen in contact." I do not dispute the last sentence, but the specimens show a variety of rocks in Radnor *between* the serpentine and limestone, which there occupy, as shown on my map, approximatively parallel positions a thousand feet and more apart—conclusive evidence that in that part of the line at least they have no possible connection.

The map in C 4 shows, as clearly as possible on so small a scale, that the line of limestone outcrops is north of the line of serpentine outcrops; all the limestone outcrops shown are west of the west end of the serpentine outcrops.

There is some evidence that this serpentine belt is an altered enstatite.

I show a specimen from near Devon Inn, Easttown township, which seems almost certainly altered enstatite; and specimens of undoubted enstatite from the Lafayette belt, the serpentine of which so strongly resembles that of the Radnor belt, both in structure and accompanying minerals.

5. The statement, p. 282: "The east end of this (the Easttown and Williamstown serpentine belt) continues much further into Montgomery county."

This is certainly an error, caused, perhaps, by confusing this belt with that north of it, as was done in C 6. This belt ceases abruptly on the land of Hon. D. J. Morell, in Radnor township, Delaware county, where the contour suggests the possibility of a fault. The lithological difference of the belts may be seen by the specimens produced. The northerly belt begins on the land of Brooke, about one-fourth mile northwest of the easterly end of the Radnor outcrop, east of Radnor station.

5. On p. 138, a Mr. Morely is quoted, without comment, as stating that the Conshohocken trap follows the *summit* of Bethel

Hill into Delaware county, terminating near the road leading from the Lancaster turnpike to the King of Prussia.

In fact, it is nowhere near the summit, but on the south flank, or at the foot, and so far from ending at the road mentioned, it extends several miles to the westward, its outcrops almost continuous.

7. P. 140: "Near Mr. Hitner's house, Marble Hall, there occurs a thin bed of very ponderous rock, resembling closely a white crystalline limestone. It contains, however, but a moderate proportion of carbonate of lime, and consists chiefly of the carbonate of strontia." Whence there is deduced a bond of connection between the valley limestone and the No. 11 limestone of the valleys of middle Pennsylvania.

Was carbonate of strontia ever found there? Is it not the well-known sulphate of baryta from that locality mistaken for carbonate of strontia?

8. P. 282: "An old quarry close by the Spread Eagle hotel, which is now filled with fragments of trap and rubbish, shows serpentine along with the schistose matter, with a dip about S. 35 E., and seemingly about 35°, etc."

"This quarry is over the line, in Delaware county."

This is an interesting contact. I regret that I have been unable to find it; the only quarry in that vicinity that I can find is about 200 feet west of the Spread Eagle, on the north side of the Lancaster turnpike, nearly opposite Pugh's store; but it contains no serpentine, and is in Rogers' altered primal quarried thence for the turnpike. It was much filled up with trap and rubbish, but has been recently opened again. Old residents assure me that it is the only quarry in Delaware county in that vicinity.

9. P. 282: "As soon as one passes the creek north of Radnor station * * * the measures assume an unctuous, schistose, partly chloritic character."

P. 284: "Fragments of chloritic mica schist."

P. 287: "Willistown, broad conchoidal mica schist, containing much *chlorite* and milk quartz."

Yet Prof. Frazer contends rightly (*Am. Nat.*, October, 1883, p. 1021) that this region contains *hydro-mica* schists only; that the expression "talc mica" is erroneous, as the rocks contain no talc; do they contain chlorite?

Dr. Frazer says (*Am. Nat.*, May, 1883, p. 524): "The observation of the intersection of the serpentine belt by the trap, which has a more northerly trend in Easttown, is *interesting*, but *not new.*" My words were: "A mile southeast of Berwyn, the latter can be seen almost, if not quite, in contact with the serpentine, the trap, however, being on the south of the serpentine. The same is true south of Paoli, except that the trap appears to be on the north side." Prof. Rogers (p. 168) speaks of this trap as "occurring along and outside the northern edge of the serpentine, in a succession of narrow, elongated dykes, ranging more northeast and southwest than the serpentine. These I have not examined, but such structure agrees precisely with what I have observed of the serpentine further east."

This interesting occurrence is not upon the map in C 4; no trap whatever is shown north of the large serpentine outcrop south of Paoli.[1]

Dr. Frazer (*J. Frank. Inst.*, October 1883) kindly compares my criticism with those of the good old gentlemen who, during the war, criticized the army officers, from a safe distance at their comfortable breakfast tables. This is not fair; every observation I have made has been made on the spot and on foot, and in proof of this Dr. Frazer has not pointed out a single error of fact. Had all the observations in C 6 and C 4 been similarly made, many blunders like those of serpentine in the Bryn Mawr cut, in the cut northwest of Wayne, and on the Gulf road north of Matsons' Ford road, would not have appeared.

"But it is not a fact that Rogers' altered primal is a well-defined rock; on the contrary, a more heterogeneous collection of gneiss, mica schists, hydro-mica schists, chlorites, feldspar porphyries, clays and quartz slates than are found in the regions which he colored as altered primal it would be difficult to collect from the two hemispheres."—Dr. Frazer, J. F. I., October, 1883.

I referred to the rock *described* by Rogers. Is it not possible that Dr. Frazer has included, in the above, adjacent rocks which Rogers had no intention of including, as the scale of the map precludes the possibility of accurate mapping; and the rocks mentioned by Dr. Frazer do lie adjacent; but the peculiar rock here shown and so well described by Rogers, is, at least through Lower Merion, Radnor and Easttown, very well defined indeed. Its breadth nowhere exceeds 800 feet, I think, and this on Rogers'

[1] In my review, J. F. I., September, 1883, I inadvertently located this in Easttown. It is really in Willistown.

map would be $\frac{1}{33}$ of an inch; its outcrops are almost continuous, and between, its existence in the fields is constant.

Dr. Frazer attempts a joke founded upon his impression of the absence of an allusion to the serpentine in Radnor and Easttown, in my criticism of C 4. It would have been well for him to have read the paper again. He will find on page 33 an "allusion" to the serpentine in Radnor; on page 34 a map of the outcrops in Radnor and some of those in Easttown.

I did not describe the echelon structure of the serpentine outcrops as a theory, as Dr. Frazer says, but, as a fact, the underground structure I do not attempt to demonstrate. That our observations agree within limits that do not affect the question, is shown in the table given below.

The lines of strike are in part deduced from the dips given by Dr. Frazer, but it may be well to quote from C 4, p. 218: "The serpentine * * * where exposed, it is so fractured and broken as to make the determination of its dip very difficult or altogether impossible. But its strike cannot unfrequently be pursued in almost straight lines for miles."

For this reason, in recording my observations, I preferred to give the dip and strike separately—for the dip varies greatly, the strike does not.

Outcrops.	Strike on map, C 4.	Strike, Frazer, J. F.I. Oct., '83.	90° from Dip. Frazer.	Strike, Rand.	Difference.
1. ½ mile E. of Radnor station.		Nearly E. and W.	N. 70 to 85 E.	Nearly E. and W.	0 to 20°
3. ⅓ mile N. W. of Radnor station.			N. 70 E. N. 60 W. (? N. 60 E. ?)	N. 60 E.	10° 120° or 0°
6. S. W. of Old Eagle station.	N. 70 E.	± N. 30 E.		N. 40 E.	10°
7. N. W. of and near Devon Inn.				N. 50 to 60 E.	
9. Ivister, S. of Berwyn.	N. 76 E.	N. 40 E.	N. 40 E.	N. 40 E.	0°

A line joining the outcrops 6 and 9 on map C 4 is N. 83 E.
One joining the Radnor outcrops on map by Hopkins, N. 80 E.

Outcrop 3 runs for nearly 1500 feet parallel, or nearly so. to a lane. The bearing of this lane, by surveys recited in the deeds, is N. 62° 40′ E.

Now if the lines of strike given by Dr. Frazer be plotted on the map, it will readily be seen that while a line about N. 83 E. will cross all of them, the strike of all will cross this line at angles from 23° to 43°, except the first. The strike of the outcrops, as given on the map, is wrong, as shown by Dr. Frazer's own figures; but in spite of this the echelon structure is delineated in the two outcrops south and southwest of Old Eagle station, the error—making them two parallel outcrops—being due to the fact that the westerly one is not over 400 feet long, the easterly not over 200, while on the map each is made over 1000 feet long.

Mr. Hall remarks (*Am. Nat.*, June, 1883, p. 647) that I do not account for the absence of slates on the north side of the valley. From the specimens exhibited it will be seen that there are in the North Valley Hill slaty rocks with segregated quartz closely resembling those of the South Valley Hill, though it is true that as a whole the hills are not alike.

I have here specimens to illustrate the succession of rocks north and south of the Radnor gneiss belt.

I would particularly call attention to the rocks immediately south of the Radnor gneiss belt. Their resemblance to those on the north is striking, and it seems worthy of further investigation whether the belt of fine grained gneiss breaking into rhomboidal fragments and connected with a white feldspathic rock, may not be identical with the eurite and adjacent rocks on the north.

I have also two more specimens of the quartzite with supposed fucoidal markings, one of which, from the Old Gulf road east of Bryn Mawr, contains them unusually well defined.

NOVEMBER 6.

The President, Dr. LEIDY, in the chair.

Forty-four persons present.

A paper, entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions. Replies to Criticisms by Mr. Alfred Russel Wallace and Prof. Theodore Gill," by Professor Angelo Heilprin, was presented for publication.

On Visual Organs in Solen.—Dr. BENJAMIN SHARP called attention to a remarkably primitive form of visual organ that he had discovered in the siphon of *Solen ensis* and *S. vagina* (the common "razor-shell").

His attention was directed to the probable possession of visual organs by observing a number of these animals which were exposed in large basins for sale at Naples. A shadow cast by his hand caused the extended siphons of the specimens on which the shadow fell, instantly to retract, while those not in the shadow remained extended. Repeating this experiment at the Zoological Station at Naples, and being fully convinced that the retraction was due to the shadow and not to a slight jar which might have been the cause; he was led to examine the siphon more closely, and he also made a series of vertical sections for the purpose of very minute study.

When the siphon of a large *Solen* is cut open and examined, a number of fine blackish brown lines or fine grooves are seen. These are situated between and at the base of the short tentacular processes of the external edge of the siphon. As many as fifty of these little grooves were found to be present in some specimens, and some of them were from 1 to 1·5 mm. in length.

When a vertical section is examined these pigmented grooves are distinctly seen, and the cells of which they are composed are very different from the ordinary epithelial cells which cover the more pigmented parts. These latter cells are ordinary columnar epithelial cells with a large nucleus which is situated near the *tunica* on which it rests. The pigmented cells are from one-third to one-half longer than those just described, and consist of three distinct parts. The upper part, or that part farthest from the *tunica*, appears perfectly transparent and takes up about one-ninth or one-tenth of the total length of the cell; this part is not at all affected with the coloring matter which was used in coloring the whole. The second part of the cell is deeply pigmented and consequently opaque; it is filled with a dark brown or almost black granulated pigment; this takes up about one-half of the length of the cell. Below this is the third part of this cell, consisting of a clear mass, which takes a slight tinge when colored; this is probably the most active part of the cell; in this is imbedded the large oval nucleus. This nucleus is sharply demarcated and is filled with a granulated matter which takes a dark color in borax carmine, as do, indeed, the nuclei of all the epidermal cells.

These *retinal cells*, if they may be so called, are similar to those described by P. Fraisse in 1881 (Zeitschr. f. wiss. Zool., Bd. xxv), in the very primitive eye of *Patella cœrulea*, the principal difference being that in *Patella* the transparent part at the top of the cell seems to be a little more extensive. This eye of *Patella* is open, being merely an invaginated part of the epidermis, and has no lense. In *Haliotis tuberculata* we find an open eye also, but with the addition of a very primitive lense. The next higher grade of eye seems to be that of *Fissurella rosea*, in which the eye is closed and possesses also a lense; now in these two latter forms, where we find a lense present, the retinal cells do not possess the transparent ends as we find in *Patella* and *Solen*, but the pigment fills the upper part of the cell quite to the top. This would indicate, he thinks, that the transparent part took the place of a lense.

No special nerve-fibres could be detected passing to these pigmented grooves. Nerves passing to the eye of *Patella* were also wanting, while, on the other hand, distinct veins were found passing to the eye of *Haliotis* and *Fissurella*.

He further stated that this power of distinguishing a shadow would be of great use to the animal in the struggle for existence. The *Solen* lies buried perpendicularly in the sand and allows the siphon to project a little above the surface. This projecting part would, probably, frequently be bitten off by fishes, were it not for the fact that the shadow of the enemy would give warning, so that the siphon could be withdrawn in time to save it from destruction.

Notes on Glaciers in Alaska.—Mr. THOMAS MEEHAN remarked that on his recent visit to Alaska he noted that the numerous icebergs coursing down Glacier Bay, always pursued their swift downward course towards the Pacific Ocean quite independently of the rising or falling of the tide. On reflection it was evident that this might be due to the greater density of the cold glacier water pressing on towards the lighter water in the Japan Sea, which set its force against the Alaskan shores. It was, indeed, incorrect to speak of a warm current flowing northwards in any active sense. Warm water never flowed or circulated because it was warm, but it flowed under the simple laws of gravitation—the heavier body pushing the lighter out of its place, and the lighter then being drawn backwards to the vacuum caused by the movement of the weightier volume. The flow of a warm current in the atmosphere or in the water must, therefore, be taken in a passive and not in an active sense; and it was, therefore, to the immense ice-fields of Alaska themselves that we have to look for the singularly moderate climate of southeastern Alaska, rather than to the mere action of heated water alone. They furnish the heavy power which draws the warm current to its shores. With the disappearance of these huge glaciers, or the diversion of the immense volume of cold water to another channel, the cold of this portion of Alaska would probably be as intense as that experienced along its northern coast. The distinction was one of vast importance, and he ventured an opinion that much of the disappointment often experienced in Arctic navigation arose from overlooking it, and in regarding the warm current as the active agent in circulation.

In examining the Davidson, the Muir, and other glaciers, it also occurred to him that there were active agencies at work, overlooked by those who had made specialties of glacial study. Beneath the Muir glacier, which was said by various authorities to be about four hundred miles long, a large volume of water was flowing in a rapid torrent—this volume, on a carefully considered guess, being about one hundred feet wide with an average depth of four feet. According to information from a white man who had long lived with the Indians of this section, this subglacial river was flowing in about the same volume, summer and winter. The mouth of this glacier hung over into the sea, and formed icebergs in three different modes. Sometimes the edge of the glacier would, in its thinner sections, float over and be lifted off by the rise and fall of the tide; at other times huge masses would break off by their own weight; and at other times the upper edges, which, by the action of running surface water, would be worn into all sorts of rough forms, would topple over, rubbing their faces against the more solid ice, and making a sound which reverberated through the ranges of hills like peals of artillery, and which could be heard many miles away. There were thousands of smaller icebergs floating down Glacier Bay, the most of these evidently formed by the latter mode. It was not safe for the vessel on which he made the visit to approach nearer than a quarter of a mile to the face of this glacier, where it anchored for a day in order to make the examination; but it was near enough, especially with the aid of the ship's boats and good field-glasses, to make excellent observations. So far as could be ascertained through occasional deep fissures, no water came out from under the face of the glacier to the ocean. The mass of ice was apparently lying flat on a bed of rock, the ice occupying a width of something less than two miles, and estimated to be about 300 feet thick on an average of its whole width. This would, of course, obstruct the run of water directly to the ocean, and thus we had the lateral flow which diverged from the glacier's bed about four miles from its mouth. The Davidson glacier, in Pyramid Harbor, had retreated from the ocean, and by comparing facts observed in tracing a portion of its bed with what was seen in connection with this torrent from the Muir glacier, it was evident that during a glacier's existence the underflowing river might often become dammed, and the torrent diverted, carrying glacial deposits to sections of country long distances away from the track of the glacier, and through portions of country over which glaciers had never flowed. And there might be immense glacial deposits left by a glacier constantly retreating, and after many subsequent years, by the diversion of the glacial river, a new channel and new remains may be deposited through the mass, even by another distant and distinct glacier. This was actually the case in this instance. This stream had torn its way through immense hills of glacial deposits, many hundreds of feet deep, exposing to view the trunks, still standing erect, of a buried forest, though not a stick of forest-growth, except a few alders and willows, could be seen anywhere in the vicinity, as far as the eye could reach, and suggesting that the original deposit was not made by the existing glacier, the waters of which now tore their way through the huge hills.

The question would now arise as to the source of the water supplying the subglacial river-bed. It would be well to carry some ascertained facts along with us in this examination. An iceberg of more than usual dimensions had got aground in Glacier Bay, and, having one good, fair face, it was found by careful soundings that the vessel could be placed close alongside. At seven and a half fathoms, we were able to hitch on to the great block, the sides of which projected far above our deck. The surface of this berg exhibited, in a small way, all the features of a tract of land: lakes, rapids, waterfalls, hills and valleys; in some places, earth and stones. To-day the course of a water-channel might be in one direction, till a falling piece of ice or earth would block it up, when a source would be opened for a new direction, and the little streams, once started, would form in a short space of time wide and deep chasms. A piece of rock, by its dark color attracting the sun's rays, would sink deep into the berg, while earth, porous and non-conducting, would prevent melting; and thus we would have mounds on the berg where the surroundings, clear of earth, would be melted away. The action of the sun on melting portions of the berg was interesting. The thermometer was but 42°; yet on any side where the sun fell, even at this low temperature, the little streams and rivulets were coursing their way to the great ocean around. But on the northern slopes, there were barely any streams, except such as originated on the sunnier sides. In fact, it was demonstrated that wherever the sun struck on ice, even at a low temperature, the deposition of water occurred. What he had carefully noted on this iceberg he had before noted on high mountain peaks: there would be always some melting from the face of a snow-bank, no matter how low the temperature, where the sun shone fairly on it, and the water would sink to the bottom of this mass. On this iceberg there were clefts and rifts and wells furrowed by the gathering together of melted water into small pools or lakes, or over where dark stones had sunk by the agency of the sun's warmth; but in no case had the holes or cavities penetrated wholly through the iceberg, except on its thinnest outer edges. The temperature necessary for melting was reduced with the depth, till at length there was not heat enough to melt further. The facts all tended to show that very little water would pass through a glacier by way of its surface. Some may pass over to the sides, and get beneath in that way, but the outer ledges of ice seemed to rest very firmly on the ground, as it necessarily must from its arch-like form, owing to the river beneath and the immense weight pressing on the edges of this arch; only occasionally can water be admitted that way, and scarcely could anywhere the volume so acquired be described as flowing from the side of the main glacier. What becomes of the melting snow on the snow-cap of the glacier, the continual and almost imperceptible meltings under the sun's influence at these heights? A prevailing impression is that glacier-ice is but snow which has become ice by the enormous pressure of so thick a body. If this be so, water thawed out from the snow by the sun's rays could not percolate far below the surface of the snow, and there seems no way left to account for the river beneath. If this be not so, then the way would be clear. With no ice below the snow, with the thermometer at the ground above the freezing-point, through the natural warmth of the earth protected by the snow-cap from escaping, the percolating water would descend to the surface of the mountain-top, part entering to furnish fountain-heads for springs and underground streams, running often hundreds of miles away, and the balance running down under the ice-channel formed by the glacier.

It seems such a fair assumption that this may be so, that it is worth while to consider the evidence offered for the belief that glacier-ice is snow under the pressure of its own weight. Snow has been artifically brought under pressure to ice, but such ice is not translucent, as is ordinary crystallized ice. The ice of the Alaska glaciers is remarkably clear, and, when in the proper position against the atmosphere, presents the most lovely cerulean tints imaginable. One of the speaker's pleasantest experiences was a wandering among the wrecks of icebergs strewn all along the shore, in Hoona or Bartlett Bay.[1]

No crystal could possibly be clearer than the fragments strewn everywhere along the beach. The only difference observed between this and the ordinary ice of every-day experience was that, melting in the mouth, it would divide into pieces of the size of peas before wholly uncongealed. Again, from the vessel

[1] At page 187, Proceedings of the Academy, 1883, Hood's Bay was inadvertently used for Hoona Bay. Hood's Bay is some hundred miles south of this point.

anchored a quarter of a mile from the face of the Muir glacier the portion to the southeast for a distance of perhaps a thousand feet, as examined by the field-glass, was of a different character to the rest of the face in having a milky white, marble-like look. The line of demarkation between this opaque and the transparent ice was exactly defined. It was not possible to get nearer for a more satisfactory examination, but the conclusion of all was that this portion was compressed snow. At this point the ice-sea had to draw in, through passing an intruding bluff of rocks, and the lateral pressure must have been enormous between the bluff and the solid ice. It would be the best possible opportunity for a mass of snow, carried down from the mountain side, and floated along on the margin of a wide glacier, to become ice if pressure would ever do it. It cannot, of course, be positively stated that this opaque section was compressed snow, in the absence of actual handling, but there is little room for doubt that it was. It was, at any rate, an opaque section, and wholly different from the glacier-ice as generally seen. Again, from the amount of air-cavities in snow, and the resistance these must offer to the self-pressure of snow, and also from actual experience of deep snow-drifts in ordinary mountain ranges, there is nothing to warrant a belief, outside of an actual demonstration, that the pressure of any depth of snow is of itself sufficient to turn it into glacier-ice.

If now we admit that above the glacial snow-line and under the great snow-cap there may not be solid ice formed by compression, but there may be a huge lake of water held back by the icy breast-work at the snow's edge, we may conceive of a method of forming the glacial sea quite different from any already proposed. The water must and will flow out from the edge of the snow-line when the temperature is far below freezing-point, and form a fringe of ice all along the line. How this is done can be readily seen passing under the snow-sheds of a mountain railroad.

On the Denver and Rio Grande Railroad, passing over Marshall's Pass, 14,000 feet altitude, as the speaker did in May of the present year, the melted snow passed as water through the mass to the bottom, then passed down the mountain-side under the snow to the snow-shed, where it formed real glaciers down the railroad—cutting under the sheds to the railway track. The law must of necessity be the same on a mountain-top in Alaska as on a mountain-top in the Rocky Mountain region. Snow occurring after this icy deposit was formed, would extend down the mountain over the ice, and new layers of ice would be continually forming over the old layers, or on their edges with the occasional retrocession of the snow. A portion of the water at the snow-head will naturally course under the ice, and form a channel beneath. This will increase in width and depth with time. In the torrent which sprung out from above the mouth of the Muir glacier myriads of stones, some of them of many cubic feet in size, were borne along by the muddy waters. The force of the water, as well as the added force of the rolling stones against the roofs of the glaciers, must have some influence on its descent, as also would the weight of water under the snow forming the cap, pressing against it at the highest point of the glacial departure. The roof of the glacier above the torrent would possibly get worn away somewhat by the friction of the torrent; but as ice is now known to be ductile, it would bend down towards the water when any great hollowing out occurred, and get aid in its downward flow. We may further imagine that under such an explanation as this, the edges of the glacier would have much more of excoriating power, than when the whole mass is spread equally over a wide rocky bed.

In regard to the existence of the glaciers, Mr. Meehan observed that in many instances there were evidences of rapid retreat. Davidson's glacier, at the head of Pyramid Harbor, near the mouth of the Chilkat River, in about lat. 59°, had fallen back several miles from the water in the bay. Having but little more than half a day on shore at this point, an effort to reach the mouth of the glacier failed through taking a "short cut" through a forest of alder and spruce, the undergrowth of the spiny *Pana horrida* being almost impassable. But field-glass observation from the vessel, together with the examination of the track of the retreating ice, showed successive terraces of moraine material, with succeeding generations of trees on them in the supposed distance of three miles from the sea to the glacier's mouth. Near the glacier the trees appeared to be about twenty or twenty-five years old; nearer the sea, from seventy-five to one hundred. But here, as in the Muir glacier, there were evidences of frequent advances and of retrocession in the glacial material. Trees which from their size may have been from thirty to fifty years of age, would have a deposit of twenty or thirty feet of material placed around them, half burying them, and then again have it all cleared away, leaving the dead trunks to tell the story.

The volume of water now flowing in the line vacated by the glacier, is not near equal to the work which has been done in former times; and the less quantity with the retreat of the glacier itself, while other glaciers not fifty miles away still continue their connection with the water, shows that local causes may be at work which may either retard or accelerate a glacier's progress. As already noted, the warmth of the atmosphere near a glacier's mouth will, in a great measure, depend on the volume of cold water projected into the ocean—the greater the volume, the more influence on the warm current which must be drawn in to take its place; and this is as true of the atmosphere as of the water. The heavy cold body pushes the higher warmed air upwards, which has to take the place of the air which rolls forward towards the lightened spot. Hence the greater the volume of cold air departing, the larger and stronger the current of lighter and warmer air which returns to the source of motion, so the temperature is not low in the vicinity of the glaciers. On the iceberg before described, the thermometer indicated 42° ; but a quarter of a mile from the immense body forming the mouth of the Muir glacier, the temperature was 60°. These warm currents, however, vary with the drafts through the mountains. Within comparatively short distances, the temperature would vary from between 40° and 60° at the time referred to. In the winter season the difference would be the more remarkable, and hence a mountain or glacier torrent, cutting out for itself a new channel, and making a deep rift in a mountain, would originate a new current—warmer or colder, as the case might be—which must have an influence on the progress or decrease of the glacier itself. The operations of these changes in the atmospheric currents were very evident in the vicinity of the Davidson glacier. Sometimes through chasms in the mountains near, the whole mass of timber on either side would be quite dead after having made a successful stand for from twenty-five to fifty years, by the work of some severe cold current, which, by some local change, had found its way along the course. Near by, on land no better, quite as steep, and in no way more favorable to the growth of vegetation, the timber would be perfectly healthy, the only difference being in the freedom from the atmospheric current that had destroyed the others. In short, the age of the trees on the successive terraces left by the waters along the line of the glacier's retreat, showed how much had been done within a comparatively recent period, and other attending facts showed that local causes, induced by the glacier itself, may rapidly retard or accelerate its development at various periods in its existence.

In the retreat of the glaciers, in this part of Alaska, an alder, *Alnus viridis*, was apparently the first arborescent plant to establish itself. Large tracts of the drift would be wholly covered by a dense, bushy growth. In time, however, many of these would advance to the dimensions of large timber-trees, surprising to those who might have only seen them as eight- or ten-feet bushes in other parts of the United States In the woods bordering on the Davidson glacier, the speaker saw Indians at work making canoes (dug-outs) from the trunks of this alder.

Favorable Influence of Climate on Vegetation in Alaska.—In his remarks on glaciers in Alaska, Mr. Thomas Meehan observed that on the tops of what are known as "totem-poles" in some of the Indian villages, trees of very large size would often be seen growing. These poles are thick logs of hemlock or spruce, set up before the doors of Indian lodges, carved all over with queer characters representing living creatures of every description, and which are supposed to be genealogies, or to tell of some famous event in the family history. They are not erected by Indians now, and it is difficult to get any connected accounts of what they really tell. At the old village of Kaigan there are numbers of poles erected, with no carving at all on them, among many which are wholly covered, and these all had one or more trees of *Abies Sitkensis* growing on them. One tree must have been about twenty years old, and was half as tall as the pole on which it was growing. The pole may have been twenty feet high. The roots had descended the whole length of the poles, and had gone into the ground, from which the larger trees now derived nourishment. In one case, the root had grown so large as to split the thick pole on one side from the bottom to the top, and this root projected, along the whole length to the ground, about two inches beyond the outer circumference of the pole. Only in an atmosphere surcharged with moisture could a seed sprout on the top of a pole, twenty feet from the ground, and continue for years to grow almost or quite as well as if it were in the ground.

We may also understand by incidents like these how tree-life endured so very long in this part of Alaska, and why rocky acclivities, on which no vegetation at all could exist in the dry climate of the eastern States, were here clothed with a luxuriant fresh growth, so thick that it was almost impossible for one to make a journey through it. Indians had very few trails; most of their journeys were by canoes. At this village he also saw a bush of *Lonicera involucrata*, which was of immense size, as compared with what he had seen in Colorado and other places. This was at the back of an Indian lodge and alongside of a pathway, cut against the hill-side. The plant was growing on the bank and grew up some ten or twelve feet, where it bent over, apparently of its own accord, and rested on the roof of the lodge, its numerous branches making a dense arbor under which the road passed. The stems near the ground were, some of them, as thick as his arm, and the whole plant was covered by very large black berries. Stopping in admiration to look at and examine the specimen, brought numbers of Indians to see what was the subject, who smiled pleasantly on being made to understand that only the sight of a huge bush had attracted the traveler. Subsequently another specimen was noted in the woods on a plant of the native hemlock, *Abies Mertensiana*. In the woods the plant is somewhat sarmentaceous. It could not climb a hemlock without assistance. This old hemlock was bereft of branches to about twenty feet high, but the *Lonicera* was above the lower branches, and had journeyed along them to the extremities, beyond which it was beautifully in fruit. It could only have been there by growing up with the hemlock when that tree was young, and was probably of about the same age. The Indian village of Kaigan is not properly in Alaska, but just over the border in British Columbia, at the southeastern point of Alaska, but the climatic conditions are about the same.

The following was ordered to be printed:—

NOTES ON GLACIAL ACTION IN NORTHERN NEW YORK AND CANADA.

BY JOSEPH WILLCOX.

In a former communication I have noted some results from glacial action in northern New York and Canada. I have recently observed some other matters connected with the same action, in that region, viz., in Lewis, Jefferson and St. Lawrence Counties in New York, and in Canada, for a distance of one hundred and twenty-five miles north of the St. Lawrence River.

In this territory all the original soil appears to have been removed by glacial action, and that which now remains there has been deposited by the receding glacier. It is thinly distributed, seldom being many feet in depth; while, in many cases, the rocks have no soil upon them. All the rocks are extensively eroded, and those which are durable still remain smooth—both above the ground and underneath—wherever I have seen the soil removed.

In the country south of the great terminal moraine, which extends across our continent, the soil is usually deep, especially in our Southern States. The top of the rocks, under this deep soil, is ordinarily in a state of disintegration; and the different stages of transition from hard rock to soil may easily be observed. Loose stones, on top of and in the soil, are more or less decomposed on their surface, relinquishing their substance slowly, as new virgin soil, for the needs of vegetation. Where the country has been extensively glaciated, this condition of the rocks and stones does not exist, the soft portion of them having been removed by attrition, and, since the glacial times, little disintegration of the surface of the granite and Pottsdam sandstone has occurred.

If the great ice sheet should have receded north speedily, by rapid melting, less material would, of course, be deposited on the ground, than in the case of a slow retrogression. In the former case little would be deposited, in any locality, except what was already on the ground, in the process of transportation.

Taking the country north of Philadelphia as illustrating probably the conditions prevailing elsewhere within the glaciated area, I have observed that north of the great terminal moraine a large amount of silt has been deposited, as moraine material, by the receding glacier, as far north as Trenton Falls, in New York, but not much farther. On the north side of the Mohawk Valley, from Utica to Schenectady, vast deposits of glacial drift may be seen. North of Trenton Falls the deposits appear to diminish rapidly in quantity, so that I observed no large accumulations near the St. Lawrence River or north of it. The farther north I proceeded the smaller the deposits appeared to be, including the ordinary surface soil.

From the above facts I consider there are reasonable grounds for suspecting that the glacier receded slowly from Pennsylvania until its southern limit was not far north of the Mohawk River, and then it was withdrawn more rapidly, with increasing speed, as it proceeded north.

Some geologists consider that there was not a great amount of glacial erosion accomplished upon the rocks in Pennsylvania. I believe that the erosion proceeded with much greater effect in Canada than in this State. While progressing from the north the glacier would operate on the rocky surface of Canada during a long time before it would reach the latitude of Pennsylvania. Also during its decline it would still continue its abrasion in Canada long after it had retreated from our State.

I have observed, in northern New York and Canada, that where the country is level it is often covered with Silurian limestones or sandstones, but where it is hilly the Laurentian rocks usually prevail. In the latter case the Silurian rocks may have formerly existed and been removed, as they were more effectually exposed to the glacial erosion.

Many sharp, angular stones are scattered over the ground in Canada among the rounded boulders. These evidently have not been transported far from the parent rock, but they are suggestive of the fact that, even near the close of the glacier's career, rocks were still being torn into fragments. These fragments were chiefly broken loose from the southwestern portions of the rocks.

As a shallow soil prevails in the district referred to, the trees do not obtain a deep, substantial hold upon the ground; consequently they are easily blown down by the storms, and the forests are filled with prostrate trees, which make travel a difficult operation there. When the forests are cleared off, the ground is in a very rough condition. A hole in the ground indicates the place where a tree formerly stood, while a pile of earth alongside denotes the place where the roots of the prostrated tree transported and deposited the soil that was in the hole. Large fields may be seen, the surfaces of which are almost wholly broken up into holes and piles of earth, by the prostration of trees.

November 13.

The President, Dr. Leidy, in the chair.

Twenty-nine persons present.

The following was ordered to be published :—

OBITUARY NOTICE OF CHARLES F. PARKER.

BY ISAAC C. MARTINDALE.

When a man has given to the service of the public good the best years of his life, and that life perhaps shortened in consequence of his devotion and faithfulness to known duties, it should rest with some survivor to so place upon the historic page this record, that perchance some disconsolate and weary follower, ready to faint by the way, "seeing may take heart again." For such a life is a conspicuous mark on the highway of honest endeavor, and a beacon light ever before the devoted inquirer after truth.

Hence I have assumed to place herein a notice of the life and services of Charles F. Parker, late Curator-in-charge of this Academy.

His parents resided in Philadelphia, where he was born on the 9th day of November, 1820. His mother dying when he was but an infant, he was deprived of a mother's love to stimulate and encourage him in his undertakings.

His father, being in humble circumstances, was able to give him but a limited education. Charles, as soon as he was old enough to be of any service, was apprenticed to bookbinding; his father having long been engaged in that business.

He remained in Philadelphia until about the age of 22 years, when he went to Boston and engaged in the same business. After residing there about two years he married Martha Kellom, and in 1851 left Boston and moved to Leominster, where he opened a book-store, and carried on bookbinding on his own account. This business enterprise, not being so successful as he had hoped, was abandoned in 1853, and he removed to Camden, New Jersey, where he resided during the remainder of his life.

About two years after the death of his mother, his father married again, and when the father died in 1835, his widow continued to carry on the bookbinding, and Charles became a partner and assumed the management of the business, subsequently conducting the work on his own account.

As a business man he was extremely conscientious in having his work performed at the exact time that had been agreed upon; and he attained an enviable reputation as a neat workman—to such an extent, that services in his business which required the utmost care and nicety were sure to be sent to him to be performed, and he would not undertake any kind of work that was expected to be done in a cheap or hurried manner. Having the oversight and employment of others for many years, his just treatment of them always gave him the choice of the best workmen, and those who were satisfactory remained year after year in his employ.

During the earlier part of his life he did not manifest any especial interest in natural history; yet for a long time he was a companion of C. S. Rafinesque, the well-known naturalist, who boarded in the same house. This was during the latter part of the life of Rafinesque, when he was engaged in the manufacture of medicines, which he contended were for the relief of "all the ills that flesh is heir to." The writer has repeatedly heard narrated some of the incidents in the life of this naturalist which occurred during those years, and which seemed to have made a lasting impression on the mind of our friend C. F. Parker; so much so that I am led to believe the love for natural science, which developed in the later years of his life, was from some of the seed then sown. One of these incidents, so characteristic of the eccentric Rafinesque, may be mentioned here: Charles was quite fond of remaining in bed at a later hour in the morning than usual when he was not expected to be at his place of business, and often entertained himself by singing some favorite tune; on one such occasion Rafinesque heard the usual melodious sounds, and went to the room door, which he quickly opened, exclaiming,

"He who sings in bed instead of sleeping,
And whistles at the table instead of eating,
Is either crazy or soon will be."

Having thus relieved his mind, he went away to his own quiet musings, which he did not seek to brighten by such displays of levity or cheer.

Very soon after making Camden his home, Charles became interested in conchology, although he had never seen a collection of shells, nor known anything of their scientific arrangement or method of study; neither was he acquainted with any one at work in that department of natural history. His attention also became directed towards insects, especially butterflies and beetles, and learning that a society had been formed for their study, he applied for membership in the Entomological Society of Philadelphia, and was elected November 11, 1861.

This brought him in contact with men of science, and gave him an opportunity to examine books and specimens that he had never known of before, opening a new life and infusing a zeal which increased with advancing years.

The study of conchology and entomology opened the way for other branches of natural history; and having become a frequent visitor at this Academy, he was brought into intimate relations with several of its members who were pursuing the study of botany and making collections of plants in the immediate neighborhood of Philadelphia. He soon became interested with them in their pursuits, and took up the same study with especial zeal. Withal, he never neglected his business, nor failed to keep his appointments and engagements therein. He was elected to membership in the Academy on the 29th of August, 1865, and forthwith entered heartily into work, for it will be remembered that at this time the collections were not well arranged, owing to the limited space occupied, and the want of means to secure the services of competent workmen; so that almost all of the labor performed was voluntary and gratuitous.

His earliest labors in the Academy were directed to the conchological collection, and for seven years he devoted a large portion of the time that could be spared from his business to its systematic arrangement, preparing and mounting during that period about one hundred thousand specimens, in a style which, for neatness and adaptability for scientific study, has not been excelled. This labor, perhaps the greatest volunteer work ever done in the Academy, was only finished a short time before it became necessary to pack the Academy's museum for removal to the present building; he immediately engaged in this labor, and had already devoted much time to it, when it became apparent to his fellow-members that the Academy would be greatly benefited by employing him permanently for a compensation. In 1874 he was elected one of the Curators, and on solicitation was induced to partially give up his business as a bookbinder and accept the meagre amount which the Society could afford to pay him, giving in return the greater part of his time to its work. The entire museum was removed under his direction and arranged in cases in this building in a very short period—the actual removal being accomplished in about a month, the unpacking and display in the cases in about five months. He has been annually re-elected one of the Curators of the Academy at successive elections, invariably receiving the full number of votes cast, however many candidates were in nomination, thus showing the value and appreciation of his services.

Although he continued his interest in the study of conchology and entomology, and made quite extensive collections in both of these departments, he seemed to have taken an especial fondness for the study of botany, which he never afterward allowed to falter. He was one of the first to discover that the ballast deposits in and around Philadelphia and Camden were prolific in introduced plants, and his knowledge of conchology sometimes enabled him to determine the part of the world from which those deposits came, as occasionally fragments of shells were found therein.

In one of his journeyings to the swamps of Cape May County he met Coe F. Austin, the noted cryptogramic botanist, who died at Closter, N. J., a few years ago, and who at that time was engaged in the study of the flora of New Jersey. There at once sprang up a real friendship between them, which increased as time advanced, terminating only when Austin died. The interest, however, which had been created to endeavor to complete a list of the plants of New Jersey was not allowed to abate; and for several years past, in connection with other botanists, the work has been approaching completion to such an extent that a preliminary catalogue has been compiled by N. L. Britton, and printed under the auspices of the Geological Survey of New Jersey, in which the name of C. F. Parker frequently appears. Probably no botanist has made more frequent visits to the pine barrens and swamps of that State, nor collected so extensively of her flora, as he did; the same ready tact displayed in the work of his hands everywhere has been especially noticeable in the preparation of his herbarium specimens; they are at once characteristic and good, so much so that exchanges were desired from him by the noted botanists of the country, and to-day his specimens enrich many private collections and herbariums of institutions of the United States and Europe. The collection of New Jersey plants which he has left is one of the finest and most perfect that exists, and of itself is a monument of patience and skill of which any one might feel proud.

The annual reports of the officers of the Academy, of late years, show somewhat of the service he has rendered. The mounting of specimens presented, and their arrangement, has been one of great labor, requiring skill, patience and care. The neatness displayed, so characteristic of the man, has made the collections of the Academy of inestimable value to the scientific world and an ornament to the institution itself. Since occupying its present building, between thirty and forty thousand additional specimens of shells have been received, all of which have been mounted by him, and nearly all outside of the hours in which he was employed by the Academy, and without compensation. He was one of the founders of the Conchological Section and of the Botanical Section, and was active in their proceedings.

It has well been said he was a born naturalist; he had a quick eye and good judgment in perceiving and estimating specific characters, and an excellent memory. His knowledge of conchology was probably almost as extensive as his acquirements in botany, although he was, perhaps, more widely known in the latter department. What he knew he was always ready to impart to others, and the many naturalists who have consulted the collections of the Academy during his curatorship invariably received from him valuable and generous aid.

The service which he gave to this Academy, the self-sacrificing devotion to its interests ever manifested by him, proved at last to be the weapon of his own destruction. In the early part of the present year his health rapidly gave way, so that he was obliged to refrain from continuous work. The Council of the Academy, mindful of his eminent services, unanimously granted him leave of absence for the summer months, in order that rest might, if possible, restore his wasted energies and give back to the Academy his invaluable services; but too late! The disease gradually assumed a more serious character, and at last paralysis of the brain set in, which terminated his life on the seventh day of September, 1883, in the sixty-third year of his age.

My acquaintance with him, extending back nearly a quarter of a century, has given me full opportunity to know his character and judge of his worth. Had he been favored with good opportunities for school education in early years, he doubtless would have ranked among the eminent scientists of the day; yet the record which he has left of overcoming the many obstacles of life, of his rigid adherence to right, his extremely conscientious desire to be found faithful in all his undertakings, and the work of his hands in all the departments in which he found engagement, have given him a record and a name which must ever remain; whilst the memory of his many social qualities well known to me serves to make up the triplicate of naturalist, companion, and friend.

NOVEMBER 20.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

The following were presented for publication:—

"Notes on American Fishes preserved in the Museums at Berlin, London, Paris and Copenhagen," by David S. Jordan.

"The Occident Ant in Dakota," by Rev. H. C. McCook.

"Staining with Hæmatoxylon," by Chas. L. Mitchell, M. D.

The death of John L. LeConte, M. D., a member, was announced.

The following was ordered to be printed:—

ON THE VALUE OF THE "NEARCTIC" AS ONE OF THE PRIMARY ZOOLOGICAL REGIONS. REPLIES TO CRITICISMS BY MR. ALFRED RUSSEL WALLACE AND PROF. THEODORE GILL.

BY PROFESSOR ANGELO HEILPRIN.

The subjoined criticism by Mr. Alfred Russel Wallace on my paper entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions," published in the Proceedings of the Academy for December, 1882, and my reply thereto, appear in *Nature* under dates of March 22 and April 26 of this year:—

"In the *Proceedings of the Academy of Natural Sciences of Philadelphia* (December, 1882), Prof. Angelo Heilprin has an article under the above title in which he seeks to show that the Nearctic and Palæarctic should form one region, for which he proposes the somewhat awkward name 'Triarctic Region,' or the region of the three northern continents. The reasons for this proposal are, that in the chief vertebrate classes the proportion of peculiar forms is less in both the Nearctic and Palæarctic than in any of the other regions; while if these two regions are combined, they will, together, have an amount of peculiarity greater than some of the tropical regions.

"This may be quite true without leading to the conclusion argued for. The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality. The absence of the families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*, *Dipus* and *Hystrix*, among mammals; and of the important families of fly-catchers and starlings, the extreme rarity of larks, the scarcity of warblers, and the absence of such widespread genera as *Acrocephalus*, *Hypolais*, *Ruticilla*, *Saxicola*, *Accentor*, *Garrulus*, *Fringilla*, *Emberiza*, *Motacilla*, *Yunx*, *Cuculus*, *Caprimulgus*, *Perdix*, *Coturnix*, and all the true pheasants, among birds, many of which groups may almost be said to characterize the Old World as compared with the New, must surely be allowed to have great weight in determining this question.

"The geographical individuality of the two regions is of no less importance, and if we once quit these well-marked and most natural primary divisions we shall, I believe, open up questions as regards the remaining regions which it will not be easy to set at rest. There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions. But even after these two are united, there will remain discrepancies of almost equal amount among the rest, since in some groups the Neotropical, in others the Australian, far exceed all other regions in their specialty. The temperate and cold parts of the globe are necessarily less marked by highly peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate, and have thus not been able to preserve so many ancient and specialized forms as the more uniformly warm areas. But, taking this fact into account, it seems to me that the individuality of the Nearctic and Palæarctic regions is very well marked, and much greater than could have been anticipated; and I do not think that naturalists in general will be induced to give them up by any such arguments as are here brought forward.

"ALFRED R. WALLACE."

Reply to the preceding :—

"Permit me to make a few remarks relative to Mr. Wallace's criticism (*Nature*, vol. xxvii, p. 482) of my paper on 'The Value of the Nearctic as one of the Primary Zoological Regions.' Briefly stated, it is maintained in the early portion of this paper (1) that the Nearctic [1] and Palæarctic faunas taken individually exhibit, in comparison with the other regional faunas (at least the Neotropical, Ethiopian and Australian), a marked absence of *positive* distinguishing characters, a deficiency which in the mammalia extends to families, genera, and species, and one which, in the case of the Nearctic region, also equally (or nearly so) distinguishes the reptilian and amphibian faunas; (2) that this deficiency is principally due to the circumstance that many groups of animals which would otherwise be peculiar to, or very characteristic of, one or other of the regions, are prevented from

[1] In the paper under consideration, I have given what appear to me satisfactory reasons for detaching certain portions of the Southwestern United States from the Nearctic (my Triarctic), and uniting them with the Neotropical region.

being such by reason of their being held in common by the two regions; and (3) that the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other faunas than either the Nearctic or Palæarctic taken individually.

"In reference to these points, Mr. Wallace, while not denying the facts, remarks: 'The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality.' Numerous families and genera from the classes of mammals and birds are then cited as being entirely wanting in the western hemisphere, and which—in many cases almost sufficient to 'characterize the Old World as compared with the New'—'must surely be allowed to have great weight in determining this question.' No one can deny that the absence from a given region of certain widespread groups of animals is a factor of very considerable importance in determining the zoological relationship of that region, and one that is not likely to be overlooked by any fair-minded investigator of the subject. But the value of this *negative* character afforded by the absence of certain animal groups as distinguishing a given fauna, is in great measure proportional to the extent of the positive character—that furnished by the presence of peculiar groups—and indeed may be said to be entirely dependent on it. No region can be said to be satisfactorily distinguished from another without its possessing both positive and negative distinguishing characters. Mr. Wallace has in his several publications laid considerable stress upon the negative features of the Nearctic fauna as separating it from the Palæarctic or from any other, but he has not, it appears to me, sufficiently emphasized the great lack, *when compared to other faunas*, of the positive element, the consideration of which is the point aimed at in the first portion of my paper, and which has led to the conclusions already stated—that only by uniting the Nearctic and Palæarctic regions do we produce a collective fauna which is broadly distinguished by both positive and negative characters from that of any other region. If, as Mr. Wallace seems to argue, the absence from North America of the 'families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*, *Dipus* and *Hystrix*,' be sufficient, as far as the mammalian fauna is concerned, to separate that region from the Palæarctic, could not on nearly equally strong grounds a separation be effected in the Palæarctic region itself? Thus, if we were to consider the western division of the Palæarctic region, or what corresponds to the continent of Europe of geographers, as constituting an independent region of its own, it would be distinguished from the remainder of what now belongs to the Palæarctic region by negative characters probably fully as important as those indicated by Mr. Wallace as separating the Nearctic from the Palæarctic region. The European mammalian fauna would be wholly deficient, or nearly so, in the genera *Equus*, *Moschus*, *Camelus*, *Poephagus*, *Gazella*, *Oryx*, *Addöx*, *Saiga*, *Ovis*, *Lagomys*, *Tamias*, in several of the larger *Felidæ*, as the tiger and leopard, and in a host of other forms. A similar selection could be made from the class of birds (among the most striking of these the *Phasianidæ* and *Struthionidæ*), but it is scarcely necessary in this place to enter upon an enumeration of characteristic forms. Divisions of this kind, to be characterized principally or largely by negative faunal features, could be effected in all the regions, and in some instances with probably more reason than in the case under discussion.

"But the question suggests itself, what amount of characters, whether positive or negative, or both, is sufficient to distinguish one regional fauna from another? Mr. Wallace states: 'There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions.' Is it to be inferred from this quotation that Mr. Wallace recognizes no such general equivalence? Is a region holding in its fauna, say from 15 to 20 per cent. of peculiar or highly characteristic forms, to be considered equivalent in value to one where the faunal peculiarity amounts to 60 to 80 per cent.? If there be no equivalence of any kind required, why not give to many of the subregions, as now recognized, the full value of region?

"Surely, on this method of looking at the question, a province could readily be raised to the rank of a full region. In the matter of geographical individuality little need be said, as the circumstance, whether it be or be not so, that the 'temperate and cold parts of the globe are necessarily less marked by highly peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate,' does not affect the present issue, seeing that the peculiarity is greatly increased by uniting the two regions in question; nor does it directly affect the question of the Nearctic-Palæarctic relationship.

"The second part of my paper deals with the examination of the reptilian and amphibian faunas, and the general conclusion arrived at is: 'That by the community of its mammalian, batrachian and reptilian characters, the Nearctic fauna (excluding therefrom the local faunas of the Sonoran and Lower Californian subregions, which are Neotropical) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæarctic (of which it forms only a lateral extension).' Towards this conclusion, which, it is claimed, is also borne out by the land and fresh-water mollusca and the butterflies among insects, I am now happy to add the further testimony of Mr. Wallace (overlooked when preparing my article) respecting the *Coleoptera* ('Distribution,' 'Encycl. Britann.,' 9th ed., vii, p. 274).

"As regards the name 'Triarctic,' by which I intended to designate the combined Nearctic and Palæarctic regions, and which may or may not be 'somewhat awkward,' I beg to state that, at the suggestion of Prof. Alfred Newton (who, as he informs me, has arrived from a study of the bird faunas at conclusions approximately identical with my own), it has been replaced by 'Holarctic.' In conclusion, I would say that, while the views enunciated in my paper may not meet with general acceptance at the hands of naturalists, it is to be hoped that they will not be rejected because they may 'open up questions as regards the remaining regions which it will not be easy to set at rest.' "ANGELO HEILPRIN.

"*Academy of Natural Sciences, Philadelphia, April* 6."

In the issue of *Nature* for June 7, Prof. Theodore Gill, in an article entitled "The Northern Zoogeographical Regions," submits the following criticisms on my paper supplementary to those of Mr. Wallace:—

"The facts of zoogeography are so involved, and often apparently contradictory, that a skilful dialectician with the requisite knowledge can make a plausible argument for antithetical postulates. Prof. Heilprin being a skilful dialectician and well informed, has submitted a pretty argument in favor of the union of the North American or 'Nearctic' and Eurasiatic or 'Palæarctic' regions (*Proc. Acad. Nat. Sci. Phil.*, 1882, pp. 316–334, and *Nature*, vol. xxvii, p. 606), but Mr. Wallace has, with perfect justness it seems to me, objected to his proposition (*Nature*, vol. xxvii, pp. 482, 483). As Prof. Heilprin's arguments have not been entirely met, however, permit me to submit some further objections to his views.

"Prof. Heilprin has contended '(1) that by family, generic, and specific characters, as far as the mammalia are concerned, the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other regions than either the Nearctic or Palæarctic taken individually; and (2) that by the community of family, generic and specific characters the Nearctic region is indisputably united to the Palæarctic, of which it forms a lateral extension.'

"Prof. Heilprin has formulated these conclusions after a summary of the families and genera common and peculiar to the regions in question.

"As to families Prof. Heilprin has presented the following figures:—

	All.	Peculiar.
Nearctic,	26	1
Palæarctic,	36	0
Oriental,	36	3
Australian,	22	8
Ethiopian,	44	9
Neotropical,	31	8

"The proportions of peculiar genera to the entire mammalian faunas of the several regions are stated to be as follows:—

	All.	Peculiar.	Percentage.
Nearctic,	74	26	35
Palæarctic,	100	35	35
Oriental,	118	54	46
Australian,	70	45	64
Ethiopian,	142	90	63
Neotropical,	131	103	78

"The question may naturally recur, why the line which separates 'regions' from 'subregions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606).

"But an analysis of more (but only approximately) correct figures and a more logical classification of mammals than that adopted by Prof. Heilprin reveal factors materially contravening the tabular statements of that gentleman.

"First we must exclude the marine mammals, because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones. A consideration then of the terrestrial forms leads to the following results:—

"The Arctamerican or Nearctic region has twenty-seven families, of which eleven are not shared with Eurasia and four are peculiar; it has sixty-eight genera, of which forty-five do not enter into Eurasia.

"The Eurasiatic or Palæarctic region has thirty-two[1] families, of which seventeen are excluded from North America, and it possesses eighty-nine[1] genera, of which sixty have failed to become developed in America.

"Such contrasts will more than compare generally with those existing between Eurasia and India, and even between the 'Triarctic' or 'Holarctic' and Indian 'regions,' and the same destructive process by which the northern regions are abrogated would entail the absorption of the Indian as well into a heterogeneous whole. The three can in fact be well united (as Cænogæa), and contrasted with a group (Eogæa) consisting of the African, South American, and Australian regions, as I long ago urged (*Ann. and Mag. Nat. Hist.* [4], xv, 251–255, 1875), but the claims of each to be considered as 'regions' or realms are not thereby affected. "THEO. GILL.

"*Smithsonian Institution, Washington, May* 12."

The above criticisms of Prof. Gill fall into two distinct categories, which may be conveniently formulated as follows:—

[1] These are the groups admitted by Prof. Heilprin, exclusive of the Pinnipeds.

1. Accepting the data as given, are the conclusions drawn from them necessarily correct?

2. Are the data themselves correct?

The first of the questions is answered by a negative in interrogation, if so it may be termed. Prof. Gill objects to my (?) method of distinguishing between the larger and smaller zoogeographical divisions, and pointingly submits that "The question may naturally recur, why the line which separates 'regions' from 'sub-regions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606)." The problem here stated is certainly one that does not admit of a ready logical solution, and one which the writer has never attempted to solve; nor, as far as he is aware, has its solution ever been effected by any other writer on zoogeography. 78 is indisputably as near to 64 as this last is to 46, and but little less near than 46 is to 35; and if one or two more terms be added to the series, it may still be contended with equal justice that 46 holds approximately the same relation (in this sense) to 35 as 35 does to 25, and 25 to 15 as 15 to 5, and so to either end. So far, well and good. But the fact still remains, nevertheless, that a region whose fauna is characterized by 90 or 78 per cent. of peculiarities is *eminently* well defined from any and all other regions; that one whose peculiarities amount to 64 or 46 per cent. is *considerably less* well-defined; and that another, where the peculiarity amounts to only 15 or 10 per cent., is still less well-defined, and, in fact, scarcely defined at all. If a line of division or separation is to be drawn at all it must be drawn somewhere, and this somewhere must be dictated in great part by common sense.

As regards the second question (2), Prof. Gill is much more emphatic in his (negative) reply. In the first place, it is pleaded that the marine mammals ought to have been excluded from any analysis bearing upon the subject of zoogeography, "because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones." But surely if these forms are to be excluded, we might for almost identical reasons exclude the birds, since in the distribution of this class of animals factors are involved which are in no way operative in the dispersal of several other classes of land animals, such as the mammals, reptiles, mollusks, etc. And yet it is largely, indeed it might be said almost wholly, upon the distribution of birds that the principles of zoogeography, with its existing classification, were originally sketched out. Granting, however, for the sake of argument, the justice of plea made, are the results in any way materially affected or altered? Most emphatically not, as will be made manifest by an examination of the accompanying tables, where the original and new (or reduced) data are placed immediately under each other:—

Of 26 Nearctic families (land and marine) 19 are also Palæarctic = 74 per cent.
Of 23 Nearctic families (land only) 16 are also Palæarctic = 70 per cent.
Of 74 Nearctic genera (land and marine) 35 are also Palæarctic = 47 per cent.
Of 62 Nearctic genera (land only) 26 are also Palæarctic = 42 per cent.
Of 74 Nearctic genera (land and marine) 26 are peculiar = 35 per cent.
Of 62 Nearctic genera (land only) 23 are peculiar = 37 per cent.

The 26 peculiar Nearctic genera (land and marine) comprise 60 species, or 21 per cent. of the entire number (279) of species.

The 23 peculiar Nearctic genera (land only) comprise 57 species, or 21 per cent. of the entire number (267) of land species.

It will thus be seen that the greatest variation in any place is only *five* per cent. If, as has been done in my paper, we unite the Nearctic and Palæarctic regions, we will then have, as claimed:—

86 peculiar genera (land and marine) out of a total of 139 = 62 per cent.; or, deducting the marine forms—
74 peculiar genera out of a total of 127 land forms = 58 per cent.

And if we consider the specific forms represented by these peculiar genera, we have—

284 out of a total of 675 (land and marine) = 42 per cent.; or, deducting the marine forms—
264 out of a total of 655 land forms = 40 per cent.

Here again, therefore, the variation is reduced to an insignificant amount—to 4 and 2 per cent.

It has been further objected, that "a more logical classification of mammals" than that which has been followed in my paper, would reveal facts materially contravening my tabular statements, but Prof. Gill fails to inform us what this "more logical classification" may be, and it therefore becomes impossible to theorize on his premises.[1] The distinguished naturalist of Washington is, however, certainly in error when he maintains that the Arctamerican fauna has 4 (instead of 2—*Haploödontidæ* and *Zapodidæ*—or at the utmost, including the not generally recognized *Antilocapridæ*, 3) peculiar families; nor can we understand from his data how, if 29 Eurasiatic genera are represented in Arctamerica, only 23 Arctamerican genera are developed in Eurasia.

From what has already been said it will be seen that there is nothing in either Mr. Wallace's or Prof. Gill's arguments which might tend towards altering my views on the question at issue; and I must therefore still maintain, in the face of the evidence before us, that, in my judgment, there is not even the shadow of a peg upon which to hang the Nearctic (as distinct from the Palæarctic) region of zoogeographers.

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[1] There can be no doubt that certain emendations to the classification followed might have been advantageously made; as, for example, by the introduction of the genus *Cariacus;* but the very few alterations that could have been suggested through the works of the most recent, and, as usually recognized, most competent authorities on the subject of the mammalia, would produce no really appreciable difference in the result.

NOVEMBER 27.

The President, Dr. LEIDY, in the chair.

Forty-two persons present.

Note on Two New California Spiders and their Nests.—Rev. Dr. McCOOK presented a small collection of spiders received from Mr. W. G. Wright, San Bernardino, Cal., mailed November 18. One of these came within a nest, and is a Saltigrade spider, probably an *Attus*. The nest is a rare one, and was so happily placed, by the builder, on a branch of sagebrush (*Ephedra antisyphillitica*), that it was preserved intact. It is the only one which Mr. Wright had seen in site. Another nest, which he had no doubt was the same, he had observed torn from its place by some bird, as material for the construction of a bird's-nest.

Nests somewhat similar are habitually made by Pennsylvania Saltigrades upon or among leaves which shrink up as they die and tear the spinning work so as to destroy the specimen. The one exhibited was in perfect condition. It is the tent and egg-nest of the species which was alive within it, and the speaker thought to be new. It is a large example, five-eighths inch in body-length, stout, the legs of moderate thickness, the whole animal covered closely with grayish white hairs, the skin beneath being black. Dr. McCook named the species, provisionally, *Attus opifex*, with a double reference to the discoverer (Mr. Wright) and the admirable housewright qualities of the aranead herself. The nest is externally an egg-shaped mass of white spinning-work, three inches long by two and one-half inches wide. The outer part consists of a mass of fine silken lines crossing in all directions and lashed to the twigs within which it is enclosed. This maze surrounds a sac or cell of thickly-woven sheeted silk, irregularly oval in shape, two inches long by one inch wide, and also attached to the surrounding twigs. At the bottom this cell or tent is pierced by a circular opening which serves the spider as the door of her domicile. It is the habit of her genus to live and hibernate within such a silken nest. Against one side of the tent within is spun a lenticular cocoon (double convex) of thick white silk, within which the eggs were placed. The young spiders when received had escaped from the cocoon, and occupied the package-box. They are about one-eighth inch long, resembling the mother, but less heavily coated with gray.

This collection also contained three specimens (♀) of the genus *Pucetia*, as defined by Thorell.[1] This genus belongs to

[1] See "On European Spiders, Novæ Acta Reg. Soci. Sci. Upsalensis," vol. vii, ser. 3d, p. 196.

the family Oxyopoidæ of the Citigrade spiders, to which it is doubtless properly relegated in spite of certain analogies with the Attoidæ (Saltigrades) on the one hand, and the Philodrominæ (Laterigrades) on the other. Mr. Wright calls them "jumping spiders." Hentz, who describes several species of *Oxyopes*, says that *O. salticus* leaps with more force and vivacity than an *Attus*.[1] Of *O. viridans* he thinks it possible that the mother carries its young like *Lycosa*. This family of spiders is arboreal in habit, is found on plants, with their legs extended, thus disguising themselves after the manner known as "mimicry," and springing upon their prey. The cocoon is usually conical, surrounded with points, placed in a tent made between leaves drawn together and lashed, and is sometimes of a pale greenish color. *O. viridans* will make a cocoon suspended mid-air by threads attached to the external prominences, which she will watch constantly from a neighboring site. Dr. McCook believed the species presented to be new; the body-length is fourteen millimetres; legs long, tapering, many long spines. The body is yellow and pale yellow; the cephalothorax striped longitudinally with bright red streaks; the abdomen marked above with red bell-shaped and angular patterns, and beneath by red streaks; the sternum red, the legs yellow with red rings at the joints. The species was named *Pucetia aurora*, because of the bright red streaks upon the yellow background, suggesting "the daughter of the dawn."

According to some field-notes forwarded by Mr. Wright since the above was in print, *Pucetia aurora* is rather abundant in a limited locality. The nests are uniformly upon bushes of *Eriogonum corymbosum*, and several specimens of them were sent. The nest is hung from three to four feet from the ground, and, being upon the topmost twigs, is easily seen from a distance. The cocoon is a straw-colored sphere or ovoid, five-eighths of an inch in diameter. It is covered externally with various pointed rugosities, from which numerous lines extend to the adjoining foliage, and into the maze of right lines which extends below the corymb of the plant upon which all the specimens sent are attached. This retitelarian snare doubtless serves as a temporary home for the young spiders. The cocoon has no suture, the spiderlings escaping by cutting the case, which is thick and closely woven. No floss padding was found inside of the case.

Upon approaching the nest, the mother is usually seen hovering over the young spiders, or guarding a new sack of eggs. She lays two, and sometimes three broods on one twig. Sometimes the young ones will be still in the old nest, while the mother is guarding a new bundle of eggs immediately adjoining the old one. In no case were any young ones seen on the mother's back. The mother stays close by her nest. If the

[1] "Spiders of the United States," p. 48.

spiderlings be hatched, she will, perhaps, drop down a foot or so, if a first effort to capture her be not successful; but will not drop to the ground, unless forced to do so. If guarding her eggs, she must be forcibly separated from the cocoon. The young ones take alarm sooner than their mother; they drop down a few inches—or, at times, two feet—every one on its tiny thread, forming a pretty, swaying fringe. In a few moments, if all is still, they climb up again; but if frightened, will drop to the ground, and run. The little ones in such case do not jump.

It is a further interesting fact in so-called "mimicry" that of several examples of *P. aurora* seen by Mr. Wright, one found on a *green* bush was in color almost wholly green, with scarcely a trace of red; while two found on a hoary-white bush had simulated the white color of their habitat. The specimens, as described above by Dr. McCook, approach in coloration the prevailing hue of the *Eriogonum* on which they were nested, and he was inclined to think that this is the normal color of the adult, which is taken on as the animal matures; indeed, as the green and whitish specimens were not sent to him, he would be inclined to think (awaiting further evidence) that those colors may have been due to immature age. At least, the tendency to such colors is strong in young spiders. However, the fact of mimicry is not improbable, as Dr. McCook had observed it in our native Laterigrades.

From the same gentleman and locality, Dr. McCook had received a ♀ specimen of *Argiope fasciata*, which is thus located upon the Pacific Coast, giving this beautiful and interesting spider a continental distribution.

A Web-Spinning Neuropterous Insect.—Dr. Henry C. McCook announced that a small neuropterous insect, *Psocus sexpunctatus*, had been recently found on the Wissahickon Creek, Fairmount Park, Philadelphia, by Mr. S. F. Aaron, of this Academy. This is the first time, so far as the speaker was aware, that this insect has been found in the United States, or indeed North America. Mr. Aaron took the insects home in the paper boxes in which he had collected them, and thus observed the fact which has heretofore been noted of the European species, that they *spin webs.* McLachlan[1] expresses the belief that both sexes possess the power of spinning a web, which, he affirms, is not distinguishable from that made by spiders. If a number of living specimens be enclosed in a pill-box, it will be found that at the end of a few hours the interior is traversed in all directions by numerous lines of web. Mr. McLachlan further states that the eggs, which are laid in clusters, are also protected with a web by the female. These insects are very common in England, where

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[1] Monograph of the Brit. Psocidæ, Entom. Monthly Magz., vol. iii, 1866–67, p. 228.

they are found more or less in societies, on tree-trunks, palings, amongst the herbage of trees, and even in houses. Mr. Aaron discovered them in similar habitat here, that is to say on the trunks of trees. A congener of the above species, *Psocus purus* Walsh, which is also found in the vicinity, makes a tubular or tent-like web in the furrows of bark and crevices of trees, in texture something like that spun by certain tube-weaving (Tubitelariæ) spiders and other species; or, perhaps more nearly like the covering woven over themselves by certain Lepidopterous larvæ. The insect lives under this tent precisely as do the spiders referred to. One who would capture them must push them out by pressing upon the tent.

It is a matter of such rare interest to find a true insect in the imago state spinning a web, and apparently for its protection, that Dr. McCook thought the discovery in our locality of such an insect worthy of this record. The spinning function among true insects, he believed, with the single exception of the Psocidæ, is confined to the larval state; spiders (it is scarcely necessary to state) not being true insects, but belonging to the Arachnida. The speaker further thought that this larval characteristic of web-spinning might be correlated with the rank which zoologists usually assign the Neuroptera as lowest among the orders of the insects, its larva-like body being one indication of its low position in its class. However, it is a striking example of the diverging and independent lines along which life-forms have sprung up in nature, that a function which belongs to the larval stage of insects, and which appears in the imago state only in the lowest type of the same, should appear as the most permanent and characteristic function of the spider—an animal which, although it is now commonly given a lower place in the same subkingdom with the insects (Arthropoda), is certainly very differently and little less highly organized. It would be a difficult task, Dr. McCook thought, to trace or even imagine any evolutionary connection, whether of progression or retrogression, between the web-spinning spider, the web-spinning insect-larva, and the web-spinning neuropterous imago *Psocus sexpunctatus*. There is, indeed, this common factor, the spinning function, but the physiologist fails to perceive any use or combination of the same which can unite the organisms in which it inheres.

Art. VI, Chap. X, of the By-Laws was amended by striking out from the first line the word "only," and from the second and third lines the words "obtain permission to," so that the article now reads: "Members and Correspondents of the Academy shall have free access to the library. Other persons may consult it at any time through the introduction of a member, or upon application to the librarian, while such member or librarian is present, but minors under sixteen years of age shall not be permitted to examine any work, except under the immediate supervision of the librarian or of a member."

Art. VII, Chap. XI, was amended by striking out all after the word "public," in the second line, and inserting in lieu thereof, "daily, except Sunday, and at least one day in the week without charge on such conditions and under such regulations as the Council shall establish from time to time," so that the article now reads: "The Museum of the Academy shall be open to the public daily, except Sunday, and at least one day in the week without charge, on such conditions and under such regulations as the Council shall from time to time establish."

The following were elected members: George L. Knowles, Ferdinand McCann, Lewis E. Levy, J. Alexander Savage, and Mrs. Wm. E. Ellicott.

The following were elected correspondents: E. Marie, of Paris, Marchese di Monterosato, of Palermo, and H. J. Carter, of Budleigh-Satterton, Devonshire, England.

The following were ordered to be printed:—

NOTES ON AMERICAN FISHES PRESERVED IN THE MUSEUMS AT BERLIN, LONDON, PARIS AND COPENHAGEN.

BY DAVID S. JORDAN.

In a recent visit to Europe, the writer had the privilege of examining numerous typical specimens of American fishes, preserved in the British Museum, in the Museum d'Histoire Naturelle in Paris, and in the Museums of the Universities of Berlin and Copenhagen. In the present paper are given selections from the notes taken on these specimens, which have a bearing on the nomenclature of our fishes.

I have to express my personal obligations to Dr. G. A. Boulenger, of the British Museum; to Dr. Bocourt and M. Thominot, of the Museum at Paris; to Dr. F. Hilgendorf, of the University of Berlin, and to Dr. Christian F. Lütken, of the University of Copenhagen, for many favors in connection with our studies of these specimens.

1. **Arius assimilis** Günther.

(Cat. Fishes Brit. Mus., v, 146.)

Type, Lake Yzabal, Atlantic slope, Central America.

Area between the eyes smooth, extending backward in the form of a rather narrow triangle which is moderately obtuse behind. Fontanelle narrow and short, ending far in front of the occipital process, not extending backward as a groove behind the smooth area of the top of the head; posterior end of fontanelle midway between tip of snout and middle of ante-dorsal shield. Occipital process broad, its edges not straight. Band of palatine teeth large, but not produced backward on the inner margin.

The character of the fontanelle in this species is not described by Dr. Günther. We have elsewhere identified with *A. assimilis* (Bull. U. S. Fish. Comm., 1882, 47), a number of specimens from Mazatlan (28161, 28189, 28210, 28213, 28221, 28232, 28276 and 28304, U. S. Nat. Mus.), belonging to a species very different from the true *A. assimilis*, although agreeing fairly with Dr. Günther's description.

There is no evidence of the occurrence of the true *A. assimilis* in Pacific waters.

2. **Arius cærulescens** Günther.

(Cat. Fish. Brit. Mus., v, 149.)

Types from Huamuchal, Pacific slope.

Head more depressed than in *A. assimilis.* Fontanelle very short, ending abruptly behind and not produced in a groove behind the smooth area of the top of the head, the boundary of the smooth area being rather broadly convex. Occipital process broader than long, its edges nearly straight. Bands of palatine teeth small, not produced backward on the inner margin. Paired fins black at base above. This species is allied to *A. guatemalensis*, but is apparently distinct. It is well separated from *A. assimilis.*

3. **Arius seemanni** Günther.

(Cat. Fish. Brit. Mus., v, 147.)

(? *Arius assimilis*, Jor. & Gilb., Bull. U. S. Fish Com., 1882, 47.)

Type from Central America, the exact locality unknown.

Fontanelle extending backward in a deep and narrow groove, which reaches the occipital process. Middle of top of head smooth, much as in *A. platypogon.*

It is probable that this specimen belongs to the species heretofore erroneously called by us *Arius assimilis.* We have had some hesitation in making this identification, because in none of our Mazatlan specimens does the fontanelle reach the occipital process, and it is not certain that the type of *A. seemanni* came from the Pacific coast. Still, the probability is so strongly in favor of identity that, in absence of further evidence, we shall consider them the same.

4. **Myrophis punctatus** Lütken.

(Vidensk. Meddel. Nat. Foren., Kjöb, 1851, 1.)

Type, West Indies; Suenson Coll.

Beginning of dorsal midway between gill-opening and vent. Head $2\frac{2}{3}$ in trunk. Cleft of mouth about $3\frac{1}{2}$ in head. This is apparently identical with *M. microstigmius* Poey (Rep. Fis. Nat., ii, 50). The description of *M. punctatus* Gthr. (viii, 51) is taken from the Panama species, *M. vafer* Jor. & Gilb. It is barely possible that *M. lumbricus* Jor. & Gilb. will prove to be the young of *M. punctatus.*

5. **Exocœtus rufipinnis** Cuvier & Valenciennes.

(Hist. Nat., Poiss., xix, 99.)

Type from Payta, Peru; an adult specimen, in good condition. Head $4\frac{4}{5}$ in length to base of caudal; depth $5\frac{2}{3}$; lower lobe of caudal $3\frac{1}{3}$; eye $3\frac{1}{3}$ in head. Ventrals $3\frac{1}{3}$ in body. D. 11; A. I, 11. Insertion of anal scarcely behind that of dorsal, its base but little shorter; both fins low, the longest ray of dorsal little more than half the base of the fin. Pectorals reaching base of caudal; ventrals to just behind last ray of anal. Third ray of pectoral branched, the fourth longest. Pectorals and ventrals centrally dusky, without distinct markings.

This species is probably identical with *E. dowi* Gill (Proc. Ac. Nat. Sci. Phila., 1863, 167), from Panama, a species not now represented in the National Museum.

6. **Tylosurus hians** (Cuv. & Val.) Jor. & Gilb.

(*Belone hians* Cuv. & Val., xviii, 432.)

In the type of this species the insertion of the ventrals is about midway between the base of the caudal and the middle of the arch of the base of the upper jaw, or slightly nearer tip of pectoral than front of anal. According to Valenciennes, "elle est attaché un peu avant le milieu de la longueur totale." This statement is not quite correct. On account of this discrepancy, Poey has described the Cuban fish as distinct, under the name of *Belone maculata* (Mém. Cuba, ii, 290), the ventral fin being inserted *behind* the middle of the length of the body. It is not likely that any real difference exists. The specimens found along our Atlantic coast agree very well with Poey's description.

7. **Querimana harengus** (Günther) Jor. & Gilb.

(*Myxus harengus* Günther, iii, 467.)

The types of *Myxus harengus* have but two anal spines, instead of three, as stated in the original description. Specimens of this species from Zorritas, Peru, are in the museum of Yale College. In the National Museum are specimens from Panama, Mazatlan, and Charleston, S. C.

8. **Querimana ciliilabis** (Cuv. & Val.) Jor.

(*Mugil ciliilabis*, C. & V. xi, 151.)

The types of *Mugil ciliilabis*, from Lima, belong also to the genus *Querimana*. The species is very close to *Q. harengus*, differing in rather stronger dentition, stiffened cilia, or teeth being present in both jaws, rather strongest in the upper. Head $3\frac{2}{5}$ in length, depth $4\frac{1}{4}$; no adipose eyelid; preorbital serrate; anal spines 2; first soft ray of anal simple, but evidently articulate.

9. **Stromateus medius** Peters.

(Berliner Monatsber., 1869, 707.)

Type, No. 7073, Berlin Museum, from Mazatlan. In the original description of this species the lateral line is said to be "keeled" on the caudal peduncle. This "keel" is simply the ordinary tubing of the lateral line, which is precisely as in the ordinary species of *Stromateus*.

Head $3\frac{1}{2}$ in length, depth $1\frac{9}{10}$; pectoral $2\frac{5}{6}$ in body; dorsal lobe $4\frac{1}{6}$; caudal $2\frac{4}{5}$. Dorsal with 42 developed rays; anal with 32. Length $7\frac{1}{2}$ inches, fins distinctly punctulate.

10. **Caranx leucurus** Günther.

(Proc. Zool. Soc. Lond., 1864, 24.)

Types, two young examples. In our Review of the Caranginæ (Proc. U. S. Nat. Mus., 1883, 194)[1] we have placed this species in the group called *Uraspis*, among the species with broad maxillaries. It should be removed to the group called *Hemicaranx*, among the species with narrow maxillaries, its relations being with *C. atrimanus* and *C. amblyrhynchus*.

Maxillary quite narrow, its length $2\frac{2}{3}$ in head, reaching pupil; eye not large. Dorsal and anal fins unusually high, but the anterior rays not exserted beyond the rest; middle rays of dorsal $\frac{1}{2}$ to $\frac{3}{5}$ length of head (probably shorter in the adult); sheath at base of dorsal little developed; caudal fin not deeply forked; pectoral short, $1\frac{1}{3}$ in head (young); curve of lateral line $1\frac{1}{2}$ in straight part, its length $3\frac{1}{2}$ times its depth. Teeth slender, rather long, uniserial above and nearly so below.

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[1] In the paper above quoted (p. 194) we have placed *Caranx ruber* in the group with the anterior rays of soft dorsal and anal not falcate. In specimens from Guiana examined by us, these rays, although very low, are still, properly speaking, falcate, the longest being about $2\frac{1}{3}$ in head. The species should therefore be removed from the subgenus *Uraspis* to that of *Caranx*.

On page 197 in the same paper, *Caranx fasciatus*, Cuv. & Val. (ix, p. 70), described from a drawing made in Mexico, may be added as an extremely doubtful synonym of *Caranx vinctus*.

Caranx cubensis (Poey) should doubtless be recognized as a distinct species.

On pages 206 and 207 the name *Chloroscombrus stirurus* occurs. This is a *lapsus* for *Chlor. orqueta*, the former having been a MSS. name for which the latter was substituted before the publication of the original description.

Body everywhere finely punctulate, with rather sharply defined dark bars. Caudal fin pale.

11. **Epinephelus galeus** (Müller & Troschel) Jordan.

(*Serranus galeus* Müll & Trosch., Schomb. Reisé, Brit. Guiana, 621.)

The types of *Serranus galeus* belong apparently to the species described as *Serranus itaiara* Cuv. & Val. and Vaillant & Bocourt, and as *Serranus quinquefasciatus* Bocourt. According to Vaillant & Bocourt (Miss. Sci. au Mexique), the species found on the Pacific Coast of Mexico (*quinquefasciatus*) is identical with the Brazilian species (*itaiara* C. & V.). The original *Serranus itaiara* of Lichtenstein is, however, apparently a very different species, having the anal rays III, 11. Assuming the identity of the Atlantic and Pacific species, which I have, at present, no reason to doubt, the oldest tenable specific name for this species seems to be *galeus*.

12. **Lutjanus argentiventris** (Peters) Jordan & Gilbert.

(*Mesoprion argentiventris* Peters, Berliner Monatsber., 1869, 707.)

Type, No. 7070, Berl. Mus., from Mazatlan. This specimen belongs to the species diagnosed by us under the name of "*Lutjanus argentivittatus*" (Proc. U. S. Nat. Mus., 1881), the Pacific representative of *Lutjanus caxis*. The name "*argentivittatus*" is a slip of the pen on our part for "*argentiventris*."

13. **Lutjanus inermis** (Peters) Jordan & Gilbert.

(*Mesoprion inermis* Peters, Berliner Monatsber., 1869.)

Type, 7069, Berlin Mus., said to have been brought from Mazatlan; 8½ inches in length, in good condition.

This specimen belongs to a species allied to *L. chrysurus*, and distinct from all those yet known from the Pacific Coast of Tropical America. The following is a detailed description:—

Head 3 in length; depth 3¼. Lateral line with 50 tubes; scales 53. Dorsal X–13; A. III–11.

Body slender and fusiform, not strongly compressed, the back not elevated. Snout very pointed; mouth unusually small, the maxillary 2½ in head, reaching to front of pupil. Eye very large, about 4 in head. Band of vomerine teeth slightly produced backward on the median line. Teeth on tongue well developed; canine teeth unusually small and slender, 2 in upper jaw and 3 or 4 on each side of lower. Nostrils well separated, subequal, the posterior oblong, the anterior round. Preorbital $\frac{2}{5}$ depth of eye. Preopercle not serrate, scarcely notched behind. Temporal region with a band of large scales, on each side of which are small scales. Scales above lateral line arranged in very oblique series which are not parallel with the lateral line.

Pectoral fins very short, reaching little past tips of ventrals, $1\frac{3}{4}$ in head. Dorsal spines very slender. Second anal spine longer than third, very small, 7 in head. Soft dorsal and anal low, scaly. Caudal fin rather deeply forked, the middle rays not half the length of the outer, which are $1\frac{1}{3}$ in head.

Color in spirits, dusky above, pale below, with distinct dark stripes, those below parallel with the lateral line, those above very oblique; these stripes extend along the edges of the rows of scales, the middle of each scale being whitish, its base dusky.

According to Peters, the color was "violet-brown; middle of each scale with a silvery shining spot; belly silvery."

14. **Lutjanus vivanus** (Cuvier & Valenciennes) Jordan & Gilbert.

(*Mesoprion vivanus* Cuv. & Val., ii, 454)

Types, young specimens in good condition, collected by Plée at Martinique.

This species is briefly and unrecognizably described by Cuvier & Valenciennes. The following is an outline of its characters, from which its close resemblance to the young of the common "Red Snapper" of Florida (*Lutjanus blackfordi* Goode & Bean = *L. campechianus* Poey) is evident.

Head $2\frac{5}{6}$ in length; depth $3\frac{1}{6}$. D. X–14; A. III–8. Lateral line with 50 pores.

Maxillary $2\frac{4}{5}$ in head; teeth rather strong; vomerine teeth in an arrow-shaped patch, being prolonged considerably backward on the median line. Posterior nostrils oval; eye 4 in head; Nuchal scales in a band, scarcely separated from the scales of the body; scales above lateral line arranged in oblique series; second anal spine long, $2\frac{1}{2}$ in head; caudal concave, the inner lobe $1\frac{2}{5}$ in the outer.

Color reddish, faintly streaked with olive; traces of a blackish blotch under soft dorsal; tips of middle rays of caudal dusky.

15. **Pomadasys modestus** (Tschudi) Jordan.

(*Hæmulon modestum* Tschudi, Fauna Peruana, Ichthyol., ii.)

(*Pristipoma notatum* Peters, Berliner Monatsber., 1869.)

The type of *Pristipoma notatum* Peters (No. 7061, Berl. Mus.: "gekauft, angeblich von Mazatlan") is identical with specimens in the same museum, which have been identified, apparently correctly, as *Hæmulon modestum* Tschudi. This identity has been already noticed by Dr. Hilgendorf (MSS.). Tschudi's original type is said to be in the museum at Neufchatel.

It is doubtful whether the specimen examined by Prof. Peters really came from Mazatlan.

The following is a redescription of the type of *Pristipoma notatum:*

Head $3\frac{1}{3}$ in length to base of caudal; depth $2\frac{2}{5}$. D. XII–15 (not XVIII, as stated by Peters); A. III–12; 51 or 52 scales in a longitudinal series; 10 rows between front of dorsal and lateral line.

An ally of *Pomadasys cæsius.* Body ovate; anterior profile regularly convex; mouth small; outer teeth in both jaws enlarged; maxillary $3\frac{3}{4}$ in head; lips thick; eye $3\frac{3}{4}$ in head; preorbital $1\frac{2}{3}$ in eye; preopercle coarsely serrate; scales above lateral line unusually small, arranged in oblique series, not parallel with the lateral line.

Pectoral fin as long as head; second anal spine much stronger than third, and somewhat longer, both much shorter than the soft rays; second anal spine $1\frac{2}{3}$ in head; dorsal spines low and not strong, the fin deeply notched; fourth dorsal spine $2\frac{1}{3}$ in head; soft dorsal scaly at base; upper lobe of caudal longest.

Color bluish gray, silvery below; edge of opercle black; a conspicuous jet-black spot at base of last rays of anal and dorsal; entire axil of pectoral, and a large roundish blotch before it, jet-black; ventrals blackish.

16. **Diabasis sexfasciatus** (Gill) Jor. & Gilb.

As already supposed by us, the type of *Hæmulon maculosum* Peters is identical with *Hæmulon sexfasciatum* Gill.

17. **Paralonchurus petersi** Bocourt.

Type, La Union, San Salvador.

Only the original type of this species is yet known. It is apparently closely related to the genus *Lonchurus*, differing externally in the presence of several barbels instead of two.

Body long and low, formed as in *Menticirrus.* Head slender, low, with protuberant snout, flattish and somewhat spongy to the touch above. Preopercle with dermal serrations; mouth horizontal, overlapped by the snout; teeth in villiform bands; upper jaw with a conspicuous outer row of larger teeth; gill-rakers very small, short and slender, not numerous; chin with five pores; rami of mandible each with a row of slender, inconspicuous barbels along the inner edge; nostrils round.

Scales rather large, smooth to the touch, apparently truly cycloid.

Head $3\frac{1}{4}$ in length; depth 4; eye very small, $8\frac{1}{2}$ in head; interorbital space $3\frac{1}{4}$; maxillary $2\frac{2}{3}$; dorsal rays XI–30; dorsal fin low, the soft dorsal highest posteriorly and scaled at base only; anal small, ending under middle of soft dorsal, its second spine as long as snout, $3\frac{2}{3}$ in head; pectoral very long, $2\frac{4}{5}$ in body; caudal lanceolate, unequal, its length $3\frac{1}{4}$ in body.

Color in spirits, light olive, with faint streaks along the rows of scales; no cross-bands; pectorals dusky; other fins plain.

18. **Polycirrhus dumerili** Bocourt.

Type, La Union.

This species seems to be identical with *Genyanemus fasciatus* Steindachner (Ichth. Beitr., ii, 31, 1875). The name given by Bocourt has precedence. The genus *Polycirrhus* is perhaps worthy of distinction from *Genyanemus*, having the dorsal spines in normal number (10 instead of 14), the mouth subinferior instead of terminal, the caudal double truncate instead of emarginate, and the gill-rakers very small. *Genyanemus peruanus* Steind. (l. c., 29) and *G. brasilianus* Steind. (l. c., 34 = *Micropogon ornatus* Gthr.) apparently belong to *Polycirrhus*.

19. **Menticirrus saxatilis** (Bloch & Schneider) Jordan.

(*Johnius saxatilis* Bloch & Schneider, Syst. Ichth., 1801, p. 75.)
(*Sciæna nebulosa* Mitch., Trans. Lit. and Phil. Soc., 1815, 408.)

The type of *Johnius saxatilis* Bloch & Schneider, from New York, is still preserved in the museum at Berlin. It is apparently identical with the common king-fish, *Menticirrus nebulosus* (Mitchill) Gill, which species should therefore stand as *Menticirrus saxatilis*. The common names of this species, of the weak fish and the striped bass, have evidently been confused by Schneider.

Johnius carutta, the species taken by Professor Gill as the type of the genus *Johnius*, has the preopercle entire, and the mouth inferior. *Johnius* is apparently not distinguishable from the subgenus *Corvina*, as defined by Jordan & Gilbert (Synopsis Fish. N. A., 1883, p. 932).

20. **Menticirrus nasus** (Günther) Jor. & Gill.

(*Umbrina nasus* Günther, Fishes Centr. Amer., 1869, 426.)

Type, about a foot in length, adult.

D. X–I, 22; eye proportionately very large, $4\frac{1}{2}$ in head; maxillary reaching to below posterior edge of pupil; snout $3\frac{4}{5}$ in head; longest dorsal spine $1\frac{4}{5}$ in head, reaching to third ray of second dorsal; pectoral $1\frac{1}{6}$ in head; ventrals short.

Gill-rakers very short, almost obsolete; posterior nostril large, oval; anterior round; interorbital width $4\frac{1}{5}$ in head; scales of breast large.

Color pale, the pectoral dusky.

21. **Isopisthus brevipinnis** (Cuv. & Val.) Gill.

(*Ancylodon brevipinnis* C. & V., v, 84.)

The type of this species (Cayenne, Poiteau; in bad condition) has the pectoral fin $1\frac{2}{5}$ in head, as in *I. affinis* Steindachner (Neue und seltene Fische aus den K. K. Zöol. Museum zu Wien, etc., 43), differing in that respect from the Panama species, *Isopisthus remifer*. There is not much doubt of the identity of *I. affinis* with *I. brevipinnis*.

22. **Gerres peruvianus** Cuvier & Valenciennes.

(Cuvier & Valenciennes, vi, 467.)

The type of this species is apparently identical with the common West Coast species called by this name by Jordan & Gilbert (Bull. U. S. Fish Com., 1881, 330), and later by Evermann & Meek (Proc. Ac. Nat. Sci. Phila., 1883, 123). The types of *Gerres gula* C. & V. also correspond with the species so named by the above writers. One of them (Brazil, Delalande) has the head 3 in length, the depth $2\frac{2}{3}$; longest dorsal spine $1\frac{3}{4}$ in head; second anal spine $3\frac{1}{4}$; eye $2\frac{3}{4}$; tip of spinous dorsal dusky. The types of *Gerres aprion* C. & V. seem to correspond with the species called by us *Gerres cinereus* (Walbaum) (= *Gerres zebra* and *Gerres squamipinnis* Gthr.). They are, however, in bad condition, the color faded and the scales mostly rubbed off.

23. **Gerres brasilianus** Cuvier & Valenciennes.

(Cuvier & Valenciennes, vi, 458.)

The type of this species is in very bad condition, unfit for detailed description. Sides apparently with dark stripes along the rows of scales. Preorbital and preopercle serrate. Frontal groove broad, naked. Longest dorsal spine 5 in body. Second anal spine $5\frac{1}{4}$. Anal spines 3 in number. Caudal fin long. This species is allied to *G. plumieri*, but the back is less elevated and the spines smaller than in the latter. *Gerres rhombeus* C. & V. is a very different species, closely allied to *Gerres peruvianus*, but with two anal spines only. It occurs on both sides of the Isthmus of Panama.

24. **Gerres brevimanus** Günther.

(Günther, Proc. Zool. Soc. Lond., 1864, 152.)

This species is distinct from *G. lineatus* (Humboldt), although closely allied to it. Only the original type is yet known. On this I have the following notes:—

Head $3\frac{1}{4}$ in length; depth $2\frac{1}{3}$; eye $3\frac{1}{3}$ in head. Coloration of *Gerres lineatus*. Back much lower than in the latter, and pectoral fins very much shorter; their length $1\frac{1}{4}$ in head; their tips not reaching nearly to tips of ventrals, which are $1\frac{1}{4}$ in head; caudal 3 in body. Preorbital very little serrate, almost entire. Preopercle weakly serrate. Second dorsal spine $1\frac{2}{5}$ in head; second anal spine $1\frac{2}{3}$. Teeth small and short. No black on base of pectoral, or on lower fins. Spinous dorsal dusky above. Frontal groove broad and naked, as in *G. lineatus*.

25. **Opisthognathus punctata** Peters.

(Peters, Berl. Monatsber., 1869.)

Type, 7064, Berl. Mus.; about one foot long, from Mazatlan.

Head everywhere finely speckled with black, the body more coarsely and irregularly spotted. Pectoral finely and closely speckled, its edge plain. Ventral fin dusky, similarly marked. Dorsal without large black blotch, finely spotted, the spots behind gradually forming the boundaries of white ocelli, the base of the fins having rings of white around black spots, the upper part with dark rings around pale spots. Caudal with pale spots, its edge, like that of the dorsal, somewhat dusky, not black. Anal with a broad, blackish edge, and with dark spots, those near the base of the fin largest. Lining membrane of maxillary with the usual bands of white and inky black.

Scales very small, about 125 in lateral line. Dorsal spines continuous with the soft rays. D. 28; A. 18. No vomerine teeth. Maxillary very long, extending slightly beyond head.

Only the type of this species is yet known.

26. **Porichthys porosissimus** (Cuv. & Val.) Gthr.

(? *Batrachus porosissimus* Cuv. & Val., xii, 501.)
(*Porichthys plectrodon* Jor. & Gilb., Proc. U. S. Nat. Mus., 1882, 291.)

The two specimens from South America referred, by Dr. Günther (Cat. Fishes, iii, 176) to *Porichthys porosissimus*, have the enlarged palatine teeth characteristic of *P. plectrodon* Jor. & Gilb. The specimen from Vancouver Island mentioned by Dr. Günther, has small palatine teeth as have all Pacific specimens examined by us. A young specimen from Panama also belongs to *P. margaritatus*. It is probable that the types of *Batrachus porosissimus* C. & V., from Guiana and Brazil, really have the palatine teeth enlarged, although Cuvier & Valenciennes say that "chaque palatin en a une rangie de petites, pointues et inegales." In that case, the Atlantic species would stand as *Porichthys porosissimus* (C. & V.) Gthr., and the Pacific species, unquestionably distinct, although closely related, as *P. margaritatus* (Rich.) Jor. & Gilb.

27. **Sebastodes matzubaræ** (Hilgendorf) Jordan.

The types of *Perca variabilis* Pallas (Zoogr. Rosso-Asiat., iii, 241 = *Epinephelus ciliatus* Tilesius), two in number, obtained in the Aleutian Islands, are preserved in the Berlin Museum.

The smaller of these specimens (6494) belongs to the species for which we have retained the name of *Sebastodes ciliatus* (Jordan & Gilbert, Synopsis Fish. N. A., 658). For this species the name *Sebastes variabilis* has been retained in MSS. by Dr. Hilgendorf.

The larger specimen (8145) is a flat skin of large red species, apparently identical with the Japanese species described by Hilgendorf under the name of *Sebastes matzubaræ*. This view is also held by Hilgendorf.

As *Sebastodes matzubaræ* has not been hitherto recognized as a North American species, we give the following outline of its characters:—

Allied to *Sebastodes miniatus*. Spines of head low, developed about as in *S. miniatus* and *S. pinniger*. Preocular, supraocular, postocular, tympanic, occipital and nuchal spines distinct; a pair of small coronal spines present, as also a small spine before and one just below eye. Maxillary reaching to posterior border of eye, $1\frac{4}{5}$ in head. Both jaws covered with rough, ctenoid scales.

Interorbital space flattish, scaled, its breadth a little less than that of eye. Preopercular spines short, simple. Preorbital spines simple. Lower jaw scarcely projecting. Second anal spine scarcely longer than third. Longest dorsal spine $2\frac{3}{4}$ in head, a little less than the longest short rays. Pectoral $4\frac{1}{5}$ in body.

Color dusky brown, apparently dark red in life; three dark shades across cheeks.

28. **Scorpæna histrio** Jenyns.

(Chinchas Islands; Schmaltz; Brit. Mus.)

This species is very closely allied to *Scorpæna brasiliensis* C. & V. It lacks the black spots which are usually distinct in the latter. In *S. brasiliensis* the suborbital stay is more broken, and the dorsal spines are perhaps a little lower.

The following is a diagnosis of *Sc. histrio*:—

Head $2\frac{1}{10}$, depth $3\frac{1}{6}$. D. XII–10. Pectoral $3\frac{1}{10}$ in body. Maxillary 2 in head. Eye $4\frac{1}{3}$ in head. Longest dorsal spine 3 in head. Second anal spine 3. Lateral line with 30 scales.

Head rough above. Nuchal pit quadrate, much broader than long. Scales present on posterior part of cheek and on front and flap of opercle. Scales on body large, not ctenoid, edged with dermal flaps. Eye large. Mouth large, the lower jaw included. Suborbital stay conspicuous, not armed with spines. Second anal spine stronger and rather longer than third.

Color gray or red, with broad darker shades, four in number, irregular and variable; fins similarly colored; pectorals barred; dermal flaps white.

29. **Prionotus horrens** Richardson.

(Voyage Sulphur, Ichthyol., 79.)

Types, Gulf of Fonseca; young. Allied to *Prionotus tribulus* C. & V., but the spines on the head still longer and more knife-shaped. First spine on edge of snout broad and serrate; behind this three similar ones progressively larger. Then two large spines on preopercle, the posterior larger. Two smaller spines on opercle, and one very large on the scapula. Two sharp spines over each eye, one behind; two on top of head and two on occiput. No groove behind eye. Belt of palatine teeth narrow. Mouth large; maxillary reaching to below front of eye, $2\frac{1}{3}$ in head. Gill-rakers long and slender, 5 in number. Scales small. Pectorals short, 3 in body, reaching somewhat past front of second dorsal.

Pectorals and tip of caudal dusky.

30. **Agonus decagonus** B och.

This species has the gill membranes attached to the isthmus, forming a narrow fold across it, much as in *A. cataphractus*, but narrower. It is therefore erroneously referred by us to the genus *Brachyopsis* (Syn. Fish. N. A., 955), and the generic name *Leptagonus* Gill, based on *A. decagonus*, cannot be used instead of *Brachyopsis*. *A. decagonus* is intermediate between *Agonus* proper and *Podothecus*, being referable to the latter, if the two genera are kept separate. According to Dr. Lütken, neither *Agonus cataphractus* nor *Cottus bubalis* have yet been actually found in Greenland. They should, therefore, be omitted from American faunal lists.

31. **Ophidium omostigma** Jordan & Gilbert.

(*Genypterus omostigma* Jor. & Gilb., Proc. U. S. Nat. Mus , 1882, 301.)

An Ophidioid fish has been referred by us to the genus *Genypterus*, which genus we have regarded as distinguished from *Ophidium* chiefly by the presence of a sharp spine on the opercle. In the type of the genus *Genypterus* (*G. chilensis* Guichénot), this spine is obsolete. *G. omistigma* is therefore not a *Genypterus*, and it may probably be referred to *Ophidium*, from which *Genypterus* is separated by Dr. Günther on the variable and perhaps unimportant charac:er of the enlarged palatine teeth.

THE OCCIDENT ANT IN DAKOTA.

By Rev. H. C. McCook, D. D.

I have recently received from Prof. J. E. Todd (Professor of Natural Sciences at Tabor College, Iowa, and an Assistant on the U. S. Geological Survey), some valuable facts concerning the distribution of *Pogonomyrmex occidentalis.* While on a visit to Dakota (1882), Prof. Todd had observed a number of ant-hills which awakened his interest, and upon which he made various observations. The facts noted, together with specimens of the insects and scrapings from the mounds, were sent to me, and justify the following record:—

1. *Distribution and Site.*—The ants were seen (A. D. 1882 and 1883) on the Missouri River, south of Bismarck, opposite the mouth of the Cannon Ball River, and at a point seventy-five miles southward. Upon the extensive plain forming the bottom of the Bois Cache Creek valley, and near the sand hills and grove which give the name to the valley, the mounds are numerous. Prof. Todd thinks with some confidence that they are not located in the valley of the James River, nor in Dakota, any considerable distance east from the Missouri River. He has traveled with a team over 2500 miles in Dakota, east of the Missouri River and south of the Northern Pacific Railroad, and has not noticed the ant-hills elsewhere than the localities mentioned. In my book on "The Honey and Occident Ants,"[1] I have located this ant in southern Dakota, upon conjecture, but the above, with specimens, now give scientific confirmation.

I wish to call attention to the additional facts thus contributed in the precise line of the striking feature formerly pointed out by me in the geographical distribution of *Occidentalis.* According to Prof. Todd, the ant is confined to the bottom lands along the Missouri, and *has not pushed eastward* through the Territory. This corresponds remarkably with my conclusion, both from my own observations and those made under my direction by Dr. Horace Griffith, of Marengo, Iowa. This conclusion is that *Occidentalis* does not dwell east of the Missouri

[1] The Honey Ants and the Occident Ants, p. 124 5. J. B. Lippincott & Co., Phila.

River, in Missouri, Iowa and Minnesota; that it avoids eastern, while abounding in western Nebraska, and is not found in Kansas further east than Brookville, longitude 22° W. from Washington, about 97° W. Greenwich, which is nearly that of the sites reported by Prof. Todd. As Prof. Packard has reported the insect in southern Montana, we may now conclude that the entire western part of the great valley of the Missouri (west of the river and the above meridian) is inhabited by this ant and its closely allied congener, *P. barbatus*, the Agricultural Ant.

It is worthy of note that all the authentic reports which we have of the latter insect also limit its eastern distribution to about the same meridian. We have no account of it as inhabiting southern Missouri, Arkansas and Louisiana, except a note of Nuttall's in 1819, which appears to refer to one of these species. Entomologists and naturalists generally in these States might do good service by some attention to this point. It is a question of profound interest, what natural cause has operated to establish this eastern limit of distribution? The writer confesses his inability to discover any relation between the structure and economy of the ant, and the physical condition of the country, that could throw any light upon the question.

The two species very closely resemble each other, the worker forms scarcely differing except in body-size; the worker-major of *Occidentalis* corresponds almost exactly with the minor of *barbatus.* The chief differences in the sexual forms are of size and color, but also a slight difference in venation. There are, however, some marked differences in nidification and habit. The Agricultural Ant occupies the southern section of the above marked geographical district, and it seems scarcely possible to resist the inference that it is a modified form of *Occidentalis* (or *vice versa*) who inhabits the northern section. The local site of the nests in Dakota is generally a sandy flat or bottom.

2. *Nidification.*—From the observations of Prof. Todd, it further appears that the Dakota ants agree with those of Colorado in the position of the gate, at one-half to one-third the distance from the base; in the general appearance of the mounds, which are uniformly in the centre of a circular cleared area three or four feet in diameter. In size they are smaller, being about six inches high and about two feet in diameter. They are roofed in some sites with small gravel stones of quartz, but in others, as at the

mouth of the Cannon Ball River, have no such covering. Prof. Todd is inclined to think that the gravel roofing is selected from the nest vicinage and placed upon the mound; but I believe the stones to have been excavated from the underground galleries, granaries and rooms, and brought up therefrom. However, I think the construction of a roof by selection to be quite within the ability of the Occidents, as I have observed them carrying pebbles up, down and around the mound in all directions after issuing from the gate.

3. *Harvesting habit.*—Among the pebbles sent to me are a number of husks, etc., of various seeds which appear to have been taken from the kitchen-middens or refuse-heaps of the formicary. These indicate that the Dakota emmets, like the more southern examples, are harvesting ants. Mr. Thomas Meehan, to whom was referred a small quantity of the debris collected from the margin of a nest by Prof. Todd, reports that there are no seeds among the pebbles, but that there are a number of calices and undeveloped capsules of a leguminous plant, *Dalea alopecuroides*, which is common on the American plains. I was puzzled to explain why such intelligent creatures should be detected in harvesting immature seeds, until, upon inquiry, I found that leguminous plants have a succession of flowers, so that there may be mature seeds and flowers on a plant at the same time. Mr. Meehan actually found upon a specimen of the above plant in the Academy's Herbarium, both the flower and the fully developed seed; indeed, the two appear to occur upon the same spike. It is thus evident that the ants were not harvesting out of season, but were occasionally deceived, and cast out to the refuse-heaps the calices that contained no edible seed.

STAINING WITH HÆMATOXYLON.

BY CHARLES L. MITCHELL, PH. D., M. D.

Hæmatoxylon or logwood was first recommended by Boehmer for the staining of tissues and sections, for microscopic examinations. Its rapid action, clearness of differentiation and beautiful tint soon made it a favorite staining agent with microscopists. Possessing even a greater selective power than carmine in separating and staining the bioplasm of animal and vegetable tissues, it was also superior to this coloring agent in the fact that the violet tint of the logwood was not nearly so fatiguing to the eye in prolonged examinations with the microscope. The deeper hue of the logwood-coloring was also an advantage in the fact that the contrasts of colored and uncolored tissue afforded by its use produced a much more perfect definition and clearness of outline than could be produced by a brighter color. Nucleus, nucleolus and cell-wall, when stained by this agent, all stand out clearly and with perfect distinctness and sharpness of outline—a result not to be attained by the use of any other coloring material.

The use of logwood as a staining agent, however, was soon found to be attended with strong and serious disadvantages. The staining fluid soon became thick, cloudy and filled with a grumous sediment, at the same time changing its color; sections and tissues, stained with it, were of a dirty brown color and soon faded, and, unless the solution was freshly prepared, the results obtained from it could not be depended upon. The numerous formulæ, published by Kleinenberg, Boehmer, Miller, Klein and many others, some of which formulæ are exceedingly complicated, are sufficient proof that the task they undertook was not an easy one; and, judging by the results, a simple, satisfactory formula for preparing this desirable coloring agent has yet to be published. It is my purpose this evening to call the attention of the members of the Section to a new and simple method of preparing a logwood staining fluid, by which a permanent, reliable and satisfactory preparation can be easily made. This method, I think, will place within the reach of every microscopist a staining fluid which is stable in composition, comparatively easy of preparation and unequaled in the delicacy and clearness of differentiation of its coloring. I have previously, at several different meetings of the Section, alluded to my experiments with this agent, and have also shown at different times some specimens of tissues stained with it; but I did not feel willing to place my results definitely before you, until sufficient time had elapsed to fully test the permanence of the preparation and of the stainings produced by its use. I have placed before you this evening, however, under the different microscopes on the table, a series of preparations, single and double stainings, which will, I think, speak for themselves, and also a sample of the staining fluid. Both fluid and specimens were prepared nearly a year ago.

In considering the method of preparation of this fluid, it will be well to review briefly the chemistry of logwood. Logwood is the heart-wood of *Hæmatoxylon Campeachianum*, a large tree found in Campeachy, Honduras and other parts of tropical America, and is used extensively in the textile arts for dyeing fabrics of a purple, blue or black color. Among its chemical constituents are resinous matter, a peculiar tannin, free acetic acid, various salts and nitrogenous principles, and a peculiar principle called hématin, or hæmatoxylon, on which the coloring properties of the wood depend. This hématin is, when pure, perfectly colorless, but affords beautiful red, blue and purple colors when in union with an alkaline base and the oxygen of the air. It also combines with the alums to form *lakes*, that peculiar class of coloring substances of which carmine is so remarkable an example. Now, this lake of logwood is the principle which acts as the dye; and, in order to obtain the color in all its delicacy and purity, all other contaminating impurities must be removed. The various formulæ for the preparation of a logwood staining fluid have nearly all directed the use of the commercial extract of logwood, which, aside from the numerous impurities necessarily found in so crude an article, is totally unfit for the purpose, for reasons which I will presently point out.

As already mentioned, logwood contains, besides its coloring principle, considerable quantities of tannin—so much, in fact, as to give it a position in the U. S. Pharmacopœia as an astringent. It is well known that vegetable infusions containing tannin are quickly influenced by the action of both light and air, and when these are assisted by heat, changes take place very rapidly. Under these circumstances, the infusions change color, become cloudy and deposit large quantities of an insoluble sediment. It therefore can be readily understood that an extract of logwood, prepared by the evaporation of an infusion of the drug, must be to some extert changed by the process of manufacture, and that any preparation made from it would (the process of decomposition having already been started) become much more liable to change. And just such a result takes place in staining fluids prepared from extract of logwood. The partially oxidized tannin in the liquid gradually absorbs more oxygen from the air, and changes to other complex organic compounds; the coloring matter is also affected by the decomposition, and gradually becomes converted into other substances, and the liquid finally becomes of a dirty, muddy color, and is half filled with a lumpy sediment. This change will be found to take place in all ordinary logwood staining fluids, whether prepared from the extract or from the drug itself, although from the nature of the case those made from the extract would be the most quickly affected. The idea, therefore, occurred to my mind, that if the tannin could be removed, and the lake of logwood isolated in a state of comparative purity, a staining fluid could be prepared which might possibly be both permanent and satisfactory. After numerous and lengthy experiments, the desired object was obtained, and the formula which I now present to your notice is the result of my investigation on the subject. As a means of distinguishing this preparation from the other and generally worthless logwood fluids, I have thought it best to call it

"MITCHELL'S HÉMATIN STAINING FLUID."

℞

Finely ground logwood, ...	ʒ ij.
Sulph. aluminum and potash (potash alum), . . .	ʒ ix.
Glycerine, ...	f. ℥ iv.
Distilled water, ...	a sufficient quantity.

Moisten the ground logwood with sufficient cold water to slightly dampen it, place it in a funnel or percolator, packing it loosely, and then percolate sufficient water through the drug until the liquid coming from the percolator is but slightly colored. Allow the drug to drain thoroughly, and then remove it from the percolator, and spread out on a paper or board to dry. Disselve the alum in eight fluid-ounces of water, moisten the dry drug with a sufficient quantity of the fluid, and again pack in the percolator, this time rather tightly, and pour on the remainder of the alum solution. As soon as the liquid percolates through and commences to drop from the end of the percolator, close the aperture with a tightly fitting cork, and allow the drug to macerate for forty-eight hours. Remove the cork at the expiration of that time, allow the liquid to drain off, and then pour sufficient water upon the drug to percolate through twelve fluid-ounces altogether. Mix this with the glycerine, filter and place in a close-stopped bottle.

In this process nearly all the tannin is removed by percolating the drug with cold water, a menstruum in which the coloring principle is not very soluble, and the subsequent maceration and percolation with the alum solution removes the logwood lake in a state of comparative purity. The glycerine is added simply for its preservative qualities, and this may be still increased by the addition of a few drachms of alcohol to the solution.

The hématin staining fluid thus prepared is a clear, heavy fluid of a deep purplish red color. It will keep its color for a length of time, and deposits no sediment. The sample exhibited to the meeting this evening has been on my working table for nearly a year, frequently exposed to a strong light and open to the air, and, as you may see, it is as yet unchanged. As a staining fluid, used either strong or diluted, I consider it far superior to any other stain I know of. Permanent and beautiful in its color, which is of a delicate violet hue, clear and sharp in its definition of the different tissues under examination, it will bear use with the very highest powers of the microscope, and, I hope, enable observers to distinguish minute differences of tissue which have hitherto escaped notice.

A few words in conclusion as regards the method of using this fluid. It yields good results, when used undiluted, as a quick stain; but the most excellent results, to my mind, are obtained by placing the tissues in a weak solution (ten drops to two fluid-drachms), with warm distilled water, for about twelve hours. This method leaves nothing to be desired, and produces results of surpassing delicacy and beauty. I had intended, in conclusion, to refer to the beautiful double-staining produced by this agent in connection with a new preparation of indigo-sulphuric acid, and have several specimens on exhibition this evening; but I think it will be best to devote a separate paper to the consideration of this subject, which I trust to be able to present at a future meeting of this Section.

DECEMBER 4.

The President, Dr. LEIDY, in the chair.

Thirty-six persons present.

A paper entitled "A Study of the Distribution of Gluten within the Starch Grain," by N. A. Randolph, M. D., was presented.

Gold from North Carolina.—Prof. H. CARVILL LEWIS exhibited some remarkable gold nuggets, found in Montgomery county, North Carolina, forty miles east of Charlotte and two miles from Yadkin River. Some of the nuggets were of great size. One of them weighed over four pounds, and contained nearly $1000 worth of gold, being finer than any specimens in the collection at the Mint. It was probably one of the largest nuggets ever found in eastern America. Many of the nuggets exhibited were nearly pure gold. The gold had a crystalline structure, and was of fine yellow color. It was stated that in the district of North Carolina whence these nuggets were taken, gold was very abundant. The larger specimens were found in the gulleys, where they had been washed out of the decomposed rock, and it had been stated that a shovelful of dirt dug out of the hillsides anywhere in this vicinity would pan out traces of gold. Some years ago one man took out of a hole sixteen feet square $30,000 worth of gold. The quartzite containing the gold occurs in a white clay or decomposed schist.

DECEMBER 11.

The President, Dr. LEIDY, in the chair.

Thirty-three persons present.

On Extinct Rhinoceri from the Southwest.—Professor COPE exhibited the skull of a young rhinoceros, probably of the species *Aphelops fossiger* Cope, from the Loup Fork Bed of the valley of the San Francisco River, New Mexico. He also exhibited photographs of a mandibular ramus of a young rhinoceros, sent him by Dr. Mariano Barcena, of the City of Mexico. The ramus had been exhumed in the State of Mexico, and apparently belonged to a young individual of the *Aphelops fossiger*, but is of relatively small dimensions. Prof. Cope regarded the discovery as proving the existence of the Loup Fork formation at that locality.

A Fungus infesting Flies.—Prof. LEIDY directed attention to a vial filled with flies adherent to fragments of leaves. He stated that on the first of August, the last summer, he had noticed that from the swarm of flies that were attracted by the ripe fruit of a black mulberrry, *Morus nigra*, many settled on the under side of the leaves, and there became fixed and died from the invasion of a fungus, in the same manner as the house-fly often becomes attached to walls and window-panes, in the autumn, through the agency of the fungus known as the *Sporendonema*. The infested flies on the mulberry-tree were so numerous, that perhaps a fourth of the foliage of the lower boughs had from one to half a dozen of the flies adherent to each leaf. The fly, though a familiar one, is unknown by name to him. It resembles the house-fly, but is larger and has a black abdomen with lateral whitish spots. The fungus, of a fuscous hue, is especially evident in the extended intervals of the segments of the abdomen, along the sides of the thorax and at the neck. Though extending to and attaching the flies to the leaves, the specimens do not exhibit the zone of spores on the leaf as commonly seen in those of infested house-flies. Microscopic examination exhibited a similar structure of the fungus to that of the *Sporendonema* or *Empusa muscæ*. It mainly consists of translucent cylindrical, straight or somewhat tortuous rods or tubes of variable length with rounded ends, and containing homogeneous liquid with rows of oil-like globules. Mingled with the tubes are numerous oval, ovoid, and pyriform spore-like bodies, usually each with two oil like globules. The spore-like bodies measure 0·028 to 0·036 mm. long, by 0·016 mm. thick. The longer tubes measure usually up to 0·16 mm. long, by 0·012 mm. thick.

On Manayunkia.—Prof. LEIDY made some remarks on a specimen of *Manayunkia*, of which he exhibited a drawing, and which had been recently obtained by Mr. Edward Potts, from the mill-pond of Absecom Creek, at Absecom, N. J. It was of especial interest as apparently confirming the fresh-water habit of a cephalobranch annelide. The worm was contained in a tube attached to the midrib of a decayed leaf, to which there were attached several similar but empty tubes about one line long. The worm, 1·5 mm. long, appears to be an immature form of *Manayunkia speciosa*. The body consists of ten setigerous segments succeeding the head. The latter supports two lophophores, each with ten tentacles, of which none are conspicuously larger than the others. A pair of eyes occupy the head, but no pigment spots exist along the base of the tentacles. The podal setæ are from two to four, but mostly three, on each side of the segments. The podal hooks, but one on each side of the setigerous segments, except the first of the latter, which has none; and the last two, which have rows of six comb-like hooks on each side. The worm is translucent white, and the blood very pale green.

Ordinarily, Absecom pond is purely fresh water, and contains in abundance the usual plants and animals characteristic of fresh waters. Mr. Stuart Wood stated that in occasional extreme high tide of Absecom Creek, the pond had been subjected to the overflow of salt water.

How a Carpenter Ant Queen founds a Formicary.—Rev. Dr. McCook presented three specimens of fertile queens of the Pennsylvania carpenter ant, *Camponotus pennsylvanicus.* These had been given him by Dr. Joseph Leidy, who had taken them during the last summer at Wallingford, Delaware Co., Pa. The circumstances under which they were captured afforded a good demonstration of the manner in which a new colony of this and other species is begun, confirming the speaker's own observations and published statements. One specimen was taken, August 9, in a chestnut log; the others, August 14, in the stump of a chestnut-tree. They were enclosed within small cavities about an inch in diameter, and, curiously, the queens had sealed themselves within their nests by closing up the original opening by which they had entered, and from which, as a nucleus, they must have cut out their resident-room and nursery. If, therefore, they sallied forth to obtain food, as they may have done (for Dr. McCook had at various times observed queens wandering solitary), they must have removed the plug or "door," and restored it to place again upon re-entrance. However, he believed it to be quite within the bounds of probability that a well-fed queen could live without additional food for several weeks—a period long enough to rear a small brood, and also feed the larvæ from the contents of her crop, which might serve as a storehouse of food, as was explained by illustrations of the anatomy of the alimentary canal.

In the same receptacle with the queens were found (1) the white, oval or cylindrical eggs of the species; (2) larvæ of various sizes, from those just escaped out of the egg (2·3 mm. long) to full-grown (about 10 mm.); (3) the cocoons, or enclosed pupæ; and in one case (4) a callow antling, which had evidently just escaped from its case. This antling was, as indeed all the larvæ and cocoons appeared to be, of the dwarf caste. There are three castes in a formicary of *Camponotus*: the worker-major, the worker-minor and the minim, or dwarf. We may infer that the latter caste is the one which is first produced in rearing a family.

In response to a remark and suggestion made that the imperfect nurture given to the larvæ, under the peculiar circumstances, might account for the appearance of small workers first in order, Dr. McCook stated that, whatever one might conjecture to have been the fact in the remote origin of these castes among ants, it is certain that when the formicary has been fully peopled with workers, and the food-supply is unlimited, the several castes still continue to appear. Minims, minors and majors not only abound among the mature insects, but are found among the larvæ and cocoons. These distinctions are a permanent feature of the ant economy; and while it is perhaps not permitted one to say that they are *not* caused by differences in amount or character of the nurture given in the larval state, yet this did not seem at all probable to the speaker. The fact that, in some genera, the workers have also remarkable differences in structure (as of the head, for example, in *Pheidole* and *Pogonomyrmex crudelis*) goes to show that differentiation into castes is regulated by something other than the food-supply.

The above observations are valuable as proving that the females of *Camponotus*, when fertilized, go solitary, and after dispossessing themselves of their wings, begin the work of founding a new family. This work they carry on until enough workers are reared to attend to the active duties of the formicary, as tending and feeding the young, enlarging the domicile, etc. After that, the queens generally limit their duty to the laying of eggs, and, as the speaker had elsewhere fully described,[1] are continually guarded and restricted in their movements by a circle of attendant workers, or "court."

The above facts are further illustrated and enlarged by a series of observations made by Mr. Edward Potts, in accordance with the speaker's suggestions and directions. On or about June 16, Mr. Potts captured a queen of *C. pennsylvanicus* running across his parlor floor, late at night. He placed it in a bottle, but forgot to examine it until five days later (21st and 22d June), when he was surprised to find that the ant was alive, and had laid six or eight eggs in the otherwise empty bottle; which eggs, in their various stages of development, she continued to attend for about fifty days. He fed the ant by dropping into her bottle a pinch of white sugar, which he moistened every evening with a drop or two of water; at which times she quit her otherwise unremitting watch over the eggs and the larvæ, to press her labium for a moment into the sweet fluid, her labial and maxillary palps meanwhile rapidly vibrating with pleasure. The egg-laying was, from the first, very deliberate; one or two eggs were added to the original stock from time to time, until about the 15th August, making the highest number counted, of all ages, nineteen.

He did not observe the date of the first hatching, but these larvæ, at first no larger than the eggs, and only distinguishable upon close observation by the slight grooves between the body segments and the ill-defined head, gradually at first, and afterwards more rapidly, reached finally a length of about one-quarter inch and began to spin their cocoons. On the morning of July 20, the first was surrounded by a single layer of web, but could still be seen working inside it. By evening the cocoon was too opaque to be seen through. On the morning of the 21st the

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[1] Proceed. Acad. Nat. Sci., 1879, p. 140; "Agricultural Ants of Texas," p. 144; "Honey and Occident Ants," p. 41.

second larva was covered in like manner, and the third by the evening of the 22d. For some days he was able to detect the dark form of the young ant in one of these cocoons, and on the evening of Aug. 11 a worker was running about the bottle and already essaying its ministrations upon the undeveloped eggs and the next series of larvæ, quite as big and much heavier than itself. We have, then, the period from, say June 20 to July 20 (thirty days), occupied in the development of the first eggs and the fulfilment of the larval stage; from July 20 to August 11, say twenty-two days, were spent in the pupa state.

The manner of the young worker was very nervous and far from soothing, especially to the well grown larvæ, who evidently much prefer a mother's care to that of an elder sister. He did not observe this antling feeding from the sugar, but upon one or two occasions saw osculatory advances towards its mother which seemed to indicate that it was not above receiving its nutriment from the maternal fount to which it became accustomed during its wriggling youth. It constantly climbed over the eggs and larvæ, apparently nipping them with its mandibles, but not moving them to any purpose. He saw no well-defined attempt at feeding them on its part; though, after patient observation, upon several occasions, he observed this act performed by the parent ant. She would caress the larva by sundry pats with her antennæ upon each side of the face, when, if hungry, it would lift up its head under her mandibles, placing its labium against hers, at which time a flow of liquid down the larval throat was seen.

As the queen's labors increased, she was less given to moving her charges from place to place, though they were not allowed to remain long quiescent. While nervously anxious about them, Mr. Potts thought that she showed little evidence of tenderness in her treatment, trampling on them with her feet or dragging them around under her heavy abdomen, as if they were really the putty they looked like.

The moisture necessary for the cleansing and growth of the larvæ was apparently supplied from the tongue of the caretaker, who examined them one after another, moistening the dry places and keeping the egg and larval skins flexible. The queen was very careful of the eggs, standing nearly all the time with her head over the little heap, occasionally picking them up to move them a quarter of an inch or more to one side. She was thrown into a great excitement of solicitude when a fly, attracted by the crumbs, intruded within her domicile. She sprang fiercely at the fly and raged around her narrow compartment, seizing a group of eggs as if to escape with them from a threatened danger, then replacing them as though recognizing the impossibility of getting away. Her demeanor on this occasion indicated strong maternal solicitude.

Mr. Potts made some attempt to follow the embryonic changes, and made a few drawings of the different phases. When first seen the egg is full of fluid, uniform in appearance throughout. When next observed segmentation had taken place and advanced to the morula stage, showing everywhere small granular cells of uniform size. Afterward a hyaline spot appears at one end of the egg, which there seems empty or filled with a homogeneous fluid; next to which are large cells, containing smaller ones of various sizes. Later both ends become transparent, the large cells bounding the small-celled body-cavity and forming the well-known ; astrula condition. He was not able to trace the formation of the various internal or external organs. The cyclosis or pulsation of the larval heart was counted in two instances at 45 and 50 per minute.

The manner of ovipositing (August 13) the nineteenth egg is thus described: When first observed the queen stood up high upon all three pairs of legs, the abdomen thrown forward between them and the head bent back almost to meet it. The egg was then about half protruded. Considerable muscular action was visible throughout the abdomen, and when presently the egg was posited she straightened herself out with a visible air of relief, but forgot all about the egg, which was left lying under her for several minutes while she attended to other matters, until at last, accidentally touching it with one antenna, she picked it up and carried it to the family apartments, where, presently, the worker found it and placed it in the group of the older eggs. An evident intent at classifying the eggs and larvæ was remarked, these (within the narrow limitations of the chosen space) having been kept to a good degree separate.

August 13, another worker was released from its cocoon. Mr. Potts did not see the act, but believed that the female assisted, as she was seen standing over the neophyte who seemed to be weak, its femora bent forward, the tarsi and tibiæ still nearly reaching the end of the abdomen, indicating the manner in which the legs were folded in the cocoon. Immediately after release the mother gave the young imago nourishment in the manner above described.

At this date there were in the formicary, beside the mature ants, two full-grown larvæ, very fat, two about half-grown, and several smaller ones, with the eggs in different stages of development. The two oldest were then evidently about ready to spin, but what chance they could have, with the mature ants continually tramping over them, standing them up on end or hauling them off to a distance, Mr. Potts was at a loss to imagine. From the mouth of one he observed a strand of silk protruding, but the workers came, apparently trying to grasp it, and left him in doubt whether their object was to help or hinder the weaving process.

August 14, one of the two full-grown larvæ was found wrapped in its winding sheet. The web was very thin and the motion of the larvæ readily seen through it. The other larva seemed almost totally quiescent, but careful examination with a Coddington lens showed some muscular action in the posterior segments of the body. Their state of comparative torpor was thought to immediately precede the act of spinning. At this date the workers had become less nervous in their motions, and the female seemed to have resigned most of her labors to them, resting much of the time quietly in one place.

August 16, the third worker had emerged and was found quite at home in attending to its duties. The second grown larva was then still uncovered and quiescent. Very close observation was required to show that it still breathed, and it made no other visible motion.

These observations of Mr. Potts establish or confirm the following points: (1) The manner of depositing the eggs, which, as well as the larvæ, are cared for by the queen until workers are matured; (2) the stages in the development of the egg and larvæ are partially noted; (3) the time required for the change from larval to pupal state is about thirty days; (4) about the same period is spent in the pupa state, the entire period of transformation being about sixty days; (5) the work of rearing the first broods of *Camponotus* begins the latter part of June or early in July; (6) about twenty-four hours are spent by larvæ in spinning up into cocoon; (7) the ant queen probably assists the callow antling to emerge from its case; (8) not only the larvæ, but occasionally also the antlings, are fed by the queen; (9) the young workers, shortly after emerging, begin the duty of nurses, caring for the eggs and tending the larvæ. Some of these points thus abstracted and formulated by him Dr. McCook was subsequently able to confirm from observations upon the same queen. His thanks were due Mr. Potts for the intelligent and successful manner in which his suggestions had been carried out.

The following was ordered to be printed :—

A STUDY OF THE DISTRIBUTION OF GLUTEN WITHIN THE WHEAT GRAIN.

BY N. A. RANDOLPH, M. D.

The object of the present paper is to briefly describe several methods for the demonstration of gluten in the central portion of the wheat grain, and the results of their application.

For many years the great majority of observers and of writers upon gluten have stated that this highly important nitrogenous element of food is found almost, if not quite exclusively, in the fourth layer (Parkes) of the grain, immediately below and adherent to the third or inner coat of the true bran; this fourth layer is composed of closely packed yellowish granular cells of ovate or cuboid form, each of which is provided with a dense, laminated cellulose wall and contains a large proportion of free fat. Immediately within this layer of so-called "gluten-cells," and constituting the greater portion of the grain, is an aggregation of much larger, usually elongated, cylindrical cells, whose contents are *apparently* made up exclusively of starch granules which exhibit great diversity in size.

So fixed and widespread has the belief become that the gluten of the wheat resides in specific cortical cells of the grain, that not only do many most intelligent persons habitually rasp their digestive surfaces with branny foods, but attempts to determine, by microscopical examination, the nutritive values of various prepared foods have been made, in which the proportion of "gluten-cells" found in a given food formed the criterion of its value.[1] These assumptions have called forth merited criticism from Prof. Richardson, of this city, and from Prof. Leeds, of Hoboken, both of whom emphasized the fact, singularly ignored by Cutter, Jacobi and their followers, that ordinary white wheat-flour contains a varying but always notable quantity of gluten.

So far as the writer is informed, however, there has not been recorded any ocular demonstration of the gluten of the wheat grain, *in situ* and entirely independent of the "gluten-cells." Such a demonstration may be conclusively made by either of the following methods:

1. If whole wheat grains be macerated in water to which a few

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[1] E. Cutter, M. D., Galliard's Med. Jour., Jan., 1882.

drops of ether have been added to prevent germination, they will, in a few days, become thoroughly softened, and the contents of such a grain may then be squeezed out as a white tenacious mass. Examination of the remaining bran shows the "gluten-cells" undisturbed, closely adhering to the cortical protective layers. By now carefully washing the white extruded mass, the major part of its starch may be removed; and upon the addition of a drop of iodine solution, microscopic examination shows numerous networks of fine yellow fibrils, still holding entangled in their meshes many starch granules colored blue by the iodine. In carefully washed specimens, these sponge-like networks are seen to retain the outline of the central starch-filled cells, and evidently constitute the protoplasmic matrix in which the starch granules lay. Upon gently teasing such a specimen under a moderate amplification the fibrils will be seen to become longer and thinner in a manner possible only to viscid and tenacious substances—a class represented in wheat by gluten alone.

An eminently satisfactory proof of the proteid nature of these central networks may be obtained by heating the specimen in the solution of acid nitrate of mercury (Millon's reagent), when the fibrils will assume the bright pink tint characteristic of albumenoids under this treatment. The results of the application of the xanthoproteic and biuret reactions are equally conclusive, but more care is required in the use of these proteid tests, and the resultant differentiation is not so clear. Reticuli similar to those above described, but much broken and smaller, may be seen, upon close examination, scattered throughout fine white flour, without the addition of any reagent.

By general consent, the albumenoids of the wheat grain are grouped together as gluten, which is, however, further separable into gluten-fibrin, gliadin and mucedin, proteid bodies practically equal in nutritive value, but differing in certain physical properties, notably that of solubility. It must, therefore, be borne in mind that in this, as in all other methods of separating gluten from the other constituents of the grain, its relatively small soluble portion is removed with the starch, and that any estimate of the quantity of gluten based upon such methods will probably be rather under than over the actual amount.

2. In even the thinnest sections of the wheat grain, the gluten of the central portion is always masked by large numbers of starch

granules. These may, to a large extent, be removed by immersing the section for a short time in liquor potassæ, with subsequent careful washing. The alkali affects the hydration and partial solution of the starch; but if its application be too long continued, the gluten will also be dissolved. This treatment is well adapted to show the rather dense gluten networks usually found in bran, immediately below the fourth layer.

3. The most satisfactory method of studying the distribution of gluten in sections of wheat is that of *artificial salivary digestion.* If the section be gently boiled for a moment to hydrate the starch, then transferred when cool to filtered saliva, and maintained for from half an hour to an hour at a temperature of about 98° Fahr., all the starch will be digested away, while the insoluble proteid and other constituents will remain entirely unaltered. A section of wheat grain thus treated will exhibit, throughout its entire central portion, close-meshed gluten networks, which become slightly denser toward the cortex of the grain. The proteid character of these reticuli is here, as in the first method, susceptible of micro-chemical demonstration by Millon's reagent or the biuret reaction. A relatively very faint coloration, indicating the presence of albumenoids, is noticeable in the "gluten-cells," while the gradual condensation of the gluten of the endosperm as the cortex is approached, is evidenced by a quite vivid coloration of the fibrils.

Schenk[1] has applied Millon's reagent to sections of wheat with a resultant assumption by the endosperm of a pink tint and "no coloration of the cortical gluten-cells." The starch was not removed and the method of distribution of gluten was not determined. By artificial gastric digestion of wheat sections, the same observer noted that the starch of the section became readily detached, and deduced from this the just proposition that the gluten lay between the starch granules.

Objections are not infrequently offered by the chemist to the microscopical determination of organic compounds, especially where any attempt at a quantitative estimation is made. All that is claimed for the methods above described is the demonstration of gluten in very considerable quantity in the inner layers of the wheat grain. It is but just to state, however, that by these methods a conception may be obtained of the quantity of proteids

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[1] Anat.-Physiol.-Unters., p. 32. Wien., 1872.

within the grain fully as accurate as that given by the usual chemical method of estimating the albumenoids of a given body, namely, from the entire amount of nitrogen contained in it. Especially is this true in the case of vegetable tissues. In a close analysis of the potato, Schultze and Barbieri found that only 56·2 per cent. of all its nitrogen existed in albumenoid combination, while in the fodder-beet only 20 per cent. of the nitrogen went to the formation of albumenous compounds; the remainder in each case entering into the composition of non-nutritious bodies, as amides, nitrates, ammonia and asparagin.

The fact that the gluten networks become denser toward the periphery of the endosperm, together with the presence of non-albumenoid nitrogenous compounds in the perisperm, explains the notable percentage of nitrogen found in bran as ordinarily roughly removed.

The color tests mentioned above indicate that the amount of proteids contained in the cells of the fourth layer is relatively very slight; but admitting for the moment that these cells contain gluten, the question naturally arises whether, in view of their dense cellulose walls, they are capable of serving as a food-stuff for man. In artificial digestions the writer has found these elements, even when thoroughly cooked, to be unaffected by the digestive juices; that is, well-boiled bran with its adherent "gluten-cells," will sustain prolonged maceration at the temperature of the human digestive tract in artificial gastric and pancreatic juice (in which, under the same conditions, fibrin is readily digested) without exhibiting any change. These cells were further found to be unaffected by maceration for thirty days in liquor potassæ, except for a slight swelling of the cell and the occasional coalescence of some of its contained oil-globules. They were also practically unchanged by a few days' immersion in strong nitric acid. In order to obtain conclusive and unassailable results as to the nutritive value of the "gluten-cells" as far as man is concerned, the writer has at present under observation a number of healthy adults, who daily receive, in addition to their regular diet, a small fixed amount of boiled bran. Their alvine dejections (containing all the undigested elements of food after the normal action of all the digestive juices) will be submitted to close microscopical examination, with a view to ascertaining the extent to which the "gluten-cells" have been digested, and a report will be made upon the results in the near future.

December 18.

The President, Dr. Leidy, in the chair.

Sixty-two persons present.

A paper entitled "Reproduction in Amphileptus fasciola," by Andrew J. Parker, M. D., was presented for publication.

Miss Adele M. Fielde made a communication on the language, literature and folk-lore of China.

December 25.

Rev. Henry C. McCook, D. D., Vice-President, in the chair.

Fifty persons present.

The following was ordered to be printed :—

REPRODUCTION IN AMPHILEPTUS FASCIOLA.

BY ANDREW S. PARKER, M. D., PH. D.

Several years ago, while examining some infusoria, I noticed a specimen of *Amphileptus fasciola* undergoing some curious changes, the nature of which, at that time, I did not fully appreciate, supposing them to be due to the dissolution of the animal. Recently I observed the same series of phenomena occurring in another individual, and on tracing them out more fully I found that they were due, not to the death of the infusorian, but to what I believe is a method of reproduction not hitherto observed, or at least not described, in this group. My attention, in both instances, was attracted by a peculiar oscillating movement, the *Amphileptus* rocking from side to side, the animal remaining stationary, although its cilia were in active motion. In other respects the animal appeared normal, no changes being observed in its nucleus, protoplasmic contents or contractile vesicle. Shortly after I had noticed this peculiar rocking movement I found that the elongated extremity was breaking up into small masses of protoplasm; these gradually separated from the parent body, and each of them exhibited distinct amœboid movements. Although the cilia seemed to break off with the small masses, I could not detect any signs of their presence after separation. For about five minutes small protoplasmic masses, exhibiting distinct and independent amœboid movements, continued to be shed.

The rocking movement still continued, but now commenced to show signs of being converted into a movement of rotation. Finally a rotary motion was established, and the animal commenced to change its position. At the same time I noticed a distinct elongation occurring at the end where the changes described above had taken place, a rounded projection appearing, which gradually elongated, until finally, in the course of about two hours, the individual had assumed its original shape and activity, although apparently somewhat diminished in bulk. Cilia covered the new growth, but they did not seem to be a new formation, but were produced by a simple elongation of the ectosarc, this being carried forward by the growing endosarc. As regards the protoplasmic masses that were shed or discharged, I observed them for about four hours, at which time they were still active, and the parent mass still in active motion. On the following day I was unable to detect them, and as to their subsequent history I know nothing.

To characterize the phenomena as described above, I propose the term "Reproduction by Partial Dissociation." Reproduction by fission, gemmation, conjugation and encystation have all been observed in the ciliated infusoria; and some of the older writers, such as Ehrenberg and others, have described a mode of increase, in which the substance of the body breaks up into a number of fragments, each of which is capable of becoming a distinct individual. This process they called diffluence, but Stein and other more recent observers have denied the existence of this process, claiming that it was merely a form of increase from encysted forms. The phenomena as exhibited by *Amphileptus fasciola* seem to be quite different from those described as occurring in diffluence, and it certainly was not a case of encystation. I have been unable to find any account of reproduction in the infusoria resembling that described above, and I therefore place the facts on record, in order that the attention of other observers may be directed towards the verification of the phenomena and views expressed above.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending November 30, 1883, twenty-four members and seven correspondents have been elected.

Resignations of membership have been received from the following, and accepted on the usual conditions:—Wm. John Potts, G. B. Cresson, Isaac S. Williams, Howard A. Kelly, M. D., John Wagner, W. G. Audenried, Charles W. Pickering, Wilson Mitchell, H. W. Workman and R. S. Peabody.

The deaths of fourteen members and seven correspondents have been announced and duly recorded in the printed Proceedings.

Thirty-five papers have been presented for publication, as follows: Edw. D. Cope, 7; Jos. Leidy, 3; Angelo Heilprin, 3; S. B. Buckley, 1; H. T. Cresson, 1; B. W. Everman and S. E. Meek, 1; S. G. Foulke, 1; Andrew Garrett, 1; Josiah Hoopes, 1; David S. Jordan, 1; Alexis A. Julien, 1; H. Carvill Lewis, 1; Graceanna Lewis, 1; Isaac C. Martindale, 1; Rev. H. C. McCook, 1; Charles L. Mitchell, 1; Henry F. Osborn, 1; Benjamin Sharp, 1; Theo. D. Rand, 1; Jos. Swain, 1; Jos. Swain and Geo. B. Kalb, 1; R. E. C. Stearns, 1; Chas. H. Townsend, 1; Jos. Willcox, 1; Berlin H. Wright, 1. One of these was withdrawn by the author; two of those by Dr. Leidy and the one by Mr. Garrett were accepted for publication in the Journal, and the others have been or are about to be issued in the Proceedings.

One hundred and fifty-nine pages of the Proceedings for 1882 and two hundred and thirty-two pages of the volume for 1883 have been published. The latter is illustrated by eleven plates. Sixty-eight pages of the Journal, Vol. IX, Part I, have also been printed. These include Dr. Leidy's paper on Urnatella gracilis, advance copies of which were issued by the author early in December of the present year, and about half of Mr. Garrett's paper on Society Islands Shells. The former is illustrated by one fine chromolithographic plate, and the latter by two plain lithographs, containing one hundred and fifty-two figures.

One hundred and twenty-one copies of the Proceedings have been distributed to subscribers. Fifty-nine copies have been sent to domestic, and three hundred and thirteen to foreign journals and societies. The exchange list has been carefully revised, several societies from which we have not received anything for more than five years having been dropped, while a number heretofore omitted have been added. It has always been the practice of the society to send its publications to a number of important foreign Universities and town libraries, situated in places not otherwise in receipt of the Proceedings and Journal, so that students everywhere may be able to inform themselves of the Academy's contributions to science. These intellectual centres have been supplied with the current numbers of the Proceedings as usual.

A circular distributed to corresponding societies in July, asking them to send their publications to the Academy by post, in exchange for a like prompt transmission on our part, has not been productive of as much result as was hoped for. An early distribution of the Proceedings is, however, of so much importance, both to the contributors and to the society at large, that each number will be mailed, hereafter, to exchanges as well as to subscribers, as soon as possible after its issue from the press.

The average attendance at the meetings during the year has been thirty-one. Verbal communications have been made by twenty-six members and two guests. Much the greater number of these have been prepared by the authors for publication in the Proceedings, and form not the least important part of the annual volume, while abstracts were made for the public press of those which could at all be regarded as of popular interest.

Art. 6, Chap. X, of the By-Laws was amended on November 27 by striking out from the first line the word "only," and from the second and third lines the words "obtain permission to." Art. 6, Chap. XI, was amended at the same meeting by striking out all after the word "public" in the second line, and inserting in lieu thereof "daily, except Sunday, and at least one day in the week without charge on such conditions and under such regulations as the Council shall establish from time to time."

Dr. Ruschenberger having been elected a Curator at the annual election in 1882, thereby became ex-officio a member of the Council; Mr. Charles Morris was elected to fill the vacancy thus created in the latter body. At the meeting of the Council held February 17, the Curator-in-charge, Mr. Chas. F. Parker, was granted a month's leave of absence in consequence of an indisposition, which it was then hoped was but temporary. It was found necessary, however, to renew the leave of absence from time to time until his death on the 7th of September. Earnest testimony to his worth as a man and to the value of his services to the Academy has been already borne by his associates, and the general feeling of the society has been well expressed in the able biographical notice by his friend and fellow-member, Isaac C. Martindale, published in the Proceedings of November 13.

At the meeting of the Academy held October 2, Prof. Angelo Heilprin was elected Curator, to fill the vacancy caused by the death of Mr. Parker; and at the meeting of the Council held on the 5th of October he was appointed Curator-in-charge, or Actuary to the Curators.

An inquiry from the New Century Club, as to the desirability of endowing a professorship in the Academy, to be held exclusively by women, having been referred for consideration to the Council, it was resolved that, inasmuch as the professorships are open to women, as well as men, it is inexpedient to restrict any professorship to either sex. This action of the Council was endorsed by the Academy and transmitted to the New Century Club, with the suggestion that if a proposition were made to endow a scholarship for women instead of a professorship, the subject might receive further consideration.

A committee, consisting of Messrs. Valentine, Corlies, Ruschenberger, Frazer and Whelen, was appointed January 2, to petition the Legislature of Pennsylvania to aid the Academy in the extension and furnishing of its building. The efforts of this committee have been so far unproductive of result, although by action of the Legislature the collections of the Second Geological Survey of Pennsylvania are now stored in boxes in the cellar of the Academy. Their value to the student would be, of course, greatly enhanced if they were properly displayed. The Academy is, however, entirely unable at present to furnish the space necessary for such exhibition, and the request to the Legislature for aid in the construction of an addition to the Academy, in which these collections would be properly placed, cannot be deemed unreasonable.

The most important additions to the Academy's possessions made during the year have been the Wm. S. Vaux collections of minerals and antiquities. After mature consideration by the Council and the Academy, the conditions proposed by the executor for the government of the bequest were finally adopted at the meeting held February 20. A special appropriation was made for the alteration of the entresol rooms at the east end of the hall, for the accommodation of these collections, and therein they have been arranged by Mr. Jacob Binder, the special curator appointed by the Council in conformity with the articles of agreement. Mr. Binder's report, which follows that of the Professor of Mineralogy, indicates the character and extent, as well as the mode of arrangement, of the collections under his charge.

At the meeting held April 24, the following was adopted :—

Resolved, That the title to certain lands in Western Virginia, belonging to the Academy, and heretofore held in trust therefor by the late Wm. S. Vaux, be vested in Messrs. T. D. Rand, Jacob Binder and S. Fisher Corlies, as trustees for the Academy, and that the title to a burial lot, owned by the Academy in the cemetery adjoining the Academy's premises on Race Street, be transferred to the Trustees of the Building Fund, in accordance with the recommendation of the Council, March 26, 1883.

The American Association for the Advancement of Science has accepted the invitation tendered by the Academy, in conjunction with other educational establishments, the officers of the municipal government and prominent citizens, to meet in Philadelphia in 1884. It is hoped that the meeting may be attended by the British Association which meets in Montreal next August, or at least by an important representation thereof. The International Electrical Exhibition, which it is proposed to hold at the same time under the patronage of the Franklin Institute, cannot fail to add largely to the interest of the occasion and to the number of those in attendance. The result will probably be one of the largest scientific meetings ever held, and one which cannot fail to exert a beneficial influence on the Academy in common with the other scientific institutions of the city. We have, therefore, abundant reason to hope that the prosperity of the society at the end of next year will be at least as great as that so clearly set forth in the accompanying annual reports of officers and sections.

All of which is respectfully submitted,

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

The Corresponding Secretary reports that the business of his office presents but little variation from that of preceding years.

There have been many favorable replies received from corresponding societies to our request for an interchange of publications by mail, the result of which will be an earlier acquaintance with the doings of other societies, greatly to the advantage of working naturalists.

The Museum has received many additions during the year, a detailed account of which will appear in the Curator's report. These have been promptly acknowledged, to the number of 119.

There have been seven Correspondents elected during the year, and acknowledgment has been received from but one who was elected during the present year.

Our corresponding societies generally acknowledge the reception of our publications by letter, and accompany their own publications with letters of transmission.

Letters of acknowledgment have been received numbering, ...	67
Letters transmitting publications have been received numbering, ...	42
Letters concerning postal interchange numbering, .	19
Ackowledgments from Corresponding Members, .	1
Miscellaneous correspondence, ...	21

In the latter number are many asking for deficiencies in their series of our publications. These have been favorably responded to whenever possible. There has been a considerable accession to our exchange list during the current year.

Respectfully submitted,

George H. Horn, M. D.,

Corresponding Secretary.

REPORT OF THE LIBRARIAN.

During the twelve months ending November 30, 1883, 3003 additions have been made to the library, an increase of 208 over the growth of 1882. These additions have consisted of 360 volumes, 2615 pamphlets and separate parts of periodicals, and 28 maps, sheets, photographs, etc.

The above increase has been derived from the following sources :—

Societies,	1113
Editors,	816
I. V. Williamson Fund,	437
Authors,	255
Joseph Jeanes,	83
Thomas B. Wilson Fund,	49
University of Würzburg,	27
Department of the Interior,	22
Geological Survey of Sweden,	22
Smithsonian Institution,	20
Department of Agriculture,	19
Dr. Frances W. Wetmore,	16
Geological Survey of Portugal,	13
F. V. Hayden,	11
Geological Survey of India,	10
War Department,	9
Geol. Survey of Pennsylvania,	8
Regents of the University of New York,	7
J. H. Redfield,	6
Minister of Public Works, France,	5
Treasury Department,	5
Engineer Depart., U. S. A.,	5
Norwegian Government,	5
British Museum,	3
Geological Survey of New Zealand,	3
Geol. Survey of Wisconsin,	3
Stephen G. Worth,	3
Navy Department,	2
Geological Survey of Belgium,	2
J. S. Newberry,	2
Department of Mines, Nova Scotia,	2
Geological Survey of New-foundland,	2
East Indian Government,	2
S. F. Corlies,	2
Thomas Meehan,	1
Trustees of the Indian Mus.,	1
Trustees of the S. African Mus.,	1
Rev. H. C. McCook,	1
David L. James,	1
Cobden Club,	1
Geological Survey of Illinois,	1
O. A. Derby,	1
Trustees of the Boston City Hospital,	1
F. v. Mueller,	1
U. S. Coast Survey,	1
Surgeon General's Office,	1
U. S. Commission of Fish and Fisheries,	1
Executor of the late Wm. S. Vaux,	1

The several lots have been presented on the Tuesday evening following their reception, and distributed to the departments of the library as follows, each title being immediately added to the card catalogue :—

Journals,	2225
Geology,	202
Conchology,	85
General Natural History,	82
Botany,	60
Entomology,	46
Bibliography,	33
Voyages and Travels,	25
Mammalogy,	25
Agriculture,	20
Anatomy and Physiology,	18
Helminthology,	18
Mineralogy,	17
Ornithology,	17
Anthropology,	12
Ichthyology,	10
Encyclopædias,	10
Chemistry,	10
Physical Science,	9
Education,	9
Herpetology,	2
Medicine,	2
Miscellaneous,	66

154 volumes have been bound, and an additional 135 are still in the hands of the binder.

Assistance furnished me during the summer months has enabled me to have the books and pamphlets on Conchology, Physical

Science, Chemistry, Geography and Medicine, together with the Italian journals, added to the card catalogue. The Department of Conchology had not been before included in the card entries, because a complete hand catalogue had been prepared just before the card system was adopted, and a similar arrangement of the other departments mentioned has not heretofore been possible for lack of time. I regret to say that, for the same reason, the American and Italian journals only have as yet been completely catalogued, although the hand index to the shelf arrangement, in use for several years back, has been kept roughly up to date, and serves its purpose reasonably well. Every effort will be made during the coming year to complete the catalogue of this department.

A circular which was sent to all our corresponding societies, proposing an exchange of publications by mail, has been answered favorably by a few societies, but the greater number seem to prefer sending but once a year, as heretofore, through the International Exchange Bureau. This is to be regretted, as early access to the current scientific literature is of the utmost importance to the student. Of course, the many journals for which the Academy subscribes, and which are all credited in the accompanying list to the I. V. Williamson Fund, are received promptly by mail as issued.

It will be observed that we are indebted to the liberality of Mr. Joseph Jeanes for 83 of the current additions, and to the fund which the Academy has received from Mr. Isaiah V. Williamson for 437 volumes and continuations of periodicals. These additions are of special value and importance, as they have been ordered at the request of the working members, and supply for the most part the material required for actual investigation.

A fine portrait in oil of Dr. Joseph Leidy, by Uhle, has been placed on permanent deposit by the Biological Club of Philadelphia. The amount required for the portrait of Dr. Robert Bridges having been secured, the order was given to Mr. Uhle early in the year. I regret to say the artist's engagements have not enabled him to complete the work, which will, however, be placed in the library at an early date.

All of which is respectfully submitted,

EDWARD J. NOLAN,

Librarian.

REPORT OF THE CURATORS.

The Curators present the following statement of the Curator-in-charge, Prof. Angelo Heilprin, as their report for the year ending November 30:—

The condition of the Academy's collections, although it cannot be stated to be absolutely satisfactory, is yet fairly good when compared to the condition of similar collections in this country, or even of those pertaining to foreign institutious. Much, however, remains to be done before either the interests of science or of general education will have been thoroughly satisfied, and until more efficient aid is added to the working power of the Academy, progress towards the obtaining of this satisfied condition must be necessarily slow. The great obstacle in the way of the systematic arrangement of the collections has thus far been, and still remains, want of space, a weighty obstacle which must ever remain as such until greater expansion will have been afforded in the construction of an extension to the present building.

The removal, at a very moderate expense, of the large central platform on the floor of the museum has permitted of a much more satisfactory arrangement of the extensive series of geological and palæontological specimens than has heretofore been possible, and has at the same time afforded room for the gathering together and proper exhibition of a special collection—namely, a collection illustrative of the natural products of Pennsylvania and New Jersey. In this "local museum," as it may be termed, it is intended to illustrate by actual specimens (as far as is practicable) the entire domains of zoology, palæontology, geology and mineralogy, in so far as these departments are directly connected with the States above mentioned, and thereby very materially facilitate the means for self-instruction in natural history, and for making such immediate examinations and comparisons as may be variously demanded. Work in the arrangement of this collection has been progressing favorably, and it is hoped that the entire exhibition will be satisfactorily displayed in the early part of the coming year.

The most important addition made during the past year to the Academy's museum is the Vaux collection of minerals and archæological implements, to which reference is made in the report of the special Curator appointed for those collections, Mr. J. Binder, by whom the specimens have been carefully arranged and classified. The other additions to the museum are recorded in the list of donations herewith appended, or are incorporated in the reports of the different sections.

The Academy has during the year benefited through the services of three Jessup Fund beneficiaries, Messrs. J. Wortman, A. F. Gentry, and S. F. Aaron, respectively in the departments of vertebrate palæontology, ornithology, and entomology, the first of whom has latterly resigned on receiving the appointment of assistant to the Curator-in-charge. An application for the filling of the present existing vacancy in the Jessup Fund is now in the hands of the Curators.

JOSEPH LEIDY,
Chairman of the Board of Curators.

SUMMARY OF THE REPORT OF THE TREASURER,

FOR THE YEAR ENDING NOV. 30, 1883.

DR.

To Balance from last account	$ 991 31	
" Initiation fees	170 00	
" Contributions (semi-annual contributions)	2000 58	
" Life Memberships	500 00	
" Admissions to Museum	457 17	
" Sale of Guide to Museum	40 00	
" Sale of duplicate books	3 53	
" Sale of Proceedings, Journals, etc	430 91	
" Fees, Lectures on Palæontology	136 00	
" Fees, Lectures on Mineralogy	189 00	
" Wilson Fund. Toward Salary of Librarian	300 00	
" Interest on Money awaiting investment	722 17	
" Interest on Deposits in Trust Companies	8 94	
" Interest from Mortgage Investment, Joshua T. Jeanes' Legacy	1000 00	
" Publication Fund. Interest on Investments	265 39	
" Barton Fund. " " "	240 00	
" Life Membership Fund. " " "	132 50	
" Maintenance Fund. " " "	102 50	
" Eckfeldt Fund. " " "	66 86	
" Museum Fund. " " "	25 00	
" Stott Legacy Fund. " " "	67 50	
		$7849 36

Cr.

Salaries, Janitors, etc		$3358 21	
Printing Proceedings	$601 16	724 41	
Binding "	123 25		
Repairs		698 17	
Printing and Stationery		85 61	
Binding		58 75	
Freight		31 13	
Plates and Engravings		109 50	
Water Rents for 1883		26 15	
Postage		127 55	
Coal		616 70	
Gas		120 67	
Miscellaneous		457 06	
Newspaper Reports		86 00	
Insurance		30 00	
Ice		7 44	
Trays		18 10	
Alcohol		23 50	
Cases		23 00	
A. Heilprin, Lectures on Palæontology		136 00	
H. C. Lewis " " Mineralogy		189 00	
Guides to Museum		23 00	
Books		164 57	
Vials		8 25	
Life Memberships transferred to Life Membership Fund		500 00	
			$7622 77
Balance, General Account			$226 59

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement		$1300 00
Life Memberships transferred to this account		500 00
Interest on Investments		132 50
		$1932 50
Transferred to General Account	$ 132 50	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1432 50
To Balance for Investment		$500 00

BARTON FUND. (For Printing and Illustrating Publications.)

Interest on Investment	$240 00
Transferred to General Account	240 00

JESSUP FUND. (For Support of Students.)

Balance, last Statement	$711 67
Interest on Investments	560 00
	$1271 67
Disbursed	676 66
Balance	$595 01

MAINTENANCE FUND.

Balance per last Statement		$2108 14
Interest on Investments		102 50
		$2210 64
Transferred to General Account	$ 102 50	
Investment in Bond and Mortgage at 5 per cent. Interest	2100 00	
		2202 50
To Balance for Investment		$8 14

PUBLICATION FUND.

Balance, last Statement		$1214 70
Income from Investments		350 69
		$1565 39
Transferred to General Account	$265 39	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1565 39

MRS. STOTT FUND. (For Publications.)

Balance, last Statement		$1300 00
Interest from Investments		67 50
		$1367 50
Transferred to General Account	$ 67 50	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1367 50

I. V. WILLIAMSON LIBRARY FUND.

Balance, last Statement		$433 48
Rents collected		835 27
Ground-rents collected		1026 28
		$2295 03
For Books	$814 60	
Binding	76 25	
Repairs to Properties	229 68	
Taxes and Water Rents	241 97	
Transfer of Property to Academy	69 05	
Collecting	93 07	
		$1524 62
Balance		$770 41

THOMAS B. WILSON LIBRARY FUND.

Balance overdrawn per last Statement	$232 89
Dulau & Co., London	51 88
B. Westermann & Co., Books	162 78
Transferred to General Account	300 00
	$747 55
Income from Investments	525 00
Balance overdrawn	222 55

ECKFELDT FUND.

Balance, last Statement		$966 86
Interest from Investments		100 00
		$1066 86
Transferred to General Account	$ 66 86	
Investment in Bond and Mortgage at 5 per cent. Interest	1000 00	
		$1066 86

BOOK ACCOUNT. (Donations from Jos Jeanes, Esq.)

Balance, last Statement	$339 83
Less cash paid for Books	302 70
Balance	$37 13

BINDING ACCOUNT. (Donations from Jos. Jeanes, Esq.)

Balance, last Statement	$277 85
Less cash paid for Binding	277 85

INSTRUCTION FUND.

Balance, last Statement	$60 00
Less cash paid for Cards	4 00
Balance	$56 00

MUSEUM FUND.

Balance, last Statement		$1000 00
Interest from Investments		25 00
		$1025 00
Transferred to General Account	$ 25 00	
Investment in Bond and Mortgage at 5 per cent. Interest	1000 00	
		$1025 00

WILLIAM S. VAUX COLLECTION FUND.

Cash received from Estate of Wm. S. Vaux, deceased		$1000 00
Interest from Investments		1000 00
George Vaux, for Mineral Case		50 00
Cash received from Sale of Five Cases		250 00
		$2300 00
Cash paid for Cases	$1469 50	
Cash paid for Miscellaneous Expenses	401 66	
		1871 16
Balance		$428 84

Also received the legacy of William S. Vaux, deceased, which was paid in ten bonds for one thousand dollars each (total, ten thousand dollars), of the seven per cent. Registered Mortgage Bonds of "The Philadelphia and Reading Coal and Iron Company." The interest of these Bonds to be applied to the use of the "William S. Vaux Collection Fund."

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

During the year eighteen meetings were held, with an average attendance of about fifteen persons.

The annual exhibition was held April 5, and was a success as to the number of visitors and in regard to the improvement noticed in general microscopical manipulation.

The following gentlemen became contributors to the Section during the year:—Dr. L. Brewer Hall, Dr. Henry Beates, Dr. Max Bochroch, Dr. Charles L. Mitchell, Dr. M. B. Hartzell, Dr. Arthur Wilson, Dr. William R. Hoch, Mr. John F. Lewis.

The following resignations were accepted:—Dr. Charles Turnbull, Dr. S. H. Guilford.

The meetings have been well supplied with material for discussion, and an increased interest has been manifested during the year.

The following are some of the more important subjects brought to the notice of the Section:—

Dr. J. G. Hunt.—Communication upon Diatomes, Desmids, Sponges, Carnivorous Plants, Mosses and on the Preparation of Animal and Vegetable Tissues.

Dr. Charles Mitchell.—A New Freezing Microtome. Also a paper upon Hæmatoxylon Staining.

Dr. L. B. Hall.—Communication upon Spirogyra.

Dr. G. A. Rex.—Upon the Trichias, with two rare forms not found before in North America.

Respectfully submitted,

ROBERT J. HESS, M. D.,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that of the various papers upon the subject of the Mollusca, accepted for publication by the Academy during the past year, the most important was one by Mr. Andrew J. Garrett, of Tahiti, upon "The Land Shells of the Society Islands," which is now in press and will soon appear as a part of the Journal.

It is with sincere regret that we record the death of our valued member, Mr. Charles F. Parker, which occurred September 7, 1883. Mr. Parker was one of the founders of the Section, and a very large portion of the leisure time at his command was devoted to its interests. In his death the Academy and Section have lost a faithful and efficient officer, and the members a worthy associate.

Our Conservator, Mr. Geo. W. Tryon, Jr., reports forty-seven donations of shells from twenty-nine different sources, all of which have been labeled and arranged in the museum. "These aggregate 1097 trays and labels, containing 4150 specimens, being a larger accession than for several previous years." Including them, the Conchological collection embraces 41,322 trays and tablets, with 145,791 specimens.

It may be stated as an illustration of the rapid growth of our museum that about one-third of these specimens have been received since the removal of the Academy to its present building in 1876. Among the donations may be particularized as important, the large collections of New Caledonian, French and Eastern European shells, generously given by Messrs. E. Marie, A. Locard, A. Montandon, and S. Clessin; also the fine collection from Mauritius and Madagascar, purchased from Mr. V. Robillard. Several other purchases of good shells were made, partly with the income of the Museum Fund, partly by money received from the sale of our publications. To obtain all purchasable novelties and desiderata would require a fund yielding an income of not less than five hundred dollars per annum; some rare opportunities were declined during the past year for want of means.

Inadequate as our resources are, our progress has been such as to receive recently the commendation of the distinguished editor of the "Journal de Conchyliologie," who writes of the "immense bibliographical and conchological collections of the Academy of Natural Sciences of Philadelphia, scientific treasures to which each year adds considerably, and which constitute working facilities of the first order." The re-arrangement of the museum, in connection with the publication of the monographs of the genera in the "Manual of Conchology," steadily progresses. The *Columbellidæ* and *Conidæ* have been carefully studied and largely re-labeled during the year; the *Pleurotomidæ* are now undergoing revision.

The officers of the Section are:—

Director, ...	W. S. W. Ruschenberger.
Vice-Director, . . .	John Ford.
Secretary, ...	John H. Redfield.
Recorder, ...	S. Raymond Roberts.
Conservator, . . .	Geo. W. Tryon, Jr.
Librarian, ...	Edw. J. Nolan.
Treasurer, ...	Wm. L. Mactier.

On behalf of the Section,

S. Raymond Roberts,

Recorder.

REPORT OF THE ENTOMOLOGICAL SECTION.

During the year past the Entomological Section has held ten meetings, at which the attendance has averaged six members, exclusive of visitors.

During the year one member has resigned, and one died. No new members have been elected, and the Section at present numbers twenty-one members.

The Section has experienced an irreparable loss in the decease of its late Director, Dr. John L. LeConte. His long services in the advancement of entomology in this country are too well known to require any rehearsal here. At the annual meeting of the American Entomological Society, it was ordered that a memorial of Dr. LeConte be prepared, and published in the Society's Transactions.

The Transactions of the American Entomological Society, vol. x, containing 344 pages and 9 plates, has been published. The Proceedings of the Entomological Section continue to be published and issued in connection with the Transactions, and contain the communications made at the monthly meetings. Members and others are thus enabled to place upon record such advanced descriptions as they may desire.

Eleven written communications have been presented for publication, and, having been favorably acted upon, will be duly published.

The Curator reports the following additions to the cabinets:—

From Dr. W. L. Abbott.

Diurnal Lepidoptera, . .	237	specimens,	40 species.
Nocturnal Lepidoptera, .	11	"	10 "
Odonata, ...	24	"	10 "

S. F. Aaron.

Orthoptera, ...	36	"	22 "
Diptera, ...	55	"	30 "
Hemiptera, ...	32	"	20 "
Pseudoneuroptera, . .	663	"	95 "
Neuroptera, ...	40	"	12 "

E. M. Aaron.

Neuroptera, ...	79	"	20 "
Pseudoneuroptera, . .	87	"	28 "
Odonata, ...	9	"	7 "
Diurnal Lepidoptera, . .	84	"	63 "

G. B. Cresson.

Diptera, ...	200	"	75 "

E. T. Cresson.

Hymenoptera, . . 11,677 " number of species not determined.

Additions were also made at various times by Dr. H. Skinner, who has given no list of the same.

Through the attention bestowed upon it by Mr. E. T. Cresson, the collection of Hymenoptera is in a specially good condition, and is beyond doubt the best in America.

The cabinets have been examined and disinfected, so that they now present a thoroughly good appearance. This is a part of the Conservator's labors in connection with entomological collections that always requires much care and time. Great assistance has been rendered to the Conservator by Mr. S. F. Aaron, who has devoted much care to the specimens. The same gentleman has also helped greatly in the arrangement of the Entomological library.

By resolution passed November 9, the Section expressed its hearty accord with the Curator of the Academy in the formation of a local museum, and directed the Conservator to render such assistance as laid in his power.

At the meeting held December 10, the following officers were elected for the ensuing year:—

Director, ...	George H. Horn, M. D.
Vice-Director, . . .	Rev. H. C. McCook, D. D.
Recorder, ...	James H. Ridings.
Conservator, . . .	Eugene M. Aaron.
Publication Committee, .	J. Frank Knight,
	H. Skinner.

Respectfully submitted,

JAMES H. RIDINGS,

Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section has pleasure in reporting to the Academy that the activity and prosperity of the Section heretofore noted, still continue. The growth of the Herbarium is fully detailed in the report of the Conservator submitted herewith. Meetings have been held regularly every month, except during the summer recess, and much interesting matter communicated and papers presented, some of the more important of which have appeared in the general Proceedings of the Academy. The Section is wholly free of debt, and has a surplus in its treasury, and has at present thirty-two members on the roll.

The officers elected to serve during 1884 are:—

Director, ...	Dr. W. S. W. Ruschenberger.
Vice-Director, . . .	Thomas Meehan.
Recording Secretary, .	F. Lamson Scribner.
Cor. Secretary, *Treasurer*, } . .	Isaac C. Martindale.
Conservator, . . .	John H. Redfield.

Respectfully submitted,

THOMAS MEEHAN,

Vice-Director.

Conservator's Report.—The Conservator reports that during the year 1883, now closing, the donations of plants to the Academy's Herbarium have been 2868 species. It is estimated that over 900 of these are new to the collection, adding 72 genera not before represented. The North American and Mexican species received were 1438; from the West Indies and South America were received 233; and from the Old World 1197. Referring to the appended list of donations for details, we may here call attention to the large and valuable additions contributed by Dr. Gray, of the Cambridge Herbarium, representing the floras of every quarter of the globe; a small collection from Australia, presented by Baron von Müller, through Mr. Meehan—nearly all of its species new to us; a collection of about 70 species of interesting Patagonian plants, made by Mr. William Bell, of the Transit of Venus expedition, and presented by him through Mr. Charles E. Smith; upwards of 400 species of plants from various regions, presented by Mr. Canby; and 51 species of Scandinavian Lichens, mostly new to the collection, presented by Dr. J. H. Eckfeldt.

These have all been poisoned, catalogued, placed in papers and distributed in their proper places in the Herbarium. This necessary work has left little time to devote to the improvement of the condition of the Herbarium generally, yet some progress has been made in that respect. Provisional lists of species have been continued as far as the order Borraginaceæ in the general Herbarium. The Endogens have been re-arranged to conform to the order adopted by Bentham and Hooker in the concluding part of their "Genera Plantarum," that vast monument of careful, patient, analytic work. And some small progress has been made in the much needed task of mounting the specimens of the North American Herbarium.

Heretofore the Academy's collection of plants has received the benefit of a large amount of faithful and intelligent labor from its late Curator-in-charge, Mr. Charles F. Parker, but his disability during the early part of the year, followed by his death on the 7th September, 1883, has deprived us of his services; and now the Conservator realizes, more than ever before, how much we have owed to Mr. Parker's diligent zeal and skilful hands. In his absence we have been indebted to the aid of Messrs. Burk, Meehan, Scribner and Brinton, who have each rendered efficient service. Mr. Scribner, though absent several months on explorations in Montana for the Northern Transcontinental Survey, has continued his critical work upon the grasses of our collection, and has made some progress in the work of mounting them.

It is very desirable that the Herbarium of the Academy should be in such condition as will make it most accessible and useful to botanists who may visit it during the meeting in this city next year of the American Association for the Advancement of Science and of the British Association; and though it will be impossible to do all that should be done in the brief intervening period, it is hoped that much may be accomplished towards this end, and that good progress may be made in the mounting of at least the North American plants.

JOHN H. REDFIELD,
Conservator.

December 10, 1883.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

Meetings of the Section have been held regularly during the year, the attendance averaging from eight to ten. The discussions have been more upon geological questions than upon mineralogical, owing to the interest excited by the Geological Survey of the State. The most important event to the Academy in connection with mineralogy has been the accession of the Vaux collection, and its arrangement by Mr. Jacob Binder, whose services in that matter have been of exceeding value.

The officers of the Section are :—

Director, ...	Theodore D. Rand.
Vice-Director, . . .	W. W. Jefferis, Esq.
Recorder and Secretary, .	Dr. A. E. Foote.
Conservator, ...	Prof. H. Carvill Lewis.
Treasurer, ...	John Ford.

Respectfully submitted,

THEODORE D. RAND,
Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALÆONTOLOGY.

The Professor of Invertebrate Palæontology respectfully begs to report that during the past year he has delivered a course of twenty-six lectures on physiographic geology and palæontology, which course, extending through the months of January, February and March, as in previous years, was attended in principal part by teachers belonging to the various institutions of learning of the city.

He further reports that the collections under his immediate supervision have been materially improved through identifications and re-determinations incident to study, and this more particularly in the special fields of Tertiary and Cretaceous palæontology; in the latter department the institution is largely indebted to Prof. R. P. Whitfield, of New York city, for numerous determinations of the fossils belonging to the State of New Jersey. The additions to the palæontological department of the Academy's museum, which are recorded elsewhere, have been inconsiderable, but it is hoped that local exchanges will shortly be instituted, whereby valuable accessions to an already very extensive collection will be insured.

A course of lectures, beginning with about the middle week of January, and embracing a discussion of the physical history and palæontology of the States of Pennsylvania and New Jersey, has been arranged for the coming year.

Very respectfully,

ANGELO HEILPRIN,

Professor of Invertebrate Palæontology.

REPORT OF THE PROFESSOR OF MINERALOGY.

The Professor of Mineralogy respectfully reports that during the past year a course of lectures, upon the mineralogy, lithology and geology of Philadelphia and vicinity, has been delivered, alternately in the lecture room of the Academy and in the field, The course treated of mineralogy in its relation to lithology and geology, and of geology, both structural and historical, with special reference to the formations in the vicinity of the city. The field lectures were given at various points, where the strata, with their enclosed minerals or fossils, could be studied in place. Owing to the exceptional geological position of the city, excursions could be made to all the principal geological formations, from the Laurentian to the Quaternary, inclusive. Among the places visited were the mineral localities of Philadelphia, Bucks and Delaware counties, the iron-mines and marble-quarries of Montgomery county, the metalliferous veins and the Triassic rocks of the Perkiomen Creek and elsewhere, the marl-pits of New Jersey, the Palæozoic strata along the Lehigh, and the coal regions of Mauch Chunk. The attendance averaged about forty, about half of whom were ladies. Reports of these lectures, as published in a city newspaper, are herewith deposited in the library of the Academy.

The mineralogical collection has increased steadily, as shown by the annexed list of donations. The magnificent collection of the late William S. Vaux, Esq., referred to in last year's report, and more particularly described in the report of its Curator, has been deposited as a special collection, under certain conditions, in a room fitted up for the purpose, and is a most valuable and noteworthy addition to the collections of the Academy.

A local collection of Pennsylvania minerals is now being formed on the lower floor of the museum, in connection with a systematic display of the natural history of the State, and the aid of collectors is hereby asked to make this collection as complete as possible. The arrangement adopted for it is that of M. Adam, of Paris (as followed by Descloiseaux, Pisani, etc.), since it serves better the purpose of public instruction than the classification of Prof. Dana, according to which the general collection is arranged.

In the hope that the generous friends of the Academy will assist in supplying a much-felt want, attention is again drawn to the urgent need of scientific instruments (goniometer, lithological apparatus, etc.), both for instruction and for original investigation in this department.

Respectfully submitted,

H. Carvill Lewis,

Professor of Mineralogy.

REPORT OF THE CURATOR OF THE WM. S. VAUX COLLECTIONS.

The Curator of the Wm. S. Vaux Collections respectfully reports to the Council of the Academy of Natural Sciences that the systematic arrangement of the collections has been completed. A catalogue has yet to be made and a portion of the labeling finished. The entire collection is now in a condition to be opened for inspection and study.

It may be hereafter found desirable to rearrange some of the specimens, so that those from the same locality be brought into closer proximity; but this can be attended to hereafter.

On the 15th of August the arrangement and classification were commenced. The Council of the Academy having made an appropriation to defray necessary expenses, Mr. G. Howard Parker, to whom acknowledgment is due for valuable services, was engaged as an assistant, and acted in that capacity until the 15th of September.

For the expenses of arrangement, reference is made to the report of the Treasurer of the Academy.

The collection has been arranged in seven upright cases, marked from A to G, and thirty-nine horizontal cases, numbered from 1 to 39. They are made of Honduras mahogany, each having four drawers, securely fastened with Yale locks. They are as nearly dust-proof as possible, and the workmanship is entirely satisfactory.

The archæological part of the collection occupies five of the upright cases, marked from A to E, and five of the horizontal, marked from 1 to 5. The specimens number (counting arrow-heads and small implements by trays as one piece) two thousand four hundred and forty-five (2445), arranged in groups according to locality. They consist of stone axes, hatchets, celts, hammers, pestles, balls, shovels, hoes, arrow-, spear- and lance-heads, discoidal or Chunkee stones, ceremonial implements, copper and bronze axes, mound pottery; Indian, Mexican, Peruvian, Costa Rican, Roman and Carthagenian antiquities.

The localities represented are: Italy, Switzerland, Germany, France, Sweden, Denmark and Ireland, and America, from Maine to Florida and from the Atlantic to the Pacific coast, with Mexico, Peru and Costa Rica; with a few implements of the Esquimaux and the South Sea Islanders. They include specimens of the palæolithic and neolithic periods, of the work of the cave and lake dwellers, the mound builders, ancient Mexicans, Peruvians and Indians of America, and from the kitchen-middens of Denmark.

The mineralogical part of the collection has been arranged and classified under the system of J. D. Dana, 5th edition, 1869. It embraces 5302 specimens, representing 466 species or groups, all mounted in trays and labeled.

All of which is respectfully submitted,

JACOB BINDER,

Curator.

The election of Officers for 1884 was held, with the following results:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	William C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.,
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.,
	Angelo Heilprin.
Councillors to serve three years, ...	George Y. Shoemaker,
	Aubrey H. Smith,
	William L. Mactier,
	George A. Koenig, Ph. D.
Finance Committee, .	Isaac C. Martindale,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	George Y. Shoemaker.

ELECTIONS DURING 1883.

MEMBERS.

January 30.—John B. Deaver, M. D., G. Howard Parker, Clarence R. Claghorn, F. A. Genth, Jr., Jacob Wortman, H. T. Cresson, William L. Springs, Emily G. Hunt.

February 27.—Walter Rogers Furness.

April 24.—Daniel E. Hughes, M. D., Edwin S. Balch.

May 29.—N. Archer Randolph, M. D., J. Reed Conrad, M. D., Spencer Trotter, M. D.

August 28.—Charles Peabody.

September 25.—Henry F. Claghorn, Emanuele Fronani.

October 30.—S Mason McCollin, Francis A. Cunningham.

November 27.—Mrs. William M. Ellicott, George L. Knowles, Ferdinand McCann, Lewis E. Levy, J. Alexander Savage.

CORRESPONDENTS.

May 29.—Arnould Locard, of Lyons; Frederick W. Hutton, of Christchurch, N. Z.; C. E. Beddome, of Hobart Town, Tasmania.

October 30.—Eugene A. Rau, of Bethlehem, Pa.

November 27.—Marchese di Monterosato, of Palermo; E. Marie, of Paris; H. J. Carter, of Burleigh-Salterton, England.

ADDITIONS TO THE MUSEUM.

December 1, 1882, to December 1, 1883.

ARCHÆOLOGY, ANTIQUITIES, IMPLEMENTS, ETC.—H. Skinner. Fragment of terra-cotta head from Mexico.

H. C. Lewis. Palæolithic implements from the glacial gravels at Trenton, N. J., collected by C. C. Abbott.

W. S. Jones. Two Indian carved images from Alaska.

T. D. Rand. Spanish water-jar from Barcelona; 2 Peruvian water-jugs; Catawba Indian pottery (1 piece); fragments of pottery from Lancaster County, Pa

T. R. Peale. Breech-clout, Oahu, Sandwich Islands.

J. M. Willcox. Two Indian implements from Brevard County, Florida.

Specimen of Wedgewood ware, designed by J. Flaxman, of London.

MAMMALIA (recent and fossil.)—J. Leidy. Molar tooth of *Equus major* (?), found near Keenville, N. Y.

J. Swartzle Jaw fragments of *Platygonus vetus* Leidy, type of species from Mifflin County, Pa.

Mr. Magee. *Felis concolor*, from Colorado.

J. Jeanes. Two skulls, and the greater portion of the skeleton of *Platygonus compressus*, from northern New York.

J. Wortman. *Mus decumanus* (disarticulated skeleton).

J. C. Willson. *Mus musculus* (skeleton).

Zoological Society of Philadelphia. *Capra hircus* (incomplete skeleton); *Vulpes littoralis; Felis pardalis* (skull); *Eumatopius Stelleri* (skull).

BIRDS.—T. C. Craig. Cape pigeon (*Daption Capensis*), from Cape Horn, S. A.

A. F. Gentry. Skeleton of parrot (*Chrysotis albifrons*), from Cuba, W. I.

Zoological Society of Philadelphia. Vulturine Guinea fowl (*Numida vulturina*), Africa; *Buteo borealis* (skeleton).

REPTILES AND AMPHIBIANS (recent and fossil).—O. C. Marsh. Cast of Pterodactyl (*Ramphorhynchus phyllurus*), from Eichstädt, Bavaria.

M. Smiley. Tooth of *Crocodilus fastigiatus*, from the Eocene of Virginia.

J. L. Wortman. *Hyla versicolor*, *Tropidonotus leberis.*

H. C. McCook. Horned frog (*Phrynosoma coronata*), from California.

FISHES (recent and fossil).—E. Zeitler. Box fish (*Diodon* sp).

S. Trotter. Skull of *Prionotus.*

A. Wenrich. Fossil fish (*Diplomystus analis*), from Wyoming Territory.

M. S Quay. Tarpum (*Megalops thrissoides*), from Florida.

N. Spang. Pharyngeal bone and teeth of *Mylocyprinus robustus,* from the Post-pliocene of Idaho.

ARTICULATES (Crustaceans, insects, arachnids, and myriapods, recent and fossil).—J. Jeanes. *Cambarus primævus*, from the Eocene of Wyoming Territory; shrimp (*Æger spinipes*); 5 *Libellulæ* and 2 *Hemiptera*, from the lithographic slate of Solenhofen, Bavaria.

J. Harley. *Belostoma grandis*, hemipterous insect.

J. Ford. Crab (*Gelasimus pugilator*), 3 specimens, from Atlantic City, N. J.

T. Meehan. Goose barnacle (*Lepas anatifa*), on sea-weed, from Killinos Island, Alaska.

T. L. Casey. 187 specimens of unidentified Coleoptera, from Wellington and Cape Town, S. Africa.

MOLLUSCA (recent).—John Ford. *Bulimus Patasensis* (Patas, Peru); *Cypræa helvola* (no locality); *Turbinella scolymus* (locality ?); two species of marine shells; *Crepidula glauca* (Cape May, N. J.).

Museum of Comparative Zoology, Cambridge. *Achatinella simularis* (Waimea), Pease collection.
S. Clessin. 20 species of land shells, from Eastern Europe.
A. E. Bush. 17 species of marine and fresh-water shells, from California.
W. D. Hartman. *Helix Mozambicensis* (near Lake Nyassa, Africa); 1 species of land shell.
A. Montandon. 64 species of land and fresh-water shells, from the Carpathian Mountains of Moldavia, and from Bucharest, Wallachia.
A. Locard. 225 species of land and fresh-water shells (1600 specimens), from France.
F. G. Sanborn. 2 species of marine shells, from Martinique.
W. W. Calkins. *Conus testudinarius*, from the West Indies.
C. R. Orcutt. 3 species of marine shells, from California, and Lower California; 10 species of marine shells, from San Diego, Cal.; 4 species of marine shells.
W. Bell. *Trophon liratus*, *T. crispus*, *T. Geversianus*, and *Pecten*, species, from Santa Cruz River, Patagonia.
G. H. Parker. 10 species of marine shells, from near Galveston, Texas; 6 species of marine shells, from near Galveston, Texas; 2 species of marine shells.
Mrs. A. E. Bush. *Helix*, from San Pedro, Cal.; 13 species of marine shells.
F. R. Latchford. 2 species of fresh-water shells, from Ottawa, Can.
F. W. Hutton. 9 species of marine shells, from New Zealand.
A. Garrett. 84 species of land shells, from the Society Islands.
A. A. Hinkley. *Unio camptodon*, Washington Co., Ill.
R. E. C. Stevens. 3 species of marine shells, from the Gulf of California and Japan; 2 species of fresh-water shells.
M. L. Leach. 11 species of land and fresh-water shells.
T. Bland. 6 species of land and marine shells.
T. R. Peale. 1 species of marine shell.
G. W. Tryon, Jr. 8 species of marine shells.
J. Willcox. 6 species of fresh-water shells.
C. Headly. 6 species of land and fresh-water shells.
B. H. Wright. 1 species of fresh-water shell.
L. H. Streng. 1 species of fresh-water shell.
E. Marie. 81 species of marine, land, and fresh-water shells, from New Caledonia; 28 species of land, marine, and fresh-water shells, from New Caledonia: 151 species of land, marine, and fresh-water shells, from New Caledonia, and the Islands Mayotte, Anjouan, and Nossi-Bé.
M. L. Leach. 5 species of land and fresh-water shells, from Michigan.
P. C. Tucker. 4 species of marine shells, from Texas.
B. Sharp. Semperian preparations of *Limax cineroniger* and *Cyclostoma elegans*.
Conchological Section, A. N. S. 2 species of *Triquetra* (Santarem, Brazil); 63 species of land, marine, and fresh-water shells, new to the collection; 33 species of land and fresh-water shells from the islands of Nossi-Bé and Mayotte, collected by E. Marie; 102 species of land, marine, and fresh-water shells; 215 species of land, marine, and fresh-water shells, from Mauritius, collected by M. V. Robillard.

MOLLUSCA (fossil.)—W. Bell. *Ostrea Patagonica*, *Turritella Patagonica*, *Cardita Patagonica*, *Tellinoides oblonga*, *Venus meridionalis*, *Dosinia* sp., *Lucina* sp.—Probably Eocene of Patagonia (Santa Cruz River).
J. Leidy. *Orthoceras* sp. From the Carboniferous of Fayetteville, Arkansas.
J. D. Conley. *Nucula Randalli*, from the Hamilton group of Madison Co., N. Y.
J. T. Rothrock. Miocene Coquina (with *Pecten Madisonius*, *P. Jeffersonius*, *Crepidula*, *Balanus*, etc.), from Jamestown Island, James River, Va., and from the James River, S. of Point of Shoals Lighthouse.
P. C. Tucker. Two species of probably Post-pliocene shells, from Galveston Bay, Texas.

Worms, Echinoderms, Cœlenterates and Sponges (recent and fossil).—C. R. Orcutt. 3 species of Serpulæ.

J. Jeanes. 4 sponges, from Florida.

J. Leidy. *Spongilla lacustris*, from the Schuylkill River, Philadelphia.

E. Potts. *Spongilla lacustroides*, from W. Branch of Chester Creek, Del. Co., Pa.

J. L. Curry. *Leptogorgia virgulata* (locality ?).

J. T Rothrock. *Columnaria sexradiata*, from the Miocene of James River, Va.

C. Morris. *Tubularia indivisa*, from Atlantic City, N. J.

Botany (recent).—Wm. M. Canby. 403 species plants from Europe, Syria, Madeira, South Africa, North Africa and Australia; 30 species collected by himself in Montana, in August, 1882, of which 9 were new to the Herbarium; flowers of *Rhododendron Vaseyi*, from plant brought from Jackson Co., N. C.; roots and stem of *Dryas Drummondii* Hk., from sand-bars of Blackfoot R., Montana.

Dr. Asa Gray, Cambridge Herbarium. 435 species collected by Cosson and others in Europe, Western Asia and N. Africa (*Reliquiæ Mailleanæ*); 77 species from the Province of Minas Geraes, Brazil; 24 species of Cyperaceæ, collected by Dr. Schweinfurth in tropical Africa; 40 species from China, Feejee Islands, Ecuador, etc. (from Kew Herbarium); 234 species of plants collected by Havard, Palmer, Schaffner and others, in the northern provinces of Mexico and in western Texas; 29 species of *Rosa*, from Herb. of J. G. Baker, European or cultivated at Kew Garden; 48 species of Arctic plants, collected in Lapland, etc., by C Flahault and others, in 1878 and 187?; 102 species plants from Morocco and Algeria; 60 species Cuban plants, mostly collected by Rugel in 1849.

Dr. Sereno Watson, of Cambridge. 69 species collected by him in 1880 in Montana, Idaho and Washington Territories.

Baron F. von Müller, of Melbourne, Australia. 52 species of rare Australian plants.

F. L. Scribner, of Philadelphia. *Diplachne viscida* Scribn. (new). *Sporobolus depauperatus*, Arizona, and *Festuca rubra* L., var. *grandiflora* Hæckel, Sweden.

Geo. W. Holstein, of Belvidere, N. J. 35 species plants from Mitchell Co., Texas.

Thomas Meehan. 7 species *Cactaceæ*, mostly from the western regions of the U. S.; specimens of *Forsythia suspensa* Wahl., and *F. viridissima* Lindl., from seeds of same parent, showing them to be forms of one species; *Hesperalöe yuccæfolia*, cult. at Augusta, Ga.; *Bletia aphylla* Nutt, Austin, Texas; *Protococcus nivalis* (Red Snow), collected on summits of Sierra Nevada, California, by Dr. Harkness, of San Francisco; *Lewisia rediviva* Pursh, Nevada; *Protomyces viticola*, Ellis, n. sp. of fungus on roots of grapevine, Chestnut Hill.

John H. Redfield. 255 species plants collected in Western States and Territories by Pringle, Parish Bros, Brandegee, etc.; 551 species plants collected in northern provinces of Mexico and on the Texan border, by Parry and Palmer.

Wm. Bell, through Charles E. Smith. 80 species plants from Santa Cruz R., Patagonia, collected on Transit of Venus Expedition.

Wm. H. Dougherty. Fruit of *Vanilla planifolia*, Mexico.

J. Donnell Smith, of Baltimore. 21 species ferns collected in Jamaica, by J. Hart, mostly new to the Herbarium.

Aubrey H. Smith. Three species of Californian plants new to the Herbarium, collected by John Eaton Leconte.

Thos. Bland, of N. Y. Capsule and seeds of 5 species West Indian plants.

Isaac Burk. 22 species of introduced plants, mostly from ballast ground, Phila., and *Helianthus giganteus* L., var., from Cape May.

Chas. Miller. *Rumex Berlandieri*, Arizona; fruit of wild Vanilla, Mexico.

Dr. W. S. W. Ruschenberger. Wood of the Tomalo, from Samoa.

Isaac C. Martindale. Ellis's 10th Century of N. American Fungi; *Dalea Ordiæ* Gray, a new species from Arizona; part of the trunk of a white birch branching into two limbs, afterwards reuniting into one.

Amer. Phil. Society. Specimens of *Selaginella lepidophylla*, from Mexico.

Prof. Jos. P. Lesley. Grains of wheat and barley, found germinating in a block of ice.

J. A. McNiel, of Binghampton, N. Y. Capsule of Sand-box tree (*Hura crepitans*), from Panama, S. A.

Dr. John W. Eckfeldt. 51 species of Scandinavian Lichens, named—most of them new to the Academy's collection.

Thos. Meehan and John H. Redfield. 148 species plants collected in Arizona by H. H. Rusby, in 1883.

Prof. H. Carvill Lewis. Radical leaves of *Argyroxiphium Sandvicense*, etc., from Sandwich Islands.

J. G. Lemmon, Oakland, California. *Tagetes Lemmoni* Gr., a new species from Arizona.

Col. Robert W. Furnas, Brownville, Neb. Wood of *Maclura aurantiaca*, taken from far below the surface of the ground, supposed to have been buried 200 years, and estimated from its annual rings to be from a tree 300 years old. Also, wood of *Salix cordata*, var. *vestita*.

Botany (fossil).—J. Jeanes. *Populus latior*, var. *rotundata*, *P. latior*, var. *cordifolia*, *Acer trilobatum*, *Cinnamomum Scheuchzeri*, *Salix tenera*, *Podogonium Lyellianum*, *P. Knorii*, and *Carpolithus pruniformis*, from the Molasse of Oeningen.

W. Bell. Silicified wood, from the Eocene (?) of Patagonia (Los Missiones).

Minerals.—Joseph Leidy. Axinite, Bethlehem, Pa.; Argentiferous Wavellite, Leadville, Col.; Limonite, pseudomorph after Gryphea, Mullica Hill, N. J.; Lepidolite, Auburn, Me.; Quartz with Pyrophyllite, Hot Springs, Ark.; Cookeite with Rubellite and Quartz, Mt. Mica, Me.; Muscovite, Chester Co., Pa.; Muscovite with Biotite crystals, Macon Co., N. C.; Tourmaline in Muscovite, Mt. Mica, Me.; Green-black Tourmaline in Muscovite, Mt. Mica, Me.; Serpentine with crystals of Chrysotile, Easton, Pa.; Green Tourmaline with nodule of Achroite, Paris, Me.; Rose Tourmaline, Mt. Mica, Me.; Rubellite, Mt. Mica, Me.; Heliotrope, India; Green Tourmaline with Lepidolite, Auburn, Me.; Rhodophyllite, Texas, Pa.; Kaolinite, Summit Hill, Pa.; Muscovite, showing 30 rays, Canada; Muscovite with hexagonal markings, Georgia; Homogeneous anthracite, and anthracite presenting a fused appearance, found in association with quartz crystals, in cavities of the calciferous Sandstone, Herkimer Co., N. Y.; Rubellite, and Rubellite passing into Indicolite, Mt. Mica, Me.; Green Tourmaline passing into fibrous Rubellite, Hebron, Me.; Allophane, Polk Co., Tenn.

W. H. Jones. Garnets, from Stikine River, Alaska.

Theodore D. Rand. Quartzite with (organic?) markings, Radnor, Pa.; Asbestos and Serpentine, Radnor Station, Pa.; Chrysotile, Radnor Station, Pa.

H. T. Cresson. Feldspar crystal, Leiperville, Pa.

C. S. Bement. Cinnabar, New Almaden, Cal.; Cinnabar and Metacinnabarite, Lake Co., Cal.; Pyrites, I. Elba and Freiberg, Saxony; Hematite, Elba and Mt. Vesuvius; Bournonite, Przibram, Bohemia; Spinel, Orange Co., N. Y.; Quartz, pseudomorph after Barite, Roxbury, Conn.; Green Pyroxene, St. Lawrence Co., N. Y.; Beryl, Quartz, Albite, and Orthoclase, Elba; Garnets in gneissose granite, Avondale, Pa.; Orthoclase, St. Lawrence Co., N. Y.; Orthoclase with Quartz, Ural Mts.; Orthoclase with Quartz, Lomnitz, Silesia; Tourmaline, McComb Co., N. Y.; Sphene, St. Lawrence Co., N. Y.; Wavellite, Hot Springs, Ark.; Apatite, Renfrew, Ontario; Plagionite, Wolfsberg, Harz Mts.; Crocidolite, Griqua Terr., S. Africa; Cancrinite, Litchfield, Conn.; Barite, Felsöbánya, Hungary; Anglesite, Sardinia; Strontianite, Hamm, Westphalia.

A. E. Foote. Heulandite on Zoisite, Chabazite with Leidyite, Chabazite, from Leiper's Quarry, Del. Co., Pa.

H. Skinner. Native Tellurium, Boulder Co., Col.; Massive Menaccanite, Fairmount Park, Phila.; Water-worn rock simulating Indian implement, Athens, Pa.; Native Tellurium, Boulder Co., Col ; Columbite, Greenland.

Joseph Jeanes. Pyrite (twin crystal), with Hematite, from Elba; Hematite crystals, Caoradi, Tavetsch Thal, Switzerland; Stibnite, Japan; Celestine, from Egypt, Girgenti, and Put-in-Bay, Lake Erie.

H. Burgin. Argentiferous Arsenopyrite, Continental Divide, Col.; Schirmerite, Summit Co., Col.; Pyrargyrite, Argentiferous Tetrahedrite, Kelso Mt., Col.; Fluorite, iridescent Quartz, White Beryl, Garnet in Albite, Microlite in Albite, Allanite in Albite, Microcline, Muscovite, Pink Muscovite in Albite, Albite, Orthoclase, Kaolinite, Columbite in Albite, and Monazite in Albite, all from Amelia Co, Va.; Vanadiferous Wulfenite, Phœnixville, Pa.; Ankerite, Chester Co., Pa.

M. E. Newbold. Amber, from the greensand of Vincentown, N. J.

W. H. H. Bates. Hornblende, from South Windsor, Me.

S. R. Calhoun. Chalcedony geode, containing water, from the Rio Salto, Uruguay.

J. M. Hartman. Octahedral crystal of Cuprite, France.

W. P. Miller. Wulfenite, from Arizona.

J. Binder. Chalcopyrite, Mt. Desert I., Me.

C. R. Gaul. Mesolite and Calcite, from Fritz's Island, near Reading, Pa,

F. V. Hayden. Viandite, Yellowstone National Park.

Purchased. Corundum, Iredell Co., N. C.; Variolite, Tyrol; Variolite pebble, Durance, France; Margerite and Emery, Chester, Mass.

In Exchange. Phosphorescent Limestone, Utah.

ADDITIONS TO LIBRARY.

1883.

Abich, Hermann. Geologische Forschungen in den Kaukasischen Ländern. I and II Th. and atlas. Jos. Jeanes.
Albrecht, Paul. Sur les 4 os intermaxillaires le Bec-de-Lievre.
Das os intermedium tarsi der Säugethiere.
Sur le crane remarquable d'une idiot de 21 ans.
Sur la valeur morphologique de l'articulation mandibulaire du cartilage de Meckel. The Author.
Ancey, F. C. Observations sur quelques Macularia.
Catalogue des mollusques marins du Cap Pinède pres de Marseille.
Sur la faune conchyliologique terrestre du pays des Somalis. The Author.
Anderson, John. Catalogue of Mammalia in the Indian Museum, Calcutta. Pt. 1.
Catalogue and hand-book of the archæological collections in the Indian Museum. Part 1, 1883. The Trustees.
Archiv. der naturw. Landesdurchforschung von Böhmen. IV, 4, 6; V, 1. I. V. Williamson Fund.
Ashburner, Chas. A. The anthracite coal beds of Pennsylvania. H. C. Lewis.
Astor Library, 34th annual report, 1882. The Trustees.
Baillon, M. H. Dictionnaire botanique, 15e fasc. I. V. Williamson Fund.
Barrois, Ch. Recherches sur les terrains anciens des Asturies et de la Galice. Text and plates. Dr. F. V. Hayden.
Bartram's Garden, three photographs of scenes in. J. H. Redfield.
Beales-Rissley Collection, W. Elliot Woodward's 60th sale. Ancient implements and ornaments, October 31, 1883.
Bellardi, L. Molluschi dei Terreni terziari del Piemonte e della Liguria. Pt. 2, 1882. I. V. Williamson Fund.
Bentham G. et J. D. Hooker. Genera plantarum. III and III, 2. I. V. Williamson Fund.
Berg, Carlos. Doce heteromeros nuevos de la fauna Argentina.
Miscellanea lepidopterologica. Buenos Aires, 1883.
Analecta lepidopterologica, 1882. The Author.
Berkeley, Rev. M. J. Description of new species of fungi, collected in the vicinity of Cincinnati by Thos. G Lea. David L. James.
Blackwall, John. Researches in zoology. 2d Ed., 1878. Jos. Jeanes.
Bland, T. Description of two new species of zonites from Tennessee. The Author.
Board of Agriculture, State of North Carolina. Report of the Session, 1883. S. G. Worth.
Bocage, J. V. Barboza du. Ornithologie d'Angola. 2me Partie. Lisbonne, 1881 The Author.
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INDEX TO GENERA.

1883.

GENERAL INDEX.